

THE FLORA OF KERALA

Volume 1



BOTANICAL SURVEY OF INDIA

Flora of India
Series 2

THE FLORA OF KERALA

VOLUME 1

RANUNCULACEAE - CONNARACEAE

Edited by
P. Daniel

With assistance from

G.V.S. Murthy

&

P. Venu



भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

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The Flora of Kerala
Volume 1
Ranunculaceae - Connaraceae

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Date of Publication: 15th Dec. 2005

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Published by
Botanical Survey of India
Ministry of Environment & Forests
CGO Complex, 3rd MSO Building
Block F (5th Floor) DF Block
Sector 1, Salt Lake City, Kolkata 700 064

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Printed by
St. Joseph's Press, Thiruvananthapuram 695 014.

Price : Rs. 1456.00 \$ 150.00

ISBN-81-8171-008-0

CONTENTS

Foreword	i
Preface	ii
Acknowledgements	iii
Contributors	iv
List of Photos	v – vi
Kerala State Map	vii
Introduction	1 – 110
Systematic Enumeration	
Ranunculaceae	111 – 118
Dilleniaceae	118 – 125
Magnoliaceae	126 – 129
Schisandraceae	129 – 130
Annonaceae	131 – 175
Menispermaceae	176 – 195
Berberidaceae	195 – 198
Nymphaeaceae	198 – 203
Cabombaceae	203 – 205
Nelumbonaceae	205 – 206
Papaveraceae	206 – 208
Cruciferae	208 – 221
Capparaceae	222 – 249
Violaceae	249 – 256
Bixaceae	256 – 260
Flacourtiaceae	260 – 282
Pittosporaceae	283 – 287
Polygalaceae	287 – 306
Xanthophyllaceae	306 – 308
Caryophyllaceae	308 – 314
Portulacaceae	315 – 320
Elatinaceae	320 – 324
Hypericaceae	324 – 328
Guttiferae	328 – 353
Theaceae	353 – 358

Dipterocarpaceae	358 – 373
Ancistrocladaceae	374 – 375
Malvaceae	375 – 441
Bombacaceae	442 – 449
Sterculiaceae	449 – 477
Tiliaceae	477 – 498
Elaeocarpaceae	498 – 505
Linaceae	505 – 509
Erythroxylaceae	509 – 513
Malpighiaceae	513 – 518
Zygophyllaceae	518 – 521
Geraniaceae	521 – 523
Balsaminaceae	524 – 565
Oxalidaceae	565 – 579
Rutaceae	579 – 616
Simaroubaceae	616 – 621
Ochnaceae	621 – 626
Burseraceae	626 – 635
Meliaceae	635 – 668
Dichapetalaceae	669 – 670
Olacaceae	671 – 679
Opiliaceae	679 – 682
Icacinaceae	682 – 691
Aquifoliaceae	691 – 695
Celastraceae	695 – 722
Rhamnaceae	722 – 736
Vitaceae	736 – 763
Leeaceae	763 – 769
Sapindaceae	769 – 787
Staphyleaceae	787 – 790
Sabiaceae	790 – 795
Anacardiaceae	795 – 820
Moringaceae	820 – 821
Connaraceae	821 – 830
References	831 – 849
Index to botanical names	850 – 877
Index to local names	878 – 883

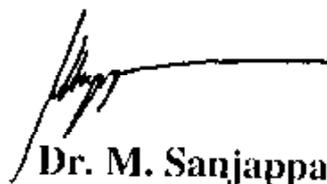
FOREWORD

The State of Kerala is known for its rich biological and cultural heritage as well as natural scenic beauty. The cultural practices in the state are driven by an agrarian lifestyle, with the agricultural practices being a culmination of long years of cultivation of a wide variety of crop plants, including coconut, cashew, spices, etc. The state is also rich in wild relatives of crop plants, which have a genetic potential of immense value. The name of the state itself is an eponym, derived from the Sanskrit word 'Keram' meaning coconut. Thus it is most appropriate that the use of natural resources of the state forms the mainstay of its economic development.

The state forms part of the Western Ghats 'hotspot' region – one of the twenty five globally recognised 'hotspot' areas that are designated so by virtue of their rich biodiversity and endemism. The state is endowed with dense tropical rainforests, which harbour unique flora and fauna, including microbial diversity that is typical of such rich tropical rainforests. Deforestation stemming from developmental activities is a major threat to all the 'hotspot' areas of the world. This global scenario and threat perception is also true for the W. Ghats 'hotspot' region. Considering that comprehensive information of natural resources is prerequisite for sustainable management of these resources and comprehensive developmental planning, it is a matter of pride that the Botanical Survey of India in accordance with its mandated work is bringing out a series of publications documenting the plant diversity of the country as a whole as well as such important 'hotspot'/sensitive ecosystem areas in particular.

The present volume of the *Flora of Kerala*, being the first of a planned trilogy, inventorying the plant diversity of state is timely and would be most useful to foresters, resource managers, and policy makers and planners alike for management of natural resources of the state as well as policy formulation for conservation and sustainable utilisation. I congratulate the scientists of BSI, Southern Circle, Coimbatore, on their commendable efforts for bringing out this important publication.

Place : Kolkata
Date : 23.11.2005



Dr. M. Sanjappa
Director, Botanical Survey of India

PREFACE

The work on the flora of Kerala, one of the species-rich states in the country, began soon after the publication of volume 3 of the *Flora of Tamil Nadu: Analysis* (1989). Though it became a little slack as the first three volumes of the *Flora of India* got priority, it got an impetus soon after the publication of the said volumes in 1993. However, due to constraints particularly lack of manpower since a number of personnel involved in the work superannuated and posts remained vacant, quite a few families especially those that were not there in the first three volumes of the *Flora of India* remained unfinished, it had to prolong. After the present director Dr. M. Sanjappa took over the administration he made it clear that the flora of Kerala is a committed project and that the publication of volume 1 was overdue. In the interregnum of more than a decade enormous amount of water had flowed under the bridge in the form of vast literature with new taxa, new records and above all new floras, some of them containing a number of endemic species. All these had to be incorporated in the revised format. The work had to be resumed with vigour for finishing the unfinished and incomplete families and incorporating all additional information. Despite the vigour it has taken inordinately long time, more than a year, to complete.

The present volume has the families Ranunculaceae to Connaraceae with 59 of them 265 genera, 687 species including few novelties. In the taxonomic citations a reference is given to all pertinent old floras as well as recent ones from Kerala. Since Rama Rao's *Flowering plants of Travancore* (1914) is just a list it is cited only when he indicates a precise locality or the species in question was recorded by later workers for the erstwhile Travancore. A reference to Rheede's *Hortus Malabaricus* is dispensed with and Nicolson & al.'s (1988) interpretation is invariably referred to. Despite the best efforts the desired consistency could not be achieved since some authors took liberty. Almost invariably the names of authors, titles of books and journals are abbreviated following *Authors of plant names* (Brummitt & Powell, 1992), *Taxonomic literature* ed. 2 and *B-(otanico)-P-(eriodicum)-H(untianum)* respectively. The distribution in Kerala is based on published literature, holdings in herbaria particularly MH and unpublished reports/theses submitted under district flora projects funded by the Botanical Survey of India/by fellows worked in the Botanical Survey of India. Admittedly there might be many lapses. We are sure that learning lessons from this volume an improved and much better volume 2 will appear soon.

ACKNOWLEDGEMENTS

We are thankful to Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkata, for encouragement, to Dr. D.H. Nicolson (US), for continued generous help with literature and expertise in solving nomenclatural problems whenever cropped up, to Drs. H.J. Noltie (E) and J.K. Sharma (Director, KFRI, Thrissur), for help with literature, to our former colleagues Dr. V.J. Nair and Shri. N.C. Rathakrishnan, for help in various ways, to fellow-taxonomists and botanists, Drs. Z. Abraham (NBPGR, Thrissur), N. Anil Kumar and M.K.R. Narayanan (MSSRF, Wynad), R. Ansari (MBG, Kozhikode), V. Chelladurai (SPSU, Palayamkottai), P. Dayanandan (MCC, Tambaram), V.S. Ramachandran (KASC, Coimbatore), R. Ganesan (ATREE, Bangalore), D. Narasimhan (MCC, Tambaram), A.K. Pradeep (CALI), T.J.S. Rajakumar (SJC, Palayamkottai), G.R. Rao, (IISc, Bangalore), N. Sasidharan (KFRI, Thrissur), C. Sathish Kumar (TBGRI, Thiruvananthapuram), P.G. Diwakar (BSI, Port Blair) and foresters and biodiversity managers, S/Shri. V. Ramakantha IFS (Principal, SFSC, Coimbatore), V. Ganesan IFS (Wildlife Warden, Indira Gandhi Wildlife Sanctuary & National Park, Pollachi) and S. Thangaraj Paneerselvam (Range Officer, Topslip) and our colleague Dr. R. Gopalan, for the photographs, to Shri. J.H. Franklin Benjamin and W. Dinesh Albertson, JRFs, Dr. C. Murugan, PDF, Miss M. Reema Kumari, SRF, Dr. K. Sasikala, Tech. Asst. and Miss R. Sumathi (SRF, BSI, Port Blair), for help in various ways and to late N.G.R. Nair, Stenographer, for typing and correcting the whole manuscript with commitment. We are obliged to express a special word of appreciation to Shri. W. Arisdason, JRF, for his invaluable help throughout.

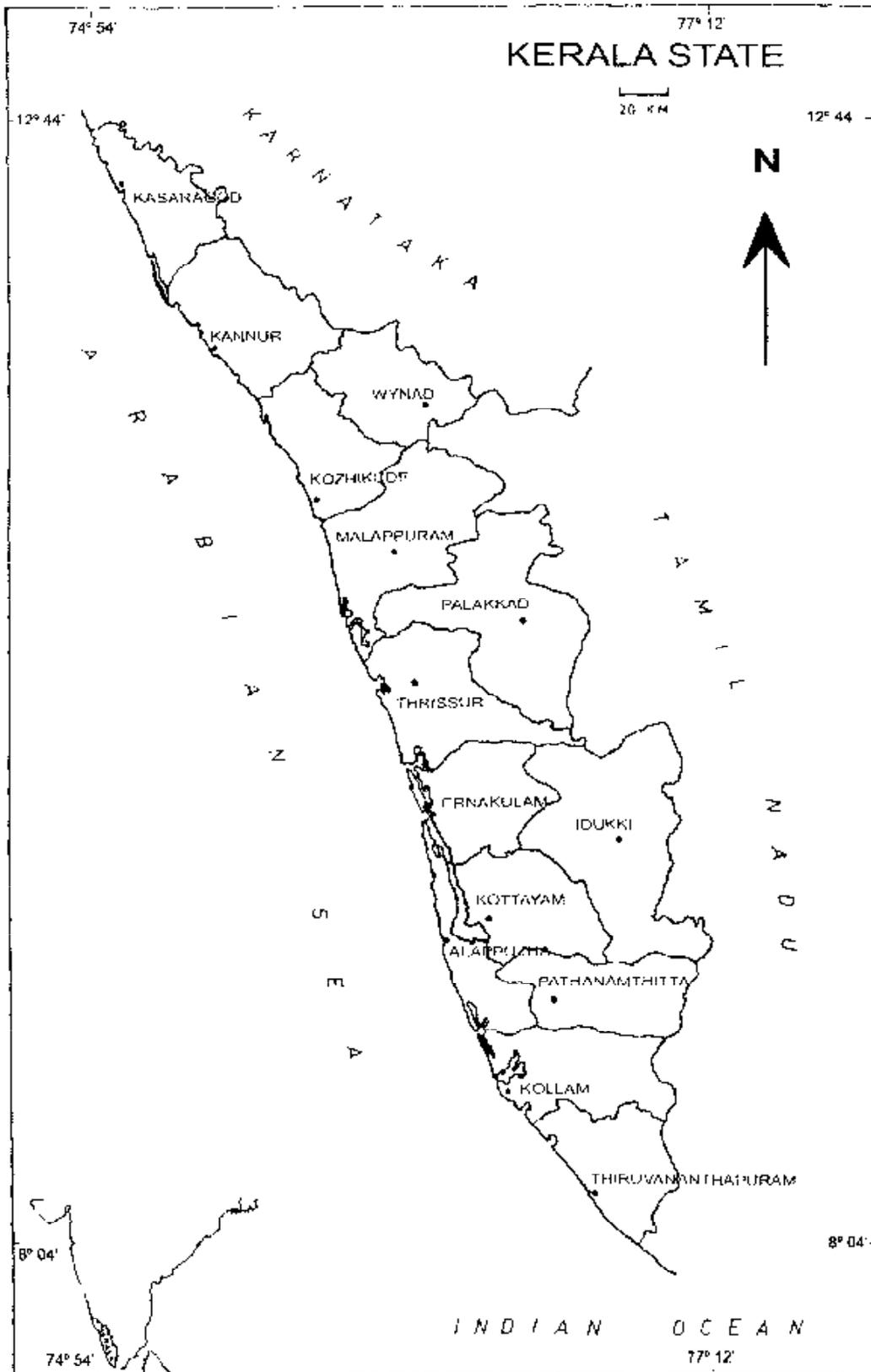
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Venu, P.
Vivekananthan, K.

LIST OF PHOTOS

1. *Anaimudi Peak*
2. *Silent Valley*
3. *Sholas*
4. *Sholas in Idukki*
5. *Myristica swamp in Kollam*
6. *Conversion of forests for plantations*
7. *Acrotrema arnotianum* Wight
8. *Dillenia indica* L.
9. *Michelia nilagirica* Zenker
10. *Cyathocalyx zeylanica* Hook.f. & Thomson
11. *Desmos lawii* (Hook.f. & Thomson) Safford
12. *Desmos viridiflorus* (Bedd.) Safford
13. *Goniothalamus wightii* Hook.f. & Thomson
14. *Goniothalamus wynaadensis* (Bedd.) Bedd.
15. *Meiogyne pumosa* (Dalzell) J. Sinclair
16. *Meiogyne ramarowii* (Dunn) Gandhi
17. *Phaeanthus malabaricus* Bedd.
18. *Polyalthia korintii* (Dunal) Benth. & Hook.f.
19. *Uvaria zeylanica* L.
20. *Sageraea grandiflora* Dunn
21. *Anamirta cocculus* (L.) Wight & Arn.
22. *Coscinium fenestratum* (Gaertn.) Colebr.
23. *Cyclca peltata* (Lam.) Hook.f. & Thomson
24. *Diploclisia glaucescens* (Blume) Diels
25. *Mahonia leschenaultii* (Wight & Arn.) Takeda
26. *Tinospora sinensis* (Lour.) Merr.
27. *Nymphaea nouchali* Burm.f.
28. *Nymphaea rubra* Roxb. ex Andrews
29. *Cadaba trifoliata* (Roxb.) Wight & Arn.
30. *Capparis brevispina* DC.
31. *Capparis rheedii* DC.
32. *Cleome rutidosperma* DC.
33. *Crataeva magna* (Lour.) DC.
34. *Viola pilosa* Blume
35. *Cochlospermum religiosum* (L.) Alston
36. *Casearia thwaitesii* Briq.
37. *Casearia tomentosa* Roxb.
38. *Flacourtia indica* (Burm.f.) Merr.
39. *Flacourtia montana* J. Graham
40. *Hydnocarpus alpina* Wight
41. *Hydnocarpus pentandra* (Buch.-Ham.) Oken
42. *Taraktogenos macrocarpa* (Bedd.) N.P. Balakr.
43. *Scolopia crenata* (Wight) Clos
44. *Polygala arillata* D. Don var. *arillata*
45. *Hypericum mysurense* B. Heyne ex Wight & Arn.
46. *Calophyllum austroindicum* Kosterm. ex P.F. Stevens
47. *Calophyllum calaba* L.
48. *Garcinia gummi-gutta* (L.) N. Robson var. *gummi-gutta*
49. *Garcinia gummi-gutta* (L.) N. Robson var. *papilla* (Wight) N.P. Singh
50. *Garcinia indica* (Thouars) Choisy
51. *Garcinia morella* (Gaertn.) Desr.
52. *Garcinia travancorica* Bedd.
53. *Garcinia wightii* T. Anderson
54. *Garcinia xanthochymus* Hook.f. ex T. Anderson
55. *Mesua ferrea* L.
56. *Poeciloneuron indicum* Bedd.
57. *Poeciloneuron pauciflorum* Bedd.
58. *Ternstroemia gymnanthera* (Wight & Arn.) Bedd.
59. *Dipterocarpus bourdillonii* Brandis
60. *Hopea racophloea* Dyer
61. *Hopea parviflora* Bedd.
62. *Hopea utilis* (Bedd.) Bole
63. *Vateria indica* L.
64. *Ancistrocladus heyneanus* Wall. ex J. Graham
65. *Abelmoschus moschatus* Medik.
66. *Hibiscus hispidissimus* Griff.
67. *Hibiscus platanifolius* (Willd.) Sweet

68. *Cullenia exarillata* Robyns
69. *Kydia calycina* Roxb.
70. *Helicteres isora* L.
71. *Firmiana colorata* (Roxb.) R. Br.
72. *Heritiera littoralis* Dryand.
73. *Heritiera papilio* Bedd.
74. *Sterculia guttata* Roxb. ex DC.
75. *Sterculia urens* Roxb.
76. *Elaeocarpus tuberculatus* Roxb.
77. *Grewia titiifolia* Vahl
78. *Elaeocarpus munroii* (Wight) Mast.
79. *Elaeocarpus serratus* L.
80. *Elaeocarpus venustus* Bedd.
81. *Hugonia belli* Sedgw.
82. *Hugonia mystax* L.
83. *Geranium nepalense* Sweet
84. *Hydrocera triflora* (L.) Wight & Arn.
85. *Biophytum reinwardtii* (Zucc.)
Klotzsch
86. *Impatiens acaulis* Arn.
87. *Impatiens auriculata* Wight
88. *Impatiens campanulata* Wight
89. *Impatiens jerdoniae* Wight
90. *Impatiens flaccida* Arn.
91. *Impatiens diversifolia* Wall. ex
Wight & Arn.
92. *Impatiens elegans* Bedd.
93. *Impatiens herbicola* Hook.f.
94. *Impatiens grandis* B. Heyne ex Wall.
95. *Impatiens hensloviana* Arn.
96. *Impatiens macrocarpa* Hook.f.
97. *Impatiens maculata* Wight
98. *Impatiens parasitica* Bedd.
99. *Impatiens inconspicua* Benth. ex
Wight & Arn.
100. *Impatiens tomentosa* B. Heyne ex
Wight & Arn.
101. *Impatiens scapiflora* B. Heyne ex Roxb.
102. *Impatiens sholayarensis* M. Kumar &
S. Seq.
103. *Impatiens wightiana* Bedd.
104. *Impatiens tangachee* Bedd.
105. *Impatiens travancorica* Bedd.
106. *Impatiens verticillata* Wight
107. *Naringi crenulata* (Roxb.) Nicolson
108. *Paramignya monophylla* Wight
109. *Vepris bitocularis* (Wight & Arn.) Engl.
110. *Ailanthes triphysa* (Dennst.) Alston
111. *Balanites aegyptiaca* (L.) Del.
112. *Gomphia serrata* (Gaertn.) Kanis
113. *Ochna obtusata* DC.
114. *Boswellia serrata* Roxb. ex Coleb.
115. *Canarium strictum* Roxb.
116. *Aglaia simplicifolia* (Bedd.) Harms
117. *Aglaia barberi* Gamble
118. *Aglaia elaeagnoidca* (A. Juss.) Benth.
var. *bourdillonii* (Gamble) K.K.N. Nair
119. *Aphanamixis polystachya* (Wall.) R.
Parker
120. *Naregamia alata* Wight & Arn.
121. *Chukrassia tabularis* A. Juss.
122. *Dysoxylum ficiforme* (Wight) Gamble
123. *Dysoxylum malabaricum* Bedd. ex
Hiern.
124. *Melia dubia* Cav.
125. *Trichilia connaroides* (Wight & Arn.)
Bentvelzen
126. *Turraea villosa* Benn.
127. *Erythralium populifolium* (Arn.)
Mast.
128. *Ximenia americana* L.
129. *Nothapodytes nimmoniana*
(J. Graham) Mabb.
130. *Pyrenacantha volubilis* Wight
131. *Sarcostigma kleinii* Wight & Arn.
132. *Ilex denticulata* Wall. ex Wight
133. *Ilex wightiana* Wall. ex Wight
134. *Bhesa indica* (Bedd.) Ding Hou
135. *Celastrus paniculatus* Willd.
136. *Euonymus crenulatus* Wall. ex
Wight & Arn.
137. *Microtropis ramiflora* Wight
138. *Microtropis wallichiana* Wight ex
Thwaites
139. *Microtropis stocksii* Gamble
140. *Salacia beddomei* Gamble
141. *Salacia fruticosa* B. Heyne ex M.A.
Lawson





Anaimudi - the tallest peak in South India

D. Narasimhan



Silent Valley

V. Ramakantha



Sholas

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Sholas in Idukki

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A Myristica swamp in Kollam

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Conversion of forests for plantations

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Acrotrema arnottianum Wight

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Phacanthus malabaricus Bedd.

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***Polyalthia korintii* (Dunal) Benth. & Hook.f.**
D. Narasimhan



***Uvaria zeylanica* L.**
S. T'Raj Panncerselvam



***Sageraea grandiflora* Dunn**

N. Sasidharan



Anamirta cocculus (L.) Wight & Arn.



E.S.S. Kumar, R. Gopalan



Coscinium fenestratum (Gaertn.) Colebr.
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Cyclea peltata (Lam.) Hook.f. & Thomson
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V. Ramakantha, R.Gopalan



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***Scolopia crenata* (Wight) Clos**

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Calophyllum calaba L.

V. Chelladurai



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S. T'raj Panneerselvam



G. gummi-gutta (L.) N. Robson var. **papilla**
(Wight) N.P. Singh
Z. Abraham



Garcinia indica (Thouars) Choisy

S. T'raj Panneerselvam



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S. T'raj Panneerselvam



***Garcinia travancorica* Bedd.**

R. Ganesan



Garcinia wightii T. Anderson
S. T'raj Panneerselvam



Garcinia xanthochymus Hook.f. ex
T. Anderson S. T'raj Panneerselvam



Mesua ferrea L.



S. T'raj Panneerselvam



Poeciloneuron indicum Bedd.

R. Ganesan



Poeciloneuron pauciflorum Bedd.

R. Gopalan



Ternstroemia gymnanthera (Wight & Arn.) Bedd.

R. Gopalan



Dipterocarpus bourdillonii Brandis
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Hopea racophloea Dyer
N. Sasidharan



Hopea parviflora Bedd.



P.S. Sivaprasad



Hopea utilis (Bedd.) Bole

R. Ganesan

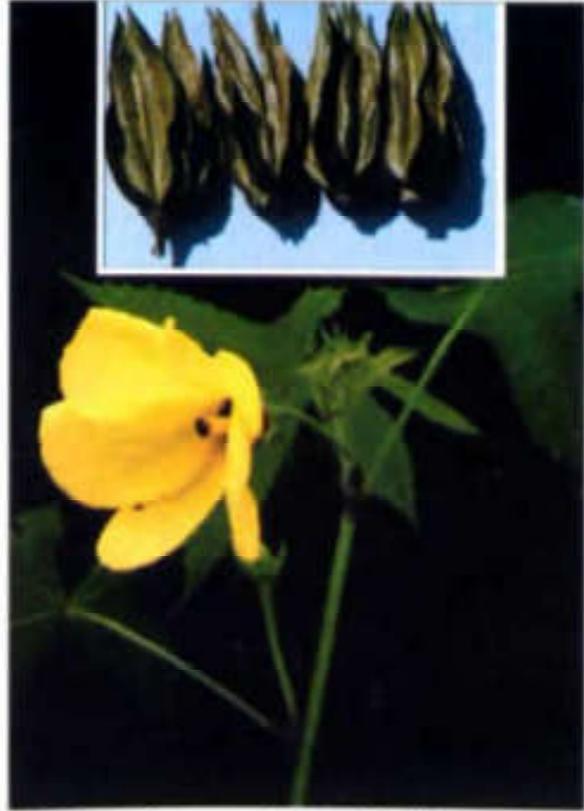


Vateria indica L.

V. Chelladurai



Ancistrocladus heyneanus Wall. ex J. Graham
N. Anilkumar



Abelmoschus moschatus Medik.
Z. Abhram, A.K. Pradeep



Hibiscus hispidissimus Griff.

G.R. Rao



Hibiscus platanifolius (Willd.) Sweet

S. T'raj Panneerselvam



Cullenia exarillata A. Robyns

S. T'raj Panneerselvam



***Kydia calycina* Roxb.**

R. Ganesan



***Helicteres isora* L.**

R. Gopalan, R. Ganesan



***Firmiana colorata* (Roxb.) R. Br.**

R. Ganesan



Heritiera littoralis Dryand.

R. Ganesan



Heritiera papilio Bedd.

R. Ganesan



Sterculia guttata Roxb. ex DC.

G.R. Rao



Sterculia urens Roxb.

S. Traj Panneerselvam



Elaeocarpus tuberculatus Roxb.

S. Traj Panneerselvam



***Grewia tiliifolia* Vahl**

R. Ganesan, P.S. Sivaprasad



***Elaeocarpus munroii* (Wight) Mast.**

R. Ganesan



Elaeocarpus serratus L.



P.S. Sivaprasad, R. Ganesan



Elaeocarpus venustus Bedd.



R. Ganesan



Hugonia belli Sedgw.

A.K. Pradeep



Hugonia mystax L.

A.K. Pradeep



Geranium nepalense Sweet

R. Gopalan



Hydrocera triflora (L.) Wight & Arn.

M. Thiyagarajan



Biophytum reinwardtii (Zucc.) Klotzsch.

E.S.S. Kumar



Impatiens acaulis Arn.

R. Gopalan



***Impatiens auriculata* Wight**

S. Suseendran



***Impatiens campanulata* Wight**

S. T'raj Panneerselvam



***Impatiens jerdoniae* Wight**

S. T'raj Panneerselvam



***Impatiens flaccida* Arn.**
S. T'raj Panneerselvam



***Impatiens diversifolia* Wall. ex Wight
& Arn.** S. T'raj Panneerselvam



***Impatiens elegans* Bedd.**
S. T'raj Panneerselvam



***Impatiens herbicola* Hook.f.**
S. T'raj Panneerselvam



Impatiens grandis B. Heyne ex Wall.

N. Sasidharan



Impatiens henslowiana Arn.

R. Ganesan



***Impatiens macrocarpa* Hook.f.**
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***Impatiens maculata* Wight**
S. T'raj Panneerselvam



***Impatiens parasitica* Bedd.**

N. Anilkumar



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Impatiens tomentosa B. Heyne ex Wight & Arn.
S. T'raj Panneerselvam



Impatiens scapiflora B. Heyne ex Roxb.

S. T'raj Panneerselvam



Impatiens sholayarensis M. Kumar &
S. Seq. M. Kumar



Impatiens wightiana Bedd.
S. T'raj Panneerselvam



Impatiens tangachee Bedd.
R. Tolstoy



Impatiens travancorica Bedd.
N. Savidharan



***Impatiens verticillata* Wight**

S. T'raj Panneerselvam



***Acronychia pedunculata* (L.) Miq.**

C. Murugan, S. T'raj Panneerselvam



Naringi crenulata (Roxb.) Nicolson

R. Ganesan



Paramignya monophylla Wight

GR. Rao



***Vepris bilocularis* (Wight & Arn.) Engl.**
R. Ganesan



***Allanthes triphysa* (Dennst.) Alston**
P.S. Sivaprasad



***Balanites roxburghii* Planch.**



R. Ganesan, S. T'raj Panneerselvam



***Gomphia serrata* (Gaertn.) Kanis**

R. Ansari



***Ochna obtusata* DC.**

S. T'raj Panneerselvam



***Boswellia serrata* Roxb. ex Colebr.**

R. Ganesan



***Canarium strictum* Roxb.**

S. T'raj Panneerselvam



***Aglaia simplicifolia* (Bedd.) Harms**

V. Chelladurai



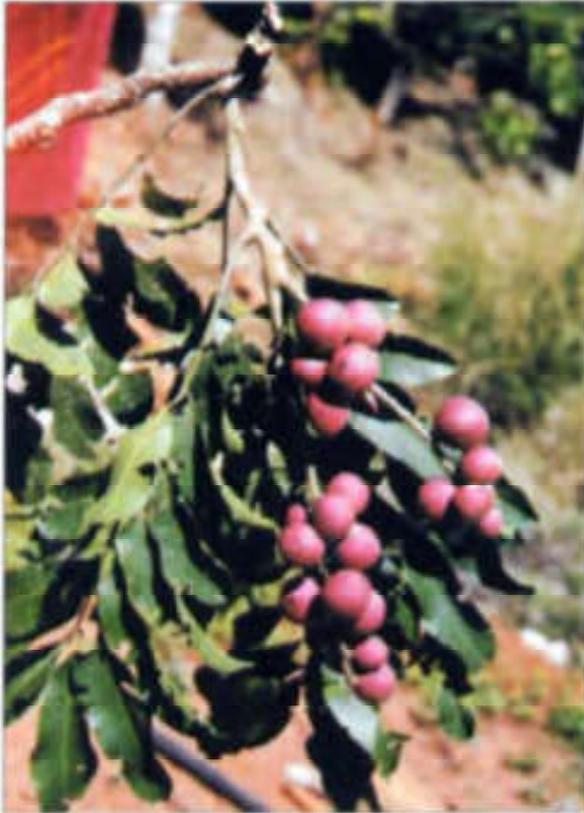
Aglaia barberi Gamble

S. T'raj Panneerselvam



Aglaia elaeagnodica (A. Juss.) Benth. var. ***bourdillonii*** (Gamble) K.K.N. Nair

R. Ganesan



***Aphanamixis polystachya* (Wall.) R. Parker**
B. Maheswaran



***Naregamia alata* Wight & Arn.**

S. Suresh



***Chukrasia tabularis* A. Juss.**

P.S. Sivaprasad



Dysoxylum ficiforme (Wight) Gamble

S. T'raj Panneerselvam



Dysoxylum malabaricum Bedd. ex Hiern

S. T'raj Panneerselvam



Melia dubia Cav.

P.S. Sivaprasad



Trichilia connaroides (Wight & Arn.) Benth.

R. Ganesan



Turraea villosa A.W. Benn.

G.R. Rao



Erythralum scandens Blume

V. Chelladurai



Ximenia americana L.

R. Ganesan



Nothapodytes nimmoniana (J. Graham) Mabb.



C. Murugan, V. Chelladurai



***Pyrenacantha volubilis* Wight**

D. Narasimhan



***Sarcostigma kleinii* Wight & Arn.**
N. Anilkumar



***Ilex denticulata* Wall. ex Wight**
R. Gopalan



Ilex wightiana Wall. ex Wight

R. Gopalan



Bhesa indica (Bedd.) Ding Hou
M. Thiyagarajan



Cassine albens (Retz.) Kosterm.
M. Thiyagarajan



Celastrus paniculatus Willd.

D. Narsimhan



Euonymus crenulatus Wall. ex Wight & Arn.

R. Gopalan



***Microtropis ramiflora* Wight**

R. Ganesan



***Microtropis wallichiana* Wight ex Thwaites**

R. Gopalan



***Microtropis stocksii* Gamble**

R. Ganesan



Salacia beddomei Gamble

E.S.S. Kumar



Salacia fruticosa B. Heyne ex M.A. Lawson

V. Chelladurai



Salacia oblonga Wall. ex Wight & Arn.



C. Murugan



Colubrina travancorica Bedd.

E.S.S. Kumar



Cissus discolor Blume

C. Murugan



Leea asiatica (L.) Ridsdale

S. Traj Panneerselvam



***Allophylus cobbe* (L.) Raeusch.**

R. Ganesan



***Dimocarpus longan* Lour.**

G.R. Rao



***Lepisanthes tetraphylla* (Vahl) Radlk.**

D. Narasimhan



Sapindus trifoliatus L.

R. Ganesan



Schleicheria oleosa (Lour.) Oken

P.S. Sivaprasad, R. Ganesan



***Turpinia cochinchinensis* (Lour.) Merr.**

R. Gopalan



***Buchanania lanzan* Spreng.**

R. Ganesan



***Gluta travancorica* Bedd.**

R. Ganesan



***Holigarna ferruginea* Marchand**

R. Ganesan



Holigarna nigra Bourd.

R. Ganesan



Nothopegia aureo-fulva Bedd.
ex Hook.f.

N. Sasidharan



Semecarpus anacardium L.f.

R. Gopalan



Connarus paniculatus Roxb.
R. Ganesan



Connarus sclerocarpus (Wight & Arn.)
G Schellenb.



Ellipanthus neglectus Gamble
N. Sasidharan



Rourea minor (Gaertn.) Merr.
R.Ganesan

INTRODUCTION

(M. MOHANAN & P. DANIEL)

Biodiversity is the primary base upon which all civilizations have been built. It is the greatest treasure of resources meeting all essential needs of mankind. Man in ancient times was indispensably associated with nature and lived in perfect peace and harmony with it. Being a life-supporting system of the planet, the natural environment constitutes diverse self-maintaining and self-regulating ecosystems, the balance of which was lost when man by his mental excellence, ruthlessly exploited the bioresources. This pervasive conflict between man and nature continued hand in hand with the evolution of various cultures and eventually put mankind on a warpath with nature. Granting natural resources to be infinite, man depleted them thoughtlessly resulting in irreparable loss of considerable biodiversity even before it was fully known. Only 1.5 million of the estimated 30 million species are known to man and about 1/4 of this risk extinction within the next 30 years (Dutta, 2000). Besides overexploiting the bioresources, man has also polluted the environment around him by releasing effluents unwittingly or otherwise, which are the byproducts of his technological innovations.

The consequence of this to nature is a planet unsuitable for living. This has forced man to think as to how to reconcile the conflicting interests of development and nature's security. A growing global concern in the mid-nineteenth century on bioerosion led to a conference by the IUCN on conservation and utilization of the resources. Ever since this conference environment has remained a major issue to be seriously addressed. Several such global conferences kept this issue alive till the Convention on Biological Diversity (CBD) came into being in 1992.

To conserve biodiversity a complete understanding of the bioresources and their commercial potential is a *sine qua non*. Taxonomic studies play a very vital role in this context. As Quicke (1993) pointed out "A vast majority of the living organisms are unknown and are likely to remain so for the foreseeable future. While most of these will be small organisms, a surprisingly large number of bigger ones are far from perfectly understood and they include some organisms of undoubted economic importance. For instance, many of the tropical rain forest trees, so prized for their timber, are still little known systematically and if some useful trees are endangered, they could easily go extinct before anyone realized

there was a threat”

The fact that a 1/4 of all prescriptions in allopathy are plant-based and that only 1% of the plants have so far been chemically investigated may point to the urgent need for a quantitative assessment of our biodiversity.

Being one of the 12 megadiversity countries of the world (Mc Neely & al., 1990) India harbours about 81,000 species of animals and 49,000 plants (Soz, 1997) and has 2 out of the 25 in the world ‘hotspots’ viz., Eastern Himalayas and the Western Ghats (Mittermeier & al., 1998). The southern part of the species-rich Western Ghats run all along the eastern border of the State of Kerala. With varied topographic features and climatic regions Kerala presents a spectrum of diverse vegetation. That the forests of Kerala are an inestimable reservoir of timbers and commercially important spices were exemplified by the presence of Kerala’s teak wood in the temple built by King Solomon and ships that fought in the memorable battle of Trafalgar (Chaithanya, 1994). A better understanding and quantitative assessment of the biodiversity of the state may certainly open new avenues for such a trade and earn more foreign exchange in its wake particularly in the context of the new Intellectual Property Rights (IPR) regimes of the WTO. For instance, the ‘Kanikar’ a tribal community living in the southern part of the Kerala forests, are perhaps the first to acquire this benefit for their traditional knowledge on the plant *Trichopus zeylanicus* var. *travancoricus*.

To safeguard our national interest in the wake of several provisions in the Trade Related Intellectual Property Rights (TRIPS) of the WTO which favour the developed countries (Utkarsh & al., 1999) it is essential that we urgently investigate and assess our bioresources and utilize them before others enjoy the benefits as it happened with neem, basmati rice and turmeric (Gadgil, 2000). Following the CBD which accepted the sovereign rights of nations over their bioresources, both the Govt. of India and Govt. of Kerala have brought out a National Biodiversity Act (NBDA) and Kerala State Biodiversity Conservation Order-2000 respectively, besides adopting Plant Variety Protection and Farmers’ Act and amending the Indian Patent Act.

With the introduction of genetically engineered seeds of the ‘gene revolution’ era by many agricultural MNCs like Monsanto, many of our crop varieties

may also be lost besides loss of the wild genetic diversity in the country. Hence, much of our valuable biodiversity is likely to be lost before it is properly understood. It is against this backdrop the present work of consolidating the floristic diversity of the State of Kerala assumes crucial importance.

Location and history

Kerala, a narrow strip of land situated on the south-west corner of the Indian Peninsula and bounded on the north by Karnataka, south by Tamil Nadu, east by the Western Ghats and west by the Arabian sea, lies between latitudes 8° 04" and 12° 44" N and longitudes 74° 54' and 77° 12' E. This green land is known not only for its scenic splendour despite rapid urbanization and influx of population but also for its "storied past and piquant loveliness of history in the making" (Chaithanya, 1994). One of the smallest Indian states, Kerala extends to a maximum of 550 km between Kaliakavila in the south and Kasaragod in the north, with a mean breadth of 70 km, narrowing towards both ends to about 12 km and widening at the central part to 121 km. The state has a total area of 38,863 km² which is about 1.8% of the total geographical area of India and a population of over 29 million (1991 census) which constitutes 3.45% of the total population of the country.

Origin of the land

Among the many legends on the origin of the landmass of Kerala that of the age-old one involving Parasurama seems to be the most plausible and prevalent one. This legend has it that Parasurama, a god-like Thor of the Nordic myth, after having 21 victories over the 'Kshathriyas' performed penance on the mountain of 'Mahandra' (Mahendragiri ?). On the advice of the chief munees Parasurama went to Gokarnam and hurling his 'parusu' (battle axe) recovered the land from the sea, the limits being Kanyakumari and Gokarnam. The land thus emerged by the recession of the sea was divided into four 'nadas' viz., kolanad, yairanad, perumbuddipur and venad, the former two comprising the Malabar province and the latter the Travancore. Although a legend many classical works like *Keralolpathi*, *Keralappazhama*, *Kerala mahatmyam* etc. contain references supporting this view (Warrier, 1988; Mohanan & Nair, 1999). *Keralolpathi* (Gundert, 1843) vividly narrated the migration of Aryans to the northern parts of Kannur and the establishment of 64 villages by the legendary Parasurama.

Mooshikavamsa, a historic Mahakavya by Atula, the court poet of the Mooshika King Shrikanta depicted the Mooshika kingdom of Ezhimala (Kannur) till the 12th century A.D. (Menon, 1972). References to Kerala are also found in epics like *Brahmandapuram*, *Devibhagavatham*, *Matsyapuram*, *Mahabharatham*, *Ramayanam* etc. This romantic fiction "no less familiarly known than confidentially believed by the people" (Ward & Corner, 1863) denotes as some scholars believe, "the success of Brahminical supremacy in their conflict with Buddhism in Kerala" (Kareem, 1976). Notwithstanding the historical veracity of this, the territorial divisions mentioned therein like nadu, desam, tara, cherries etc. continue to exist even today.

More scientific is the opinion of some of the geologists who believe that the land of Kerala has been shaped by a geological upheaval. They relate it to a strange phenomenon—the mud banks (chakara) of the coastal belt of the sandy seashore particularly in Alappuzha which have extended inland considerably. The marine fossils (*vide* Geology) and coral reefs unearthed at Vazhappalli near Changanasserry might substantiate the fact that the Arabian sea must have once extended right up to the foot of the Western Ghats and that most parts of the district *viz.*, Ambalapuzha, Cherthala and Karthikapally were under the sea in ancient times. Furthermore, the coast of Kerala passed through the district of Kottayam in ancient days is evidenced by the names of such places as Vaikom (new land), Kadathuruthi (sea island) etc. A cataclysm could have resulted in the sea receding and the submerged bed emerging to the surface. The Parasurama origin of Kerala as a gift of the Arabian sea perhaps finds its roots in the geological fact of the elevation of the land from the sea. The gap at Palakkad gives additional support to the above theory. The rivers that originate in the Western Ghats might have brought down in their spate immense quantity of sand and silt and built up the huge deltas which eventually jutted out into the sea. Being a fertile land suitable for cultivation of crops, these deltas might have attracted colonists in later years (Menon, 1975). This process might have synchronised with the late Miocene regression that happened 25,000 to 30,000 years ago leading to the rapid fluctuation in the sea level. Periodical transgressions, of both rapid and slow, during the Holocene might have resulted in relative stability and gradual evolution of the coastal areas associated with the sedimentary deposits by the rivers and streams.

Yet another view is that the subterranean passages resulting from the cataclysm links the sea with the rivers and backwaters, the silt and sand thereby finding their way to the littoral currents forming the mud banks.

Origin of the name

The most popular among the explanations offered for the origin of the name Keralam (Kerala) is that it is derived from the word 'Kera' which means a coconut palm. The interpretation that Keralam was originally Cheralam, the land of the Cheras, is untenable as the word cher also means 'to add'. The most convincing one, therefore, seems to be that it is the land that was added by the recession of the sea (Chaithanya, 1994).

Historical perspective

Unlike the East Coast, the prehistory of the West Coast remained a mystery and hence the reconstruction of the ancient history of the state is difficult. Moreover, the material available on the prehistoric antiquities of this area also is very scanty compared to that of the great river valleys of India. Although apocryphal in nature, the epigraphic and numismatic works of the classical geographers and some ancient literature contain some information on ancient Kerala.

Excluding Kerala from the paleolithic map of India, Sankhalia (1962) observed that "Kerala and Malabar have so far not yielded any paleoliths probably because no search has been made". Going a step further, Aiappan (1958) stated that the absence of paleoliths from Kerala is due to the fact that this part of the land came to be populated only during and after the neolithic agricultural revolution. Primitive man preferred parklands and it must have been that only after population pressure increased on the East Coast migration began to the West Coast through the half a dozen 'gaps' in the Western Ghats. The extreme paucity of paleoliths and neoliths of the prehistoric period in the state is also cited to support the above observations. However, the discovery of a few paleolithic sites on the banks of Malampuzha in Palakkad District by Rajendran (1975) and results of the recent excavations being carried out at several sites along Kanjirampuzha in Palakkad District which appear in the press now and then contradict the above view of Aiappan and support Sankhalia's (1962) observations that lack of evidence of the palaeoliths in Kerala is due to inadequate probe. In the light of

Rajendran's discovery, Nair (1981) stated that the Silent Valley and Malampuzha-Kanjirampuzha tract are important areas in tracing the origin of man.

Remnants of some old relic of the prehistoric age have come to light in many parts of the state. There are monuments of megaliths belonging to the south Indian megalithic complex. There are urn burials all over the High Ranges; dolmens and menhirs have been excavated in the Anchanad Valley, interior parts of Alappuzha, Ranni and Kodukuthi in Pathanamthitta District, Kunnathur and some parts of Ernakulam District and several sites in the Malabar area. The Thalipparamba-Kannur-Thalassery tract abounds in several rock-cut caves, stone circles, dolmens and menhirs (Logan, 1951). Schists, which are megalithic burials, were discovered in Kallarpatom colony in Udumbanchloa, Bison Valley and Marayur. Various types of iron age pottery are found in Thondaimala. Some monolithic relics dating back to 200 BC were discovered in Kodanad in Ernakulam District. The megalithic sites in Palakkad District are known as 'Kurangu pattadai' associated with the monkey hordes of Lord Rama. Some of the monuments in Palakkad are kudakkallu (hood stone), thoppikkallu (umbrella stone), pulachikkallu (?), Mesakkallu (table stone) and Nannangadi (?) (Warrier, 1988) in addition to pothole schists and rock-cut caves.

There are different views on the basic racial strain of the people of the state, the most accepted one being the presence of the negrito and the protoaustraloid elements in the earliest racial strain of the population. The physical characters like curly hair, dark skin, rounded head and broad nose of some of the tribes inhabiting the Western Ghats represent the survival of this strain. The primitive artisan tribe, the Uralis and the agricultural Paniyas of Wynad, the Kadars of Parambikulam, the Muthuvas of Devikulam are stocks of the Negrito strain. The protoaustraloid who succeeded the Negrito, distinguished by their long head and flat nose, are represented by the Kurichiyas and Kurumbas of Wynad.

This land was later occupied by the Dravidians who represent the present Keralites divided into Nairs and Vellalars. The Ezhavas or Thiyyas, as they are called in south and north Kerala respectively, migrated later from the island country of Sri Lanka as both the names have a Sinhala origin (Chaithanya, 1994).

The last to penetrate into the land of Kerala through the West Coast (Kasaragod and Hosdurg) from the northern part of the country were the Aryans

whose representatives are found in the Nampoothiris (N. Kerala) and Potties (S. Kerala). Considerable number of 'Pattars' (Iyers of Tamil Nadu), also of Aryan origin, also migrated to Kerala, once the Brahmins established their supremacy. A mix of Dravidian and Aryan blood is found in the Nairs since the Nampoothiri men were allowed to marry Nair women.

This indigenous stock has considerably changed with the infusion of alien blood of Syria (Christians) and Arabia (Muslims). The protohistory of Kerala is closely associated with the botanical history which is also a part of the trade and trade routes of the ancient world (*vide* Botanical history).

The 64 gramams or petty principalities which constituted the ancient Kerala became the 3 major states after the collapse of the second Chera Empire. These were Travancore, Kochi and Kozhikode. There were also some smaller principalities which remained outside these 3 major states. They were Neeleswaram, Vettathunadu, Thirur, Kodungallor, Idappally, Vadakkumkur, Thekkumkur, Odanad and Purakkad. Along with the national struggle for independence of the whole country there was another movement in Kerala for the unification of the Malayalam-speaking people into one state. After independence, on 1 July 1949, Travancore and Kochi were integrated into a new state of 'Thiru-Kochi' and on 1 Nov. 1956 when the states of the Indian Union were reorganized on linguistic basis, Malabar including Kasaragod which was a part of the Madras Province, was also added to Thiru-Kochi separating the Tamil-speaking Thovala, Agastheeswaram, Kalkulam, Vilavancode and Shencottah (Shenkottai).

The state now is divided into 14 districts. The names of the districts with their area and population are Thiruvananthapuram (2186 km²; 25,96,112), the capital deriving its name from "Thiruananthapuram" which is presumed to be after 'Anantha' the many-headed serpent supporting 'Sri Padmanabha', the deity of the famous Sri Padmanabha Swami temple (Menon, 1962; Pillai, 1940); Kollam (2687.50 km²; 21,92,901), associated with the origin of the famous Kollam Era in 825 A.D. and was one of the largest ports in the world at that time (Menon, 1964); Alappuzha (1360.58 km²; 18,65,580), the smallest district without highlands and with a network of rivers and backwaters and the unique phenomenon of 'chakara' (mud banks); Pathanamthitta (2518.98 km²; 11,07,658), one of the few districts without a coastline; Kottayam (2195.50 km²; 16,97,442), another district without a

coastline, 73% of which lies in the hilly terrain; Idukki (5149.62 km²; 9,69,292) which forms a mountainous amphitheatre of the Western Ghats with the highest peak in southern India, the Anamudi (2695 m); Ernakulam (2358.19 km²; 22,35,294), displaying a panoramic view of backwaters studded with several islands and the land which supplied 'Sri Sankara' of the Advaita philosophy; Thrissur (2993.90 km²; 24,39,543), the cultural capital of Kerala and the land of 'poorams'; Palakkad (4389.80 km²; 20,44,399), the largest district in the state; Malappuram (3632.30 km²; 24,02,701), a muslim dominated district; Kozhikode (2333.30 km²; 22,45,265), the land where Vasco da Gama landed in 1498; Wynad (2125.60 km²; 5,54,026), the least populated district but with most hilly terrain and Kannur (2966 km²; 19,30,223) and Kasaragod (1981.30 km²; 8,72,741) adjacent to Karnataka with some Tulu-speaking population. These 14 districts are divided into 61 taluks and 1446 villages.

Geology

Kerala forms a part of the continental fragment of the earth's surface which is stratigraphically different from the extrapeninsular Indian region. The mountains and the surface relief are considered to be relic in nature and are not formed by uplift (Wadia, 1965). The entire area is geologically divisible into 4 minor belts, (1) a coastal belt of recent deposits, (2) a narrow belt of Pleistocene or late Tertiary (Warkalli beds), (3) another narrow belt of laterite and (4) a high mountain belt in the midlands and mountainous zones formed from Precambrian-Archean chrySTALLINE hard rocks consisting of granites, schists, gneisses, quartz etc.

Coastal region: The Malabar Coast, of which the coast of Kerala forms a part, is generally smooth and fronted by broad submerged continental shelf that stretches in a straight line from Karachi to Kanyakumari at a depth of 180 m. It is considered to be the result of faulting in the late Pliocene (Wadia, 1965). However, the coastal area was uplifted as in 'Kuttanad' extending over 855 km² which is about 1.2 m below sea level. The total uplift in the Malabar region, estimated to be about 52.4 m from the sea level, took place in stages, one possibly in Miocene and the other in Pliocene (Menon, 1975). The average elevation of the coastal region is 15.24 m but a few outcrops of the Western Ghats extend in certain areas like Pallipuram, Vizhinjam, Varkala and Changanassery.

The coast comprises I. Recent sediments, II. Residual laterite, III. Tertiary sediments like Vaikom beds, Quilon beds, Warkalli beds and clay and IV. Dykes and gneisses of the Archean period in some places wherever the Western Ghats extend towards the coast.

I. Recent sediments: These are a. Alluvium b. Teris and blown sands and c. mud banks.

a. Alluvium: The numerous rivers that drain the Western Ghats bring along the products of weathering and deposit them on either sides of the banks. The alluvium thus deposited is dark-coloured, clayey and very fertile. The coastal alluvium, on the other hand, is light-coloured and sandy, highly porous and with less nutrients.

b. Teris and blown sands: The coastal sands comprise the red-coloured one which forms the well-known teris and white sand forming the coastal dunes. The teris sands are siliceous or ferruginous, rounded and coated with a film of red oxide of iron. Garnet sand is also found in certain parts of the beach. The beach sands along the Valarpatanam river and at Azhikode in the north have cerianite while those of the beach at Eroor, Puthiyakavu, Nettur, Panangad and Palluruthi, all in Ernakulam District, Cherthala in Alappuzha District and Chavara in Kollam District, are rich in minerals like ilmenite, monozite, zircon, thorianite etc. Glass-making sand is found at Cherthala.

c. Mud banks: Popularly known as 'chakara' the mud banks in certain places like Purakkad, Cherthala, Alappuzha, all in Alappuzha District, Njarakkal and Kochi, in Ernakulam District, are an off-shore barrier with a peculiar, very fine unctuous mud containing a large quantity of foraminiferal and infusorial remains (Menon, 1975). Light-coloured mud apparently devoid of ferruginous matter is seen south of Alappuzha. During the southwest monsoon, while sea is rough all along the coast, the nearshore waters in these areas become very calm over an extent from 10 - 25 km² in somewhat semicircular form on account of fine clayey mud of 1 - 2 m thickness. These are mudbanks. Mathew & al. (1984) made extensive studies on mud-banks.

II. Residual laterite: This is a subrecent geological formation which is well-developed in the midlands but less extensively towards the coast. This term was first used for the material at Angadipuram (Malabar) by Francis

Buchanan in 1800. A national geological monument for laterite at Angadipuram wherefrom the term laterite originated and spread throughout the world was erected in 1979. This is formed by the *in situ* decomposition of rocks of gneisses, sandstones etc.

III. Tertiary sediments:

(a) Vaikom beds: These probably represent a fluvial facies which got formed along the slopes and depressions perhaps as alluvial fans or channel-fill deposits.

(b) Quilon beds: These are of marine origin resulting from the invasion of the area by sea. The credit for discovering this unique limestone beds at Padappakkara near Kollam, known as "Quilon limestone" to Indian geologists goes to Gen. Cullen. These beds consist of blue or grey-bluish, highly plastic calcareous clays containing remains of corals, molluscs and foraminifera. Associated with these are compact fossiliferous limestones in some areas. It was also recently discovered at Paravur below 12 m overlain by Warkalli beds. The limestones have yielded abundant fossils including *Orbiculina malabarica*. This is an Oligocene and a lower Miocene system.

(c) Warkalli beds (Varkala beds): These are fossiliferous beds of the Miocene period consisting of clayey sandstones, white and variegated clays, carbonaceous clays containing lignite and resinous materials. They are mostly found in places wherever the Western Ghats extend towards the coast. Rocky cliffs with fossiliferous Miocene beds edging out from the seashore can be seen at Varkala (Mohanan & Nair, 1999; Mohanan & Henry, 1994), Parvur, Tangasseri and Anjengu (Menon, 1964) and Kannur and Kasaragod (Krishnan, 1956). The lignite found near Varkala is very extensive and is estimated to the order of 270 million tonnes (Krishnan, 1956). The lowermost bed in the Varkala cliff is often interbedded with peaty lenses containing thin veins of pyrite. This bed is about 4.6 m thick. South of Kottayam it forms a fringe between the areas of backwaters and metamorphic rocks. At Mavelikkara and Changanasserry inland exposures of this bed, extending for about 35 and 42 km length respectively and 8 km breadth, are found.

(d) Clay: Both residual and sedimentary types of clay occur here. The largest deposit of the residual type is found at Kundara in Kollam District beneath

a cliff of 18.3 m high. This cliff of Warkalli formation is capped by laterite and with a bed of clay at its base which is about 1.5 m thick. The clay beds at Chathanur (Kollam District) is of sedimentary type. In Kuttanad (Alappuzha District) hard stiff clay of variegated colours is seen alternating with loose sand.

IV. Dykes and gneisses: These complex geological formations, less common towards the coast, are well-developed in inlands. Dolerite dykes traverse in a north-west and east-west direction in the coast at Changanasserry and Alappuzha and are composed of plagioclase, feldspar and pyroxenes. In some areas the gneisses are also traversed by dykes of varied composition. The gabbro and dolerite dykes are grey to dark grey but the norite shows a green hue due to the alteration of pyroxenes to hornblende. The gneisses group in coastal areas is either fresh or completely decomposed.

Midlands and mountainous regions: Most parts of the midlands are covered by residual laterite whereas the greater parts of the highlands are covered by rocks of the Archean groups. Rocks of the Western Ghats often extend to considerable part of the midlands and in a few areas up to the coast as mentioned elsewhere. They form the basement on which all tertiary sediments are deposited and are essentially gneisses and schists. Gneiss is a grey or white, coarse or medium-grained, light feldspathic rock usually containing garnet and biotite and occasionally flakes of graphite in varying proportions. In some cases it may also contain veins of pegmatite and quartz. In some places it exhibits a banded appearance and hence called 'garnite gneiss'. Dark grey foliated garnet is found throughout the eastern part. Foliated hornblende-biotite gneiss of grey or white is found in the northern part of the state. In Perdała (Kannur District) another type consisting of quartz, microcline, biotite, magnetite and occasional zircon is found. Cordierite bearing rocks have been recorded from Kottayam, Changanasserry, Thiruvalla and Kozhencheri. An optically negative mineral, cordierite, found in Kottayam District, is unusually optically positive (Menon, 1975).

The interior midlands of Palakkad are characteristic with numerous hills of porphyritic biotite and hornblende granite besides some hypersthene granite. The gneiss bed of the Periyar basin and neighbourhood passes gradually into charnockites.

Charnockites: Fine-grained, basic charnockite with biotitic-pyroxene granu-

lite and abundant hypersthene are found in Kannur whereas bluish grey quartz-veined charnockites with hypersthene are common in Palakkad. In the south both grey and bluish black charnockite containing hypersthene, quartz and feldspar and garnite are met with.

Dykes: The gneisses are often traversed by dykes of varied composition. They are very complex and devoid of any fossil. Different types of dykes like gabbro and dolerite which are usually grey, and norite, which is green, are common at Kothamangalam, Perumbavur and Muvattupuzha. Dolerite dyke is also found at Meenachil, Changanassery etc. Norite covered on either side by gneisses along with xenoliths with thin veins of quartz is common at Periyar and Bhoothathankettu. The gabbro dykes, characteristic of central Kerala, extend up to Punalut.

Residual laterite: It is a peculiar ferruginous material which is a porous, pitted, clay-like rock with red, yellow-brown, grey and mottled colour depending on the composition. It is composed of oxides of iron and aluminium along with manganese, titanium, zirconium etc. It has extensively developed in the midlands. As a covering over the gneisses of flat-topped ridges and hillocks, the laterite develops into circular or elliptic patches. The west flowing rivers often incise the lateritic plateau in many areas. Ferruginous laterite suitable for quarrying is common in southern Kerala but the peltate variety is less common.

Economic geology

The state is rich in mineral wealth. The following are some of them.

1. Quilon limestone: This is found 2.1 m below the surface at Padappakkara near Paravur in Kollam and near Vembanad lake in Kottayam. This forms the raw material for the Travancore cements. Limestone is also found in Palakkad to an extent of over 1000 ha and in Kasaragod along the Mogral river.

2. Lignite: The Warkalli formation along the coast contains beds of carbonaceous clay with lignite. This is found at Koilthittam and Edava. Overlain by variegated clay, it also occurs at Kannur and Kasaragod.

3. Glass-making sand: The famous Chertala glass is manufactured from this sand which was once abundant in and around the beaches of Cherthala

(Alappuzha District). Now due to over-exploitation it has become scarce. Its presence is also reported at Eroor, Puthiyakavu, Nettur, Panangad and Palluruthi in Ernakulam District.

4. China clay (Kaolin): A product of the weathering of feldspathic gneiss, kaolin is common throughout the state. In the north it generally occurs under laterite while in the south it is common below Warkalli formations. The clay is mined at Vanchi in Chathanur. At Kundara the residual clay deposits are exploited for the manufacture of porcelain-ware in the government ceramic factory. The sedimentary clay is utilized for making refractory bricks. Kaolin devoid of iron compounds is found in other districts also. Alluvial clay is also found along banks of rivers and towards the coast.

5. Monazite, ilmenite etc.: Monazite containing uranium, thorianite with uranothorianite and cerianite are reported from beaches throughout the state with the largest concentration at Chavara in Kollam District. Ever since its discovery in 1906, it is being mined at Chavara. It generally occurs along lagoons. Magnetite and ilmenite are also found in the Periyar and Muvattupuzha river sands. Ilmenite, monazite, zircon, thorianite and cerianite occur in Valarpatanam river, Azhikkode and throughout the beaches of Kannur and Kasaragod.

6. Graphite: Large deposits of graphite occur at Punalur, Muvattupuzha and Thodupuzha and in smaller quantities in several other places in the state.

7. Mica: Associated with an altered pegmatite and veins of quartz, mica occurs in some places particularly Oachira. Phlogopite mica, common at Punalur, is mined.

8. Marcasite, peat, pyrite and fossils: They are found in the Warkalli beds along the southern coast. Marine fossils identified from Warkalli beds are *Cassis sculpta*, *Cerithium rude*, *Conus calanulatus*, *C. marginatus*, *Ranella leufo*, *Strombus fortisi*, *Voluta jugosa* and species of foraminifera and *Orbitolites*.

9. Iron ore: Lateritic iron ore is found in many places like Puthenkurusu (Puthencruz), Kasaragod and Kunnathunadu. Ore of quartz-magnetite type is also found in some places in Ernakulam District.

10. Gold has been reported from Mandur in Kasaragod District and some other places in the north.

11. Precious stones: Gem stone (quartz) is abundant throughout the state. Banded agatejaspar (vaiduryam) is common at Nedumangad and Chirayinkil, Kulathupuzha-Thenmala region and is mined clandestinely. At Odara in Kottayam District pegmatite contains small quantities of aquamarine columbite, beryl etc.

12. Chalcopyrite occurs at Vandavattur near Kottayam.

13. Building stone (Vettukal), a characteristic of southern Kerala, is typically charnockite and leptynite and occurs in the midlands and coastal belt.

Soil

The composition of soil in an area is generally determined by the nature of the rocks from which it is derived. Seth and Yadav (1960) broadly classified the soils as upland soils developed from bedrocks and lowland soils developed from alluvial materials brought from the uplands. The upland soils are relatively shallow, poor and rocky while those of the lowlands are deep, fertile and fine-textured. The soils in Kerala are generally classified as 1. Laterite (high and low level), 2. Red soil (red loam), 3. Forest soil (medium black), 4. Alluvial soil including coastal alluvium and 5. Peaty soil.

1. Laterite: This is derived from rocks rich in aluminium such as gneiss, sandstones and granites and are generally reddish or yellowish, gravelly on the top and mixed with iron beneath. This may also contain some quantities of titanium and manganese. Major parts of the hilly areas of the state are covered by this type. This soil is fairly rich in nitrogen but poor in phosphorus and calcium due to heavy leaching. It is essentially a mixture of aluminium oxide and hydroxides and hence highly porous. The pH is between 4.5 and 6. The laterite in valleys is mostly sterile.

2. Red soil: Derived from ancient crystalline and metamorphic rocks, this type covers large areas in midlands and some places in the coastal region. It varies greatly in fertility and is deficient in nitrogen, phosphorus and lime. It is acidic to neutral in reaction. The texture depends upon the relative proportion of kaolin, silicic acid and ferric hydroxide. When mixed with other types it forms sandy to clayey loam. It is light and porous with low water-absorbing capacity. Red loam is the most prominent soil in the Western Ghats. The colour is due to the oxidation and diffusion of iron.

3. Forest soil (medium black soil): It is derived from the decomposition of trap-rocks. It is more fertile and contains large quantities of lime, magnesium, potash and aluminium but is poor in nitrogen and other organic matter. The black colour is due to the presence of iron.

4. Alluvial soil: This type is found in low-lying, marshy and submergible areas and along the coast. Though deep, the composition varies from place to place. The pH is near-neutral. It is poor in nitrogen, average to low in phosphorus but is usually rich in potash, lime and organic matter. Mixed red or black alluvium is also met with. The coastal alluvium is sandy and has less water-holding capacity and low nutrient status but alluvium along the banks of rivers is highly fertile.

5. Peaty or Kari soil: Owing its origin to accumulation of large quantities of organic matter, the peaty soil found in the karinilams of Alappuzha and Kottayam Districts, has a number of trees at different stages of decomposition buried at different depths. The black colour is due to the presence of free aluminium and ferrous compounds. This soil is heavy and highly acidic ($\text{pH} < 3.8$) due to the decomposition of organic matter in anaerobic conditions.

Topography

Kerala presents a considerable diversity in general appearance. Retreating from the surface of the generally flat coast, the surface suddenly becomes unequal, roughening into slopes which gradually combine and swell into mountainous amphitheatre (Ward & Corner, 1863). Based on physiography the state is divided into three natural zones, viz., lowlands or coastal zone (Theerabhoomi) bordering the seacoast below 300 m, midlands (Idanadu) comprising the undulating low hills and valleys east of the lowlands between 300 and 600 m and highlands (Malanadu) on the extreme east covered by dense forests above 600 m. The lowlands are again divided into plains, between 30 and 300 m and the coastal zone below 30 m.

a. **The lowlands (Theerabhoomi):** Interspersed with extensive backwaters, lagoons and canals and flanked by luxuriant coconut groves and green rice fields, the coastal zone is the most picturesque of them all in Kerala (Chaithanya, 1994). This narrow strip of land, usually flat but undulating at times, extends for about 560 km from Kasaragod in the north to Thiruvananthapuram in the south

with an average width of about 25 km and an altitude ranging between 10 and 30 m. In the south a ledge of rock stretches out from the coast at Pallippuram. At Vizhinjam the sea forms a small bay and the creek runs into the Venganoor glen. Varkala has a series of rugged cliffs whereas at Veli and Changanasserry the coast is elevated due to the extension of the Archean rocks. Towards the central part of the state the lowlands consist of long, narrow stretches of sand intercepted by several rivers and backwaters and are generally swampy and liable to be flooded during the monsoon. In Kochi several islands are formed by backwaters in the deltaic region of the Periyar river. The coastal tract in the north has rather loose and sandy soil frequently broken by the rocky shore. This zone often extends far interior at Kasaragod where tobacco is cultivated, this being the only place where this crop is cultivated. Inland navigation is one of the natural advantages due to the presence of a continuous chain of rivers and backwaters. All the coastal lagoons extending from Thiruvananthapuram to Kottappuram in Thrissur are connected by a 370 km long navigable canal. All rivers, backwaters and canals in the coastal tract together form an inland water way of 1920 km long which is more than 1/5 of the total length of India's inland water ways (Chaithanya, 1994). Of this the portion between Kollam and Kottappuram is included in the National Water Ways III, the Ganges and the Brahmaputra being I and II respectively. The water way connecting Kottappuram with Kasaragod in the north is likely to be included in National Water Ways III soon under the Inland Water Ways Authority of India (IWAI). Another unique feature of the state is the extensive fertile region, universally known by the appellation Kuttanad, which is a narrow strip of land of about 855 km² bordering the Vembanad Lake from Karthikapally to Vaikom constituting "the greenary of the state". Situated 1.2 m below sea level, perhaps it is the only place of its kind in the whole country. This land was possibly uplifted during the late Tertiary period. The lands south of Kuttanad and east of Purakkad and Thottapally and south of Thakazhi are known as Karinilam due to the characteristic black soil in which a number of trees in different stages of decomposition is found buried at different depths. A fertile zone lining the coast for its whole length so near the sea imparts a peculiar character to this landscape (Ward & Corner, 1863).

b. The Midlands (Edanadu): Lying to the east of the coastal zone and merging with the highlands are the undulating midlands with small hills and valleys

extending to over 500 km long and 10–40 km wide. This tract is traversed by several rivers and placid streams. The elevation of the land increases gradually from the coast towards east, the average being 200 m. Sometimes rocky spurs from the Western Ghats are found projecting towards the midlands, often extending almost up to the coast. Such spurs forming a secondary range beside the Western Ghats soften into undulating smaller hills and valleys south of the Kallada river whereas in the north of the Cardamom Hills, except at the Palakkad gap, these spurs and ravines merge westward into gentler slopes and end abruptly into cliffs. Midlands are thickly populated and dotted everywhere with homesteads and farms of crops like coconut, arecanut, cashew, tapioca, paddy etc. and present a “dense greenery broken by gabled house-tops, undulating roads, groves and parks” (Chaithanya, 1994). In spite of the tremendous population pressure and aggressive farming, there still remains a few pockets of forested hillocks standing out isolated conspicuously throughout the midlands which represent their original features. Notwithstanding their degradation, the sarpakavus (sacred groves) in the midlands also possess some of the original vegetation.

c. The Highlands (Malanadu): The mountainous zone or the highland is essentially the southernmost part of the Western Ghats that forms the eastern ramparts of the state consisting of a series of hills with an average height of about 1000 m. There are several peaks of over 1500 m. The height of the hills generally decreases from north to south, abruptly sloping towards the west and gradually so towards the east along the entire length. Towards the south the mountains assume some “striking rocky precipitous acclivities and fantastic forms but towards the north this tract is not sharply well defined and has some rugged cliffs and conical summits along the otherwise rounded and sombre outline” (Ward & Corner, 1863). The ghats run almost parallel to the sea coast, at a distance of 12 km from Vevelmala in the north to Kozhikode, at times coming down to the shore in some places. The highest peak in this section is the Vevelmala (2339 m). Veidalmala (1371.6 m) is a grassy mountain standing at right angles to the Western Ghats. Ezhimala (260 m) is another small but important rugged hill jutting into the sea in isolation on the Kannur coast. The first landmass to be sighted by Vasco da Gama, the Ezhimala, was a separate kingdom in the early centuries of the Christian era. The Purali ridge is unconnected with the main ghat system in Thalassery section.

The ghats turn abruptly eastward from Kozhikode and bend northwards.

North Wynad lying above the crest of the Western Ghats is the continuation of the Mysore Plateau. This section, known as the Wynad Plateau, has a number of hills with an average height of 950 m. Some of these hills attain greater heights (Banasura Mala 1912 m and Brahmagiri 1608 m). Brahmagiri, the abode of Lord Brahma, is a ridge branching off from the main ghats at Mananthavady. This peak is the limit between Coorg and Wynad and between these two ridges lies the Valley of Thirunelli. The Perambadi ghat and the Peria ghat are the two passes in this region providing access to Coorg and Mysore respectively.

In the north the ghats join the Nilgiris and the Kundhas presenting a sublime scenery of several peaks and ridges sloping down into the Nilambur vested forests. This area has the oldest teak plantations in Asia (Sivarajan & Mathew, 1997) producing the finest teak (Ward & Corner, 1906). The upper reaches (2760 m) and the steep valleys possess dense forests with almost little biotic interference. The ghats stretch further into the Attapadi Valley for about 320 km². This area comprises hills and valleys over-run with dense vegetation infested with innumerable elephants and has several hamlets of hill tribes. The hills adjoining the Nilgiris in Palakkad have an elevation varying from 900 to 2132 m, the highest being Anginda (2366.14 m) which is at the northeast corner of the Silent Valley. The other important peaks are Karimala (1998 m) and Padagiri (1585 m).

The Silent Valley (89.52 km²) is a rectangular plateau in Palakkad District. Surrounded by high ridges ranging from 1200 to 2000 m, the valley is almost shielded from extremes of climate. The name is derived from the absence of the cicada insect which usually produces a distinct noise in tropical rain forests (Manilal, 1988). The entire area is a gradual slope without much steep gradient. It is traversed by Kunthipuzha, a perennial river, originating at the Kozhipara peak (2200 m), bisecting all along into a narrow western and a broad eastern sector before joining the Bharathapuzha. The Karimpuzha Valley links this area with New Amarambalam which is a huge amphitheatre of deeply dissected valleys and sharp ridges which are drained by the Punnapuzha, Talipuzha, Karimpuzha and Cherupuzha (Anon., 1980). The entire Silent Valley and New Amarambalam have relatively undisturbed evergreen and moist deciduous forests. The ghats further stretch with a ridge and reach the Palakkad gap with Walayar at its northern end forming almost the state boundary.

The unique feature of the highlands is the Palakkad gap. It is a major breach in the otherwise continuous ghats which is 32.2 km wide and 80 km long separating the Anaimudi from the Nilgiris. This pass connects the West Coast with the Deccan region in the east. Guarded on either side by lofty hills reaching 1100 - 2000 m, the elevation in the gap is 20 - 100 m. Logan (1887) described this gap thus, "Here by whatever natural agency the break occurred, the mountains appear thrown back and heaped up as if some overwhelming deluge burst through sweeping them left and right". During January - April hot land winds rush into the state from the plains of Coimbatore through this gap. The Palakkad gap, according to Legris and Meher-Homji (1977), is a pre-Pleistocene river.

The hills attain lofty heights beyond the gap with ridges in Manachadmala along the northwest and southeast directions flanked by the Chelakkara-Elanad Valley in the north and Vazhani Valley in the south merging with the Vellanimala running eastwest. Another ridge, Anaikkal-Mangattukombom, runs eastwest bordering the Chimmuni Valley with the highest point at Ponmudi (923 m). A ridge with Karimalagapuram (1450 m) separates the Sholayar and Parambikulam Valleys. The Kuduyattur-Vindyan are the noteworthy hills in Ernakulam District with an average elevation of 915 m. The mountains swell into the High Ranges with Anaimudi (2695 m), the highest peak in southern India, forming a junction from where three ranges of hills strike off: the Anamalai in the north, the Palnis in northeast and the Elamalai (Cardamom hills) in the south. The southern block which slopes towards the West Coast forms another plateau the Periyar Plateau, with Elamalai in the east. Elamalai derives its name from the large number of cardamom plantations there. The central range abruptly terminates in a sheer cliff (1000 m) with a massive Varnanad-Andipatti branch which merges with the Kambam Valley south of the Devarmalai (1922 m).

The High Ranges, also known as the Elamalai (Cardamom hills), present a grand and imposing spectacle with their great height and varied configuration. Some of the loftier hills in this section are Karimkulam (2698 m), Devimala (2643 m), Chockenmudy (2224 m), Perumpetty kullu (1981 m), Vagavarai (2560 m), Alleanala (2103 m), Eravimala (2381 m), Kattumala (2590 m), Kumarikkal (2575 m), Chemmun peak (2163 m), Payratmala (2254 m), Korumpara (2529 m), Pampadumchola (2560 m) etc. Although often called a plateau, the High Ranges are really a succession of hills and valleys with several plateaus of which the most

important ones are 1. Gudarmala with an average elevation of 1828 m and area of 10.36 km², 2. Devikulam Plateau with an average elevation of 1828 m and area of 7.77 km², 3. Anaycudoo, a smaller plateau lying west of Devikulam, 4. Eravimala with an average elevation of 2132 m and area of 7.77 km², 5. Anchanad with an average elevation of 934.47 m and area of 7.77 km² and 6. Vattavada with more than 1,828 m and less area than others. All these plateaus have their valleys known by the same names.

Rising suddenly from a lower altitude, the High Ranges begin with Sholamala in the northwestern corner of Idukki District and it runs southwesterly to Gennewura and further southwest passing through Corichy to Ruddikut from where a chain of hills runs to Coorkacomboo. It then turns westward and rises to Chockinnamuddy and dissolves into a gap. From the gap the hills extend southwest to Perumpully kollu and turn to join Anamudi. The stretch connecting Anamudi and Eravimala is broken at some places and the ranges descend into a deep valley and ascend towards northwest to Kottamala. After forming a plateau with the Chennun peak east of Kottamala, the ranges merge with the Anchanad Valley. A ridge separating the watershed between the Anchanad Valley and Munnar joins the peaks bordering the Palnis.

The High Ranges slope down to form three major valleys *viz.*, Aryanad Valley in the northeast, Kadampara Valley in the west and Elamalai-Peermade in the south. The slopes of these valleys display a panoramic view of dense evergreen forests. The famous Sabarimala (1154 m), where the Hindu shrine Lord Ayyappan temple is situated, is on the Peermade hills. Like the northern portion, the ranges of the Western Ghats here also have many passes allowing controlled interaction with the plains in the west and the east. They are the Bodinaickanur pass which connects Madurai with Devikulam and Munnar, the Thevaram pass which links Thevaram with the Cardamom hills over the top of the High Ranges by a very steep ascent, the Kambam Pass which lies between Kottayam and Madurai through a rugged terrain, the Gudalur or Kumili pass which connects Peermade and Kanjirapally with Kambam and Uthamapalayam and the Sivagiri pass which ascends the hills south of Gudalur to Sabarimala.

The ghats continue beyond Sabarimala with some branches jutting out picturesquely from their bases westwards spreading even up to Kuttanad. But

from Kollam southwards they soften down into an undulating plateau. Some of the lofty peaks in this labyrinth of mountains include Karimala (1998 m), Sabarimala (1154 m), Pambamala (1550 m), Meenmala (1734 m), Koyilmala (1600 m), Sivagiri (1500 m), Pulamala (1450 m), Muthiramala (1041 m), Kakkiyarmala (1350 m) etc. The south-oriented ghats are again interrupted by another pass - the Achenkovil gap or Aryankavu pass providing access to Tirunelveli in Tamil Nadu from Pathanapuram for a total length of over 30 km presenting on either side a splendid scenery of luxuriant evergreen forests. The chain of hills beyond this extends further to Thenmala-Kulathupuzha and finally merges with the Agasthyamalai-Kalakkad Ranges with the Agastyarkudam (1869 m) as its highest point. The mountains of this section in general are round in outline but the uniformity is broken towards the southernmost part of the hills with "craggy tops rising in every variety of grotesque shape" (Ward & Corner, 1863). They are Aduppukal mottai, Chemungi, Ponmudi and Braemore. The ghats culminate at Mukkuni mala (1074 m) in Neyyattinkara taluk of Thiruvananthapuram. Ponmudi (1000 m), 59 km away from Thiruvananthapuram, is a well known hill station. The major passes in this section are the Aramboly pass through which passes a trunk road from Tirunelveli to Thiruvananthapuram and the Aryanad pass from Nedumangad to Tirunelveli. These apart there are some narrow paths like Kadukkara to Shoravalli madam and Kannikkatti-Boneccord which are used by the Kanikkar tribals and farm labourers in hills.

Lakes and backwaters

The singular natural advantage of Kerala is a succession of lakes and/or estuaries connected by canals of 370 km long with variable ramifications in dimension and depth. These lakes together present a very irregular and broken figure, enrich their neighbourhood, unite the distant parts and increase the value of natural production (Ward & Corner, 1863). The total area occupied by lakes is 363 km² with 251 km² in southern, 85 km² in central and 25 km² in northern Kerala. Most lakes are separated from the sea by a narrow strip of land. During monsoon the enormous quantity of water they receive from the rivers make them overflow. The slimy deposits left by the retreat of thin "turbid but salutary floods effuse an abundance of fertility over the land exposed to it" which are cultivated on their subsiding (Ward & Corner, 1863). Along the banks of the lakes are noted "an infinity of reeds and aquatic plants particularly of lotus which clothes all the

pools with its lively verdure" (Ward & Comer, 1863). But, of late, these lakes are mostly devoid of any vegetation, due to reclamation, except for a network of fibrous and clustering roots of Odallam (*Cerbera odollam*) and species of *Pandanus*.

There are 21 major lakes in the state of which the Vellayani, Sasthamcotta and Puzhakkad are fresh water ones. Veli, Anchuthengu (Anjengo) and Kadinamkulam in the south are smaller. The larger ones are the following -

Edava-Nadayara kayal is located south of Kollam town and is connected with sea by bars which open during the monsoon.

Paravur kayal is very deep and fraught with dangers as it is very close to the sea and exposed to sudden sea breeze. The Paravur thode and Kollam thode connect it to other lakes on either side.

Ashtamudi kayal derives its name from the eight divisions of creeks known by different names. This has a total area of 435 km² with an outlet to the sea at Neendakara.

Sasthamcotta kayal is a fresh water lake and is situated in the northeast of Kollam town, beside the Kallada river. The total area is 2 - 3 km² and maximum depth is 70 m. It is protected by an earthen embankment on the eastern side and is surrounded by high hills on three sides.

Kayamkulam kayal has a total area of 60 km². It extends from Panmana to Karthikapalli. This shallow lake has an outlet at Kayamkulam. The Ashtamudi is connected to this by the Chavara-Panmana thode.

Vembanad kayal stretches for 83 km from Alappuzha to Kochi with an average breadth of 14 km. The southern borders are reclaimed by bunds. The entire lake is affected by tidal action. Five major rivers discharge into this lake. It has a small and bewitchingly beautiful island called Pathiramanal (mysterious sands of midnight) with luxuriant vegetation. Pallippuram and Perumpallam are the other important islands.

The backwaters around Kochi are dotted with several islands like Wellington, Vaipin, Ramanthuruthu, Ponjikara (Bolgatty), Vallarpadam etc.

Chiranallur and Edapalli are connected by a canal and Ernakulam and Elamkulam by another lake. Varapuzha and Kodungallor are the other two kayals around here. The Chavakkad lake spreads into a variety of forms presenting a

very irregular and broken outline with low banks and varying depth. This is connected with the Ponnani estuary with a channel. The Veleankode is "quite a beautiful sheet of water extending into every possible form" (Ward & Corner, 1906). The Koilandy estuary is formed by river Punut. The Kavvayi lake lies in Kasaragod and Hosdurg taluks. With outlets at Chandira and Pazhayangadi, it runs for over 20 km parallel to the coast. The smaller lakes are Kambala, Kalnad, Bakel and Chittari.

Rivers

The unique feature of the state is the presence of a number of rivers, their innumerable tributaries and several streams with laterite overhanging at their sources, forming a network of river system. In the highlands these rivers support a rich and varied vegetation and in the plains they enliven and fertilize the cultivated lands. No other geographical area in the country comparable to Kerala has been blessed with such a perennial water resource. Except for their irregular and capricious course and varying distance and depth, these rivers are almost similar with their rocky beds of coarse granite, elevated portions on either sides with beds of sands and clayey deposits along their banks (Ward & Corner, 1863). The summit of the Western Ghats forms the watershed with the drainage system towards the western parts with two knick points for the rivers at 500 - 800 m and 90 - 150 m corresponding to the prominent breaks on the slopes marking the midlands and lowlands. They have a straight course flowing at a low gradient towards the sea in the coastal plains.

Of the 44 main rivers that originate from the Western Ghats forty one cut across the state and empty themselves into the Arabian sea directly or through backwaters. The east flowing rivers are the Bhavani, Kabini and Pambar. The entire state is therefore conceived as a totality of forty four river basins. Compared to other major rivers in the country, the rivers in Kerala are dimensionally small but are prominent by the heavy load of water and sediment drained annually. The following are the major rivers.

1. Neyyar: It is 56 km long and originates from the foot of the Agastyarkudam (1869 m) and is interrupted by several falls in its early course. It takes a rapid course over a partially rocky bed and discharges into the Arabian

sea near Paravur.

2. Karamana: It is 68 km long and originates from the northwestern part of the Agastyarkudam and slopes of Chemungi (1706 m), flows over a narrow rocky bed through a thickly forested and uneven terrain and reaches Punthura where it unites with Killiyar which in turn is a 14 km long river that arises in the hills of Nedumangad and joins the sea near Kovalam.

3. Mamom river: A 27 km long river adjacent to Vamanapuram river that discharges into the Arabian sea near Anchuthengu.

4. Attungal-Vamanapuram river: It is 88 km long and originates from Chemungi (1706 m). After traversing through forests for 36 km it reaches Vamanapuram. It joins the Kilimanoor river just thereafter. The combined river discharges into the Anchuthengu ('Anjengo') estuary.

5. Ayoor river: A small river of 17 km long and lies almost parallel to Vamanapuram river.

6. Ithikkarayar: It is 56 km long and originates from the base of Madathurikunnu. Pursuing a sinuous course westward over a partially rocky bed, it joins the Paravur lake at Meenad after joining the Vattaparambuthode.

7. Kalladayar: It is 121 km long and is initially formed by the confluence of three rivers viz., Kulathupuzha, Chendurunni and Kalthuruthi rivers at Parappara. Kulathupuzha in turn is the result of the union of Pongumala aar originating at Karimala-Kadakkal (1500 m), Sinikalayar originating from Sinikala hills (1000 m) and Sankalipalayamar from Ponmudi. Several streams springing from Kottavasal and its neighbourhood unite to form the Kalthuruthi river. The combined river joined by Chittar flows westwards forming several cataracts, the notable being Meenmutty and falls into the Ashtamudi kayal at Enathu.

8. Pallikkal river: A small river of 42 km long near Kalladayar which joins the Ashtamudi lake.

9. Achenkovil river: It is 128 km long and is formed by the confluence of several streams that spring from the foot of the Rishimala and adjacent hills near the Achenkovil pass in Kollam District. Quitting the wild tract it runs west widening its bed in its course till Kumbazha where it is joined by Kallar, turns west

again giving out two streams which join the Pamba river at Parumala. The main branch also splits and joins the Pamba river.

10. Pamba river: This holy river of the Hindus is 196 km long. It is formed by the union of the Pambayar, Kakkiyar, Arudayar, Kakkadaar and Kallar. The streams that spring from the Peermade plateau join to form the Pambayar which rushes down to 350 m altitude receiving several other streams, flows southwest down to 150 m altitude and joins the Kakkiyar. The Kakkiyar originates from the Gudarakal plateau (1400 m) and joined by the Chinnakallar flows down to Pamba. The combined river spills over rocks at Poothenaruvi and forms a fall of considerable magnitude and joins the Kakkadaar which is a union of the Moozhiyar and Manianar. Joined by the Kallar, the Pamba flows northwest to Ranni where it takes the name Ranni river and runs into the plains of Kuttanad with an impetuous current where it bifurcates. The branches joined by the Achenkovil and Manimala rivers flow into the Vembanad lake forming several islands. The third largest river in the state, it is also known as the 'gift of Kuttanad'

11. Manimalayar: It is 91.77 km long and originates from the Mothavara hills (1280 m) and flows southwards joined by Kokkayar, a stream rising from the Peermade plateau, Chittar and Muleplakkalthode into the plains of Alappuzha to join the Pamba river.

12. Meenachil aar: It is 78 km long and springs from the Western Ghats as a confluence of several streams. The Kadampuzha rising from Aikunnumudi (1907 m) joins the Konipad thode to form the Kadathukadavu aar. The Thrikkoilaar originating at Madavimala meets the Kadathukadavu and flows south to Erattupetta, joins the Poonjar which takes its origin from Thalamalai and carries with it the waters of the Chittar and Payapparathode on its course. All these combine to form the Meenachil aar which meanders and flows down to Kottayam where it splits into several streams before emptying into the Vembanad lake.

13. Muvattupuzha: It is a 120.75 km long river. The confluence of the Thodupuzha, the Kaliyar and the Kothamangalam aar at Moovattupuzha town forms the Moovattupuzha. Thodupuzha is formed by the union of the streams Kodayator and Vazhi at Thalinal. The combined river meets the Kaliyar which is formed by the union of Kambaar and Thoniyar. Kothamangalam aar originating

from Neriya Mangalam reserve forests also meets the other rivers at Moovattupuzha and hence the name of the town meaning meeting point of three rivers. This river bifurcates and joins the Vembanad lake as Ithipuzha and Murinjapuzha.

14. Periyar: It is 244 km long and is one of the principal rivers in the West Coast and the second largest in the state. It rises at the Sivagiri peak (2560 m) and takes a circuitous course through immense cliffs of rocks and gorges. It is joined by the Mullayar after 16.9 km down stream and by the Perunthura river further down and still down by Cheruthoni, Chittar, Perinjankutty, Muthirapuzha as well as a number of streams along its course. Dashing down the narrow breadth guarded by mountains and interrupted by several falls it joins Deviar and Edamalayar and reaches Aluva and bifurcates. The principal branch joins the Chalakkudi river and “expands into a broad sheet of water” (Menon, 1975) and the other branch splits into several streams and joins the Vembanad lake forming many large islands in its widening course.

15. Chalakkudi river: It is 130 km long and is the result of merger of the Karampara and Sholayar rivers. The combined river from Orukombam flows west in the name of Chalakkudi. It is also joined on its course by the Anakkayam river, Charappathode and Kannankuzhithode before joining the branch of Periyar.

16. Karivannur river: It is 49 km long and has its origin in the High Ranges.

17. Puzhakkal river: Another small river of 29 km long beside Karuvannur river.

18. Keechery river: Adjacent to Puzhakkal river, it is 51 km long,

19. Bharathapuzha or Ponnani river: It is 251 km long. A sacred river of the Hindus and popularly known as the Nila nadi, this is the largest in the state and has its origin in the Anamalai hills. It is very shallow with sandy beds and often widens in its course forming many “moving islands of sand” (Ward & Corner, 1906). The main tributaries are the Gayathripuzha, Kannadipuzha, Korayar, Thuthapuzha, Kalpathipuzha, Pandiyar etc. Gayathripuzha is formed by the union of five smaller rivers viz., Mangalam river, Aylurpuzha, Cherukunnapuzha, Vandazhipuzha and Meenkara river. Kannadipuzha known as Chittur puzha and

Amaravathy river as well also originate from the Anamalais by the union of three streams viz., Palai, Aylur and Uppar. The Korayar, Kalpathipuzha and Pandiyar join the main stream at Parali. The Kalpathipuzha is formed by the union of the Karai river, Varattar, Walayar and Malampuzha. After traversing the entire Palakkad District it discharges into the Arabian sea at Ponnani.

20. Tirur river: A 48 km long river beside Bharathapuzha discharging into Arabian sea near Ponnani.

21. Kadalundi river: It is 130 km long and rising from the southern slopes of Kundah it meanders westward with several serpentine windings and empties into the sea at Kadalundi. A branch strikes off northeast about 4 km before and joins the Beyporepuzha to form an island.

22. Chaliyar: It is 169 km long and springs from the upper slopes of Nilambur and flows westwards and drains into the Arabian sea at Beypore. The major tributaries include, among other streams, Chaliyarpuzha, running down from the Wynad plateau, Karimpuzha rising from the Kundah hills and Punnapuzha originating from the Gudalur hills. The Chaliyarpuzha in turn is the result of the union of Kuthirapuzha, Kuruampuzha and Kanjirapuzha. The Karimpuzha is fed by Cherupuzha and Thalipuzha. The combined river joins the Beyporepuzha.

23. Kallayi river: This small 22 km long river lies between Chaliyar and Korapuzha.

24. Korappuzha: It is 40 km long and lies almost parallel to the Kallayi river.

25. Kuttiyadi river: It is a 74 km long river between Korapuzha and Mahe river.

26. Mayyazhipuzha or Mahe river: This river rises from the dense forests of Wynad and after a course of about 55 km discharges into the Arabian sea at Mahe. It has no major tributaries except for some small feeder streams. There is tidal influence up to 32 km from its mouth.

27. Thalassery river: It is a 24 km long river in Kannur District.

28. Anjarakanadi river: It is 64 km long and has its origin in the thick

forests of Kannothe. It flows for 64 km in Thalassery taluk of Kannur District and bifurcates forming an island at Dharmapatanam at its junction with the Arabian sea. Dharmadam Kadavu river is its main tributary which has two principal sources in the mountains of the Kakany range.

29. Valapatanam river: It is 110 km long. Its three tributaries are the Sreekantapuram, Valiyapuzha or Barapole and Aralampuzha. The first two originate from Padivalkana in Karnataka and the third one is formed by the union of the Kannirapuzha, Kuttupuzha and Karattipuzha, all flowing through thick forests. The combined river joins the sea at Valarpatanam in Kannur District.

30. Kuppam river: A 82 km long river, it originates at Coorg, Karnataka. Also known by the name Mattul it flows parallel to the Valarpatanam river through steep valleys and joined by the Perimpuzha, Alukutthode and Pakkathupuzha, flows to Thadikadavu where it is known by the name Karimpuzha. Kuttikoil river also joins it. The river takes the name Kuppam at Thaliparamba in Kannur District.

31. Ramapuram river: A small river of 20 km long which rises from the Pariyaran hills in Kannur District and flows through several villages and falls into the sea at Puthiyangadi.

32. Peruvamba river: A 51 km long river, it originates in the dense forests of Pekunnu in Thaliparamba in Kannur District. At Ezhimala it bifurcates and merges into the sea. Machanthode is the main tributary.

33. Kavvayi river: This 31 km long river is the result of the union of three streams at Chimeni in Kannur District. They are Kanakole, Peralum and Maniyalthode. The combined river enters the Podna backwaters which extend from Cheruvathur to Ramanthali.

34. Karingote river (Kariyangode): This 64 km long river originates from Padinakad ghats, Coorg, Karnataka. After running for about 20 km in Karnataka it meets the Mundrahole and Padimalahole in its course through dense forests and becomes wider with two notable falls. The Pulingam chal formed by the union of two streams originating near Brahmagiri also joins this river before reaching Kakkadavu where it takes the name Perembattehole. Then the Malothuhole joins the main river and the combined one is known here as the

Ariyakadavuhole which meets the Neleswar river, splits into several branches and enters the sea at Tiruthi, Kannur District forming a common estuary of Karigote and Nileswar.

35. Nileswar river: It is a 46 km long river. It has its origin at Kinanur in Hosdurg and is known at its source as Kubalpathichal. Joined by two other streams 6 km down, it widens in its lower reaches into a vast stretch of water at its estuary at Tiruthi in Kannur District.

36. Chittari river: This 25 km long river is an accumulation of backwaters along the coast near Chittari in Kasaragod District. Many small streams from all directions discharge into this backwater. The main streams are Kundyia, Tayakolam, Pullur and Anjanur.

37. Chandragiripuzha: With 105 km length it is one of the major rivers in Kasaragod District. It is formed by the union of the Payaswani river and Chandragiriñhole, both originating from Coorg, Karnataka. Koyanadhole, Balnadhole and Kadatkahole join the main stream on its course before Peraga. Before entering the sea this river winds through Kasaragod in a 'U' form forming small islands and the left arm stretches long into backwaters.

38. Mogral river: This 34 km long river flows parallel to the Shiriya river, runs northwest from its origin from the Payaswani river at Kantar village (Kasaragod District). The Muliya joins it before it widens at Yedanir from where it meanders in northwest direction and joins backwaters.

39. Shiriya river: It is formed by the confluence of two streams originating in Karnataka. It takes an S-shape before entering the Kumbala backwaters. Out of its 60 km length only 41 km lies in Kasaragod.

40. Uppala river: It is a river of 50 km which lies in the south of Manjeswar town. It originates from the Kudipatti hills in Karnataka and enters Kasaragod District after running for 20 - 30 km. Taking a north-westerly course it discharges into the Arabian sea.

41. Manjeswar river: A small stream of 16 km and originating from Kadandur and traversing westward through Manjeswaram town (Kasaragod District) it joins the Uppala backwaters.

42. Bhavani river: This east-flowing river springs from the Kundah Ranges near Kudikkadu Betta. Before entering Kerala it is fed by two streamlets. It then turns at right angles and takes a circuitous course through the Attapadi Valley. At the border of Kerala and Tamil Nadu the Siruvani joins the Bhavani.

43. Siruvani river: A tributary of the Bhavani, this small river originates from the base of the Attapadi hills, flows into a deep legendary lake Muthikulam at 1219 m from where a diversion takes off its waters to Coimbatore city. It joins the Bhavani at Koolampatty near the state border with Tamil Nadu.

44. Kabini river (Kabani): One of the important tributaries of the Cauvery, river Kabini has its origin in Wynad forests and flows towards east to join the main river. It is formed by the union of the Panamaram and Mamanthody, the former originating from Lakkidi and the latter from Thondarmudimala in north Wynad. The combined river flows for 8 km through Kerala before entering Karnataka at Kalvatti.

Some of the minor rivers in the state are the following.

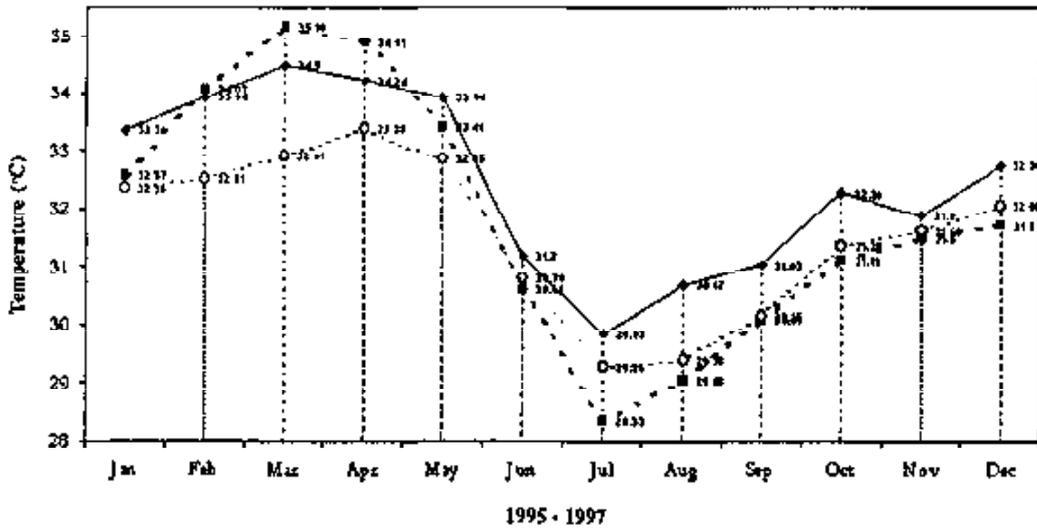
Chimminipuzha: It rises from Kallichittar and flows westwards, joins the Mooplypuzha at Olanaparambu and takes the name Kurumalipuzha.

Vadakkancheripuzha: It has its source in the Vazhani Valley in the Machad mala and flows southwest to discharge into the Arabian sea.

Manali river: Rushing through the Olakkara Valley in the Anaikkal-Mangattukombon ridge it is joined by streams originating in the Vellanimala.

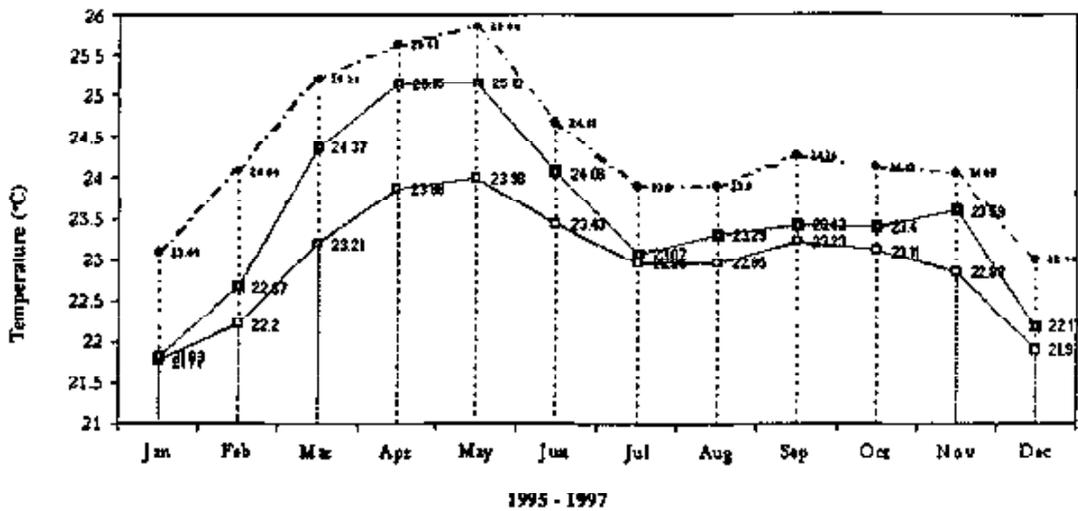
Beyyorepuzha: It is the union of several tributaries, the principal one being the Ponpuzha which rises at Naduvattam, meanders through Wynad for a long distance. The other one, the Chola river, which originates in the hills of Wynad unites with the other near Nilambur. The combined river after receiving the waters of the Kallakanpuzha, Carcoorpuzha and Cholipuzha on the right bank and Karimpuzha on the left, runs in a serpentine course to Azhikode and finally discharges into the estuary with several branches forming islands.

Thiruvangadi river: It originates from Kundah and flows with several windings for about 35 km westwards before the Purakkad river joins it.



1995 - 1997
Monthly Mean Maximum Temperature

—●— South Kerala —■— North Kerala —○— Central Kerala



1995 - 1997
Monthly Mean Minimum Temperature

—○— South Kerala —●— Central Kerala —■— North Kerala

Kotye river: It is 33 km long and has several sources in the highlands of Vattachira and adjacent areas which join near Tirunelly, then flows westward into Kotye and then running parallel to the sea, separated from it by a sand bank, joins the Ponnani river.

Kumbla river: A 10 km long river, it originates as a small stream at Yedenad and widens considerably at its mouth forming the Kumbla backwaters in Kasaragod District.

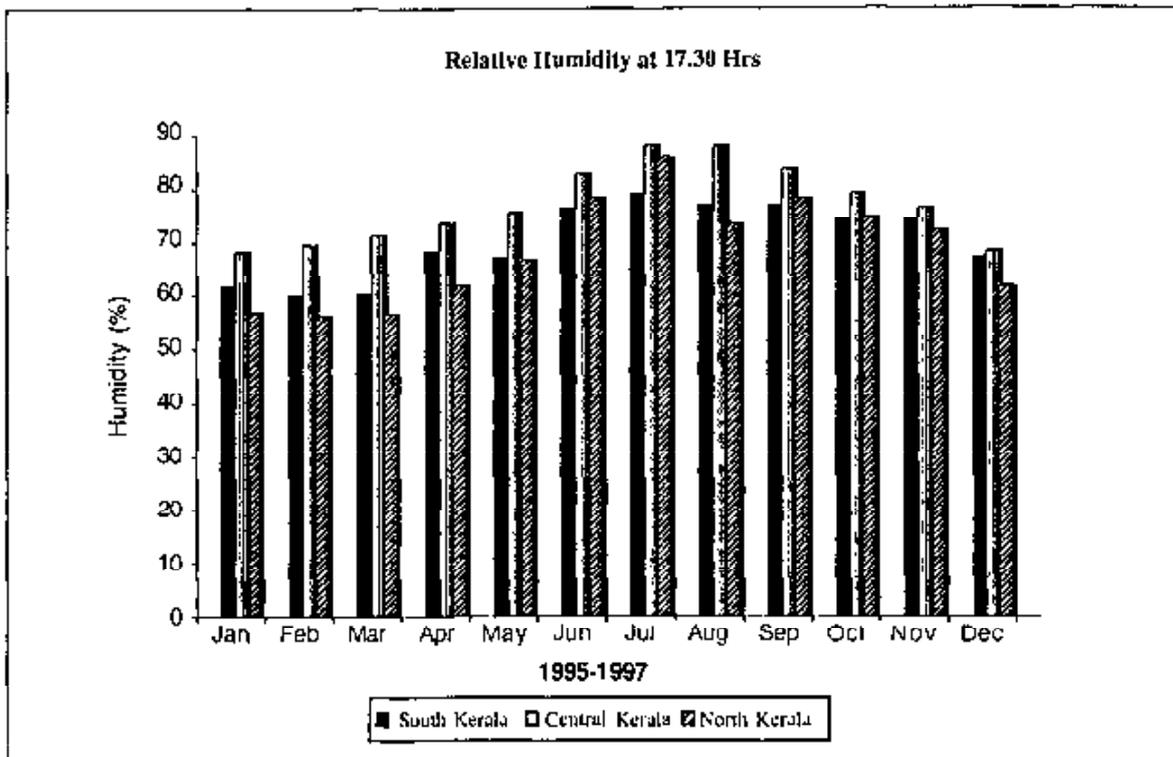
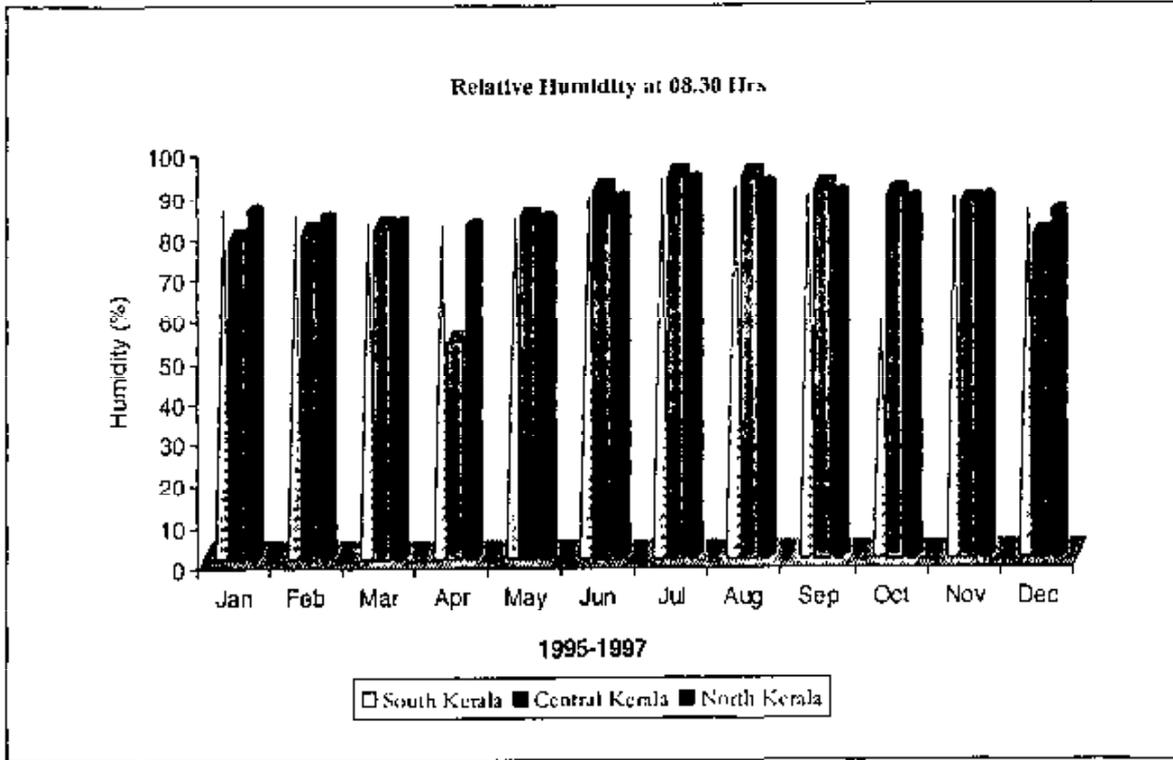
Kalnad stream: An 8 km long stream lying south of Chandragiripuzha, it originates from Chittirackal and flows through densely populated areas of Kasaragod District and joins the Kalnad lake.

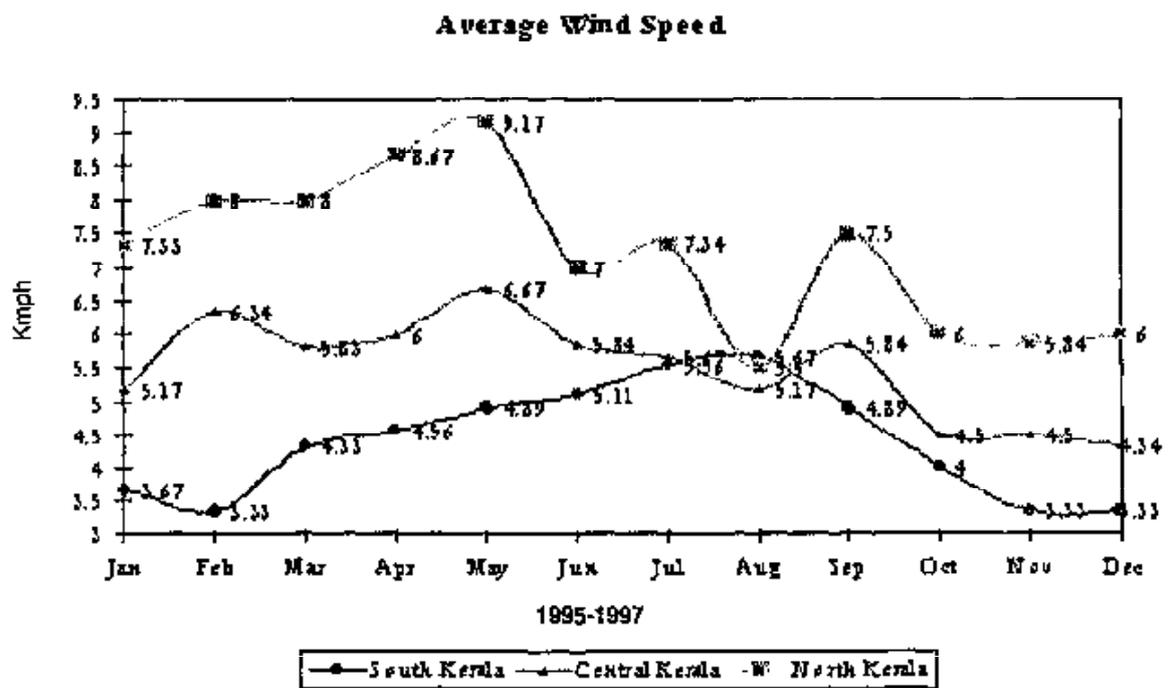
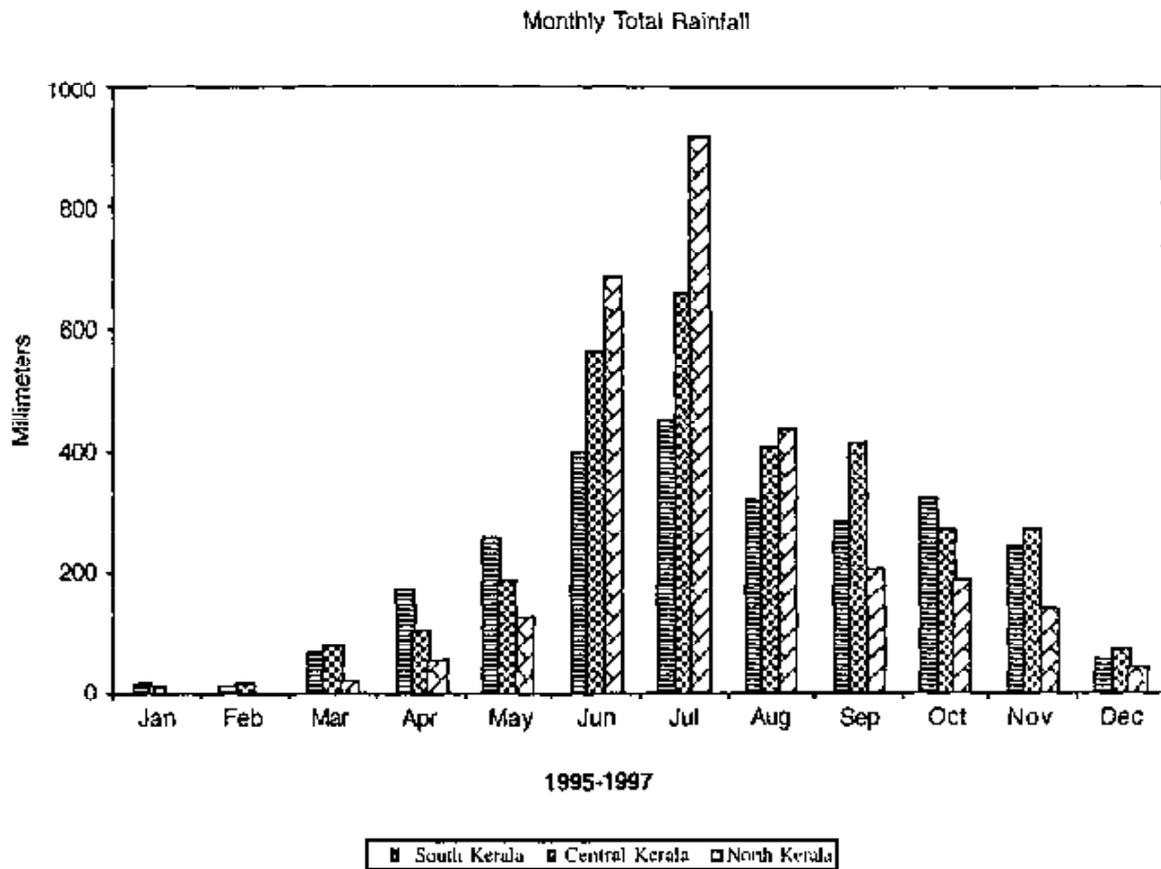
Bakel river: It is 9.6 km long and runs parallel to the Kalnad stream. It flows southwards through Kasaragod District and joins the Bakel backwaters.

Ponnayam river: Also called the Tellicherry river it is 22 km long. It originates from Kannothe and flows westwards and empties into the Arabian sea after joined by a stream at its right bank.

Climate

Kerala enjoys a warm-humid tropical climate with very little variation in temperature. The Keralites of yore divided a year into six seasons, viz., one which commences with the new moon in March - Vasantha kalam (spring) and continues till May; Grishma kalam (summer) which sets in with the new moon in May and continues till July; Varsha kalam which begins with the new moon in July and corresponds to the monsoon and continues till September; Sarat kalam (Autumn) which commences from the close of the previous season and continues till November; Hemantha kalam which succeeds the above and is marked by strong winds and lasts till January and Sisira kalam (winter) which lasts till March. Meteorologists today recognize only four seasons, summer from March to May followed by the SW. monsoon which continues till the end of September and October and November form the postmonsoon (autumn). The NE. monsoon follows and extends up to the end of February with less rain after December. This coincides with the winter. With the environment now having been degraded there is always an overlapping in the seasons and hence the six seasons of earlier days cannot be clearly demarcated now as in the past.





The maximum mean daily temperature in the coastal region is 32° C (April - May) and minimum is 22° C (Dec. - Jan.). The maximum temperature may rise up to 37°C in some areas in the plains. The minimum temperature also drops to 7° C in hills varying slightly with altitude. The seasonal variations in temperature are minimal. Both day and night temperature increases after January with the maximum in March, April and May. The hilly regions enjoy a cool and pleasant climate.

The state receives the maximum rainfall during the SW. monsoon from June to September. However, it is less in the south (up to 250 cm). Idukki and Wynad Districts receive the highest rainfall (over 350 cm). During the NE. monsoon the situation reverses and the south receives more rains. As a whole Kozhikode receives the highest rainfall (375 cm) and Thiruvananthapuram the lowest (181 cm). The average annual rainfall in the state varies from 101.6 to 362 cm. The average districtwise distribution of rainfall in cm is Thiruvananthapuram (181), Kollam (256), Pathanamthitta (313), Kottayam (313), Alappuzha (301), Ernakulam (327), Idukki (337), Thrissur (313), Palakkad (233), Malappuram (291), Wynad (359), Kozhikode (375), Kannur (374) and Kasaragod (358).

The atmosphere is highly humid throughout the year particularly during the SW. monsoon. The relative humidity decreases during December - April. It varies from 70 - 90 percent.

Wind is light to moderate with some additional force during the SW. monsoon. It is stronger in the afternoons from January to May. In the mornings the wind blows between northeast and southwest during October - March and in the afternoons, it is west to northwest. The directions of the wind is primarily westwards or northwestwards throughout the day during the monsoon.

With the increase in temperature and humidity during the last 10 days of May thunderstorms are very common.

Botanical history

Timber such as teak and rosewood and spices like pepper, cardamom and ginger were well known to the ancient world as oriental luxuries and the first traders in these articles were the Arabs (Nair & al., 1996). But the first to trade in spices of Kerala were the Phoenicians, the most enterprising traders known to

antiquity (Chaithanya, 1994). The monopoly of the trade in spices, however, changed hands during the course of history. In the 10th century BC, King Solomon sent a fleet to Ophir which is identified as Puvar, a village in Neyyattinkara taluk of Thiruvananthapuram District (Aiyya, 1906). Herodotus (5th century BC) also referred to the trade in spices with Kerala. Hippalus (47 AD), a Greek sailor, was the first to discover the monsoon winds of the Arabian sea and to point out that if the ships left Cape Fertak in Arabia in June - July, the Southwest monsoon trade winds would take them to pepper-bearing Kerala within forty days and the North-east winds of December would be ideal for the return journey. With this remarkable discovery there was a considerable increase in the Roman trade with Kerala which was later taken over by the Arabs. The anonymous author of the '*Periplus of the Erythraean sea*' a first century work on navigation has several references to places in Kerala such as Mandagara (Madai), Barace (Purakkad), Cottanara (Kottarakkara), Muziris (Kodungallor), Nilkanda (Neendakara) and Varkala hills (Iyer, 1961). Murachi of Valmiki's *Ramayana* is also identified as Kodungallor which was a famous port at that time. Pliny (Gaius Plinius Secundus, 23 BC - 74 AD), the Roman writer, in his *Historia naturalis* mentioned Kerabothras as the rulers of the West Coast which refers to Kerala puthras, the name for the Chera rulers, besides giving an account on the trade route to India and described Muziris as the 'first emporium in India' (Chaithanya, 1994). He also indicated Cottanara (Kottarakkara) as the place where large quantities of pepper were produced. Ptolemy (126 - 161 AD) also mentioned about some principal ports of Kerala where there was a brisk trade in pepper. These are Naura (Kannur), Kauba (Kawai), Mastanour (Mattannur), Adarima (Athirampuzha) and Smemne (Chempur).

There are a number of words of Malayalam origin in Greek such as ingiver (*Zingiber*), elathari (*Elatteria*), sandanam or chandanam (*Santalum*) and sarkara (*Saccharum*) (Nair & al., 1996). The last Greeco-Roman account dealing with Kerala is perhaps the visit of the Byzantine monk Cosmos Indicopleustus to the Malabar Coast in 522 AD who wrote about pepper, ginger, turmeric, indigo etc. in his *Topographia Indica Christiana*.

Sangam literature of the first five centuries of the Christian Era gives excitingly vivid descriptions of Kerala and its landscape. The *Ahananuru* refers

to the “thriving town of Muchiri (Kodungallor) where the beautiful ships of the Yavanas bringing gold came splashing white foam in the waters of the Periyar which belongs to the Chera and return laden with pepper” *Purananuru* refers to sacks of pepper being brought from the houses to the market. The gold received from ships in exchange of articles sold is brought on shore in barges at Muchiri where the music of the surging sea never ceases” (Chaithanya, 1994). Thus the pepper of Kerala became the ‘black gold’. The demand for pepper is further exemplified by the fact that it is one of the items included in Constantine’s gift to the church and that when Alaric the Goth attacked Rome in 410, he demanded 3,000 pounds of pepper! In Sangam literature there are also references to Kuzhumur, the capital of the early Cheras which is now identified as Kumuli and Perumanthurai which happens to be the once famous port of Vaikom. There are also references to the two geographical divisions of Kannur, viz., Pozhinad comprising the entire coastal belt of Kozhikode to Kasaragod and Karkanad forming the Wynad-Gudalur area including Coorg.

References to the geography of the lands are also present in ancient Malayalam literature. For instance, many poets of Kerala, following Kalidasa composed what are known as ‘Sandesa kavyas’ which give descriptions of the landscapes in different regions of Malabar. ‘*Suka sandesa*’ of Lakshmidasa has beautiful descriptions of the backwaters of Kodungallor and Rameswaram. *Hamsa sandesa*, *Subhaga sandesa*, *Kama sandesa*, *Chataka sandesa* etc. also have some beautiful portraits of the landscape of different parts of Kerala besides romantic overtones. Mathangaleela, written in the sixteenth century, is a unique work on ecology particularly of the elephants.

Ayurveda, the indigenous system of medicine, had a profound influence on the people of Kerala. Several translations and commentaries of *Ashtanga hridaya*, *Charaka samhita* and *Sushruta samhita* have been brought out in Malayalam besides several works of great importance in Malayalam in recent years such as that of Warriar & al. (1994).

The picture of Kerala in the post-Sangam period is rather obscure except for some significant hymns sung by Nammalvar of the 9th century in praise of the vishnu temple at Thrikkodithanam in his *Thiruvaymozhi* as one of the ‘pugal petra kshethrams of malainadu’

Record of Colon (Quilon) is also found in a letter written by the Nestorian Patriarch Jesajabus (660 AD) to Simon Metropolitan of Persia. During the 9th century AD, Kollam emerged as a major political and commercial centre and established extensive trade contacts with Arabia and China. This perhaps is the reason for some to suggesting a Chinese origin of the name Kollam, as coilon in Chinese means a great market. The Kollam Era (Kollavarsham) was believed to be founded by King Udaya Marthanda Verma in the "Kali year 3926 (825 AD) adopting the New Era to start on 1st Chingam of that year (15 Aug. 825) as Kollam year one. This was later followed by Malabar, Tirunelveli, Madurai and Ceylon" (Pillai, 1963). Many inscriptions unearthed at Kollam and assigned to the 9th and 10th centuries also contain records of the Kollam Era.

The Muslim travellers have left very comprehensive accounts on the geography of southern India and particularly of Kerala as there was a new zest for learning in the Islamic world from 8th century onwards. The most remarkable among these was Batuta (1304 -1368). However, the spice trade with Kerala was taken over by the Arabs long before the advent of Islam itself (Chaithanya, 1994). According to Sheik Zainuddin, an Arab historian who visited Kerala in the 16th century, a group of Islamic missionaries sent by the Prophet landed in Kodungallor during 642 - 643 AD. After dividing themselves into two groups they proceeded along the coast, one towards the north and the other towards the south linking trade with South Asia and Africa. Al Kazuwini (1263 - 1275) describing his visit to Kollam commented "there are places here, where the teak trees grow to a very great height exceeding even one hundred cubits" Books of Al Beruni, Al Idrisi, Ibu Khaldun and Abd-er-Razzak also contain a number of references to important towns of Kerala and the plant products exported therefrom. Mention is made about rice cultivation at Valarpatanam and its export to Sri Lanka. Marco Polo who visited Kerala towards the end of the 13th century described Coilam (Kollam) and recorded the items traded from here including ginger, pepper etc. He also gave a brief account on Kolathiri (Kannur) as "Eli is a kingdom towards the west about 300 miles from Comari" (Menon, 1924 - 1937).

The Tamil classic *Pathittupatru* is a cycle of about one hundred poems written by the court astronomer of the Chera emperor of the 3rd century who was elevated to the position of a poet laureate and he was a native of Chittur in Palakkad.

This work mentions about a variety of grains, pulses and other food crops. The 7th century Tamil classic *Chilapathikaram* (Silappatikaram) written by the Chera prince Ilango Adigal described the Chera kingdom of Vanchi and bears testimony to the great encouragement given to arts, music and dance forms of Kerala like chakiyarkoothu and mohiniyattam.

With the landing of Vasco da Gama at Kozhikode in 1498, the colonist Europe intruded into the history of the West Coast. With the arrival of the Portuguese the age-old trade connections between Kerala and Western Asia ended along with the secular economy of Kozhikode. However, they left some legacies in agriculture, particularly in the commercial cultivation of coconut which was till then cultivated for only household use and coir became an item of export. Besides, the extent of pepper and ginger cultivation also expanded considerably. The credit of introducing new cash crops such as cashewnut, tobacco, custard apple, guava, pine apple and papaya also goes to the Portuguese. Shortage of wood in the regions near the Red sea besides their interest in the spices of Kerala were the reasons cited for the growth of the Portuguese trade in Kerala. A great contribution to the botany of India during this period was the publication of *Coloquios dos simples* by a pharmacist from Elvas, Garcia de Orta (1563) who had consulted several Ayurvedic physicians in the country including some in Kerala.

In 1663 when the Portuguese strongholds of Kollam, Kodungallor, Kochi and Kannur were conquered by the stronger Dutch, the Portuguese flag ceased to fly in Kerala. It was the Dutch who promoted the cultivation of rice and indigo in Kerala. Dyeing was also introduced by them. Although they suffered a signal defeat at the hands of Marthanda Verma of Travancore in 1741, they succeeded in establishing a monopoly in the trade of spices. In 1667 Hendrick Adriaan van Rheede tot Draakestein was appointed governor of the Dutch possessions in Malabar. A zealous explorer that he was, Rheede visited the entire West Coast, making notes and collecting plants with the help of local physicians like Itti Achuthan, Ranga Bhat, Vinayaka Pandit, Appu Bhat and Fr. Matthew. This ultimately led to the preparation of the monumental treatise *Hortus Indicus Malabaricus* in Latin on the medicinal properties of plants of this region in twelve magnificent volumes with 794 copper plate engravings covering 780 species of

plants. It may be pointed out that the basic work of the *Hortus* and the manuscript were prepared by Itti Achuthan whose contribution appears not to have been given due credit when it was published at Amsterdam during 1678-1703. A recent attempt to collect the plants of the *Hortus* (Nicolson & al., 1998) was not completely successful as they could identify only 660 of the 780 species mentioned. It was these illustrations based on which later authors like Linnaeus (1753, 1754), Adanson (1763), Jussieu (1798), Dennstedt (1818) and Hasskarl (1867) described several new species and a genus *Rheedia* L. commemorating van Rheedee. His co-workers were later honoured in generic names such as *Achudemia*, *Mathaea* etc. Over a thousand species of plants are today known by the Latinized Malayalam names of the Malabar Coast (Nair & al., 1996).

The English traders reached Kochi in 1583 and it was Captain Keeling who arrived at Kozhikode in 1615 who made the first English contact with Kerala and by 1635 the first shipment of pepper from Kochi to England was made. The first treaty that the British entered into with an Indian state was with Travancore in 1723 which resulted in the construction of a port at Kolachal (now in Tamil Nadu) and later on Anjengo (Anchuthengu). After 1750 the British produced a number of descriptive volumes on southern India, the most comprehensive being Francis Buchanan's (1807) *Journey from Madras through the countries of Mysore, Canara and Malabar* in three volumes. The survey made by the East India Company to establish a better understanding of the land and her people also resulted in valuable geographical accounts. *The memoir of the surveys of Travancore and Cochin* by Lieutenants Benjamin Swain Ward (1786-1835) and Peter Eyre Comer (1794-1821), a monumental work in two volumes shedding light on the geographical, topographical, socio-economic and political conditions of Travancore, is undoubtedly an eloquent testimony to the handy work of the professional surveyors. Originally published in 1863 and 1901 respectively these were reprinted in 1898 and later a new reprint was brought out by the Govt. of Kerala in 1994 with a detailed sketch on the biographies of these great accomplished authors. This was followed by the publication of a similarly important *A descriptive memoir of Malabar* by the same authors in 1906 which was also reprinted by the Govt. of Kerala in 1995.

Inspired by the earlier mentioned unique work '*Hortus Indicus Malabaricus*' by van Rheedee with whom they were closely associated, the En-

lish also started collecting plants in India. Although most of these collectors were not botanists, they sent specimens to England to be studied by Petiver and Du Bois. Paul Hermann (1646 - 1695) of Leiden who visited Kochi in 1675 is believed to have sent his botanical collections made around Kochi to Linnaeus. An outstanding field botanist, Buchanan-Hamilton, collected extensively in the Malabar region in 1801 and published his observations in three volumes (*l.c.*). The work on *The flora of British India* was subsequently initiated by J.D. Hooker and his associates and was published in seven volumes (1872 - 1897). It formed the most significant contribution of the Britishers towards a better understanding of Indian flora. As far as peninsular India is concerned the contributions of Robert Wight and Beddome are indeed significant. Wight's collections from Kollam, Palakkad and Thiruvananthapuram as well as other areas formed the basis of his *Icones plantarum Indiae orientalis* (1838 - 1853) and *Illustrations of Indian botany* (1840 & 1850) and with Arnott he published *Prodromus florae peninsulae Indiae orientalis* (1834) which has a large number of new taxa. The major contribution of Beddome was on the lower groups particularly pteridophytes but equally remarkable are his works on the peninsular Indian angiosperms like *The flora sylvatica for southern India* (1869 - 1874) and *Icones plantarum Indiae orientalis* (1868 - 1874).

Among the regional floras that followed Hooker's work, Gamble and Fischer's *Flora of the presidency of Madras* (1915 - 1936), acclaimed as one of the best, includes Kerala as well. More popular, though not scientifically significant is the *Vernacular list of trees, shrubs and woody climbers of Madras presidency* by Lushington (1915) as it contains almost all Malayalam names. The quest for botanical knowledge in the state was taken forward by some of the English men who resided at Thiruvananthapuram, prominent among them being William Cullen who collected extensively in the forests around Thiruvananthapuram. Many later authors utilized Cullen's collections. They are Drury who published *The handbook of Indian flora* (1864) in three volumes and *Useful plants of India* (1858). Mention may be made of *Eulophia cullenii* a lovely ornamental orchid collected by Cullen in Thiruvananthapuram based on which Wight described it as new species in 1861. Rev. Fr. E. Johnson, another resident of Thiruvananthapuram in early 1800, was greatly attracted by the orchids of this region. List of his orchid collections appeared in the *Madras J. Lit.*

Sci. 19: 215–220, 1858. M.A. Lawson who frequently visited Kerala during 1893–1894 collected at Ponmudi, Merchiston and Thiruvananthapuram in southern Kerala and Palakkad and Wynad in the north. Observations made on his tour to the southern part of the state was published in his *Notes of a tour in Travancore etc.* (1894). Sporadic collections were also made by Cleghorn and Davidson in Kerala during this period, the latter's collections were sent to Kew in 1883. A coffee planter turned forester, T.F. Bourdillon, the first Conservator of Forests of Travancore made a systematic and in-depth study of the forest trees of Travancore with special reference to their economic importance. The survey commencing in 1871 continued till 1893 when he prepared a 'report' which was later consolidated in the form a book entitled, *The forest trees of Travancore* (1908) which deals with 582 indigenous trees making incidental references to more important climbers also. However, his collections also included several shrubs and herbaceous material which he left in the conservator's office with a handwritten list; perhaps he desired to get it published later. His successor, Rao Sahib M. Rama Rao, who arrived at Thiruvananthapuram in 1908, on seeing Bourdillon's collections and manuscript, decided to continue the work. His strenuous efforts culminated in the publication of *Flowering plants of Travancore* in 1914 containing 3535 species. In this endeavour, Vencoba Rao, who was also a devoted collector in this area made significant contributions by way of collecting in different parts of Travancore from 1913 onwards. Besides this he also took the assistance of a local 'vaidyan' (Ayurveda physician) to comment on the medicinal properties of the plants collected. Most of the collections of these forest officers were sent to Kew for identification, the duplicates are in the herbaria of the University College, Thiruvananthapuram (UCT); Tropical Botanic Garden & Research Institute (TBGRI), Botanical Survey of India, Calcutta (CAL) and Coimbatore (MH) and Forest Research Centre, now IFGTB (FRC), Coimbatore. V. Narayanaswamy, C.A. Barber (1895, 1904), Raju and Ratnavelu (1929), Fischer (1914–1915) are among other notable contributors during this period. Beside, some geographers like Aiyya (1906) who gave a delightful description of the vegetation of Travancore, followed by Pillai (1940). The Cochin State Manual (Menon, 1911) and the Malabar State Manual (Logan, 1951) also appeared around this period. Brandis (1908) included the trees of Kerala also in his *Indian trees*.

The High Ranges of Kerala was a botanical paradise for the earlier work-

ers and remains to be so even today. Barnes (1938) was the pioneer in recognizing the tremendous floristic diversity of this area. He extensively collected here but was particularly interested in the *Gesneriaceae* which he subsequently published in 1939. Several other collections of Barnes from the High Ranges formed the types of names of new taxa described later by others (Fischer, 1934, 1935, 1938, 1939; Bor, 1949). More recently Sebastine and Vivekananthan (1968); Shetty and Vivekananthan (1968, 1969, 1970, 1971, 1972, 1973, 1975, 1991) and Sharma & al. (1974) explored the area intensively discovering several new and otherwise interesting taxa. The vegetation of this area has been considerably damaged by the construction of a major hydroelectric project at Idukki. A multidisciplinary team made a thorough investigation on the ecological impact of this project and made a consolidated report (Nayar & Nair, 1983) with several recommendations besides reporting several new, rare and endemic plants (Pandurangan & al., 1985). Menon and Pillai (1991) studied the changes in vegetation using landsat imageries during 10 years from 1973-1983 and noted major spatial and temporal changes in habitat.

K.C. Jacob of the Madras Herbarium collected grasses in Travancore in 1942 in addition to other plants. Mention may also be made of the sporadic collections made by Gopal Rao and Rangachari about the same period. Puri and his colleagues (Puri & al., 1959) also made floristic studies in Kerala when the state was a part of the Western Circle of the Botanical Survey of India, Pune. However, a systematic survey of the flora of Kerala was initiated when Kerala came under the jurisdiction of the Southern Circle. Pioneers in this survey are K.M. Sebastine, J. Joseph, K. Subramanyam, B.D. Sharma, B.V. Shetty and K. Vivekananthan. While some workers concentrated in the south, Ellis & al. (1968), Ramamurthy and Chandrasekaran (1981), Ramachandran and Nair (1988), Ansari (1985), Manilal and Sivarajan (1982), Sivarajan and Mathew (1997) and Sasidharan and Sivarajan (1996) explored the north. It was around this period (1980s) the controversial Silent Valley came into prominence consequent to a proposal by the Govt. of Kerala to construct a dam across the Kunthipuzha. Involving fully in this controversy Nair (Nair & al., 1980) along with his associates (Nair & Bhargavan, 1982, 1985; Vajravelu 1990; Vajravelu & al., 1968; Bhargavan & Mohanan, 1982) and others (Anon. 2003) intensified the floristic studies in this tract which led to several interesting observations. A comprehensive account on the flora of this region was prepared in addition to the discovery of a new primitive grass genus

Silentvalleya (Nair & al., 1982) commemorating the floristically rich Silent Valley itself. Subsequently Mani (1988) published *The flora of Silent Valley*. This area also attracted many botanists from other disciplines whose single expedition resulted in the discovery of several new taxa and additions (Vohra & al., 1982). Meanwhile plant exploration in the southern part was intensified by Mohanan in Thiruvananthapuram District (Mohanan, 1981, 1985; Mohanan & Sreekumar, 1982; Mohanan & al., 1980, 1982a, 1982b, 1982c; Mohanan & Henry, 1980, 1986, 1987, 1991, 1994), Mohanan & Sivadasan (2001) and Dan & al. (1993, 1997). Thomas (1962) studied the Veli hills with special reference to ecological aspects and changing pattern of the vegetation. He also studied the aquatic vegetation of Thiruvananthapuram (Thomas, 1976). Joseph and Chandrasekaran (1973, 1974, 1978, 1980, 1982) collected plants in the Neyyar Wildlife Sanctuary and Bonaccord and described a few new taxa including a genus, *Janakia*. Orchids of Agastyarkudam, particularly the lady's slipper orchid *Phaphiopedilum druryi* attracted several foreigners (Mammen & Mammen, 1974). Over-collecting has rendered this lovely orchid critically endangered.

Kollam was partially explored by Subramanian (1980) and later a few collections were made by Chandrabose. Mohanan (1984) explored the area systematically and reported an additional genus *Kunstleria* to the Indian flora and several rare taxa from the sacred groves of Adoor (Mohanan & Nair, 1981). Pathanamthitta District was surveyed by Anilkumar (1994). R. Chandrasekaran (1993, 1995) augmented it under a task force for underexplored areas in Goodrical and Moozhia. Antony (1989) studied the flora of Kottayam District and published a few papers (Kadavil & Antony, 1998). The grasses were studied by Sreekumar and Nair (1991). A neglected group till that time, this study resulted in the discovery of several novelties including a genus *Chandrasekharania* (Nair & al., 1982) named in honour of late Dr. N. Chandrasekharan Nair, formerly Joint Director, BSI, Coimbatore, a distinguished conservationist and taxonomist and whose persistent fight along with others for the cause of the Silent Valley successfully resulted in shelving the hydro-electric project and declaring it a national park.

The vegetation of the coast was studied by Rao and Sastry (1971, 1972, 1974a,b). Abraham and Vatsala (1981) collected orchids in various localities of Kerala which was later continued by Sathishkumar. He has compiled a compre-

hensive account of the orchids of Kerala, besides publishing many new species (Sathishkumar, 1989; Sathishkumar & Rasmussen, 1997). Sathishkumar and Manilal (1994) brought out a catalogue of the orchids of the country. Kumar (1991, 1995), Kumar and Kumar (1997); Kumar & al. (1999, 2000, 2001a & b) and Seethalakshmi and Kumar (1998) studied the bamboos. Renuka (1992) and Swarupanandhan (1984, 1991), studied the rattans and *Asclepiads* respectively while, Mangaly and Sabu (1992) took to the *Zingiberaceae*. Notable contributions were also made by Pradeep and Sivarajan (1993), Manilal and Sathishkumar (1991), Sivarajan and Mathew (1983), Sivarajan and Pradeep (1996), Sivadasan (1983, 1985), Sivadasan and Nicolson (1983) and Sivadasan & al. (1981, 1994).

Ever since the publication of *The flora of British India* (1872–1897) and later *Flora of the presidency of Madras* (1915–1936), lots of material and tremendous data on the flora have accumulated which enabled the Botanical Survey of India to take up the revision of the excellent but outdated flora of British India along with other continuing projects like fascicles of flora India, state floras, district floras etc. Besides this, colleges, universities and research institutions (CALI, KFRI, TBGRI etc.) also contributed much to revisionary as well as floristic studies as mentioned earlier. Manilal and Raveendrakumar (1998) made a welcome beginning by compiling all species from Kerala published/ reported since the publication of Gamble and Fischer's *Flora of the presidency of Madras*. The present attempt is therefore aimed at achieving the final goal of publishing the flora of Kerala which is the fond hope of all taxonomists, teachers and students and all those interested in the flora of this region. The primary objective of this endeavour is to study all holdings and literature and provide the correct identity and nomenclature of the plants with the firm belief that this work would certainly prove useful to the botanical public at large and the practical plant users of the state.

Vegetation

A warm humid climate coupled with a network of perennial water resource that enliven the rich soil has given rise to a flora of great variety which is exceptional not only by its relic nature but also because of the presence of high endemism. The floristic composition of certain hilly terrains in the coastal lowlands and in sarpakavus (sacred groves) of both coastal and midlands substantiates the fact that the entire area of the state was once covered by dense forests.

This is further supported by the fossils and coral reefs excavated from the coastal region (*vide* Geology). This vegetation has, of late, undergone considerable change with the influx of population and consequent developmental activities. However, remnants of natural vegetation although not virgin, are still preserved throughout the state in all the three zones. The vegetation is hence discussed here with reference to the physiographic zones of the state as: I. vegetation of the lowlands and coastal zone, II. vegetation of the midlands and III. vegetation of the highlands.

I. Vegetation of the lowlands and coastal zone

The coastal zone is very vast with a low relief of 4–6 m above the present day sea level. The existence of numerous beach dune ridges almost parallel to the shore is a characteristic feature. The strand plains have several lagoons and marshy areas which lie between the beach dune ridges. The two major characteristic types of vegetation of the coastal zone are (1) strand and (2) estuarine vegetation.

1. Strand vegetation: This type is characterised by open mat-forming pioneers in varying proportions followed by herbs, shrubs and trees distributed on a relief beyond the hightide limit designed as supra-littoral zone of backshore (Rao & Sastry, 1972). This consists of three subtypes - (a) strand sand, (b) strand rock and (c) strand coral of which the first two are present on Kerala coast.

(a) Strand sand: The strand sand plains, though 560 km long is only 10 km wide and is the widest in the central part. This area is intercepted by numerous rivers and backwaters. Winds and waves are the two main interacting factors in the formation of this habitat. A remarkable feature is the presence of a few plant indicators here. Morphologically divisible into three distinct regions reflecting a graded sequence of different floristic composition in each, these plains are also bordered by coconut groves and *Casuarina* plantations in degraded areas here and there. The zones that exist in areas where natural vegetation still found are on outer open pioneer zone, a closed herbaceous zone following it, a middle mixed bushy zone and an inner woodland zone.

The outer zone is dominated by sand-binders. The common herbaceous species are *Cyperus arenarius*, *Fimbristylis cymosa*, *Gisekia pharnaceoides*, *Heliotropium marifolium*, *Hydrophylax maritima*, *Indigofera pulchella*, *I. spicata*, *I. uniflora*, *Ipomoea pes-capre*, *Justicia tranquebariensis*, *Launaea*

sarmentosa, *Mollugo cerviana*, *M. nudicaulis*, *M. pentaphylla*, *Polycarpaea corymbosa*, *Polycarpon prostratum*, *Phyla nodiflora*, *Rothia indica*, *Spermacoce hispida*, *Spinifex littoreus* and *Zoysia matrella*.

Common shrubs in the mixed bushy zone are *Calotropis gigantea*, *Capparis brevispina*, *Cassia auriculata*, *Erythroxylum monogynum*, *Fioria vitifolia*, *Gmelina asiatica*, *Hugonia mystax*, *Hygrophila schullii*, *H. erecta*, *Ixora coccinea*, *Opuntia elatior*, *Premna serratifolia*, *Sida cordifolia*, *Solanum virginianum*, *Sphaeranthus indicus*, *Tephrosia hirta*, *T. maxima*, *T. purpurea*, *Turnera angustifolia*, *T. subulata*, *Vitex trifolia* etc.

The inner woodland may have *Calophyllum inophyllum*, *Coffea travancorensis*, *Derris indica*, *Hopea ponga*, *Morinda citrifolia*, *M. pubescens*, *Manilkara hexandra*, *Thespesia populnea*, *Uvaria zeylanica* and *Wrightia arborea*. *Anacardium occidentale*, *Casuarina litorea* and *Cocos nucifera* are the more important cultivated trees besides the recently introduced species of *Acacia*. The parasitic climber *Cassytha filiformis* is common over bushes. Tobacco is cultivated on the Kasaragod coast (Ansari, 1985).

(b) Strand rock: This is found in places wherever the Western Ghats extend up to the coast such as Kovalam, Varkala and Veli in Thiruvananthapuram District and Bakel in Kasaragod District. The three distinct aspects of this habitat are (1) steep rising rocky slopes with pot-holes, (2) solution cups and crannies and (3) wave-cut rocky shores with undulating surface and crevices. A group of plants showing obvious preference to this habitat is a unique feature of this vegetation. They are *Blumea obliqua*, *Calotropis gigantea*, *Capparis* spp., *Helichrysum* spp., *Indigofera glabra*, *I. nummularifolia*, *I. spicata*, *Indoneesiella echioides*, *Ipomoea* spp., *Jatropha gossypifolia*, *Polycarpaea corymbosa*, *Polygala erioptera*, *Portulaca quadrifida*, *Sporobolus diander*, *Tephrosia purpurea*, *Tridax procumbens* etc.

2. Estuarine vegetation: This type is characterised by the presence of "dense woody plants including succulent herbs and shrubs in varying proportions distributed on a coastal relief under the constant influence of tidal and freshwater resources" (Rao & Sastry, 1972). The typical estuarine vegetation does not occur on the Kerala coast. The entire vegetation along the backwaters of the Kerala coast is classified under proestuarine like (a) prohaline, (b) euhaline and (c) tidal mangroves.

(a) Prohaline: This type consists of salt-tolerant freshwater plants such as *Barringtonia acutangula*, *Caesalpinia crista*, *Ceratopteris siliquosa*, *Corchorus aestuans*, *Crinum asiaticum*, *Cyperus javanicus*, *Dolichandrone spathacea*, *Hygrophila erecta*, *Kandelia candel*, *Salvinia molesta*, *Scirpus litoralis*, *Sphenoclea zeylanica*, *Striga asiatica*, *Tylophora tenuis*, *Xyris indica* etc.

(b) Euhaline: This type is characterised by the presence of highly salt-tolerant plants like *Acanthus ilicifolius*, *Acrostichum aureum*, *Burmannia coelestis*, *Cerbera odollam*, *Dalbergia* spp., *Derris* spp., *Pandanus* Spp. and *Samadera indica*.

(c) Tidal mangroves: The backwaters along the coast support a vegetation distinguished by highly salt-tolerant species with characteristic features like pneumatophores, vivipary etc. The margins of these lakes are abundant with thickets of *Acanthus ilicifolius* and *Acrostichum aureum*. More common trees in this habitat are *Aegiceras corniculatus*, *Avicennia marina*, *A. officinalis*, *Barringtonia racemosa*, *Bruguiera conjugata*, *B. gymnorrhiza*, *Carallia brachiata*, *Lumnitzera racemosa*, *Rhizophora apiculata*, *Scaevola sericea*, *Sonneratia caseolaris* etc.

II. Vegetation of the midlands:

Exclusively under laterite cover, the midlands are mostly under cultivation of different crops like coconut, arecanut, cashew, rice, tapioca, pepper, cocoa etc. Owing to population pressure and rapid urbanization and industrialization, the midlands have lost their original features, but there still remain in some areas a few patches of forests which are the remnants of moist deciduous and evergreen forests of the past. These areas have *Albizia chinensis*, *A. odoratissima*, *Alstonia scholaris*, *Artocarpus hirsutus*, *Bridelia retusa*, *B. scandens*, *Clerodendrum infortunatum*, *Cycas circinalis*, *Ixora coccineu*, *Mucaranga peltata*, *Mallotus philippensis*, *Tabernaemontana heyneana*, *Terminalia crenulata*, *T. paniculata*, *Trema orientalis*, *Wrightia arborea* etc.

Amidst crops in the cultivated lands are often seen trees left undisturbed, the more prominent ones being *Albizia odoratissima*, *Ailanthus triphysa*, *Artocarpus heterophyllus*, *A. hirsutus*, *Carallia brachiata*, *Careya arborea*, *Mucaranga peltata*, *Mangifera indica* etc.

The midlands have a number of sacred groves establishing the fact that the entire state was once covered by forests.

1. Vegetation of sacred groves (sarpakavus): As the name denotes, these are abodes of snakes where special offerings are performed to snake deities and a part of the vegetation around these deities are left undisturbed. And hence they form repositories of the original vegetation wherein the original floristic diversity is often preserved. Attached to some ancient Hindu families amidst thickly populated villages and urban colonies these groves remain undisturbed as pockets of luxuriant climax formations as removal of any plant from these groves is a taboo. Preserved for centuries, the sacred groves serve the vital role of conserving the original vegetation which contain many endemics which have become rare/threatened elsewhere (Gadgil & Vartak, 1975, 1981). Unlike many other protected areas, which set aside human populations, these groves form a part of the daily life of the local people (Induchudan & Balasubramaniam, 1991). They also serve as indicators of natural productivity. The total area of a grove varies from a few cents to 1-2 ha. These groves were surveyed by Ramachandran and Mohanan (1989), Mohanan and Nair (1981) and, Nayar (1987). Prasad & al. (2000) studied the litter dynamics of them.

Dominant trees found here are *Aegle marmelos*, *Aglaiia elaeagnoidea*, *Alstonia scholaris*, *Aporusa lindleyana*, *Artocarpus heterophyllus*, *A. hirsutus*, *Bambusa bambos*, *Buchanania axillaris*, *B. lanceolata*, *Calophyllum inophyllum*, *Carallia brachiata*, *Caryota urens*, *Cinnamomum malabattrum*, *Diospyros candolleana*, *D. malabarica*, *Ficus exasperata*, *F. religiosa*, *Holigarna arnottiana*, *Hydnocarpus pentandra*, *Knema attenuata*, *Litsea glutinosa*, *Macaranga peltata*, *Mangifera indica*, *Mimusops elengi*, *Olea dioica*, *Sterculia foetida*, *S. urens*, *Strychnos nux-vomica*, *Syzygium cuminii*, *S. travancoricum*, *Trema orientalis* etc.

Smaller trees and shrubs beneath this are *Alangium salvifolium*, *Canthium angustifolium*, *Chassalia curviflora*, *Clerodendrum inerme*, *C. infortunatum*, *Coffea travancorensis*, *Glycosmis pentaphylla*, *Hibiscus tiliaceus*, *Litsea coriacea*, *Mackenziaea integrifolia*, *Memecylon edule*, *M. wightiana*, *Ochna obtusata*, *Polyalthia korintii*, *Samadera indica*, *Streblus asper*, *Syzygium jambos*, *Tarenna asiatica* etc.

Common lianas are *Acacia caesia*, *Anamirta cocculus*, *Ampelocissus latifolia*, *Cissus glauca*, *Connarus monocarpus*, *Ellertonia rheedei*, *Gnetum ula* and *Sarcostigma kleinii*. Climbers encountered are *Abrus precatorius*, *Asparagus racemosus*, *Cayratia pedata*, *Cissus repens*, *Flagellaria indica*, *Merremia* spp., *Micania micrantha*, *Mucuna pruriens*, *Mukia maderaspatana*, *Naravelia zeylanica*, *Passiflora foetida*, *Pothos scandens*, *Smilax zeylanica*, *Stenochlaena palustre*, *Tragia involucrata*, *Wattakaka volubilis* and *Ziziphus oenoplia*. Some of the common epiphytes are *Acampe praemorsa*, *Drynaria quercifolia* etc. The herbaceous plants include *Commelina* spp., *Cyanotis* spp., *Fioria vitifolia*, *Justicia* spp., *Malaxis rheedi*, *Costus speciosus*, *Tephrosia purpurea* and *Zingiber zerumbet*.

2. Vegetation of the wetlands: By virtue of its natural advantage of the river system vast areas of the midlands are under rice cultivation. Alappuzha and Ernakulam Districts have the largest extent of wetlands. The Kuttanad rice fields stretch for about 774 km². A large area in Kottayam District is also "karinilam". Besides there are many ponds, tanks, canals etc. Wetlands of Kerala are estimated to be, using remotely sensed data, 127930.07 ha of which the inland ones cover 34149.75 ha and costal ones 93930.5 ha. All these together constitute an aquatic habitat which is classified here as (a) aquatic and (b) semiaquatic and moisture-loving.

(a) Aquatic vegetation: Common submerged aquatic plants are *Blyxa aubertii* var. *aubertii* and var. *echinosperma*, *B. octandra*, *Cladopus hookeriana*, *Dalzellia zeylanica*, *Hydrilla verticillata*, *Hydrobryopsis sessilis*, *Indotristicha ramosissima*, *Podostemon subulatum*, *Polypleurum dichotomum*, *P. stylosum*, *Vallisneria nutans* and *Zeylanidium johnsonii*.

More common floating species are *Azolla filiculoides*, *Eichhornia crassipes*, *Lemna perpusilla*, *Ludwigia adscendens*, *Pistia stratiotes*, *Utricularia aurea* and the noxious *Salvinia molesta*.

The rooted aquatics include *Aponogeton natans*, *A. undulatus*, *Eleocharis dulcis*, *E. retroflexa*, *Ipomoea aquatica*, *Lagenandra ovata*, *Leersia hexandra*, *Limnocharis flava*, *Limnophila aquatica*, *L. heterophylla*, *L. repens*, *Monochoria vaginalis*, *Najas graminea*, *Nymphaea nouchali*, *Nymphoides hydrophylla*, *N. indicum*, *N. parviflora*, *Ottelia alismoides*, *Panicum paludosum*, *Paspalum*

geminatum, *Potamogeton javanicus*, *Rotala rotundifolia*, *Schoenoplectus juncooides*, *Utricularia stellaris*, *U. reticulata*, *U. uliginosa* and pteridophytes like *Ceratopteris thalictroides* and *Marsilea coromandelica*.

(b) Semiaquatic and moisture-loving plants: There are innumerable ponds and canals in addition to vast areas covered by rice fields which together form a semiaquatic habitat characterized by the presence of some specialized plants. Some low-lying areas in the highlands also have marshes which are occupied by semiaquatic plants such as *Alternanthera sessilis*, *Artanema longifolia*, *Bacopa monnieri*, *Centranthera indica*, *Colocasia esculenta*, *Commelina diffusa*, *C. bengalensis*, *Cyanotis vaginata*, *Cynodon dactylon*, *Cyperus cyperoides*, *C. corymbosus*, *C. pilosus*, *Eriocaulon quinquangulare*, *E. truncatum*, *E. xeranthemum*, *Fimbristylis aestivalis*, *F. miliacea*, *F. schoenoides*, *F. tetragona*, *Fuirena* spp., *Glinus oppositifolius*, *Grangea maderaspatana*, *Hedyotis auricularia*, *Heliotropium marifolium*, *Hygrophila schullii*, *Hygroryza aristata*, *Lindernia anagalis*, *L. antipoda*, *Lobelia trigona*, *Mariscus dubius*, *Melochia corchorifolia*, *Pandanus fascicularis*, *Panicum brevifolium*, *P. repens*, *Paspalum scrobiculatum*, *Pilea microphylla*, *Polygonum* spp., *Pouzolzia zeylanica*, *Sacciolepis interrupta*, *Sphaeranthus indicus*, *Wedelia chinensis*, *Utricularia* spp., *Xyris pauciflora* etc. Pteridophytes like *Acrostichum aureum*, *Adiantum latifolium*, *Selaginella delicatula* and *Stenochlaena palustre* are also common. In the marshes in Nilambur are seen scattered trees of *Tamilnadia uliginosa*.

3. Cultivated lands: Along with the different crops cultivated in the midlands and the coastal zones are found several species of weeds but the weeds found in disturbed areas in the highlands like *Chromolaena odorata* and *Lantana camara* forming impenetrable thickets are the most noxious. Other weeds in the highlands are mostly herbaceous like *Ageratum* spp., *Argemone mexicana*, *Bidens* spp., *Blumea lacera*, *B. virens*, *Centrosema pubescens*, *Crassocephalum crepioides*, *Martynia annua*, *Mimosa diplotricha*, *Oxalis latifolia*, *Richardia scabra*, *Vernonia cinerea* etc.

The lands under tapioca, arecanut, coconut etc. are mostly invaded by herbaceous weeds like *Acalypha ciliata*, *Acrocephalus hispidus*, *Ageratum conyzoides*, *Alloteropsis cimicina*, *Biophytum sensitivum*, *Bulbostylis barbata*,

Catharanthus pusillus, *Centella asiatica*, *Cleome viscosa*, *Cyperus killinga*, *C. rotundus*, *Emilia sonchifolia*, *Euphorbia thymifolia*, *Dactyloctenium aegyptium*, *Hedyotis corymbosa*, *Heliotropium scabrum*, *Micrococca mercurialis*, *Peperomia pellucida*, *Phyllanthus amarus*, *Pouzolzia zeylanica*, *Spermacoce articularis*, *S. latifolia*, *S. ocymoides*, *Synedrella nodiflora* and *Tridax procumbens*. *Parthenium hysterophorus* is spreading rapidly in cultivated fields.

4. Wastelands: Compared to other states, the extent of wastelands in Kerala is negligible. These are mostly found in Kasaragod and Palakkad Districts and are usually inhabited by herbs like *Eriocaulon keralense*, *Exacum bicolor*, *Justicia jayachandranii*, *Kalanchoe pinnata*, *Mollugo pentaphylla*, *Neanotis foetida* etc. along with grasses like *Arundinella mesophylla*, *Bhidea burnsiana*, *Danthonidium gammiei*, *Glyphochloa acuminata* etc. Shrubs common here include *Canthium parvifolium*, *Ixora coccinea*, *Caesalpinia mimosoides*, *Tabernaemontana divaricata* etc. Scattered trees like *Sapium insigne* may also be found. Wastelands near human habitations are covered by abundant growth of species like *Abelmoschus manihot*, *Abrus precatorius*, *Acanthospermum hispidum*, *Achyranthes aspera*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Amaranthus spinosus*, *Asystasia dalzelliana*, *Breynia vitis-idaea*, *Cassia occidentalis*, *C. tora*, *Cardiospermum halicacabum*, *Chromolena odorata*, *Coccinia grandis*, *Crotalaria* spp., *Datura metel*, *Diploclisia glaucescens*, *Emilia sonchifolia*, *Erigeron karvinskianus*, *Hibiscus hispidissimus*, *Hemidesmus indicus*, *Hyptis suaveolens*, *Indigofera hirsuta*, *I. tinctoria*, *Melothria heterophylla*, *M. maderaspatana*, *Mimosa pudica*, *Sida acuta*, *S. rhombifolia*, *Smilax zeylanica*, *Tephrosia purpurea*, *Tridax procumbens* and *Vernonia cinerea*.

Under plantation crops like cashew, rubber etc. may be found grasses like *Apocopis mangalorensis*, *Arundinella cannanorica*, *Chrysopogon tadulingamii*, *Danthonidium gammiei*, *Glyphochloa acuminata*, *Heteropogon contortus*, *Ischaemum indicum*, *I. mangaloricum*, *Oplismenus burmannii*, etc. mixed with herbs like *Drosera indica*, *Indigofera glabra*, *I. prostrata*, *Ophioglossum gramineum* and *Zornia diphylla*.

5. Roadsides and railway tracks: Many alien weeds generally spread through railway tracks and roads, the sides of which form important habitats for

their initial establishment and regeneration. More common weeds of this habitat are *Cassia tora*, *Croton bonplandianum*, *Heliotropium indicum*, *Leea indica* etc. More common trees found along roadsides are *Artocarpus hirsutus*, *Ficus exasperata*, *Holigarna arnottiana*, *Mimusops elengi*, *Lophopetalum wightianum*, *Sterculia guttata*, *Strychnos nux-vomica* and *Vateria indica* along with introduced aliens like *Acacia* spp., *Adenanthera pavonina*, *Delonix regia*, *Eucalyptus* spp., *Casuarina litorea*, *Peltophorum pterocarpum* and *Samanea saman*. *Dicranopteris linearis* is a very common fern found along road and railway cuttings along with *Canscora diffusa*, *Cassia tora*, *Impatiens minor*, *Osbeckia muralis* etc. Frequent near railway tracks are *Aerva lanata*, *Boerhavia diffusa*, *B. repens*, *Calotropis gigantea*, *Evolvulus nummularius*, *Leucas aspera*, *Sesamum indicum* etc.

6. Wall flora: As Varshney (1968) pointed out, walls of ancient forts, buildings etc. form a specialized habitat for plant succession. East and west forts in Thiruvananthapuram, the Bakes fort and several other old buildings in the state manifest this habitat with abundant growth of *Acalypha indica*, *Achyranthes aspera*, *Ageratum conyzoides*, *Amaranthus spinosus*, *A. viridis*, *Apluda mutica*, *Blumea mollis*, *Boerhavia diffusa*, *Cassia tora*, *Chloris barbata*, *Cyperus compressus*, *Eclipta prostrata*, *Eleusine indica*, *Euphorbia hirta*, *E. thymifolia*, *Evolvulus alsinoides*, *E. nummularius*, *Ficus exasperata*, *F. religiosa*, (the most frequent tree in such habitats), *Lantana camara*, *Lindernia crustacea*, *Ocimum basilicum*, *Oxalis corniculata*, *Paspalum distichum*, *Phyllanthus amarus*, *P. reticulata*, *Physalis angulata*, *Pilea microphylla* (abundant forming mat-like covering), *Portulaca oleracea*, *Rivina humilis*, *Solanum nigrum*, *Tridax procumbens*, *Vernonia cinerea* and *Vicoa indica*.

III. Vegetation of the Highlands:

The vegetation of the highlands is essentially that of the Southern Western Ghats which is one of the most complex and diverse types found in India. A part of the megadiversity region, the flora and vegetation of this tract was under constant surveillance of botanists since the 19th century, more active among the earlier ones being Hooker and Thomson (1855), Beddome (1869 - 1874), Hooker (1904), Bourdillon (1908), Rama Rao (1914), Gamble (1915 - 1936) and others. Of the later contributions that of Champion (1936), and Champion and Seth (1968),

seem to be the most comprehensive and outstanding. They classified the forests of India into six major types with several subdivisions and edaphic or seral variations. The forests of Kerala, according to this classification, fall under four major categories viz., (1) Moist tropical forests, (2) Dry tropical forests, (3) Moist subtropical forests and (4) Montane temperate forests, with 24 subdivisions. Chandrasekharan's (1962, 1973) classification is not essentially different from that of Champion and Seth but with a little modification. He classified the forests of Kerala into five major categories: (1) Tropical wet evergreen forests with three climax forest types viz., (a) Lowlevel evergreen forests, (b) Highlevel evergreen forests and (c) 'Low' tropical ghat forests; seven secondary forest types viz., (a) semievergreen forests, (b) Secondary evergreen forests, (c) Moist deciduous forests (d) Open deciduous forests, (e) Wet bamboo (reed) brakes, (f) Moist bamboo brakes and (g) Lowlevel grasslands, and 6 edaphic forest types such as: (a) *Myristica* swamps, (b) Tropical valley freshwater swamps, (c) Tropical riverine forests, (d) Cane brakes, (e) *Xylia* mixed forests and (f) Laterite scrubs; (2) Tropical deciduous forests with two climax forms as (a) Wynad Plateau deciduous forests and (b) Moist mixed deciduous forests; two secondary forms as (a) Moist savanna and (b) Secondary bamboo forests and a single edaphic type viz., Post climax evergreen forests; (3) Tropical dry deciduous forests having only climax and secondary forest types. The climax types are: (a) Tropical dry deciduous forests and (b) Mixed dry deciduous forests with sandal; (4) Montane subtropical forests having only one climax formation viz. Subtropical wet hill forests and (5) Montane temperate forests with one climax type viz., Wet temperate forests and one secondary forest viz., High level (montane) grasslands.

Krishnamurthy (1962) studied the evergreen forests and *Myristica* swamps of Kerala. More recent are the vegetation maps of the Western Ghats which depict either partially or wholly the various types of vegetation and the environmental conditions therein. Valuable contributions on these aspects were provided by Bellan (1980, 1985a). Four sheets covering the entire Western Ghats prepared by the French Insitute, Pondicherry is a substantial contribution (Pascal, 1982a, 1984, 1988a). Their work has culminated in the preparation of another magnificent work, Atlas of endemics of the Western Ghats (Ramesh & Pascal, 1997).

The Forest Survey of India under the MoEF also has taken up the assessment of forest cover in the country using satellite imaging technique (Anon., 1993).

The latest assessment shows a marginal increase of 44 km² in the forest cover in the state.

According to recent estimate (Sharma, 2003), the state has 3299 km² (31.1%) of Tropical wet evergreen and Semievergreen forests, 4100 km² (43.6%) of moist deciduous forests, 100 km² (1.1%) of tropical dry deciduous forests, 70 km² (0.7%) of montane subtropical and temperate forests, 132 km² (1.4%) of grasslands and 1701 km² (18.1%) of plantations.

A detailed analysis of the association between species and relationship between vegetation types was given in the ecological studies by Aiyar (1932), Ahuja and Singh (1963), Arora (1964), Legris (1963) and Pascal (1984, 1988a). The biogeographic classification of Gadgil and Meher-Homji (1982) has forty types of vegetation. A classification chiefly based on dominant tree species and their associations, this also reflects the vegetation dynamics of the entire Western Ghats. The types of forests with major associations within are 1. Wet evergreen forest of West Coast - Western Ghats. This type has five major associations of which *Cullenia Mesua - Palaquium* association is found in the southern parts and montane shola type (*Elaeocarpus serratus*, *Gordonia obtusa*, *Meliosma and simplicifolia*, *Schefflera stelluta*) is found in the High Ranges. 2. Wet evergreen teak ecotone with *Tectona Lagerstroemia Dillenia Terminalia paniculata* association exists almost throughout the western part of the Western Ghats.

Nair and Daniel (1986) and Vajravelu and Vivekananthan (1996) also dealt with the vegetation of this area in general. The vegetation accounts given in the working plans of various forest divisions are basically that of Champion and Seth (1968) augmented with additional floristic components. The gazetteers of various districts also throw some light on the vegetation and flora. The district floras also briefly describe the forest types met within the respective districts.

The following classification is chiefly based on Champion and Seth (1968) with slight modifications in terminology.

A. Tropical moist forests

1. Tropical wet evergreen forests
 - a. West Coast tropical evergreen forests
 - b. Southern hilltop tropical evergreen forests

2. Tropical semievergreen forests
 3. Tropical moist deciduous forests
 - a. Southern moist mixed deciduous forests
 - b. Southern secondary moist mixed deciduous forests
 - c. Moist teak forests
 - d. *Xylia xylocarpa* dominant lateritic deciduous forests
 - e. Low-lying marshy deciduous forests
 4. Tropical freshwater swamps
 5. Wet bamboo brakes
 6. Low level grasslands
- B. Subtropical montane forests
1. Southern subtropical hill forests
- C. Montane temperate forests
1. Southern montane wet temperate forests
 2. Southern montane wet grasslands
- D. Dry tropical forests
1. Southern dry mixed deciduous forests
 2. Southern tropical thorn forests

A. Tropical moist forests: They occur mostly in warm humid areas characterized by high rainfall, temperature, humidity and uniform photoperiods throughout the year. Winter in such forests will be of a short period. Occurrence of frost or fog is uncommon. These forests are mostly confined to altitudes between 200 and 1500 m in areas with several broken hills, long spurs and extensive ravines. Trees are generally tall and broad-leaved.

1. Tropical wet evergreen forests: These forests with lofty trees are unique by their closed canopies with a dark, gloomy, sombre appearance (Krishnamurthy, 1962). They are also remarkable by the presence of various synusiae viz., trees, shrubs and herbs, lianas, stragglers and epiphytes (Richards, 1952; Whitmore, 1975). These multistoried forests often have emergent trees of over 60 m with straight boles, thin soft bark, entire broad leathery leaves which are generally dark green. But in growing seasons some of these trees present a reddish foliage (*Cinnamomum* spp. and *Harpullia arborea*) facilitating their easy spotting. *Elaeocarpus* spp., on the other hand, have red older leaves. Some trees develop characteristic plank buttresses at their bases which are sometimes up to

35 m or more from the base. Other remarkable features are cauliflory, presence of feeder roots in the decaying litter layer of the soil and a ground layer matted with seedlings of trees and few tuberous or rhizomatous species of the *Zingiberaceae*, *Costaceae* etc. The ground is almost devoid of grasses except along the fringes.

The two types of tropical wet evergreen forests met with are (a) West Coast tropical evergreen forests and (b) Southern hilltop tropical evergreen forests.

(a) West Coast tropical evergreen forests: This type is generally found in valleys at high altitudes between 200 and 1500 m. *Cullenia* - *Mesua* - *Palaquium* series (Gadgil & Meher-Homji, 1986b) is the major association here. This association is considered biologically the richest. A total of 867 km² of this forest is protected which spreads over the Silent Valley National Park (90 km²) and the Periyar Wildlife Sanctuary (777 km²), the rest being subjected to various types of threats.

No two sites of these forests in the state have the same floristic composition nor do they have the same composition at different altitudes. Sasidharan and Sivarajan (1996) demarcated the floristic composition into two altitudinal zones, one below 700 m and the other above 700 m. in Thrissur forests. This may be applicable to most other areas as well. The following is a possible combination of floristic elements of this type of forests spread over the entire state which is not site-specific.

The top canopy is formed of trees like *Acrocarpus fraxinifolius*, *Aglata elaeagnoidea*, *Ailanthus triphysa*, *Antiaris toxicaria*, *Artocarpus heterophyllus*, *A. hirsutus*, *Bischofia javanica*, *Calophyllum calaba*, *C. polyanthum*, *Canarium strictum*, *Chrysophyllum roxburghii*, *Cullenia exarillata*, *Dillenia bracteata*, *Diospyros bourdillonii*, *D. candolleana*, *Dimocarpus longan*, *Dipterocarpus indicus*, *Drypetes elata*, *D. macrophylla*, *Dysoxylum malabaricum*, *Elaeocarpus tuberculatus*, *Epiprinus mallotiformis*, *Garcinia gummi-gutta*, *G. xanthochymus*, *Holigarna arnottiana*, *H. beddomei*, *H. ferruginea*, *Hopea parviflora*, *H. racophloea*, *Litsea oleoides*, *Lophopetalum wightianum*, *Mangifera indica*, *Mastixia arborea*, *Mesua ferrea*, *Myristica dactyloides*, *Ostodes zeylanicus*, *Palaquium ellipticum*, *Paracroton pendulus* subsp. *zeylanicus*, *Poeciloneuron indicum*, *Polyalthia coffeoides*,

Reinwardtiodendron anamallaiense, *Syzygium chavaran*, *S. gardneri*, *S. parameswaranii*, *Terminalia travancorensis*, *Tetramelos nudiflora* and *Vateria indica*.

The second storey has medium-sized trees adapted to partial shady conditions such as *Actinodaphne bourdillonii*, *A. tadulingamii*, *Aglaia elaeagnoidea*, *A. lawii*, *A. malabarica*, *Aphanamixis polystachya*, *Apodytes dimidiata*, *Aporusa lindleyana*, *Beilschmiedia bourdillonii*, *Canthium dicoccum*, *Carallia brachiata*, *Cryptocarya beddomei*, *Dendrocnide sinuata*, *Diospyros paniculata*, *D. pruriens*, *Ficus* spp., *Elaeocarpus glandulosus*, *E. serratus*, *Fahrenheitia zeylanica*, *Flacourtia montana*, *Glochidion ellipticum*, *Gordonia obtusa*, *Goniothalamus cardiopetalus*, *Gymnacranthera fraquhariana*, *Glyptopetalum zeylanicum*, *Hydnocarpus pentandra*, *Knema attenuata*, *Litsea coriacea*, *L. floribunda*, *Macaranga peltata*, *Mallotus philippensis*, *Melicope lanuankenda*, *Mimusops elengi*, *Myristica malabarica*, *Nageia wallichiana*, *Nothapodytes nimmoniana*, *Polyalthia fragrans*, *Prunus ceylanica*, *Symplocos cochinchinensis*, *Turpinia malabarica*, *Xanthophyllum flavescens* etc.

The third storey possesses small trees and large shrubs like *Achronychia pedunculata*, *Agrostistachys indica*, *Antidesma menusu*, *Atalantia wightii*, *Callicarpa tomentosa*, *Canthium angustifolium*, *C. travancoricum*, *Celtis timorensis*, *Chassalia curviflora*, *Clausena indica*, *Chionanthus malabarica*, *Elaeocarpus munroii*, *Euonymus indicus*, *Flacourtia montana*, *Grewia flavescens*, *Humboldtia trijuga*, *Ixora elongata*, *I. malabarica*, *I. nigricans*, *Isonandra lanceolata*, *Lasianthus jackianus*, *Leea indica*, *Leptonychia caudata*, *Nothopegia beddomei*, *Pandanus thwaitesii*, *Pavetta hispidula*, *Psychotria nodiflora*, *Sarcococca coriacea*, *Tabernaemontana gamblei*, *Tournefortia heyneana* etc.

The fourth storey is formed by shrubs, undershrubs and herbs like *Acranthera grandiflora*, *Alpinia galanga*, *A. malaccensis*, *Amomum muricatum*, *Agrostemma courtallense*, *Asplenium indicum*, *Begonia malabarica*, *Boesenbergia pulcherrima*, *Barleria courtallica*, *Blachia denudata*, *Costus speciosus*, *Curcuma ecalcarata*, *C. neilgherrensis*, *Calamus gamblei*, *C. travancorensis*, *Elatostema acuminatum*, *E. lineolatum*, *Elettaria cardamomum*, *Murdannia trichocarpa*,

Munronia pinnata, *Mycetia acuminata*, *Neanotis monosperma*, *Neurocalyx calycinus*, *S. pulneyensis*, *Ophiorrhiza brunonis*, *O. eriantha*, *O. hirsutula*, *O. mungos*, *Orophea uniflora*, *O. zeylanica*, *Pavetta calophylla*, *Psychotria congesta*, *Phrynium rheedei*, *Saprosma corymbosum*, *Sarcandra chloranthoides*, *Sonerila rheedei*, *Schumannianthus virgatus*, *Thottea siliquosa*, *Tarennia monosperma*, *Zingiber macrostachyum*, *Z. roseum* etc.

Saprophytic orchids which are rare here are *Aphyllorchis montana*, *A. prainii*, *Epipogon roseum*, *Zeuxine gracilis*, *Z. longilabris* etc. Other common ground orchids are *Calanthe masuca*, *Eulophia epidendreaea*, *E. graminea*, *Habenaria crinifera*, *H. longicornu*, *H. plantaginea*, *Geodorum densiflorum*, *Peristylus goodyeroides*, *Malaxis intermedia*, *M. rheedei*, *Nervilia aragoana*, *N. plicata*, *N. prainiana*, *Trichoglottis tenera* etc. *Aeginetia pedunculata*, *A. indica*, *Balanophora fungosa* subsp. *indica*, *Buchnera hispida*, *Christisonia bicolor* etc. are the common root parasites.

Moist hollows and steep valleys are often inhabited by gregarious palms like *Arenga wightii*, *Caryota urens*, *Pinanga dicksonii* and gigantic ferns such as *Angiopteris evecta*, *Marattia fraxinea* and *Cyathea gigantea*. Common semiparasites are *Dendrophthoe falcata*, *D. memecylifolia*, *Helicanthus elastica*, *Helixanthera intermedia*, *H. wallichiana*, *Macrosolen parasiticus*, *Taxillus cuneatus*, *T. tomentosus* and *Viscum orientale*. Epiphytes are very common and belong to the orchid genera *Bulbophyllum*, *Coelogyne*, *Dendrobium*, *Eria*, *Oberonia*, *Pholidota*, *Polystachya* and fern genera *Pyrrosia* and *Drynaria*. *Peperomia* spp., *Aeschynanthus* spp. etc. are also common. Climbers are represented by *Acacia concinna*, *Adenia hondala*, *Ancistrocladus heyneanus*, *Argyreia hirsuta*, *Aristolochia indica*, *Artabotrys zeylanicus*, *Bauhinia phoenicea*, *Butea parviflora*, *B. purpurea*, *Caesalpinia cucullata*, *Calamus pseudotenuis*, *C. huegelianus*, *Calycopteris floribunda*, *Clematis gouriana*, *Derris brevipes*, *Desmos lawii*, *Dioscorea oppositifolia*, *Dunbaria ferruginea*, *Entada rheedei*, *Erycibe paniculata*, *Erythrophalum scandens*, *Gnetum ula*, *Kunstleria keralense*, *Luvunga sarmentosa*, *Miquelia dentata*, *Myxopyrum serratum*, *Neonotonia wightii*, *Piper* spp., *Pothos armatus*, *P. crassipedunculatus*, *P. scandens*, *Raphidophora laciniata*, *Rourea minor*, *Rubus ellipticus*, *R. rugosus*, *Sarcostigma kleinii*, *Senecio walkeri*, *Strychnos colubrina*, *S. lenticellata*, *Tetracera akara*, *Thunbergia mysorensis*,

Uvaria hookeri and *Ventilago bombaiensis*. In crevices of rocks are seen *Canscora diffusa*, *C. pauciflora*, *Eriocaulon* spp., *Osbeckia muralis*, *Sonerila rheedei*, *S. versicolor*, *Exacum* spp. etc.

(b) Southern hilltop tropical evergreen forests: This type is generally seen above 1200 m in valleys surrounding ridges. The trees are usually shorter compared to the previous type and are with fuller and rounded crowns. It is considered a transitional stage from tropical to subtropical type.

The uppermost storey here is dominated by trees like *Bischofia javanica*, *Calophyllum austroindicum*, *Cullenia exarillata*, *Elaeocarpus serratus*, *E. tuberculatus*, *Ficus arnottiana*, *Garcinia morella*, *Glochidion ellipticum*, *Gluta travancorica*, *Gordonia obtusa*, *Heritiera papilio*, *Holigarna arnottiana*, *Mesua ferrea*, *Persea macrantha*, *Prunus zeylanica*, *Semecarpus anacardium*, *Syzygium zeylanicum* etc.

The second storey consists of medium-sized trees of younger forms of the upper storey along with *Alstonia venenata*, *Alseodaphne semecarpifolia* var. *parvifolia*, *Baccaurea courtallensis*, *Beilschmiedia bourdillonii*, *Cinnamomum filipedicellatum*, *Diospyros* spp., *Debregeasia ceylanica*, *Elaeocarpus glandulosus*, *Harpullia arborea*, *Humboldtia brunonis*, *Litsea bourdillonii*, *L. floribunda*, *L. oleoides*, *Memecylon angustifolium*, *Meliosma pinnata*, *Mallotus simplicifolia*, *M. tetracoccus*, *Otonophelium stipulaceum*, *Toona ciliata*, *Trichilia connaroides*, *Turpinia malabarica* etc.

The third storey of large shrubs and small trees generally merge with the lower layer formed of herbaceous species. The herbs, shrubs, and smaller trees of this storey are *Aglaiia tomentosa*, *Aporusa acuminata*, *Ardisia pauciflora*, *Asystasia dalzelliana*, *Casearia ovata*, *Clausena austroindica*, *Diotacanthus grandis*, *Gomphandra tetrandra*, *Lepisanthes erecta*, *Meiogyne pannosa*, *Strobilanthes foliosus*, *S. heyneanus*, *S. warrensis*, *Oreocnide integrifolia*, *Orophea uniflora*, *Pavetta oblanceolata*, *Phaulopsis imbricata*, *Plectranthus wightii*, *Pogostemon paniculatus*, *P. travancoricus*, *Psychotria anamalayana*, *P. flavida*, *Rauvolfia densiflora*, *Rostellularia quinquangularis*, *Sarcandra chloranthoides*, *Sarcococca coriacea*, *Symplocos* spp., *Tarenna alpestris*, *T. canarica*, *Thottea siliquosa* and *Wendlandia bicuspidata*. The common climbers are *Aganosma cymosa*, *Calamus gamblei*, *Elaeagnus conferta*,

Embelia ribes, *Jasminum cordifolium*, *Millettia rubiginosa*, *Moulluva spicata*, *Mucuna hirsuta*, *Salacia beddomei*, *Shutteria vestita* and *Vigna dalzelliana*. The trunks of trees are more carpetted with mosses and lichens compared to the earlier type.

2. Tropical semievergreen forests: Of the three main semievergreen forests recognized in the southern tropical semievergreen forest types, Kerala has the West Coast semievergreen forests which are found along banks of rivers and streams adjoining evergreen forests. These are usually confined to areas rich in alluvial soils. This type has a mixture of both evergreen and deciduous trees as it is an intermediate form between these two types. The stratification here is not as marked as in the evergreen types. However, two storeys can be easily discernible. Champion and Seth (1968) considered it to be a climatic climax while Chandrasekaran (1962) and others considered it to be a transitional stage with much biotic interference.

The dominant elements of the first storey are *Ailanthus triphysa*, *Alstonia scholaris*, *Antiaris toxicaria*, *Artocarpus heterophyllus*, *A. hirsutus*, *Buchanania lanceolata*, *Baccaurea courtallensis*, *Bombax ceiba*, *Calophyllum calaba*, *C. inophyllum*, *Carallia brachiata*, *Chukrasia tabularis*, *Dimocarpus longan*, *Diospyros buxifolia*, *Elaeocarpus tuberculatus*, *Grewia tiliifolia*, *Holigarna arnottiana*, *Hopea parviflora*, *H. ponga*, *Hydnocarpus alpina*, *H. pentandra*, *Humboldtia vahliana*, *Ixora brachiata*, *I. nigricans*, *Knema attenuata*, *Lagerstroemia microcarpa*, *L. speciosa*, *Madhuca neriifolia*, *Mangifera indica*, *Mastixia arborea*, *Nothopegia travancorica*, *Otonephelium stipulaceum*, *Polyalthia fragrans*, *Pterocarpus marsupium*, *Schleichera oleosa*, *Sterculia guttata*, *Syzygium gardneri*, *Tamilnadia uliginosa*, *Terminalia bellirica*, *T. paniculata*, *Trewia nudiflora*, *Vateria indica*, *Vitex altissima*, *V. pinnata* and *Xylia xylocarpa*.

The lower storey is formed of smaller trees, shrubs and undershrubs like *Aglaia barberi*, *A. lawii*, *Agrostistachys borneensis*, *Aporosa lindleyana*, *Arenga wightii*, *Bischofia javanica*, *Cinnamomum verum*, *Clerodendrum infortunatum*, *Diospyros montana*, *Elaeocarpus serratus*, *Flacourtia montana*, *Flemingia semialata*, *F. strobilifera*, *Ficus nervosa*, *Homonoia riparia*, *Harpullia arborea*, *Mallotus philippensis*, *Saraca asoca*, *Xanthophyllum flavescens* etc. Com-

mon climbers are *Abrus pulchellus*, *Adenia hondala*, *Acacia concinna*, *A. pinnata*, *A. sinuata*, *Anamirta cocculus*, *Anodendron manubriatum*, *Aristolochia indica*, *Butea parviflora*, *Caesalpinia bonduc*, *Calamus* spp., *Calycopteris floribunda*, *Combretum latifolium*, *Elaeagnus indica*, *Entada rheedei*, *Gouania microcarpa*, *Mezoneuron cucullatum*, *Cissus* spp., *Cayratia* spp., *Olax imbricata*, *Salacia oblonga*, *Strychnos colubrina*, *S. minor*, *Tiliacora acuminata*, *Tinospora cordifolia*, *Uvaria narum* etc. along with some of those found in the evergreen type.

As the ground in these forests is more open compared to that of the evergreen type, there is a better herbaceous cover including grasses. More common herbs found here are *Centotheca latifolia*, *Costus speciosus*, *Crotalaria* spp., *Curcuma* spp., *Strobilanthes* spp., *Psychotria* spp., *Geophila repens*, *Gymnostachyum febrifugum*, *Mussaenda belilla*, *Ophiorrhiza mungos*, *Spodiopogon rhizophorus*, *Scleria* spp. etc. Large thickets of *Bambusa bambos* are common along fringes of rivers and streams.

3. Tropical moist deciduous forests: The south Indian moist deciduous forests particularly those bearing teak are variously classified as moist, very moist and slightly moist teak forests. The other two types are the southern moist mixed deciduous forests and southern secondary moist mixed deciduous forests. These two are considered together here as there is little difference in the floristic composition between the two. The main difference is the degree of degradation.

(a & b) Southern moist mixed deciduous forests and Southern secondary moist mixed deciduous forests:

These forests occur at lower elevations (500 - 900 m) receiving less rainfall (250 - 350 cm). They have a mixed composition with a few evergreen trees as well. The chief association found is *Tectona Dillenia Lagerstroemia lanceolata Terminalia paniculata* series (Gadgil & Meher-Homji, 1986b). The canopy is rather open and defoliation begins during December - January. These forests have the following dominant trees. The top storey has *Achroynchia pedunculata*, *Albizia amara*, *A. lebbeck*, *A. odoratissima*, *A. procera*, *Alstonia scholaris*, *Anogeissus latifolia*, *Bombax ceiba*, *B. insigne*, *Bridelia retusa*, *Buchanania lanzan*, *Careya arborea*, *Chukrasia tabularis*, *Dalbergia latifolia*,

D. sissoides, *Dillenia pentagyna*, *Grewia* spp., *Haldina cordifolia*, *Hymenodictyon obovatum*, *H. orixense*, *Lagerstroemia lanceolata*, *L. microcarpa*, *L. speciosa*, *Lanea coromandelica*, *Macaranga peltata*, *Mastixia arborea*, *Melia dubia*, *Mitragyna parviflora*, *M. tubulosa*, *Olea dioica*, *Pongamia pinnata*, *Pterocarpus marsupium*, *Pterospermum reticulatum*, *Radermachera xylocarpa*, *Scleropyrum pentandrum*, *Stereospermum colais*, *Tectona grandis*, *Terminalia auriculata*, *T. bellirica*, *Tetrameles nudiflora*, *Vitex altissima*. *Xylia xylocarpa* etc. Scattered amidst dense grasses is found *Phyllanthus emblica*.

In the middle layer smaller trees like *Bauhinia malabarica*, *B. racemosa*, *Bridelia retusa*, *Buchanania lanzan*, *Butea monosperma*, *Careya arborea*, *Cipadessa baccifera*, *Cassia fistula*, *Clausena austroindica*, *Catunaregam spinosa*, *Cleistanthus collinus*, *Cycas circinalis*, *Dalbergia sisso*, *Eriolaena quinquelocularis*, *Ficus callosa*, *F. exasperata*, *F. hispida*, *F. racemosa*, *Garuga pinnata*, *Gmelina arborea*, *Grewia tiliifolia*, *Macaranga peltata*, *Miliusa tomentosa*, *Kydia calycina*, *Morinda tomentosa*, *Nothapodytes nimmoniana*, *Schleichera oleosa*, *Spondias pinnata*, *Sterculia foetida*, *S. guttata*, *S. villosa*, *Trema orientalis*, *Trewia nudiflora*, *Wrightia arborea*, *Zanthoxylum rhetsa*, *Ziziphus xylopyrus* etc. are present.

The lower layer forming the undergrowth has *Abelmoschus moschatus*, *Abutilon indicum*, *Allophylus cobbe*, *Baliospermum montanum*, *Canthium rheedei*, *Cassia* spp., *Clerodendrum serratum*, *C. infortunatum*, *Cynoglossum zeylanicum*, *Desmodium* spp., *Ecbolium viride*, *Embelia tsjeriam-cottam*, *Flemingia strobilifera*, *Gomphostemma heyneana*, *Gardenia* spp., *Glycosmis pentaphylla*, *Helicteres isora*, *Hibiscus* spp., *Ixora* spp., *Pavetta* spp., members of the Acanthaceae, Orchidaceae and ferns. Climbers that are frequent are *Acacia pennata*, *A. torta*, *Asparagus gonocladus*, *Butea parviflora*, *Caesalpinia bonduc*, *Calycopteris floribunda*, *Cynanchum callialatum*, *Capparis rheedei*, *Combretum albidum*, *C. ovalifolium*, *Connarus wightii*, *Dalbergia horrida*, *D. volubilis*, *Dioscorea pentaphylla*, *D. tomentosa*, *D. wallichii*, *Diploclisia glaucescens*, *Erythralum scandens*, *Hibiscus surattensis*, *Jasminum azoricum*, *Naravelia zeylanica*, *Tiliacora acuminata* etc. The floor is covered by grasses like *Apluda mutica*, *Bothriochloa pseudoischaemum*, *Brachiaria distachya*, *Centotheca*

etc. with gregarious growth of *Strobilanthes* spp. Amidst the 'knee roots' on the floor are seen dense growth of Aroids like *Lagenandra ovata* and *L. toxicaria*.

These swamps are more or less constant in their floristic composition in all the sites noticed with little variation in the associated species on their edges and maintain a warm humid climate as they are enclosed within valleys. They are also resources of abundant ground water. Of late most swamps have been reclaimed for rice cultivation.

(b) Tropical riverine forests: The forty four rivers and their tributaries together form a specialised habitat for a plant community remarkably similar in appearance but a totally dissimilar taxonomic affinity. Trees common to this habitat are *Agrostistachys borneensis*, *Calophyllum apetalum*, *Cleidion javanicum*, *Ficus heterophylla*, *Garcinia wightii*, *Helicia nilagirica*, *Holigarna arnottiana*, *Homonoia riparia*, *Hydnocarpus alpina*, *H. pentandra*, *Lagerstroemia microcarpa*, *L. reginae*, *L. speciosa*, *Lophopetalum wightianum*, *Madhuca neriifolia*, *Neolamarckia cadamba*, *Ochreinauclea missionis*, *Ochlandra* spp., *Rapanea wightiana*, *Syzygium hemisphericum*, *S. heyneanum*, *S. occidentale*, *Tetrameles nudiflora*, *Vateria indica*, *Vitex alata* and *V. leucoxydon*.

More common herbs and subshrubs are *Alpinia malaccensis*, *Cryptocoryne retrospiralis*, *C. spiralis*, *Cyperus* spp., *Hydrobryopsis sessilis*, *Hypolytrum nemorum*, *Impatiens chinensis*, *I. scapiflora*, *Indotristicha ramossisima*, *Lagenandra meeboldii*, *L. toxicaria*, *Musa rosacea*, *Ophiopogon intermedius*, *Persicaria chinensis*, *Pogonatherum crinitum*, *Rotula aquatica*, *Silentvalleya nairii*, *Saccharum spontaneum*, *Themeda triandra*, *Willisia selaginoides*, *Zeylanidium lichenoides* etc. *Acacia pennata* and *Hibiscus hispidissimus* are the armed climbers which at times may completely cover the bushes on the banks of rivers.

5. Wet bamboo brakes: This type occurs in places wherever there is a break in the canopy such as sides of streams, on higher slopes or gaps created by felling. Being very aggressive, reeds colonize very rapidly and form large populations especially in gaps that are partially shaded. Common such reeds are *Ochlandra ebracteata*, *O. scriptoria*, *O. travancorica* and *O. wightii*.

6. Low level grasslands: Grasslands found below 1000 m are usually classified as low level grasslands. These include secondary grasslands of the lower elevations also. They are scattered amidst moist deciduous and dry deciduous forests based on which they are divided as (a) Dry and (b) Wet grasslands.

(a) Dry grasslands: They are limited in occurrence. Northern parts particularly Kasaragod, Kozhikode, parts of Palakkad and Wynad Districts have dry rocky areas which are covered by grasses intermixed with scrub jungles and dry deciduous forests. Grasses frequent here are *Arundinella cannanorica*, *A. mesophylla*, *Bhidea burnsiiana*, *Danthonidium gammiei*, *Dimeria bialata*, *Heteropogon contortus*, *Ischaemum indicum* and *Pseudanthistiria heteroclita*.

Vast areas in the dry and moist deciduous forests are covered by grasses which are formed consequent to biotic interference like fire, grazing and indiscriminate felling of trees. In such areas are found *Arundinella ciliata*, *A. mesophylla*, *Chrysopogon orientalis*, *C. zeylanicus*, *Cymbopogon flexuosus*, *Digitaria ciliaris*, *Eragrostis tenuifolia*, *Eulalia trispicata*, *Heteropogon contortus*, *Ischaemum timorense* etc. Gregarious amidst these grasses occurs the fire-resistant *Phoenix loureiri*. More common shrubs associated with these grasses are *Hedyotis purpurascens*, *Uraria rufescens* and herbaceous species of *Biophytum*, *Crotalaria*, *Cyanotis*, *Fimbristylis*, *Leucas*, *Phyllanthus*, *Rhynchosia*, *Striga* and *Vernonia*.

(b) Wet grasslands: These are characteristic of low lying wetlands of the coastal regions particularly in Alappuzha District. The common grasses adapted to this situation are *Brachiaria nutica*, *Imperata cylindrica*, *Eriochloa procera*, *Paspalum conjugatum*, *Paspalidium geminatum*, *Panicum repens* etc. Grasses found in areas with tidal action adapted to saline conditions are *Sporobolus virginicus*, *Paspalum scrobiculatum*, *Zoysia matrella* etc.

B. Subtropical montane forests:

These are the Southern subtropical hill forests. They occur mostly on plateaus in the upper reaches of slopes in higher altitudes (1000 – 1800 m). A transitional stage between tropical wet evergreen and temperate shola forests, they are miniature sholas with a floristic composition of both these types. Though they may not be as luxuriant as the wet evergreen types the trees are taller (20 – 30 m)

than the wet temperate forests (shoñas). The low stature of the trees is attributed to the high velocity of winds and less favourable conditions of soil. The stratification is not clearly marked. The dominant elements in the top storey are *Actinodaphne bourdillonii*, *A. bourneae*, *A. lanata*, *A. salicina*, *Bischofia javanica*, *Callicarpa tomentosa*, *Chionanthus courtallensis*, *C. mala-elengi*, *Celtis tetrandra*, *Cinnamomum macrocarpum*, *C. sulphuratum*, *C. verum*, *C. wightii*, *Cryptocarya lawsonii*, *C. neilgherrensis*, *Daphniphyllum neilgherrense*, *Dimocarpus longan*, *Elaeocarpus serratus*, *E. turberculatus*, *Eurya nitida*, *Fagraea ceylanica*, *Ficus arnottiana*, *Glochidion neilgherrense*, *Gordonia obtusa*, *Heritiera papilio*, *Ligustrum robustum* ssp. *walkerii*, *Maesa indica*, *Neolitsea cassia*, *Persea macrantha*, *Pittosporum neelgherrense*, *Symplocos* spp., *Syzygium cuminii*, *S. densiflorum*, *Toona ciliata* and *Turpinia malabarica*.

The second storey may have *Actinodaphne campanulata* var. *obtusa*, *Byrsophyllum tetrandrum*, *Canthium dicoccum*, *Cinnamomum filipedicellatum*, *C. sulphuratum*, *C. travancoricum*, *Gomphandra tetrandra*, *Hydnocarpus pentandra*, *Memecylon angustifolium*, *Pavetta brevifolia*, *Pittosporum napaulense*, *Rapanea wightiana*, *Schefflera wallichiana*, *Symplocos cochinchinensis* subsp. *laurina*, *Ternstroemia gymnanthera*, *Vernonia monosis*, *Wendlandia notoniana* and *Syzygium* spp.

The third storey is formed of younger forms of the upper two storeys along with shrubs and undershrubs like *Canthium neilgherrense*, *Hedyotis purpurascens*, *H. ramarowii*, *H. swertioides*, *Knoxia heyneana*, *Pavetta hispidula*, *Psychotria nigra*, *Saprosma fragrans* etc.

The ground is often covered by *Arundinella tuberculata*, *Elatostema lineolatum*, *Strobilanthes heyneanus*, *S. wightianus*, *Pogostemon purpurascens*, *Polygala arillata*, *Viola pilosa* in addition to pteridophytic species of *Asplenium*, *Osmunda*, *Selaginella* etc. The common epiphytes are orchids like *Aerides crispa*, *A. ringens*, *Bulbophyllum fischeri*, *B. tremulum*, *Coelogyne nervosa*, *Dendrobium herbaceum*, *Eria nana*, *E. polystachya*, *E. reticosa*, *Liparis elliptica*, *Oberonia santapau*, *Trichoglottis tenera* etc. *Impatiens auriculata* and certain *Peperomia* spp. are also common. More common ground orchids are *Calanthe masuca*, *Habenaria longicorniculata*, *H. plantaginea*, *Peristylus aristatus*, *P. densus*,

Pectilis gigantea, *Phaius luridus* etc.

C. Montane temperate forests:

These are of two types 1. Southern montane wet temperate forests (sholas) and (2) Southern montane wet grasslands (High altitude grasslands). Both are closely associated with each other.

1. Southern montane wet temperate forests (Sholas): Confined to depressions and moist sheltered folds of valleys, the sholas are unique type of vegetation distinct from other types by various features. They are small, isolated, compact and sharply defined evergreen woodlands scattered amidst vast stretches of grasslands at higher altitudes above 1500 m. The sholas in their best manifestation are seen in the Silent Valley adjacent to the Nilgiris and in the High Ranges. A fast-receding community (Vishnu Mittre & Gupta, 1968), the sholas are characterized by stunted trees with short boles reaching less than 15 m high. The crowns of these trees are usually dense and rounded with entire and coriaceous leaves usually reddish when young. The trunks are not buttressed and branches are crooked and densely clothed with lichens, mosses, ferns and epiphytic orchids. The stunted growth and slow spread of this vegetation is generally attributed to the high velocity of winds and unsuitable soil nearby (Adriel, 1964). Meher-Homji (1965), however, gave two other factors viz., frost during cold season and fire during summer for the non-regeneration and slow spread of these forests. A mixture of both temperate and tropical elements are found. Another remarkable feature is the occurrence of the Sino-Himalayan *Rhododendron* in such forests in the High Ranges. Unlike tropical evergreen forests, this type has only two well marked storey. The dominant trees in the top storey are *Actinodaphne bourneae*, *Cinnamomum wightii*, *C. perrottetii*, *Callicarpa tomentosa*, *Daphniphyllum neilgherrense*, *Elaeocarpus tuberculatus*, *Euonymus indicus*, *Glochidion neilgherrense*, *Gordonia obtusa*, *Litsea wightiana*, *Melicope lunuunkenda*, *Meliosma simplicifolia*, *Microtropis ramiflora*, *Neolitsea cassia*, *Phoebe wightii*, *Syzygium calophyllifolium*, *S. densiflorum* etc. Along the fringes are found light-loving *Elaeocarpus munroii*, *E. recurvatus*, *Eurya nitida*, *Prunus zeylanica*, *Rhododendron arboreum* var. *nilagirium*, *Rhodomyrtus tomentosa*, *Symplocos cochinchinensis* subsp. *laurina* and *Ternstroemia gymnanthera*.

The second storey is with smaller trees like *Actinodaphne salicina*, *Appollonias arnottii*, *Cryptocarya stocksii*, *Gomphandra coriacea*, *Hydnocarpus alpina*, *Ixora notoniana*, *Ligustrum roxburghii*, *Memecylon malabaricum*, *Pittosporum tetraspermum*, *Rapanea wightiana*, *Schefflera capitata*, *S. racemosa*, *Symplocos foliosa*, *S. pendula*, *Syzygium gardneri*, *Turpinia cochinchinensis*, *Vaccinium leschenaultii*, *V. neilgherrense*, *Viburnum erubescens*, *Vernonia monosis* and *Wendlandia notoniana*.

The ground layer may have shrubs and herbs such as *Anotis monosperma*, *Canthium neilgherrense*, *Elatostema lineolatum*, *Gnidia glauca*, *Hedyotis stylosa*, *Hypericum mysurense*, *Hypochaeris glabra*, *Impatiens* spp., *Laportea bulbifera*, *Lasianthus cinereus*, *L. jackianus*, *Linocera ligustrina*, *Maesa indica*, *Memecylon flavescens*, *Micromeria biflora*, *Polygala arillata*, *Psychotria congesta*, *Sarcococca saligna*, *Senecio lavandulaefolius*, *Strobilanthes* spp., *Rotala rotundifolia*, *Rungia latior*, *Viola pilosa* etc. Lianas are not common. The common climbers are *Clematis wightiana*, *Elaeagnus indica*, *E. kologa*, *Jasminum* spp., *Lonicera leschenaultii*, *Piper* spp., *Pentapanax leschenaultii*, *Rosa leschenaultiana*, *Rubia cordifolia*, *Rubus racemosus*, *Schefflera venulosa*, *S. wallichiana*, *Senecio candicans*, *S. corymbosus*, *S. intermedius*, *Tylophora pauciflora* etc. Parasites are rare but epiphytes are abundant. More common epiphytes are orchids like *Aerides ringens*, *Bulbophyllum tremulum*, *B. sterile*, *Chilochista pusilla*, *Coelogyne mossiae*, *C. odoratissima*, *Dendrobium barbatulum*, *D. herbaceum*, *D. heterocarpum*, *D. heyneanum*, *Eria dalzellii*, *E. polystachya*, *Liparis viridiflora*, *Oberonia proudlockii*, *O. santapau*, *Sirhookera latifolia*, *Trias bonaccordensis*, *T. stocksii*, and *Vanda spathulata*. *Hoya ovalifolia*, *Peperomia tetraphylla* and ferns are also common. Mosses and lichens completely cover the branches and trunks of trees. On the fringes of water courses *Ochlandra beddomei* may be found.

The ground is matted with litter and is almost devoid of any plant except for some seedlings of trees of the upper storey, ferns and some saprophytic orchids.

The status of the shola forests has been a subject of dispute. While Champion and Seth (1968) and Chandrasekharan (1962) considered them as temperate

vegetation, Meher-Homji (1965) treated them as subtropical montane type.

2. Southern montane wet grasslands (High altitude grasslands or shrub savannas): Associated with and dominating the shola woodlands are vast stretches of grasslands, a characteristic feature of the high mountains above 1500 m. The Eravikulam National Park, Munnar and Devikulam in the High Ranges of Idduki, Ponnambalamedu in Sabarimala, Pookunnamala and the Silent Valley present a captivating scenery of such extensive grasslands. These are often mixed with herbs and shrubs in varying proportions and hence called shrub savannas. These montane grasslands have superficial resemblance to the 'patenas' of Sri Lanka (Sreekumar & Nair, 1991). Except for some areas coming under the Eravikulam and Silent Valley National Parks, most high altitude grasslands are severely depleted due to biotic interference and fire during summer. The chief communities of grasses met with are (a) *Sehima Dichanthium* type (Gupte & al., 1967) wherein *Heteropogon contortus*, *Sehima nervosum* and *Dichanthium* species are the dominant elements, (b) *Cymbopogon Themeda* type, the dominant species of which are *Cymbopogon flexuosus* and *Themeda cymbaria*, (c) *Saccharum Imperata - Phragmites* association consisting of grasses like *Phragmites karka*, *Saccharum spontaneum*, *Imperata cylindrica*, *Paspalum conjugatum* etc. A number of temperate grasses such as *Agrostis schmidii*, *A. zenkeri*, *Brachypodium sylvaticum*, *Bromus diandrus*, *Poa gamblei* along with temperate species of *Exacum*, *Gentiana*, *Bupleurum*, *Dipsacus*, *Ranunculus* are also found. The grasses generally grow to a height of 1 - 1.5 m, the tallest being *Bothriochloa insculpta*. Those attaining about 1 m height are *Arundinella purpurea*, *Chrysopogon zeylanicus* etc. These grasses have their maximum development in some moist depressions beside the woodlands. Other predominant grasses are *Agrostis peninsularis*, *A. setosa*, *Andropogon polyptychus*, *Arthraxon castratus*, *Bromus ramosus*, *Chrysopogon zeylanicus*, *Cymbopogon flexuosus*, *Eragrostis nigra*, *E. tenuifolia*, *Indochloa oligantha*, *Isachne bourneorum* and *Tripogon bromoides*. The sedges found amidst these grasses are *Killinga cylindrica*, *Mariscus cyperinus*, *Pycneus angulatus* etc. *Anaphalis neilgerriana*, *Conyza* spp., *Crotalaria barbata*, *C. formosa*, *C. ovalifolia*, *Eulophia* spp., *Habenaria* spp., *Hedyotis leschenaultiana*, *Helichrysum* spp., *Impatiens* spp., *Memecylon lawsonii*, *Osbeckia* spp., *Ranunculus peninsularis* and *Senecio* spp. are also common.

The ecological status of the shola-grasslands has been a matter of dispute. A majority of workers (Bor, 1938; De Rosaryo, 1945; Holmes, 1951; Shankarnarayan, 1958; Gupta, 1960; Legris, 1960; Gupta & Shankarnarayan, 1962; Chandrasekharan, 1962; Noble, 1967) consider these as a biotic climax while Ranganathan (1936) treated it as a climatic climax. However, Meher-Homji (1967) opined that frost and fire are the limiting factors for this type to spread.

D. Tropical dry forests: These are of limited occurrence in Kerala. The two types met with in the drier areas of Chinnar (Idukki District), Palakkad and Kannur are 1. Southern dry mixed deciduous forests and 2. Southern tropical thorn forests.

1. Southern dry mixed deciduous forests: They occur in drier areas of Chinnar in Idukki District and some areas in Palakkad district. Characterized by the light unstoreyed canopies, these forests occur at lower elevations between 300 and 900 m and receive less rainfall, 100 - 200 cm. The undergrowth is dense as light penetrates the canopy sufficiently but epiphytes and ferns are rare. The common association here is *Terminalia - Anogeissus latifolia - Tectona* series. Dominant trees are *Albizia amara*, *Anogeissus latifolia*, *Bauhinia* spp., *Buchanania lanzan*, *Butea monosperma*, *Dillenia pentagyna*, *Ehretia laevis*, *Garuga pinnata*, *Gmelina arborea*, *Haldina cordifolia*, *Phyllanthus emblica*, *Pterocarpus marsupium*, *Semecarpus anacardium*, *Terminalia* spp. etc.

The smaller trees and shrubs are *Acacia pennata*, *Carissa congesta*, *Desmodium gangeticum*, *D. laxiflorum*, *D. triangulare*, *Holarrhena pubescens*, *Leea indica*, *Solanum americanum*, *S. torvum*, *Wrightia tinctoria* and *Zingiber* spp.

The herbaceous flora after the monsoon may have *Corchorus aestuans*, *Crotalaria evolvuloides*, *C. heyneana*, *C. nana*, *Desmodium heterocarpon*, *D. heterophyllum*, *D. triflorum*, *Mimosa pudica*, *Sida acuta*, *S. alnifolia*, *S. rhombifolia* and grasses like *Apluda mutica*, *Eragrostis japonica*, *E. tenella*, *Oplismenus compositus* and *Themeda triandra*. Gregarious growth of the bamboo *Dendrocalamus strictus* is a distinguishing feature.

2. Southern tropical thorn forests: Unlike the eastern slopes of the Western Ghats which possess extensive areas of thorn forests, the western slopes have

only scanty patches. Laterite scrubs which are comparable to laterite thorn forests of the eastern slopes are found in a few places in the northernmost part. Presence of a large number of sandal trees is a distinguishing feature of this type. Such forests occur below 300 m and receive very less rainfall. The trees are deciduous, shorter (less than 10 m high), hard-wooded and frequently armed with thorns or spines. Plants as a whole may also exhibit different xerophytic modifications. The dominant trees are *Acacia chundra*, *Albizia amara*, *Anogeissus latifolia*, *Azadirachta indica*, *Bridelia retusa*, *Buchanania lanzan*, *Butea monosperma*, *Cassia fistula*, *Cordia dichotoma*, *Diospyros candolleana*, *Holarrhena pubescens*, *Limonia acidissima*, *Strychnos nux-vomica*, *Tectona grandis*, *Terminalia bellirica*, *Ziziphus oenoplia* etc.

The common stragglers include *Capparis zeylanica*, *Carissa congesta*, *Flacourtia indica*, *Maytenus emarginata* and *Toddalia asiatica*. More common climbers are *Cardiospermum halicacabum*, *Ceropegia candelabrum*, *C. juncea*, *Cissus quadrangularis*, *C. repanda*, *Cyclea peltata*, *Hemidesmus indicus*, *Ichnocarpus frutescens*, *Jasminum* spp., *Tylophora* spp., *Ziziphus oenoplia*, *Z. rugosa* and *Z. xylopyrus*.

The area being dry for most part of the year, the ground is almost barren. After the monsoons it is covered by herbs like *Achyranthes aspera*, *Allmania nodiflora*, *Apluda mutica*, *Aristida setacea*, *Blumea mollis* and species of *Barleria*, *Blepharis*, *Cleome*, *Cymbopogon*, *Glinus*, *Indigofera*, *Leucas*, *Mollugo* and *Hedyotis* and a few shrubs like *Canthium coromandelicum*, *Catunaregam spinosa*, *Pavetta indica*, *Ixora coccinea*, *Pseudaidia speciosa* etc.

Hill tribes

The wild mountain dwellers who share the hilly tract of the state are split into several tribes who are generally isolated from each other. Each of these tribes has its own territory, the tract with which they are well acquainted. Living in clans, they have almost a similar mode of life, its subsistence being derived chiefly from "the spontaneous produce of the wilderness through which they roam" (Ward & Corner, 1863). They live in huts mostly built on rocks or on tree tops to safeguard themselves from wild animals, "their fellow occupants with whom they share or dispute possession" (Ward & Corner, 1863). Most tribes are haunted by a variety

of superstitions. The chief of these tribes usually serves as a physician also, but some tribes have their separate 'doctors' the medicine being herbal. The major tribes inhabiting the forests of Kerala are the following.

Kanikkar or Kanis: They live in forests in Thiruvananthapuram and Kollam Districts. There are about 75 settlements of them in Thiruvananthapuram and a few of them in Pathanapuram and Kulathupuzha. They claim to be the descendants of the Pandiyas of Madurai. They practice shifting-cultivation in addition to collecting hill produce. The Moopan, the chief of this tribe, also practices herbal medicine.

Kochuvelans: They are in Ranni, Konni, Pathanamthitta and Sabarimala reserve forests. They are also called Malakuravans. These hunters claim themselves to be the descendants of Lord Ayyappa.

Malavedans: They are confined to Kollam and Pathanamthitta. Their settlements are found in Kadimeenchira, Narayanamuzhi, Kumarapuram, Katachira, Ottakkal, Thenmala and Achenkovil. They are primarily hunters but sometimes cultivate rice and collect hill produce.

Malapandarams: This tribe lives in forests of Kollam, Pathanamthitta and Kottayam. A primitive hunting tribe, they also gather hill produce as they roam about the forests. Both men and women use maravuri (bark of trees). This primitive race inhabits usually deeper and higher forest tracts of Manimala, Achenkovil and Sabarimala.

Mannans: An agricultural tribe that inhabit the forests of Pathanamthitta, Kottayam and Ernakulam. They are generally found in elephant infested areas and live in tree-top huts. In addition to cultivating and collecting minor forest produce and honey, they also hunt animals to supplement their diet. Their settlements are scattered in Kanjirapally, Devikulam, Udumbanchola and Thodupuzha.

Mala Ulladans: As the name denotes, they are "people of interior forests" and are nomads who subsist chiefly on food gathering and hunting. Claiming themselves to be a progeny of Valmiki, some of these people also engage in cultivation. Women-folk make baskets and mats while the menfolk collect medicinal herbs and sell them in nearby markets. They live in the Ranni Range of Pathanamthitta, Meenachil and Kanjirapalli Taluks of Kottayam and Thodupuzha

of Eranakulam.

Karavazhis: They are confined to Chinnar and Marayur in Anchanad Valley in Idukki. Popularly known as the Malapulayan, they are basically an agricultural tribe.

Kurumbas: They also live in the Anchanad Valley of Idukki and Attappadi in Palakkad. They were originally food gatherers who subsist solely on fruits, yams and fish. Most of them are now employed as forest labourers.

Mala Arayans: As the name connotes they are the kings of forests and are considered one of the indigenous tribes. They inhabit the hilly tracts of Kanjirapally, Meenachil and Peermade in Kottayam District and Edapalli, Kodayattur and Thodupuzha of Ernakulam. They subsist mainly on pepper cultivation in forests in addition to collecting minor forest produce.

Muthuvans: They are found only in Kottayam. A comparatively more civilized tribe, they claim to have been Vellalars who accompanied some princes of Madurai to these hills. Secluded amongst the hills of Devikulam and Neriya Mangalam, these people follow different occupations. While some are engaged in cultivation, others collect hill produce, still others rear cattle, goats and poultry.

Paliyar: This is another tribe confined to Kumili, Periyar, Vandanmedu ranges of Udumbanchola Taluk of Idukki District. Originally belonging to Cumbam in Tamil Nadu, they are comparatively primitive. The women wear maravuri (bark of trees). Of late they are more civilized and wear modern dresses. They are an agricultural community and do not migrate frequently.

Uralis: They are people of the soil ('ur' means land/soil, 'al' means people) who claim themselves to be the aborigine of the Aryans. But some people believe that they were brought from Madurai in Tamil Nadu. As they live in areas infested with elephants in Devikulam and Peermedu Taluks of Idukki, Thodopuzha and Muvattupuzha of Ernakulam District, they construct two huts each, one on the land and other on tree-tops. The tree-top huts with ladders leading to them are used only for sleeping. The huts are generally found (1 - 6) together. They generally collect minor forest produce, honey, cardamom and sell them for their require-

ments. Of late some of them have taken to cultivation.

Ulladans: It is a tribal community confined to Kottayam District. Ulladans are also known as kattalans denoting that they are the 'people of the forests'. They subsist on fruits, roots, tubers, small animals, and fish besides bison meat. This nomadic tribals wear a hat made of the base of arecanut palm leaf and always keep with them staffs with sharp iron points.

Irulas, Mudugas and Kadars: They are seen mostly in Palakkad. A few kadars live in southern parts also. Basically agricultural labourers, they live in Parambikulam and Malampuzha. They are comparatively more civilized than any other tribe in Kerala. They are also found in Vazhamoola in North Wynad.

Paniyas: One of the most primitive tribes in Kerala, they were the main stock-in-trade for a kind of slave trade on the West Coast which led to the general impression that these people were brought from Africa and sold in Malabar in the past (Luiz, 1962). They live in forests in Nilambur, Palakkad and Wynad and form the largest tribal population in Wynad. Living in colonies in the fringes of forests, these people freely mix with others.

Adiyans: They live in Thirunelli in north Wynad. They are now mostly low-paid agricultural labourers attached to landlords in this area.

Chingathans of Taliparamba in north Wynad are a hunting tribe.

Karimpalans: They live in low-lying hills and private forests in Thalassery and Taliparamba Taluks of Kannur. They are engaged in 'punam' (shift-cultivation) and collect wild pepper for a living. Some of them work as forest labourers.

Kattunayakans: They inhabit deep forests in north Wynad. As the name connotes, they are the chiefs of forests and are otherwise named 'then kurumbar' based on their occupation of honey collecting. They subsist on roots, tubers, herbs, fruits and honey.

Koragas: They are of two kinds, Sopukoragas who use garments of leaves while Kuntukoragas use clothes. Inhabitants of Kasaragod, these people engage themselves in basket- and mat-making for their subsistence.

Kudiyas: They live at Panamthody village in Hosdurg. Their chief occupation is agriculture and cattle and poultry rearing.

Kurichiyas: They live in forests in Thalassery and north Wynad. Considered aristocrats among the tribes of the state, they occupy a higher social position among them. They practice both shifting- and permanent-cultivation. Some of them are well-to-do as they raise cash crops in their own land. The poor among them collect wild pepper while women-folk go fishing.

Malayalars: They also live in Thalassery forests. A relatively advanced tribe of Wynad, they once practiced shifting-cultivation but now they have taken to permanent agriculture.

Malayans: Inhabit forests in Kannur and are food gatherers in addition to harvesting bamboos for basket-making.

Maratis: They live at Adur and Delampadi in Kasaragod and Panamthady in Hosdurg. Regarded as immigrants from Maharashtra and Goa they speak a dialect mixed with Marati and Kannada. Economically superior to other tribes of Malabar, most Maratis are petty traders. Some have taken to farm labour while others rear cattle.

Mulla kurumbas: They are an agricultural tribe found only at Kuppathode in north Wynad.

Urali kurumbas: Settlements of this tribe are found in several areas of forests in Kannur. They live in small huts made of bamboos and reeds thatched with grasses. Being primarily a nomadic food gathering and hunting tribe, they also make baskets and mats.

Shola Naikens: The most secluded hill tribe of Kerala, Shola Naikens of Nilambur were unknown to outside world till recently as they live in caves in deep and inaccessible areas of forests (Sivarajan & Mathew, 1997). They live in colonies and their population is dwindling. Their subsistence depends on root tubers, fruits etc. They also collect minor forest produce.

Naikans: They are comparatively an advanced tribe and freely mix with the outside world although they still live in fringes of forests in Nilambur. These people also collect minor forest produce and honey. Some of them also work as

forest labourers.

Floristic diversity

A better understanding of the enormous heterogeneity in the flora of the state is possible only by tracing its origin, evolution and phytogeographical affinities.

The discovery of the famous 200 million year old 'Talcher beds' in Orissa and Madhya Pradesh and the subsequent excavations of fossils of both Lower Gondwana (*Glossopteris* flora dominated by Pteridosperms, Cordaitales, Equisetales and Sphenophyllales) and Upper Gondwana (cycads and conifers) dating from the Carboniferous and Permian periods of the Paleozoic era to Cretaceous period of the Mesozoic might substantiate India's Gondwana origin and past connections with South America, Malasian Islands, Madagascar, Australia and Antarctica. This fact is further established by the presence of common or allied floristic elements like species of *Acrotrema*, *Apodytes*, *Gomphandra*, *Herna-ndia*, *Hydnocarpus*, *Laurenbergia*, *Pittosporum*, *Sarcostigma* etc. in India and other countries of Gondwana origin. Nair (1981) and Nair and Daniel (1986) cited several such instances supporting the antiquity of the flora of the Western Ghats in contrast to the view held by Nayar (1980a) that Indian flora was established only during the postglacial period. The Lower Eocene Deccan Intertrappean flora, presumed to be a mixture of elements from North (*Datisceae*) and those derived from the South (Lakhanpal, 1970), may indicate that the evolution of the peninsular Indian flora commenced from mid-Tertiary onwards progressively enriching the northern predominantly tropical groups of angiosperms (*Dipterocarpaceae*). Recent phytogeographical analysis (*vide* Phytogeography) has also shown its uniqueness and similarities with the flora of other regions.

This variety and variability of plants (animals and micro-organisms) is organized at various hierarchical levels such as genes, organisms, populations, communities, landscapes, biomes and biogeographic provinces and is acted upon by several natural governing factors to enhance, sustain or decimate the biological diversity. These are breeding systems, population size, dispersal mechanisms, environmental gradients, topography, hydrology and human beings.

That India harbours about 200,000 species of living organisms which is about 6.5% of the species worldwide might indicate the extent of the diversity (Gadgil & Meher-Homji, 1986a). This includes 45,000 species of plants and 77,000 species of animals. More species are being added to the list constantly.

Owing to its characteristic location in the southwestern corner of the peninsula with the Southern Western Ghats as its eastern boundary, Kerala enjoys a humid tropical climate endowed with plentiful rainfall and less diurnal and seasonal thermal variations. Besides, the varied topography ranging from a flat coastal belt intercepted frequently by lagoons, the undulating midland with low hills and valleys and the rugged slopy terrain of the highlands, together provide a congenial environment for the thriving of a very complex and diverse vegetation which ranges from coastal estuarine to wet evergreen forests in the highlands.

Based on plant explorations conducted by the Botanical Survey of India and literature Mohanan and Nair (1999) estimated that there are about 4000 species of flowering plants in the state. Over 1330 species of vascular plants belonging to 251 genera and 195 families were recorded for the southernmost district of Thiruvananthapuram (Mohanan & Henry, 1994). Mohanan (1984) enumerated 1400 species belonging to 160 families in his flora of Kollam District. From Kottayam District Antony (1989) reported 1151 species belonging to 731 genera and 184 families. These three districts along with Pathanamthitta which is also well-explored (Anilkumar, 1994), Eernakulam and Alappuzha which were partially explored form a cross-section of south and central Kerala corresponding to erstwhile Thiru-Kochi state. From northern Kerala (Malabar), Palakkad (Vajravelu, 1990) accounts for 1355 species belonging to 737 genera and 196 families. The Silent Valley with an area of 39,100 ha. alone has 966 species of flowering plants belonging to 559 genera and 234 families (Manilal, 1988). Ramachandran and Nair (1988) explored Kannur District including a part of present Wynad and Kasaragod and reported 1132 species belonging to 658 genera. From Kasaragod, which is the northernmost district, Ansari (1985) recorded 890 species belonging to 550 genera and 142 families. Nilambur covering just 150 km² in Malappuram District was explored by Sivarajan and Mathew (1997) and they reported 1132 species belonging to 665 genera and 130 families. The forests of Thrissur District covering an area of 1041 km² were studied by Sasidharan and Sivarajan

(1996) and they enumerated 1225 species belonging to 703 genera and 129 families. Manilal and Sivarajan (1982) studied the flora of Kozhikode District with 600 km² and recorded 983 species belonging to 566 genera and 132 families. Similar studies were also undertaken by Subramanian (1980) in Thenmala (Kollam District), Shetty and Vivekananthan (1971, 1981) in Idukki, Nair (1988) in Pooyamkutty and Nayar and Nair (1983) in Idukki. Besides these, Moozhiyar (Kollam) and Pooyamkutty (Idukki) were also explored by Chandrasekaran and Bhargavan respectively (unpublished).

Analysis of the above data indicates that the family Poaceae ranks first in the ten largest families which is similar to that of Madras Presidency and India. *Poaceae* is followed by *Fabaceae*, *Orchidaceae*, *Acanthaceae*, *Euphorbiaceae*, *Cyperaceae*, *Asteraceae*, *Rubiaceae*, *Lamiaceae* and *Scrophulariaceae* in the descending order.

The largest family in India, the *Poaceae*, are well represented in Kerala as well. Being the largest family, they consist of 296 species belonging to 106 genera and 24 tribes (Sreekumar & Nair, 1991). This study also resulted in the discovery of 2 new unispecific genera viz., *Chandrasekharania* and *Silentvalleya* besides 26 new species and several new records. A few more were later added by Ravi (1995) and Ravi and Anil Kumar (1992). Of the 32 species of bamboos belonging to 8 genera in peninsular India 24 species belonging to 6 genera are present in Kerala (Kumar, 1991, 2001b; Kumar & al., 2001b).

Leguminosae, the third largest family in the world with 18,000 species (Polhill & al., 1981) are another well represented family. Over 320 species of legumes out of the 1151 reported from India occur in Kerala of which 44 are economically important (Sanjappa, 1991, 1992). The diversity of the family is manifested in the habitat representing trees, shrubs lianas, tiny herbs etc. Many timber-yielding trees like *Dalbergia* spp., *Albizia* spp. etc. are also common. The most conspicuous are the giant lianas like *Entada rheedei* with its huge pods and *Butea parviflora*. *Butea monosperma* is conspicuous by its reddish blossom in deciduous forests and is known as the 'flame of the forest' The family also has many endemics like *Dialium travancoricum*, *Cynometra* spp. etc. besides many edible and medicinal plants.

Another fascinating family exhibiting maximum diversity is the

Orchidaceae. From the Western Ghats about 272 taxa of orchids (267 species, 3 subspecies and 2 varieties) belonging to 72 genera have been reported (Sathishkumar, 1991) of which over 214 species occur in Kerala. Presence of the lonely Peninsular Indian lady's slipper orchid *Paphiopedilum druryi* in Agastyarkudam in Thiruvananthapuram district is a striking feature of the flora. The fact that in the Silent Valley alone Manilal (1985) collected 108 species of orchids might indicate the enormous diversity of the family. Many orchids in the state have beautiful flowers and are horticulturally important. Some of them are *Aerides crispera*, *A. ringens*, *Eulophia cullenii*, *Dendrobium* spp., *Habenaria* spp., *Pecteilis gigantea*, *Rhyncostylis retusa*, *Vanda* spp. etc. Of more significance is the presence of some ephemerals like *Nervilia* spp., *Epipogon roseum*, *Aphyllorchis* spp., *Zeuxine* spp. etc. besides the wild stocks of important *Vanillas* viz., *V. wightiana*, *V. walkeri* etc. Interestingly there is an increasing tendency among the farmers of Kerala to cultivate orchids particularly *Vanilla planifolia*.

A predominantly East African family, the *Asteraceae* comprise mostly herbaceous members represented by both high altitude genera and weed genera in the plains. However, the arborescent ones are *Vernonia monosis* and *V. travancorica*.

Acanthaceae is another family that has contributed significantly to enrich the flora of Kerala. The diversity is evident by the presence of over 20 genera of which *Andrographis*, *Asystasia*, *Baerleria*, *Strobilanthes*, *Justicia* etc. are well represented. Many species of *Strobilanthes* at higher altitudes sholas are endemics. Many are pliestesials flowering at long intervals. The once-in-twelve-year-flowering 'neela kurinji' is gregarious in Kurinjimala in the Kerala-Tamil Nadu border (Uthaman, 1991).

Rubiaceae with its maximum development in southern India and Sri Lanka have over 28 genera, *Hedyotis*, *Ixora*, *Ophiorrhiza*, *Psychotria* and *Spermacoce* being well represented. Several cultivars of coffee (*C. arabica* and *C. robusta*), a native of Africa, are extensively planted in the hills.

The presence of *Rhododendron arboreum* subsp. *nilagirium* (*Ericaceae*) in the High Ranges further establishes the affinity of the flora with temperate and alpine zones of the Himalayas in addition to highlighting the disjunction in its distribution. *Ericaceae* also have two more species in 2 genera

while the closely associated *Vacciniaceae* have only one species in *Vaccinium* but is prominent in the 'sholas'

Another well developed family is the *Asclepiadaceae*. With 55 taxa (51 species and 4 infraspecific taxa) (Swarupanandan, 1991) this family has its maximum development in the genus *Ceropegia* (44 species in India, 35 in the Western Ghats of which 26 are endemic, (Ansari, 1984). Besides, 22 other genera have medium representation. *Janakia* (*Periplocaceae*) is a genus described from Kurisumala (Joseph & Chandrasekaran, 1978). Most species of *Asclepiadaceae* and *Periplocaceae* are highly medicinal.

Impatiens (*Balsaminaceae*), the largest genus in India with 203 species of the 430 species in the world, has attained its maximum development in Kerala. A large assemblage of these plants (about 86 species) on the hill-tops of the Western Ghats particularly of the High Ranges shows its affinity with that of the Eastern Himalayas and Myanmar. In Nair's (1991) list of endemic *Impatiens*, 7 are restricted to Wynad while 20 are from the High Ranges. Shetty and Vivekananthan (1991) enumerated the endemic species of the Western Ghats of which 18 are from Kerala. In the last decade itself 4 new species were described from Kerala.

Annonaceae, a chiefly tropical family having its maximum development in the rain forests of Brazil, West Africa through Sri Lanka, South Myanmar and Malesia, is well represented here with 50 species belonging to 17 genera, including many endemics (to Western Ghats) like *Popowia beddomeana*, *Goniothalamus* spp., *Sageraea grandiflora* etc. in addition to the introduced species of *Annona* and *Artabotrys*.

An Afro-Asian family found in predominantly drier areas, the *Capparaceae*, is poorly represented (27 species belonging to 5 genera). So is the case with *Flacourtiaceae*, a Malesian family (16 species belonging to 6 genera). *Hydnocarpus* has three species. The seeds of *H. alpina* and *H. pentandra* yield an oil which is used in Ayurvedic medicines. *Ranunculaceae* and *Magnoliaceae* with their centre of development in the temperate regions of the Northern Hemisphere are very poorly represented.

The *Celastraceae* considered to be well developed in peninsular India

have only poor representation in the state with *Euonymus*, *Glyptopetalum*, *Loesneriella*, *Lophopetalum*, *Microtropis*, *Pleurostyliia*, *Reissantia* and *Salacia*.

Prunus, *Rubus*, *Photinia* and *Rosa* are the temperate genera of the *Rosaceae* while *Lamiaceae* have moderate development with *Ocimum sanctum*, the widely cultivated 'tulasi' venerated by Hindus and several wild genera like *Pogostemon*, *Plectranthus*, *Leucas*, *Orthosiphon* etc.

With Deccan peninsula as its centre of development in India, the *Euphorbiaceae* are well represented. The fleshy/succulent species mark their African influence but the gregarious *Euphorbia santapau* confined to the top of Agastyarkudam is endemic. Tapioca (*Manihot esculenta*) and rubber (*Hevea brasiliensis*), both natives of tropical America, are extensively cultivated throughout Kerala besides several horticultural forms of *Codiaeum* spp. as ornamentals. *Phyllanthus emblica*, the goosberry, is abundant in deciduous forests and is a good source of vitamin C and forms a constituent of several Ayurvedic preparations.

Family *Araceae* has maximum diversity both in habit and habitat. They range from terrestrial herbs (*Arisaema*, *Typhonium*, *Amorphophallus*, *Colocasia* and *Alocasia*) to climbers like *Pothos*. Of the total 163 species in India 58 occur in Kerala (Sasikala, 2000). *Anaphyllum* is an endemic genus with 2 species. *Arisaema* is the largest genus in India with 46 species. Twelve species of this genus are reported from Kerala. The medicinal *Acorus calamus* (*Acoraceae*) is marshy. Though with less diversity, the *Musaceae* also has its presence in the wild (*Ensete glauca*) and cultivated banana (*Musa paradisiaca*). With rhizomatous tuberous stems, the *Zingiberaceae* have a fair representation in genera like *Amomum*, *Curcuma*, *Zingiber* etc. *Curcuma* is the largest genus in south India with 17 species, most of these are found in Kerala too. Economically important ones are the widely cultivated cardamom (*Elettaria cardamomum*), turmeric (*Curcuma domestica*) and ginger (*Zingiber officinale*). *Marantaceae* are very conspicuous by the presence of only 2 species, the wild *Schumannianthus virgatus* as gregarious undergrowth in moist forests and the other, the cultivated *Maranta arundinacea*, the arrowroot. *Dioscoreaceae* have more than 11 species in *Dioscorea*. Many produce edible bulbils.

The predominantly tropical and subtropical *Commelinaceae* are another

family with their full development. Of the 81 species in India 45 are found on the Western Ghats of which 17 are endemics. Most of these are present in Kerala also.

With 21 species, most of them wild, the palms have moderate representation. Coconut, the most extensively cultivated tree with its innumerable uses, controls the economy of the state. Arecanut is another popular crop. Of more significance is the presence of the endemic *Bentinckia condapanna* in gregarious masses on the inaccessible steep rocky slopes of the Agasthyarkudam. The wild coconut, *Arenga wightii*, is also abundant in valleys, so is *Pinanga dicksonii*. Rattans, the climbing palms, are the well represented and well exploited plants and belong to *Calamus*. Of the 60 species of rattans in India 13 occur in the state (Renuka, 1992). The most majestic palm, the talipot palm (*Corypha umbraculifera*), is now found only in some private fields. *Phoenix* is widespread among grasses in secondary moist mixed deciduous forests. Similar in habit but scarcely represented are the *Pandanaceae* which are common along streams and rivers. *Pandanus kaida* is a critically endangered species. With characteristic scandant habit, the predominantly cosmopolitan *Menispermaceae* have fair representation in the flora with 15 species in 10 genera. 'Maramanjil' (*Coscinium fenestratum*) and 'Padathali' (*Cyclea peltata*) are valuable medicines in Ayurveda. *Araliaceae* also have a similar scandant habit in many species of *Schefflera*. With 11 species in 4 genera, the family has a meagre presence including *Schefflera bourdillonii*, a rare plant endemic to the Agasthyarkudam-Tirunelveli region.

Malvaceae have 62 species belonging to 17 genera including several economically important plants, while *Apiaceae* (11 genera and 24 species) and *Gentianaceae* (8 genera and 32 species) have moderate diversity. With diverse edible fruits in a number of species *Citrus* is extensively cultivated in Kerala. The family *Rutaceae* has 30 species in 17 genera. Although without any diversity at the generic level, *Symplocaceae* are prominent by the presence of 10 species in one genus (*Symplocos*) while *Gesneriaceae* are better represented with 13 species belonging to 6 genera.

The diversity of the flora is further evident by plants or groups of plants which are peculiar in many respects. For example, *Lemna* (*Lemnaceae*) with two species represents the smallest flowering plant in Kerala. So is *Sciaphila janthina*

(*Triuridaceae*), a tiny but curious less known saprophytic herb with scale leaves, which has its relative (*S. khasiana*) in Assam. *Flagellaria indica* (*Flagellariaceae*) is another interesting plant in the estuaries.

The insectivorous plants belong to the *Droseraceae* and *Lentibulariaceae*. Twenty of the 35 species of *Utricularia* (Janardhanam & Henry, 1991) reported from India and 3 species of *Drosera* have been collected in the state. *Sarcandra chloranthoides* (*Chloranthaceae*), a primitive vesselless angiosperm, in undergrowth of evergreen forests further manifests the unique diversity of the flora. *Podostemaceae*, with most members presenting a thalloid appearance resembling an alga or bryophyte, are found submerged and attached to rocks in fast-flowing streams. There are 13 species in 9 genera indicating its maximum development (Mathew & Satheesh, 1997). Another interesting group of plants is those with defence mechanisms such as *Holigarna* spp. with blistering principles, *Laportea* spp. and *Tragia* spp. with stinging hairs.

The parasites are spread over different families. The *Loranthaceae*, a tropical and subtropical semiparasitic family, has attained its maximum development in the Malabar and Assam rain forests. The related *Viscaceae* exhibiting characteristic cryptic mimicry and hyperparasitism have 11 species out of the 19 reported from India of which *Viscum* alone has 10 species and *Korthalsella* one (Sanjai, 1999). *Santalaceae* have 4 species out of the 13 species in India including the commercial *Santalum album*. The broomrapes (*Orobanchaceae*) are also well developed with 13 species, 3 of *Aeginetia*, 4 of *Christisonia* and one of *Orobanche* (Anilkumar, 2000). The deeply coloured flowers with showy floral structures are next only to the orchids. *Convolvulaceae*, *Lauraceae*, *Olacaceae*, *Opiliaceae* and *Scrophulariaceae* also have parasites.

The *Eriocaulaceae*, is represented by the lone genus *Eriocaulon* with 30 species (Ansari & Balakrishnan, 1994). Sedges also show much diversity particularly in the genera *Cyperus* and *Fimbristylis*.

Gymnosperms: The gymnosperms are mostly evergreen woody plants and are very poorly represented in Kerala. Of the world's 750 species of living gymnosperms belonging to 53 genera, India has only 48 species and 10 infraspecific taxa belonging to 15 genera, and Kerala has just 5 species belonging to 3

genera. The only remarkable feature of the gymnospermous flora is the presence of *Negeia wallichiana* (= *Podocarpus wallichianus*), the only native conifer of Peninsular India. This species considered threatened till recently is now found in abundance in Goodrical Reserve Forest in the Ranni Forest Division (Nair, 1991). *Cycas circinalis* is common in deciduous forests while *C. revoluta* and *C. rumphii* are sometimes planted. Both species of *Gnetum* (*G. contractum* and *G. ula*) are evergreen climbers. These apart, a number of exotic species have been introduced into gardens as ornamental trees on hills.

Diversity of wild relatives of crop plants: Cultivated species are the result of a series of changes through human processes such as selection, diversification, spread and acclimatization. About 300 species have evolved as useful crops through these processes (Vavilov, 1951). These crops are related either distantly or closely to several members of a gene pool at different levels such as intervarietal, interspecific or intra-generic (Harlan & de Wet, 1971). Being one of the 12 main centres of origin of cultivated plants (Vavilov, 1951) India has a domesticated plant diversity of 152 species (Khoshoo, 1987). Rana (undated), however, considers India to be a centre of origin of 166 species of cultivated plants and estimated about 320 wild relatives.

The Western Ghats are one of the centres with maximum diversity in wild crop relatives (Velayudhan & al., 1991). Since these plants are the source of potential untapped genetic material valuable for plant breeders to augment the reservoir of gene pool for future utilization in breeding programmes, their preservation should receive adequate attention of conservation biologists. The NBPGR Regional Research Station at Thrissur is engaged in this job. It has a collection of 84 species belonging to 14 genera from different parts of Kerala (Velayudhan & al., 1991) including wild relatives of rice like *Oryza meyeriana* subsp. *granulata*, *O. officianalis* subsp. *malampuzhaensis* and *O. rufipogon*, many wild peppers, turmeric etc. Other genera present in the state which are wild genetic resources are *Alpinia*, *Amomum*, *Andropogon*, *Artocarpus*, *Atylosia*, *Canavalia*, *Cinnamomum*, *Cissus*, *Coffea*, *Cymbopogon*, *Dioscorea*, *Eleusine*, *Elettaria*, *Garcinia*, *Glycine*, *Ipomoea*, *Lansium*, *Mangifera*, *Momordica*, *Musa*, *Myristica*, *Nephelium*, *Panicum*, *Pennisetum*, *Phaseolus*, *Piper*, *Rauvolfia*, *Saccharum*, *Setaria*, *Vigna* and *Zingiber*.

Diversity of cultivated plants: Considerable diversity is found in the cultivated plants of Kerala although no proper documentation is available as yet. The major crops cultivated are cereals and millets, rice (*Oryza sativa*) is the major cereal cultivated extensively in all the districts from coastal plains to interior midlands. Palakkad District leads in the production of rice followed by Kuttanad area; others are cholam Jowar (*Sorghum vulgare*), makkacholam (*Zea mays*), ragi (*Eleusine coracana*), chama (*Panicum miliare*), tina (*Setaria italica*), kambu-bajra (*Pennisetum typhoides*) etc.

Pulses: Major pulses include pigeon pea thavarapparippu (*Cajanus cajan*), horsegram muthira (*Macrotyloma uniflorum*), blackgram uzhunnu (*Vigna mungo*), greengram cherupayaru (*Vigna radiata*), common pea/green pea (*Pisum sativum*), chick pea chundakadala (*Cicer arietinum*), thatappayar (*Vigna unguiculata* var. *cylindrica*) etc.

Vegetables: Common vegetables are broad beans (*Vicia faba*), kidney bean/French bean (*Phaseolus vulgaris*), brinjal kathirika (*Solanum melongena*), tomato thakkali (*Lycopersicon esculentum*), venda (*Abelmoschus esculentus*), muringa (*Moringa pterygosperma*), snake gourd padavalam (*Trichosanthes anguinea*), bitter gourd pavakkai (*Momordica charantea*), peechinga (*Luffa aegyptica*), mathan or poosani (*Cucurbita maxima*), elavan or kumbalam (*Benincasa cerifera*), vellari (*Cucumis sativus*), thannermathan (*Citrullus vulgaris*), avara (*Lablab purpureus*), vanpayar (*Phaseolus multiflorus*), valari (*Canavalia ensiformis*), churakka (*Lagenaria vulgaris*), agathikeera/Agasthya muringa (*Sesbania grandiflora*), chuvanna cheera (*Amaranthus* spp.) etc.

Tuber crops: Cheeni/madhura kizhangu (*Ipomoea batatas*), kurka (*Coleus parviflorus*), chena (*Amorphophallus campanulatus*), chembu (*Colocasia antiquorum*), kachil (*Dioscorea alata*), cheruvalli kizhangu (*Dioscorea esculenta*), kappakizhangu/maracheeni (*Manihot esculenta*), arrowroot koova kizhangu (*Maranta arundinacea*) are the common tuber crops.

Fruit yielding plants: More common are mavu (*Mangifera indica*), peraa (*Psidium guajava*), mathalam (*Punica granatum*), plavu (*Artocarpus heterophyllus*), anjili (*Artocarpus hirsutus*), seemaplavu (*Artocarpus communis*), oomakka (*Carica papaya*), purthi chakka pine apple (*Ananas comosus*), sa-

pota (*Manilkara zapota*), parankimavu cashew (*Anacardium occidentale*), seemakumbalam (*Passiflora quadrangularis*), panineerjamba (*Syzygium jambosa*), bilimbi puli (*Averrhoa bilimbi*), pulinchikka (*Averrhoa carambola*), lavallolikka love-love (*Flacourtia inermis*), arinelli/seemanelli (*Phyllanthus acidus*), nelli gooseberry (*Phyllanthus emblica*), atha (*Annona squamosa*), vilathi (*Annona reticulata*), ethakka/nendran (*Musa paradisiaca*), plum (*Prunus domestica*), passion fruit (*Passiflora edulis*), mangosteen (*Garcinia mangostana*), mandarin (*Citrus reticulata*) etc.

Oil yielding plants are thengu - coconut (*Cocos nucifera*), ellu (*Sesamum indicum*), nilakkadala/kappalandi (*Arachis hypogea*) restricted to Palakkad District), avanakku (*Ricinus communis*), jathikka (*Myristica fragrans*) etc.

Spices: The spices of Kerala played a significant role in world trade besides having a profound influence on its history and civilization. Pepper/ kurumulaku (*Piper nigrum*), a native of Malabar, was the most sought after spice. The name is derived from the Sanskrit word pippali (Purseglove & al., 1981). Kerala accounts for about 97% of the pepper produced in the country (over 38,000 tonnes in India) with a coverage of 11,84,100 ha.

Cinnamon/patta (*Cinnamomum verum*), a native of Sri Lanka, is also cultivated extensively in the state from ancient times. Nutmeg/jathikka (*Myristica fragrans*) also has a good coverage. It has two products the nutmeg (kernel of seed) and the mace (dried aril). Both are used in medicine. A native of the Moluccas, this plant is also extensively cultivated in the midlands.

Clove/grambu is the dried unopened flower buds of *Syzygium aromaticum*, indigenous to the Moluccas and was introduced into India about 200 BC. The Arabs and Portugese had it from Malabar which indicates that it was under cultivation in Kerala long ago.

Pimento or allspice (*Pimenta dioica*) is also occasionally cultivated in hills. The flavour resembles a mixutre of cinnamon, clove and nutmeg and hence the name. Also known as Jamaica pepper this plant is a native of the West Indies and Central America.

Chillies/chuvanna mulaku (*Caspicum* spp.), the most important contribution of America to spices, is not widely cultivated in Kerala.

Ginger/inchi (*Zingiber officinale*) is another major spice in the state. Its nativity is unknown and now nowhere is it known in the wild. India is the largest producer of ginger, the bulk of it being from Kerala. Kerala ginger is considered the best due to its lower fibre content, boldness and characteristic aroma and pungency (Purseglove & al., 1981). Nearly 60% of the cropped area in the country is in Kerala forming 90% of the export trade.

One of the most extensively cultivated spices cardamum/elakka (*Elettaria cardamomum*) is indigenous to the Western Ghats. It was one of the most important articles of Greek trade in the 4th century BC. Of the 45,000 ha. of the cropped area in Western Ghats 50% is in the Cardamom hills and the total production amounts to over 1055 tonnes.

Turmeric/manjal (*Curcuma domestica*) and coriander/kothamalli (*Coriandrum sativum*) are also cultivated. Recently many farmers in the state have taken to vanilla (*Vanilla planifolia*) cultivation.

Plantation crops: A major part of Kerala is covered by plantation crops. Rubber (*Hevea brasiliensis*) is the most important crop. Kottayam District has the largest rubber acreage in India. A native of the Amazon Valley in Brazil, rubber came to Kerala through Sri Lanka where it was first planted in 1875. Kerala now holds monopoly in natural rubber production in the country.

In terms of net value tea/theyila (*Camellia sinensis*) ranks second among cash crops of Kerala with about 41,358 ha. Most hill districts have tea plantations, Idukki being the largest grower. The first tea plant in Kerala was planted by A.H. Sharp in 1877 in Kannan Devan Hills in the High Ranges. The plantation has spread to over 11,736 ha. now. This might indicate the magnitude of clearing of forests within a century. Though not as extensively as tea, coffee (*Coffea* spp.) is also grown almost throughout Kerala.

Coconut (*Cocos nucifera*), the kalpakavirksha of Kerala, is the most extensively cultivated crop in the state. Its role in the routine life of Kerala, besides the state's economy, is so unique that no Keralite would like to live without it even for a day. The plant grows from coastal areas to about 915 m.

Other important plantations include mula (*Bambusa bambos*), kallanmula (*Dendrocalamus strictus*), etta (*Ochlandra travancorica*), ottal (*Ochlandra*

rheedei), teak/thecku (*Tectona grandis*), anjili (*Artocarpus hirsutus*), pongu/urup (*Hopea* spp.), cocoa (*Theobroma cocoa*), wattle (*Acacia* spp.), camphor (*Cinnamomum camphora*) etc.

Karimbu sugarcane (*Saccharum officinarum*), arecanut pakk/adakka (*Areca catechu* - total area about 88,633 ha.), cotton/paruthi (*Gossypium hirsutum*) restricted to 7,476 ha. in Palakkad District only) etc. are also cultivated.

Common fodder crops are beli karuka (*Cynodon dactylon*), inchipul (*Panicum repens*), muthanga (*Cyperus rotundus*), *Chloris barbata*, *Paspalum scrobiculatum*, *Echinochloa colona* etc.

The common hedge plants are *Pandanus* spp., *Opuntia dillenii*, *Euphorbia antiquorum*, *E. tirucalli*, *Ananas comosus*, *Sesbania grandiflora*, *Adhatoda vasica*, *Lawsonia inermis*, *Agave americana*, *Glyricidia sepium* etc.

More common avenue trees are *Ficus bengalensis*, *F. religiosa*, *Artocarpus heterophyllus*, *A. hirsutus*, *Tamarindus indica*, *Mangifera indica*, *Syzygium cuminii*, *Thespesia populnea*, *Lagerstroemia reginae*, *Calophyllum inophyllum*, *Albizia lebeck*, *Samanea saman*, *Pithecellobium dulce*, *Polyalthia longifolia*, *Azadirachta indica*, *Pongamia pinnata*, *Vateria indica* etc.

Lemon grass (*Cymbopogon citratus*) is cultivated in most districts. Kasaragod is the only district where tobacco (*Nicotiana tabacum*) is cultivated. Sarpagandhi (*Rauvolfia serpentina*) is cultivated on a commercial scale in Ernakulam District.

Major timber-yielding plants are teak (*Tectona grandis*), eetti rose wood (*Dalbergia latifolia*), anjili/ayani (*Artocarpus hirsutus*), plavu (*Artocarpus heterophyllus*), kadambu (*Haldina cordifolia*), ventekku (*Lagerstroemia lanceolata*), irul (*Xylia xylocarpa*), nangu - iron wood (*Mesua ferrea*), karimaruthu (*Terminalia crenulata*), poomaruthu (*Terminalia paniculata*), urup (*Hopea parviflora*), vellakil white cedar (*Dysoxylum malabaricum*), ebony (*Diospyros ebenum*), white damar (*Vateria indica*), venga (*Pterocarpus marsupium*), vakka (*Albizia lebeck*), kattupunna (*Calophyllum polyanthum*), vayila (*Poecilonueron indicum*) etc.

Phytogeography

The current distribution of the vegetal cover and physiography of the country in general and Kerala in particular are the reflections of the geological and climatic changes that occurred in the past. Several theories like continental drift, land-bridge, polar oscillations and permanence of oceans and continents (Polunin, 1960) have been put forward to explain the geological history and current distribution of plants. Though controversial, the most promising and plausible theory is the continental drift which convincingly explains the similarities of floristic (and faunistic) composition of continents which are widely separated now. India, according to this theory, was a part of Gondwanaland of the Southern Hemisphere along with South America, Australia, South Africa and Madagascar. After drifting away from this landmass, the Indian plate moved northeastwards pressing against the Asian mainland creating the folds of the Himalayas and other central Asian mountains. This was followed by the Ice Age resulting in the migration to and fro of plants of north and south. The similarity of the Indian flora with that of the above continents has to be viewed against this backdrop.

The first major effort to classify the world's flora dates back to 1823 when the Danish botanist J.F. Schouw divided the world into 25 major kingdoms and several provinces. The work done on this aspect later was briefly reviewed by Balakrishnan (1996) who also gave a broad outline of the latest classification of Takhtajan (1986). Kerala, according to this classification, falls under the Paleotropical kingdom which is one of the six major kingdoms with three subdivisions viz., Africa, Indomalasia and Polynesia. The Indomalasian subkingdom has three regions of which the first is the Indian region which in turn has three provinces. The Malabar province is the first of which Kerala forms a part.

Attempts were also made to phytogeographically classify the vegetation of India since 1855. Based on floristic composition, Hooker and Thomson (1855) and later Hooker (1904) divided the vegetation of India into nine botanical regions of which the state of Kerala comes under the Malabar region. Clarke's (1898) Malabarica, one of his 11 botanical regions corresponds to Hooker's Malabar and is based chiefly on climatology and distribution of Cyperaceous plants. All the contemporary or later classifications (Prain, 1903; Calder, 1937; Good, 1947; Turrill, 1953; Chatterjee, 1940, 1962; Razi, 1955; Puri, 1960; Maheshwari & al., 1965),

though based on different criteria, invariably included Malabar as a separate botanical region. Based on endemic elements, Subramanyam and Nayar (1974) subdivided the Western Ghats into four regions. Gadgil and Meher-Homji (1986a), on the other hand, considered the vegetation types and their distribution as the main criterion and recognised 40 biogeographic zones which contain eight major vegetation types of the Western Ghats including Kerala. Udvardy (1975) classified the Indian subcontinent into 12 biogeographic regions in which Kerala falls under the Malabar rain forests.

The most comprehensive of them appears to be the ecosystemic classification of Rodgers and Panwar (1988) who grouped Indian natural habitats into ten major biogeographic zones based on their species composition and geographic distribution. These zones are divided into biotic provinces distinguished by their species composition. Some of the larger provinces are further divided into biogeographic regions which are again grouped into a set of biomes. The same biome may be present in different biogeographic zones as is the case with the evergreen rain forest biome in the Western Ghats, Northeast India and the Andaman & Nicobar Islands.

The latest phytogeographic classification of the Indian flora is that of Balakrishnan (1996) who divided the country into 11 phytogeographic regions. Kerala comes under the 8th zone *viz.*, Southern-Western Ghats, South-West Coast and Lakshadweep.

The Western Ghats being an important biogeographic region and one of the 25 hotspots (Mittermeier & al., 1998) in the world are also the confluence of the Afro-tropical and Indo-Malayan biotic zones. Hence, India shares floristic elements of both Afro-tropical and tropical-Asian regions besides a large concentration of endemics (*vide* Endemism and vicariance). However, the Western Ghats have a closer affinity with the Indo-Malayan realm. Bourdillon (1908) in his *Forest trees of Travancore* observed, "Travancore has many species which greatly resemble but are very different from the species found in the Malayan peninsula which has a similar climate"

The predominant Indo-Malayan affinity in the flora of the Western Ghats was discussed by some other authors too (Razi, 1955; Subramanyam & Nayar,

1974; Nair & Daniel, 1986). Legris and Meher-Homji (1977) analysed the forests of Kerala and found that the evergreen forests have 26%, semievergreen forests 31% and deciduous forests 30% of Indo-Malayan affinity. A recent study by Suresh and Sukumar (1999) on the phytogeographical affinities of the Nilgiri Biosphere Reserve, part of which is in Kerala, further substantiates this view.

The Indo-Malayan affinity of the flora is evidenced by the presence of *Acacia procera*, *Acrocarpus fraxinifolius*, *Albizia chinensis*, *Aglaia* spp., *Antiaris toxicaria*, *Aphanamixis polystachya*, *Azadirachta indica*, *Bauhinia racemosa*, *Bischofia javanica*, *Bombax ceiba*, *Butea monosperma*, *Capparis zeylanica*, *Canthium dicoccum*, *Cassia fistula*, *Celtis tetrandra*, *Cleidion spiciflorum*, *Chukrasia tabularis*, *Dalbergia latifolia*, *Dendrocnide sinuata*, *Dillenia pentagyna*, *Diospyros montana*, *Elaeocarpus tuberculatus*, *Eurya nitida*, *Ficus nervosa*, *Glochidion zeylanicum*, *Gmelina arborea*, *Gomphandra tetrandra*, *Ixora nigricans*, *Lagerstroemia reginae*, *Mesua ferrea*, *Mallotus philippensis*, *Maytenus emarginata*, *Melicope lunuankenda*, *Morinda* spp., *Naringi crenulata*, *Neolitsea zeylanica*, *Ophiorrhiza mungos*, *Polygonum chinensis*, *Pothos scandens*, *Prunus zeylanica*, *Radermachera xylocarpa*, *Sida* spp., *Strychnos potatorum*, *Terminalia bellirica*, *Xylia xylocarpa* etc.

Those with common distribution in the Indo-Chinese and Malayan regions include species of *Acrotrema*, *Garcinia*, *Goniothalamus*, *Haldina*, *Hedyotis*, *Knoxia*, *Lasianthus*, *Litsea*, *Medinella*, *Myristica*, *Neolamarckia*, *Persea*, *Terminalia*, *Tetracera*, *Uvaria* and *Xylia*.

The intertropical flora is chiefly represented by trees and shrubs, the Dipterocarpaceous trees being very predominant. This tropical Indomalaysian family has some species exclusive to Kerala particularly in the genera *Dipterocarpus*, *Hopea* and *Vateria*. Ramesh and Pascal (1991) studied the distribution of 13 species of the *Dipterocarpaceae* in the Western Ghats of which 12 are endemics. *Dipterocarpus bourdillonii* and *D. indicus* are dominant in low level evergreen forests (below 700 m) of southern Kerala and the former shows disjunct distribution while the latter is widely and evenly distributed. Similarly *Vateria indica* has a wider distribution compared to *V. macrocarpa* which is restricted to Palakkad. *Hopea* has 8 species with 2 centres of speciation viz., Kalakkad Travancore and Malabar (Coorg South Kanara).

The mangrove constituents of the intertropical flora are found in the predominately African *Avicenniaceae* (*Avicennia*), *Rhizophoraceae* (*Bruguiera*, *Carallia* and *Rhizophora*), *Sonneratiaceae* (*Sonneratia*) and the endemic *Blepharistemma serratum* along backwaters.

The subtropical and extratropical elements are found usually at higher elevations. The best example is the *Asteraceae* represented by high altitude genera like *Anaphalis*, *Bidens*, *Blumea*, *Centipeda*, *Conyza*, *Dicrocephala*, *Galinsoga*, *Gynura*, *Helichrysum*, *Laggera* etc. The tree forms of *Vernonia* are *V. monosis* and *V. travancorica*. *Myrtaceae* with several endemics in the genera *Eugenia* and *Syzygium*, the poorly represented *Magnoliaceae* with cultivated *Michelia champaca*, the *Theaceae* with the discontinuously distributed (tropical Asia and tropical America) and widely cultivated *Camellia sinensis*, *Oleaceae* with the abundant *Olea dioica* of the deciduous forests and *Jasminum* spp. are the other representations.

Plants with a wide range of distribution which tend to be indifferent to environmental conditions are the wides or panendemics. The cosmopolitan families in the flora are represented by the *Arecaceae*, *Convolvulaceae*, *Euphorbiaceae*, *Fabaceae*, *Malvaceae*, *Menispermaceae*, *Moraceae*, *Poaceae*, *Polygalaceae*, *Rubiaceae*, *Rutaceae*, *Scrophulariaceae*, *Sterculiaceae*, *Thymeliaceae*, *Tiliaceae* and *Violaceae*. Weeds of cultivated fields belonging to the above families are the major cosmopolitan elements besides some from the cryptogams also.

Pantropics are represented by the *Agavaceae*, *Anacardiaceae*, *Annonaceae*, *Apocynaceae*, *Bignoniaceae*, *Burseraceae*, *Chrysobalanaceae*, *Combretaceae*, *Clusiaceae*, *Elaeocarpaceae*, *Myristicaceae*, *Simaroubaceae*, *Verbenaceae*, etc.

Tropical Asiatic and Australian elements in the flora include *Diospyros montana*, *Helicteres isora*, *Mallotus philippensis*, *Syzygium cuminii* and *Toona ciliata*.

The Northeast Asiatic families are *Cornaceae*, *Dipsacaceae*, *Elaeagnaceae*, *Olacaceae* and *Oxalidaceae* while Southeast Asia is represented by the *Clusiaceae* and *Gesneriaceae*.

The Indo-African affinity is manifested in the genera *Albizia*, *Acacia*, *Alstonia*, *Cryptostegia*, *Euphorbia*, *Erythralium*, *Geissaspis*, *Grewia*, *Pedaliium*, *Tamarindus*, *Withania* etc. Of the 139 species of the tribe Andropogoneae of the *Poaceae*, 52 species occur in India and Africa (Mehrotra & Jain, 1982)

The Indo-Pak representation is very little. These are *Cordia obliqua* and species of *Glochidion* etc. The Sino-Himalayan affinity of the flora is exemplified by the presence of *Rhododendron* in the High Ranges and *Pittosporum* spp. besides other temperate Asiatic elements of the *Ranunculaceae* and *Rosaceae*.

Clematis, *Viburnum*, *Rubia*, *Anaphalis*, *Senecio* etc. are the temperate European elements. A large assemblage of *Impatiens* species in the High Ranges may show the East Himalayan and Myanmar affinity. About 57 species of orchids are common to Peninsular India and the Himalayan regions (Joseph & Rao, 1981). Most of them are present in Kerala too.

The tropical and subtropical American representation in the flora is seen in *Schumannianthus virgatus* which is gregarious in undergrowth in moist forests besides several cultivated plants and weeds like species of *Eupatorium*, *Lantana*, *Parthenium* etc. *Eriocaulaceae* are another South American representation.

The scarcely represented Mediterranean elements in the flora belong to the *Brassicaceae* and *Caryophyllaceae* while *Jasminum* and *Diospyros* are Sino-Japanese entries into Kerala. The Arabian influence is found in *Acacia*, *Heliotropium* and *Dodonaea*.

The flora of Kerala shows striking similarity to that of Sri Lanka. There are 27 genera endemic to peninsular India and Sri Lanka (Nayar & Ahmedulla, 1984). Indo-Lankan species found in Kerala are *Acacia chundra*, *Alseodaphne semecarpifolia*, *Ailanthus excelsa*, *Anogeisus latifolia*, *Andrographis zeylanica*, *Anodendron rhinosporum*, *Casearia ovata*, *Careya arborea*, *Cayratia pedata*, *Chloroxylon swietenia*, *Clausena indica*, *Cissus heyneana*, *Dalbergia lanceolaria*, *Diospyros paniculata*, *D. sylvatica*, *Eria muscicola*, *Exacum walkeri*, *Fagraea ceylanica*, *Ficus arnottiana*, *F. tsjakela*, *Filicium decipiens*, *Garcinia rubroechinata*, *Glyptopetalum zeylanicum*, *Hydnocarpus alpina*, *Hunteria zeylanica*, *Indigofera constricta*, *Isonandra lanceolata*, *Lanea*

coromandelica, *Macaranga peltata*, *Myristica dactyloides*, *Meliosma simplicifolia*, *Miliusa indica*, *Paracroton pendulus* subsp. *zeylanicus*, *Phaius luridus*, *Persea macrantha*, *Polyalthia coffeoides*, *Premna tomentosa*, *Pseudaida speciosa*, *Pterocarpus marsupium*, *Rapanea wightii*, *Rubus micropetalus*, *Sapindus emarginatus*, *Sterculia guttata*, *Strychnos potatorum* and *Syzygium gardneri*.

Those restricted to peninsular India and Sri Lanka are *Ampelocissus indica*, *Aporusa acuminata*, *A. lindleyana*, *Artabotrys zeylanicus*, *Capparis brevispina*, *C. moonii*, *Cissus discolor*, *C. glyptocarpa*, *C. heyneana*, *Cyathocalyx zeylanica*, *Garcinia splcata*, *Gouania microcarpa*, *Hedyotis nitida*, *Hypericum mysurense*, *Ischaeum zeylanicum*, *Mesua ferrea*, *Miliusa indica*, *Naravelia zeylanica*, *Neurocalyx calycinus*, *Polyalthia korintii*, *Syzygium caryophyllatum*, *S. lanceolatum*, *Tarenna asiatica*, *Tephrosia hookeriana*, *T. pulcherrima*, *T. tinctoria*, *Thottea siliquosa*, *U. narum* and *Ziziphus xylopyrus*.

The flora of Kerala also shows close affinity with those of Northeast India and the Eastern Ghats. Arora (1964) observed that 98 families of the woody dicotyledons are common to Assam and the Western Ghats.

Endemism and vicariance

A concept introduced by De Candolle, the endemics are those taxa whose distribution is confined to a restricted area due to their narrow ecological preference. Endemic area is the area of a taxon that its distribution is limited to single natural region. Determination of the proportion of endemics and their classification in a flora is the most important exercise in vegetation analysis besides a detailed study of the vicarious elements. This is particularly useful in indicating antiquity, isolation and diversification of the habitat.

Endemism in Indian flora has been discussed by several authors (Chatterjee, 1940; Rao, 1972; Blasco, 1971; Nayar, 1980a, 1980b, 1996). More recent and perhaps the most comprehensive work seems to be that of Ahmedullah and Nayar (1987) who estimated that there are 141 endemic genera within the present political boundaries of India in which 58 belonging to 25 families are confined to peninsular India. Of the 58 genera 49 are from the Western Ghats (Nayar, 1980a,

1980b). On the contrary, Nair (1991), after a thorough analysis of recent taxonomic findings made a modest estimate of 51 genera for the Western Ghats of which 43 are unispecific. A majority of the 1932 species endemic to peninsular India are also present in the Western Ghats. Vajravelu and Vivekananthan (1996) enumerated 35 endemic genera from the Southern Western Ghats, of which 11 extend up to Goa as well, of which 21 are unispecific. They also provided a list of 27 genera common to peninsular India and Sri Lanka besides analysing the endemism at familial level. Of the 27 genera 20 occur in the Western Ghats of Kerala as well.

Basha and Nair (1991) also enumerated the endemic genera and their species from the Western Ghats/Peninsular India with information on habit and distribution. Endemism in the Western Ghats being a fascinating subject in the recent past, taxonomists/ phytogeographers have brought out very valuable information for setting priorities for conservation. A recent study by Ramesh and Pascal (1991) reveals that 63% of the trees of both low and medium level evergreen forests of the Western Ghats are endemics. This high level of endemism coupled with its tremendous biological diversity have qualified the Western Ghats as one of the 25 hotspots in the world (Mittermeier & al., 1998). This is due to its characteristic geographically isolated position from other moist formations and peculiar bioclimate which led to the development of several vicarious species which are closely related but occupying geographically, altitudinally and ecologically different areas. These vicarious species finally develop into endemics. Some of the common examples are *Diospyros assimilis* in moist forests and *D. ebenum* in dry forests, *D. pruriens* is replaced by *D. saldanhae* in drier areas, *Vernonia monosis*, a widely distributed tree, is replaced by *V. travancorica* in Travancore (Ramesh & Pascal, 1997). *Garcinia*, *Dipterocarpus*, *Humboldtia*, *Hydnocarpus* and *Vateria* are other examples showing vicariance.

Some species are restricted to very narrow geographical areas probably due to their antiquity or habitat specificity. They are in most cases highly prone to extinction. The best example of such a local endemic is *Paphiopedilum druryi* which is exclusive to the mountain tops of Agasthyarkudam in the Southern Western Ghats.

Except for some sporadic reports on the endemic plants of certain areas/

families, no comprehensive attempt appears to have been made to study the endemics of the whole of Kerala. Henry & al. (1984) estimated 150 endemics for Agasthyamalai area including Tirunelveli. Binoy & al. (1991) recorded 51 endemics for the same area. The first attempt to compile an exhaustive list of species endemic to Kerala was made by Singh and Subramanian (1991) who estimated 108 endemics. They further classified these into three different regions each at three different altitudes. Accordingly, there are 25 endemic species in North Kerala of which 4 are distributed in upper ghats, 17 in middle ghats and 4 in lower ghats including plains. Of the 29 species present in central Kerala, 11 are found in upper ghats, 8 in middle ghats and 10 in plains. Southern Kerala has comparatively more endemics there are 61 endemics of which 10 are confined to upper ghats, 28 to middle ghats and 22 to lower ghats and plains. Basha and Nair (1991) provided a more exhaustive list which contains 115 endemic species. Nair and Basha (1995) added a few more to this list. Mohanan and Nair (1999) also gave a list of species with approximate localities/regions of their occurrence. The most magnificent work on this aspect is that of Ramesh and Pascal (1997) who compiled an *Atlas of the endemics of Western Ghats (India)* which contains distribution maps for 352 species of the Western Ghats most of which are from Kerala.

As for endemism at familial or generic level *Acanthaceae* and *Poaceae* rank first with 6 endemic genera each followed by *Periplocaceae* with 3. *Asteraceae*, *Podostemaceae* and *Apiaceae* have 1 endemic genus each. The arborescent endemic genera in Kerala include *Blepharistemma*, *Meteoromyrtus*, *Otonophelium* and *Poeciloneuron* of which the first three are unispecific. In species content, the families *Poaceae*, *Rubiaceae*, *Acanthaceae*, *Orchidaceae* and *Fabaceae* have the largest representation of endemic taxa.

Karthikeyan (1982) estimated 13 genera and 155 species of endemic grasses for Peninsular India, a majority of them being found in Kerala also. Sreekumar and Nair (1991) listed 37 endemic species from Kerala belonging to 14 genera which is about 11.8% of the total number of grasses in the state. Ramesh and Pascal (1991) discussed the distribution of the endemic arborescent evergreen species in the Western Ghats including Kerala with special reference to ecological, edaphic and anthropogenic factors responsible for their endemism. Sanjappa (1991) enumerated 80 endemic Leguminous taxa from the Western

Ghats of which only 16 are exclusive to Kerala. Jain and Ved Prakash (1995) studied the phytogeography and endemism of the Indian *Zingiberaceae* which is comparatively poor in endemic concentration. The *Orchidaceae* have a high percentage of endemism. Of the 267 taxa recorded from the Western Ghats, 111 are endemic with most of them occurring in Kerala. The *Araceae* have 69 taxa endemic to India in 13 genera of which 46 are endemic to Peninsular India and 12 to Kerala (Sasikala, 2000). Among the other families *Balsaminaceae* has the highest with 14 endemics followed by the *Rubiaceae* with 10.

Most endemics of the Western Ghats including Kerala are considered to be paleoendemics which had a wider distribution in the past but are now restricted to certain localities like mountain tops. Neoendemics are less. It is because they are more aggressive. Species of *Impatiens* in the High Ranges are neoendemics (Nair, 1991) whereas *Buchanania lanceolata*, *B. barberi*, *Cynometra beddomei*, *Dipterocarpus bourdillonii*, *Hopea parviflora*, *Syzygium travancoricum*, *Vateria indica* etc. are some of the paleoendemics. Agasthyarkudam-Tirunelveli region, Anaimudi and its neighbourhood and the Silent Valley - Wynad - Nilgiri junction are the three major areas with maximum concentration of endemics.

Threats and vulnerability

Population pressure coupled with technological innovation of the modern age has drastically changed the harmony between biological and cultural diversity that existed in the past. This has led to the depletion of vast natural resources on earth, the bulk of which being the tropical forests which are regarded as the richest and most diverse biomass on earth. Mayloard (1980) estimated a loss of about half of the world's woodland forest areas which is about 20-50 million acres on a global basis since 1952. About 2,00,000-2,50,000 km² of primary tropical rain forests are subjected to various types of threats (Myers, 1980). According to a recent estimate of FAO (Anon., 1993a) 15 million ha. of tropical forests are lost per annum. The Indian scenario is no exception to this phenomenon. By 1975 about 63.3% of the tropical rain forests in India, Myanmar and Sri Lanka had been lost.

Of the 38,863 km² area of Kerala, 22,800 km² is hilly terrain and had been completely covered forests till recently. About 35,000 km² of forest land was

diverted for non-forestry purposes chiefly plantations (1319 km²) between 1940 and 1970 reducing the forest cover to 9,400 km². There was a slight increase in 1991 (10,292 km²) and 1993 (10,336 km²) (Anon., 1993). This increase is probably due to the increase in plantations to 1701/ km² (Sharma, 2003). In 1991 there was again a slight decrease of 11 km² in the total forest cover (Anon., 1999) but when considered districtwise, Kannur, Kozhikode and Wynad accounted a slight increase of 6 km² while Kottayam and Kollam registered a decrease of 6 and 1 km² respectively. However, there was a decrease of 25 km² of dense forests during this period making the total densely forested area to 8,454 km² which is about 28.37%. The destruction and resultant habitat loss was due to various factors - natural or man-made. These factors which are hostile to the very existence of life on earth are termed threats.

Threats are generally classified into five major categories. 1. Destruction or modification of habitats 2. Over-exploitation for commercial, scientific and educational purposes 3. Diseases 4. Inadequate regulative mechanisms and 5. Other factors. Many of the 22 threats listed by the Threatened Plant Committee of the IUCN are not applicable to Kerala.

Destruction or modification of habitats is due to various biotic factors such as grazing, farming, forestry operations, pollution, industrialization and urbanization, construction of roads, dams, buildings, tourism, mining/quarrying, fires, and effect of aliens on the natural habitats.

As mechanised farming is uncommon in the state, the farming community mostly depend on cattle which are set free for grazing in the adjacent forests. The local people usually depend chiefly on forests for their fuel-wood which is also traded in urban and rural areas.

Plantations of tea, coffee, teak, rubber etc. are raised by clearing vast areas of forest lands. About 1,701 km² of the land in the state is now under plantation crops (Sharma, 2003) of which 3/4 of the area is under teak and *Eucalyptus*. Added to this is the rubber plantation covering a large portion in the mid-land. Adding other crops like cashew, pepper, arecanut, coconut, tapioca and rice, about 60% of the total land area is under agriculture. Most of these areas were developed at the cost of virgin forests. Vast areas of forest lands have also been utilized for forestry operations including monoculture of *Eucalyptus*, *Pinus*, *Acacia*,

oil palm etc by the Forest Department. All these together resulted in the large scale shrinkage of habitats besides several other consequences like floods, drought, fire, soil erosion, siltation etc.

Tribal settlements in different parts of the forests also contribute largely to the destruction of the natural vegetation. Slash-and-burn cultivation, though not very common among all the tribals, may not only affect the nutrient level of the soil but also cause soil erosion and plant succession by way of competition from weeds.

Another important factor which depletes biological diversity to a considerable extent is pollution. Unwise use of pesticides in agricultural fields and untreated effluents released from various industries cause a serious threat to the existence of plants. There are 58,365 industrial establishments in Kerala. Most of them are located in Ernakulam and Kottayam Districts.

Azis and Nair (1981) consolidated the information on major industries, quality of water and nature of pollutants discharged into the major rivers of Kerala.

Construction activities are another major threat to biodiversity in the state. There is a tremendous demand for land due to the high density of population. Consequently construction of buildings, roads etc. are very rapid. Added to this are the construction of dams for irrigation and hydroelectric power. There are 44 major dams in Kerala under different irrigation and power projects. The major power projects are Pallivasal, Sengulam, Neriya Mangalam, Panniar, Perinjankutty, Edamalayar, Lakshmi Scheme, Mananthavady, Barathapuzha, Idukki, Sabarigiri, Peppara etc.

Important irrigation projects include Neyyar, Peppara, Kallada Valley, Pamba Irrigation Scheme, Aruvikkara, Periyar Valley, Chalakkudi River Division Scheme, Malampuzha, Walayar, Mangalam Project, Chitturpuzha Project, Pothundy, Attapadi, Kuryarkutty-Karappara etc. Vast stretches of virgin forests have been submerged besides causing several other disastrous consequences due to the construction of these dams such as degradation of soil, water-logging, earthquakes etc. Nayar and Nair (1985) studied the environmental impact of the multipurpose river valley project at Idukki which reflects the many adverse consequences usually caused by major dams.

Logging in natural forests not only alters their physiognomy but also damages plants in the lower strata. The implications of selective felling of trees on the epiphytic flora was stressed by Nair and Daniel (1986).

The forests are also over-exploited by many plant based- industries such as paper, plywood, cane etc. These industries mostly consume soft-wooded trees, bamboos, rattans besides timber-yielding trees. That Kerala used to export rose wood to the tune of 10,000 cu.m. in the 1970s and that now it is very difficult to procure even a few hundred cubic metres for domestic wood industries may point to the gravity of the situation (Viswanadhan, 1991). White cedar (*Dysoxylum malabaricum*) is another over-exploited tree.

Many botanically curious plants like *Equisetum* spp., *Gnetum ula*, *Helminthostachys zeylanica*, *Osmunda regalis*, *Psilotum nudum*, *Utricularia* spp. etc. have been over-collected from the wild for either scientific or educational purposes. The rhizomes of *Helminthostachys zeylanica* (*Ophioglossaceae*) locally called 'pazhutharakali' as it resembles 'pazhuthara' (centipede) is sold at Rs. 30/kg. These species have now become very rare.

Of comparatively recent origin are threats like unplanned tourism and rapid urbanization. About 65 tourist centres spread over the entire length of Kerala attract both inland and foreign tourists. Many of these centres such as Ponmudi, Neyyar (Thiruvananthapuram District), Pamba-Sabarimala (Pathanamthitta), Periyar, Thekkady (Kottayam District), Anaimudi (Idukki District), Parambikulam, (Thrissur District), Malampuzha, (Palakkad District), Bhradhagiri (Kannur District) etc. are located in hilly areas amidst thick forests. These forests are subjected to severe biotic interference every day.

Species which are subjected to natural threats are those with narrow geographical distribution (endemicity), narrow habitat preference and highly patchy distribution and those which are sparse wherever they occur due to very low colonising abilities, mating systems etc. Many species that are handicapped by the above factors occur in the state.

Native species are also subjected to severe competition from alien weeds which spread rapidly. Those that pose severe threat are *Chromola odorata*, *Lantana camara*, *Mikania cordata*, *Parthenium hysterophorus* and the aquatic

Eichhornia crassipes, *Salvinia molesta* etc. The above mentioned threats are to be taken into account when conservation strategies are formulated.

Rare and threatened plants

Rare and/or threatened plants are those encountered only in traces at specific sites in their natural habitats for the past 50 years (Leucas & Syngé, 1978; Syngé, 1981). They are species that occur in widely separated small populations so that interbreeding between them is restricted (Drury, 1980). These are extinction-prone and urgent remedial measures are to be adopted. Consolidation of information on localities/niches, population size, breeding systems and present status of rare taxa identified is of paramount importance for formulating effective conservation strategies.

Information on rare and threatened species of the state is scattered in several reports (Henry & al., 1979; Jain & Sastry, 1980; Raghavan & Singh, 1983; Vajravelu, 1983; Vajravelu & Daniel, 1983; Nayar & Sastry, 1987, 1988, 1990). Sreekumar and Nair (1991) listed 19 rare grasses from Kerala. Of the 50 rare and threatened legumes reported from India (Sanjappa, 1991), 20 occur in Kerala. About 75 species of aroids are reported to be threatened (Sasikala, 2000). Binoy & al. (1991), Sasidharan (1991), Joseph (1991), Shetty and Vivekananthan (1991), Renuka (1991), Sathishkumar (1991), Kumar (1991), Mohanan and Nair (1997) etc. are the other important contributions to our knowledge on such species. Forty one papers on the rare/endangered and endemic plants of the Western Ghats presented during a symposium at Thiruvananthapuram in 1991 was compiled by Karunakaran (1991). Manoharan & al.'s. (1999) is another important contribution.

Protected areas and conservation strategies

That the state had a deep-rooted tradition of conservation in its civilization from the early hunting-gathering days is well manifested in the small 'serpent groves' still extant amidst thickly populated villages. With time, however, the conservation ethics also changed from the ancient Keralites' mythological concepts in sacred groves to a clear awareness of nature conservation of the modern Keralites to ensure their own well-being. Furthermore, there is also a marked shift in the earlier 'single species targeted' concept in conservation to a broad concept of

conserving biological diversity.

In Kerala there are two biosphere reserves, three national parks and twelve wildlife/bird sanctuaries.

1. Biosphere reserves:

a) **Agasthyamalai Biosphere Reserve:** A total of 1701 km² in the Western parts of the Agasthyamalai in Kerala region was designated as the 13th biosphere reserve in this country on 12th Nov. 2001 (Anon., 2002–2003). The area includes the wildlife sanctuaries of Neyyar and Peppara in Thiruvanthapuram and Shendurunny in Kollam Districts. The areas in Thiruvananthapuram Districts coming under this biosphere reserve was earlier proposed for a biological park viz., Agasthyavanam Biological Park. This area has moist deciduous and ever-green forests with remarkable diversity of flora and fauna, plenty of water resources and excellent scope for afforestation.

Named after the magnificent Agasthyarkudam peak (1869 m), this Biosphere Reserve aims at, among other things, eco-restoration, afforestation and conservation. The flora of this region was studied by Joseph and Chandrasekaran (1982), Mohanan and Henry (1994) and Mohanan and Sivadasan (2002).

b) A part of the **Nilgiri Biosphere Reserve** is in Kerala (*vide* under National parks).

2. National parks:

a) **Silent Valley National Park:** Forming a part of the core zone of the Nilgiri Biosphere Reserve the Silent Valley National Park is situated in the Northeast corner of Palakkad District adjacent to the Nilgiris. The Sirandhri vanam of the Mahabharatha is traversed by river Kunthi, another name related to the Mahabharatha. The proposal to construct a dam across the Kunthi was shelved due to the widespread protest from conservationists and naturalists all over the country. Recognizing the inexplicably unique forests and biodiversity, the area comprising 90 km² in the valley of the Kunthi was declared a national park. The area possesses dense tropical rain forests harbouring 1104 species of flowering plants in 592 genera belonging to 134 families of which 392 are endemics with 15 species exclusive to the valley; 106 species are either rare or threatened (Anon.,

2003). These apart, the valley also contains several species of wild animals including the endangered lion-tailed macaque (*Macaca silenus*) and preserves its pristine glory due to its remoteness and inaccessibility.

b) Periyar National Park: The most popular tourist centre in Kerala, this park lies surrounding the 26 km² Periyar reservoir near Kumili in Idukki District. The total area of the park is 777 km². One of the oldest wildlife sanctuaries in the state, it was established by Shri. Chithirathirunal, the Maharaja of Travancore, in 1934. This was later declared as a tiger reserve in 1978 and recently a national park. The area has tropical evergreen, moist deciduous and riverine forests. The best game sanctuary in the state to see nature in her virginal beauty, this park attracts a large number of tourists every day. The rich floristic diversity consists of 1985 species of flowering plants in 824 genera belonging to 151 families of which 515 are endemics with 5 species exclusive to the park and 150 rare or threatened (Sasidharan, 1998).

c) Eravikulam National Park: This is the only protected area exclusively for shola vegetation, another one in the Western Ghats being the Mukurthy National Park in Tamil Nadu. This park is located in the Eravimala Plateau of the High Ranges in Idukki District. The area has vast stretches of montane grasslands intermixed with sholas besides a rich fauna. The average altitude is 2224 m and the total area is around 60 km². Also known by the name Hamilton Plateau, this is one of the least disturbed areas holding probably half of the world's Nilgiri tahr (*Hemitragus hylocrius*) population, a critically endangered species (Schaller, 1970). Shetty and Vivekananthan (1971, 1972, 1973) made extensive studies on the flora of this area.

3. Wildlife sanctuaries

a) Neyyar Wildlife Sanctuary: Situated at the southeast corner of the southernmost part of the Western Ghats, this sanctuary lies in the drainage basin of the Neyyar river and its tributaries Mullayar and Kallar. Covering an area of 128 km² this has as its eastern parts the Agastyarkudam (1869 m), the southernmost towering peak in the Western Ghats associated with the legendary Agastya who is believed to have a pioneering role in bringing the culture of the north to the south. Sixty km² of the total area is marked as core zone which comprises varied

natural vegetation supporting several rare/endemic species of plants and animals, the most prominent being the only lady's slipper orchid, *Paphiopedilum druryi*. The sanctuary also has a lion safari for the tourists besides boating facilities and a crocodile farm. The floristics of the area was dealt with by various authors.

b) **Peppara Wildlife Sanctuary:** Established in 1983 this sanctuary is situated in Nedumangad Taluk of Thiruvananthapuram District enclosing the Peppara reservoir. It has a total area of 53 km² of which 32 km² forms the core. The area possesses a complex and diverse vegetal cover including tropical and subtropical evergreen forests and preserves an ideal gene pool of endemics of the Agasthyamalai-Tirunelveli belt in the Southern Western Ghats. Chemungi (1717 m) at its eastern border is the type locality of several species and is a known centre of speciation. The sanctuary is drained by the Karamana river and its tributaries Thodayar, Kaviyar and Attayar.

c) **Shendurney Wildlife Sanctuary:** Owing its name to chenkuringi (shendurney *Gluta travancorica*), this sanctuary lies on either side of the Shendurney river north of the Kulathupuzha Valley and separated from it by the Churuttumoola ridge. Of the total area of 100 km² about 45 km² has very dense forests with great diversity. The only sanctuary in Kollam District and established in 1984, it has many inaccessible peaks, Alvarakurichi (1550 m) being the highest. It also encloses the Parappar and Thenmala reservoirs. The Palaruvi waterfalls which is a well-known picnic spot is on its northern fringe and on the east is located the tourist resort Courtallam in the adjoining Tamil Nadu. A total of 951 species belonging to 581 genera in 118 families occur here of which 310 are endemics and 100 rare or threatened. Five species are exclusive to this area (Sasidharan, 1997).

d) **Idukki Wildlife Sanctuary:** Spread over the undulating terrain with lofty hills and precipitous slopes in Thodupuzha and Udumbanchola Taluks of Idukki District, this sanctuary encloses the man-made lake of 33 km², formed by the construction of Kulamavu, Cheruthony and Idukki dams. It has an area of 77 km² and the altitude ranges from 450 - 746 m, the highest being the Kizhachelachi mala (1476 m). The sanctuary has tropical wet evergreen, southern tropical semievergreen, southern tropical moist deciduous, and south Indian subtropical hill forests. The vegetation of these areas was studied by Shetty and Vivekananthan

(1968, 1969, 1970, 1971, 1972, 1973, 1975, 1981, 1991).

e) **Chinnar Wildlife Sanctuary:** This is another sanctuary in Devikulam Taluk of Idukki District and was established in 1984 with an area of 90.44 km². Located in the rain shadow region of the Western Ghats, it is noted as the second largest habitat for the endangered giant grizzled squirrel (*Ratufa macroura*) in the country. Spread over 422 km² from scrub jungles in the lower reaches to deciduous and shola forests and grasslands in an undulated rocky terrain with an altitude varying from 500–2400 m, this sanctuary has only 48 rainy days in a year with a mean annual rainfall of 100 mm. The uniqueness of the sanctuary is that within a small area almost all types of forests of the Western Ghats can be seen. A total of 961 species of angiosperms in 582 genera belonging to 135 families have been recorded of which 175 species are endemics with only one species exclusive to the area and 26 rare and threatened plants (Sasidharan, 1999).

f) **Chimmony Wildlife Sanctuary:** Situated in Mukundapuram Taluk on the western slopes of Nelliampathi in Thrissur District, this sanctuary with an area of 1000 km² is surrounded by hills which were once owned by the Maharaja of Kochi and leased out to private parties. Over-exploitation for timber for a century (1800 to 1900) has adversely affected the vegetation. However, a large area of this sanctuary still has thick vegetation of evergreen and moist deciduous forests with a variety of fauna. Established in 1984, this sanctuary is noted for wildlife tourism.

g) **Peechi-Vazhani Wildlife Sanctuary:** Established in 1958 this sanctuary is contiguous with the Nelliampathy and Palapalli Reserves and shares a common boundary with the Chimmony Wildlife Sanctuary in the south. Stretching over 125 km² in an undulating terrain between 45 and 900 m altitudes this sanctuary receives heavy rainfall (3000 mm). The highest peak within the sanctuary is Ponmudi (923 m). It encloses the reservoirs of Peechi and Vazhani dams spreading over 14 km². The vegetation is mainly moist deciduous and semievergreen forests with large stretches of grasslands at Ponmudi. The remarkable aspect is the presence of over 50 species of orchids in such a small area. A total of 829 species belonging to 545 genera in 120 families have been reported from this area of which 164 are endemics with 5 species exclusive to the area and 34 are rare or threatened. (Sasidharan & Sivarajan, 1996).

h) Wynad Wildlife Sanctuary: Contiguous with the Nagarhole and Bandipur Wildlife Sanctuaries of Karnataka in the Northeast and the Mudumalai Wildlife Sanctuary of Tamil Nadu in the south, this sanctuary is an integral part of the Nilgiri biosphere reserve. It was established in 1973 clubbing the notified reserves of Wynad. A very complex and diverse flora and fauna along with several hill tribes constitute the biodiversity of the area. The altitude varies between 650 and 1150 m. The sanctuary has mostly moist deciduous and semievergreen forests in its 110 km² area.

i) Aralam Wildlife Sanctuary: A small sanctuary of 55 km², it is located on the western slopes of the Western Ghats in Aralam in Kannur District. It has a varied topography. The altitude ranges from 50 to over 1145 m. The highest peak is 'Kalli betta'. It has both evergreen and semievergreen forests besides some teak and *Eucalyptus* plantations on its fringes.

j) Parambikulam Wildlife Sanctuary: Established on 12th Feb. 1973, this sanctuary with an area of 295 km² is situated in Nemmara Division adjacent to Nelliampathi, Palakkad District. The area possesses evergreen and deciduous forests. Sasidharan (2002) made extensive studies on the flora of this region. A total of 1432 species belonging to 704 genera in 136 families have been reported of which 285 species are endemic with 4 exclusive to this area and 46 are rare/threatened.

k) Thattekkad Bird Sanctuary: It is a small sanctuary with an area of 28.16 km², notified on 27th Aug. 1993.

As the national parks and sanctuaries did not yield the desired results (Gadgil, 1983), the current conservation efforts are mostly aimed at establishing biosphere reserves. Gadgil and Meher-Homji (1986a) conducted a status survey of the biodiversity in India and stated that the conservation of the total spectrum of biological diversity must be based on various zonal and azonal biomes. They also summarised the information on 43 vegetation types in India which included those from Kerala too.

The Govt. of Kerala has also launched some prestigious projects for the rehabilitation of some of the individual species such as 'project rosewood' to save rosewood, vellakil (*Dysoxylum malabaricum*), shendurney (*Gluta travancorica*)

and ebony (*Diospyros ebenum*). Some of the other projects are 'operation watershed' for the development of the Kallar Valley catchment area and genetic improvement of plant species. Recently the Govt. of Kerala introduced in the Assembly the "Kerala State Biodiversity Conservation Order - 2000" in close tune with Govt of India's Biodiversity Bill. The essence of the bill perhaps lies in the fact that there is a large involvement of the panchayat raj institutions in the conservation and utilization of the bioresources of the state. The bill intends to constitute a State Biodiversity Board with a State Biodiversity Cell, District Biodiversity Councils and People's Biodiversity Register (Anon., 2000).

Ex situ methods of conservation are mostly attempted through botanic gardens by introduction, acclimatization, propagation etc. and by other sophisticated preservation techniques like cryo-preservation. A right step towards this direction appears to have been made by some botanic gardens and nurseries in the state.

As a part of the strategy to speed up the conservation efforts, many conservationists have proposed the setting up of a 'network of nature reserves' as the best method of conserving the biodiversity of the state. The size of such reserves depends upon the size of the population to be conserved. For example, to maintain a population of large trees of the Western Ghats areas larger than that of Silent Valley should be selected (Singh & al., 1984). Nair and Daniel (1986) observed that the number of the nature reserves already established in the Western Ghats is inadequate and suggested the setting up of huge reserves of over 2500 km².

It is suggested that a suitable area may be notified in central Kerala for another biosphere reserve. Anaimudi and adjoining areas, a centre of speciation, may best serve this purpose. Smaller reserves may also be set up along the coastal and in the midland regions so as to conserve the coastal/midland ecosystems. The areas for such reserves may be identified consulting experts both in governmental and non-governmental organizations on the basis of merit of ecological value and administrative viability so that a network of nature reserves can be established throughout the state with specific management objectives, institutional mechanisms for monitoring and scope for research.

Another unique method of conserving the vegetation of the midlands and coastal region is 'sacred groves' which are repositories of pristine vegetation. These groves have been conserved over the years on the basis of religious beliefs. Of late, a number of such groves are cleared due to the pressure for land. The groves are generally attached to some ancient Hindu families. With the breakdown of the ancient Hindu joint family system in Kerala in the recent past as elsewhere, houses of many such old families having sacred groves were sold to people of other religions who do not attach any importance or faith to such beliefs leading to their destruction. In spite of this there still remain a number of such groves in the south and central parts of Kerala. Describing the sacred groves as 'saviours of endemics' Induhoodan and Balasubramanian (1991) reported 28 species endemic to the Western Ghats from three such groves covering an area of just 36 ha. It is suggested that speedy steps be taken urgently to protect at least the remaining groves before they are lost for ever. Mohanan and Nair (1997) suggested several measures to be given priority while formulating effective and purposeful conservation strategies for the state.

SYSTEMATIC ENUMERATION

RANUNCULACEAE

(N.P. BALAKRISHNAN)

Annual or perennial herbs, small shrubs, stragglers or climbers, rarely dio- or monoecious. Leaves radical, cauline, alternate or opposite, simple, serrate-crenate, often lobed or compound, usually exstipulate, sometimes petiole base broadened into a stipule-like auricle; leaf bases often sheathing. Flowers solitary or in cymes, racemes, panicles or thyrses, bi- or unisexual, hypogynous, actino- or zygomorphic. Sepals (3)5 8, free, imbricate, rarely valvate, sometimes petaloid, rarely spurred. Petals (0)5(12), free, imbricate, rarely minute or deformed, sometimes spurred, often with sub-basal nectar glands, sometimes with honey-scales between perianth and stamens. Stamens usually numerous, free, in many rows; outer ones rarely staminodal and petaloid; anthers basifixed, extrorse, dehiscing longitudinally; connectives rarely produced at apex. Carpels numerous, spiral, sometimes connate at base; style short or elongate; stigma simple, ventrally or apically decurrent; ovules 1 - numerous in each ovary, ventral, anatropous. Fruit an aggregate of 1-seeded achenes or many-seeded follicles, rarely a capsule or berry; seeds small; embryo minute; endosperm copious, fleshy.

Mostly in temperate and cold regions of northern and southern hemispheres, a few tropical, 62 genera and 2450 species, 28 and 91 in India and, 3 and 8 in Kerala.

Key to genera

- 1a. Plants herbaceous, erect, decumbent or prostrate, rarely scrambling; leaves radical and cauline, alternate or whorled. **3. Ranunculus**
- b. Plants woody, erect shrubs or climbers; leaves cauline only, opposite **2**
- 2a. Plants climbing by means of tendrils; terminal leaflet modified into a tendril; sepals not showy; petals present. **2. Naravelia**
- b. Plants climbing by means of twining petioles; terminal leaflet normal; sepals showy; petals absent **1. Clematis**

I. CLEMATIS L.

Climbing or rarely erect shrubs or subshrubs. Leaves opposite or whorled, simple, variable, 3-foliolate or pinnately compound, exstipulate; petioles and petiolules often twining. Flowers solitary or in fascicles at nodes or in axillary or terminal panicles, uni- or bisexual, actinomorphic. Sepals usually 4, sometimes to 8, free, valvate, petaloid, white or yellowish, reddish or purple. Petals absent. Stamens numerous; filaments glabrous, sometimes hairy. Carpels 5 many, distinct; ovule 1 in each ovary, pendulous; style usually hairy. Fruit a head of sessile or stalked laterally compressed achenes; style persistent, feathery with long straight hairs or rarely short stout and without plumose hairs.

Cosmopolitan, chiefly in temperate and subtropical regions, ca 295 species, 32 in India and 4 in Kerala.

Literature: Gupta, A.L. 1961. Illustrations of Indian plants I. *Clematis* I. *Bull. Lucknow Natl. Bot. Gard.* 54: 1 - 21. Gupta, A.L. 1963. Illustrations of Indian plants II. *Clematis* II. *Bull. Lucknow Natl. Bot. Gard.* 80: tt. 22 - 46. Kapoor, S.L. 1962. Flowering plants of India. *Clematis* I. *Bull. Lucknow Natl. Bot. Gard.* 78: 1 - 67. Kapoor, S.L. 1966. Flowering plants of India. *Clematis* II. *Bull. Lucknow Natl. Bot. Gard.* 124: 1 - 94.

Key to species

- 1a. Leaflets irregularly dentate, brown-silky-villous; stamens hairy in middle **4. C. wightiana**
- b. Leaflets entire or serrate, glabrous or pubescent; stamens glabrous **2**
- 2a. Flowers less than 1.5 cm across; connectives scarcely produced beyond anther lobes **2. C. gouriana**
- b. Flowers more than 1.5 cm across; connectives conspicuously produced beyond anther lobes **3**
- 3a. Leaves simple or 3-foliolate; leaflets usually 5 - 7-nerved at base; filaments constricted below anthers **3. C. munroiana**
- b. Leaves 1- or 2-ternate or ternately cut; leaflets 3 - 5-nerved at base; filaments not constricted below anthers **1. C. bourdillonii**

1. Clematis bourdillonii Dunn in Bull. Misc. Inform. 1914: 101. 1914 & Gamble, Fl. Madras: 3(2). 1915; Vajr. in Pl. Conserv. Bull. 4: 15. 1983 & S.K. Jain

& Sastry, Indian Pl. Red Data Book: 140. 1984; M.A. Rau in B.D. Sharma & al., Fl. India 1: 59. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 40. 1994.

Climbing or straggling shrub; branches glabrous or sparsely hairy. Leaves 1- or 2-ternate; leaflets oblong or elliptic, entire, sometimes coarsely toothed, acute or obtuse, 6 - 8 x 2.8 - 4.5 cm; nerves raised. Flowers many, ca 2 cm across, in axillary or terminal panicles; pedicels to 1.7 cm long. Sepals 4, reflexed, villous outside, glabrous inside. Filaments glabrous; connectives produced considerably beyond anther lobes. Achenes with ca 5 cm long feathery tails.

Fl. & Fr.: April - May.

Habitat: Evergreen forests, ca 750 m.

Distrib.: Thiruvananthapuram. Endemic and endangered.

Note: Not collected since the type from Travancore (Merchiston, *Bourdillon* 554 K, MH; *Bourdillon* 860 UCT).

2. *Clematis gouriana* Roxb. ex DC., Syst. Nat. 1: 138. 1817; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 4. 1872; Rama Rao, Fl. Pl. Travancore: 1. 1914; Dunn in Gamble, Fl. Madras: 3(2). 1915; Manilal, Fl. Silent Valley: 1. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 35. 1988; Vajr., Fl. Palghat: 43. 1990; M.A. Rau in B.D. Sharma & al., Fl. India 1: 64. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 40. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 24. 1996; Sivar. & P. Mathew, Fl. Nilambur: 33. 1997.

Extensive woody climber, often reaching over tall trees: stems and branches 6 - 12-furrowed and -ribbed, sparsely hairy or glabrous. Leaves opposite, compound, pinnate to 2-pinnate, variable, with 5 - 9 leaflets, to 14 x 10 cm; leaflets ovate or elliptic-lanceolate, rounded at base, entire, acute or acuminate at apex, 2.5 - 8 x 1.5 - 4.5 cm, glabrous or sparsely pubescent on nerves; petiolules slender, to 2.5 cm long. Panicles cymose, axillary or terminal, crowded; branches rather stout, pubescent. Flowers 1 - 1.5 cm across, greenish white, pale yellow or white, fragrant. Sepals spreading from base, elliptic, rounded at apex, pubescent. Stamens 30 - 35; filaments linear, flat, glabrous; connectives scarcely produced beyond anther lobes. Carpels 10 - 15, oblong or linear, hairy; style to 2.5 mm long; stigma clavate. Achenes ovoid or narrowly oblong, compressed, 3 - 5 x 1 - 2 mm, densely hairy with to 5 cm long feathery styles.

Fl.: Aug. - Feb. *Fr.*: Sept. - May.

Habitat: Spreading on thickets and climbing on shrubs and trees in shaded places in subtropical and tropical forests, 150 - 1500 m.

Distrib.: Almost throughout Kerala. Throughout India. South and SE. Asia.

3. *Clematis munroiana* Wight, Ill. Ind. Bot. 1: 5, t. 1. 1840; Dunn in Gamble, Fl. Madras: 3(2). 1915; M.A. Rau in B.D. Sharma & al., Fl. India 1: 71. 1993. *C. smilacifolia* auct. non Wall. 1820: Hook. f. & Thomson in Hook.f., Fl. Brit. India 1: 3. 1872 p.p.; Vajr., Fl. Palghat: 43. 1990.

Mal.: *Vadiyambu*

Climbing shrub; stems and branches glabrous. Leaves pinnately 3-foliolate or simple near flowering region; leaflets ovate, ovate-oblong or -lanceolate, acute or obtuse, entire or irregularly serrate, 4 - 12 x 2 - 8 cm, 5 - 7-nerved at base, glabrous on both surfaces. Inflorescences axillary, 1 - 5-flowered. Flowers nodding, ca 4 cm across, deep purple; pedicels to 10 cm long. Sepals 4 or 5, spreading or reflexed from base, velvety-tomentose and maroon with whitish margins outside, glabrous inside. Filaments linear, constricted just below anthers, glabrous; connectives produced much beyond anther lobes. Achenes ovate, compressed, margined, hairy with ca 6 cm long feathery tails.

Fl.: June - Aug. *Fr.*: Oct. - Nov.

Habitat: Subtropical forests, 1000 - 2000 m.

Distrib.: Idukki, Kollam and Palakkad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

4. *Clematis wightiana* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 2. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 5. 1872; Dunn in Gamble, Fl. Madras: 3(2). 1915; M.A. Rau in B.D. Sharma & al., Fl. India 1: 80. 1993.

Large, woody climber; branches to 12-furrowed and -ribbed, covered with soft greyish or brownish hairs. Leaves pinnately 3 - 5-foliolate; leaflets oblong-ovate or orbicular, 3 - 5-lobed, irregularly dentate, to 8 cm long, softly brown-silky-villous on both surfaces; nerves thick and prominent beneath; petioles to 12 cm long, more or less hairy. Inflorescences axillary, paniced; bracts and bracteoles ovate to linear-oblong. Flowers 3 - 6 cm across, white, pale creamy or golden yellow. Sepals broadly ovate, spreading from base, somewhat ribbed,

softly brown-tomentose outside, glabrous inside. Filaments linear, silky-hairy in middle, glabrous at base and apex; connectives not produced beyond anther lobes. Achenes ovate, compressed, densely silky-hairy with 3 - 5 cm long feathery tails. *Fl.*: Nov. - March *Fr.*: Jan. - May.

Habitat: Subtropical evergreen forests, 800 - 1600 m, rare.

Distrib.: Wynad. Western Ghats and E. Ghats of Andhra Pradesh. Endemic.

Excluded species

Mohanan and Henry (*l.c.*: 41) included *C. hedyarifolia* DC. (= *C. naravelioides* Kuntze) based on the enumeration by Rama Rao (*l.c.*). However, it does not occur in Kerala (*vide* M.A. Rau, *l.c.*). There is no specimen either.

2. NARAVELIA Adans., nom. & orth. cons.

Climbing shrubs similar to *Clematis*. Leaves opposite, 3-foliolate with terminal leaflet usually modified into a tendril. Flowers in axillary or terminal panicles, bisexual, actinomorphic. Sepals 4 or 5, caducous. Petals 6 - 12. Stamens many. Staminodes petaloid. Ovary 1-ovuled. Achenes stipitate, linear with persistent twisted feathery tails.

Indomalesia, 7 species and 1 in India.

Naravelia zeylanica (L.) DC., *Syst. Nat.* 1: 167. 1817; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 6. 1872; Dunn in Gamble, *Fl. Madras*: 3(2). 1915; Manilal & Sivar., *Fl. Calicut*: 25. 1982; Manilal, *Fl. Silent Valley*: 1. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 35. 1988; Vajr., *Fl. Palghat*: 44. 1990; M.A. Rau in B.D. Sharma & al., *Fl. India* 1: 106. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 41. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 25. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 33. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 48. 2002. *Atragene zeylanica* L., *Sp. Pl.*: 542. 1753; Roxb., *Pl. Coromandel* 2: 47, t. 188. 1805.

Woody climber, to 12 m long; young parts pubescent; roots tuberous. Leaves 2- or 3-foliolate, ca 15 cm long; petioles to 4.5 cm long; terminal leaflet modified into a 3-fid hooked tendril, to 12 cm long; lateral leaflets broadly ovate, rounded or cordate at base, entire, acuminate at apex, 7 - 12 x 3 - 8 cm, glabrous above, pubescent beneath, 5-nerved at base; petiofules to 2 cm long.

Flowers 12 - 17 mm across, numerous, in divaricately branched, to 15 cm long panicles. Sepals 4 or 5, elliptic to broadly ovate, ca 6 x 3 mm, appressed-pubescent outside, falling off soon after petals expand. Petals 6 - 12, linear to spatulate, ca 7 x 1 mm, glabrous, dull white or greenish yellow. Stamens many; filaments ligulate, glabrous; connectives produced into a short point beyond anther lobes. Achenes on ca 1 mm long stalks, ca 7 x 1 mm, sparsely hairy with 3.5 - 5 cm long twisted feathery tails.

Fl. & Fr.: Oct. - Feb.

Habitat: Fringes of tropical and subtropical forests, to 1000 m.

Distrib.: Throughout Kerala. Gangetic Plains, C., NE. and S. India. South and SE. Asia.

3. RANUNCULUS L.

Annual or perennial, terrestrial or aquatic herbs; rootstock tuberous often fibrous, sometimes horizontal; stems erect, decumbent, prostrate or creeping. Leaves radical and cauline, alternate or whorled, lobed or dissected often lobes capillary when aquatic; stipules membranous or absent. Flowers solitary or in panicles, white or yellow. Sepals 3 - 5, green or petaloid, caducous. Petals as many as sepals or more, usually 5, with a nectariferous pit at base. Stamens many. Carpels many; ovule 1 in each ovary, ascending; style short. Fruit a head of achenes; achenes compressed or inflated, apiculate or beaked, smooth, tubercled or spinose.

Cosmopolitan, mostly in temperate regions and tropical mountains, ca 600 species, 33 in India and 3 in Kerala.

Key to species

- | | | |
|-----|---|---------------------------|
| 1a. | Decumbent or trailing herb; sepals reflexed; achenes with a few blunt tubercles | 3. R. wallichianus |
| b. | Erect herbs; sepals not reflexed; achenes without tubercles | 2 |
| 2a. | Leaves deeply divided; achenes strongly flattened-compressed, ribbed on either side of margin | 2. R. subpinnatus |
| b. | Leaves not divided; achenes turgid-inflated, not ribbed | 1. R. peninsularis |

1. Ranunculus peninsularis C.J. Saldanha, Fl. Karnataka 1: 91. 1984; Manilal, Fl. Silent Valley: 1. 1988; Sivar. & P. Mathew, Fl. Nilambur: 34. 1997. *R.*

reniformis Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 3. 1834, non Gilib. 1782; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 16. 1872; Dunn in Gamble, Fl. Madras: 5(4). 1915; M.A. Rau in B.D. Sharma & al., Fl. India 1: 126. 1993.

Perennial herb, erect, to 50 cm high; stem soft-hairy; branches few, 1-flowered; rootstock stout, horizontal, densely fibrous. Radical leaves long-petioled, broadly ovate or orbicular, truncate or cordate at base, coarsely dentate-crenate, 3 - 7 cm across, thick. Cauline leaves few, with narrow lobes. Flowers ca 2.5 cm across, yellow. Petals 12 - 15, ovate-oblong. Achenes in a globose head, oblong, turgid with straight beaks.

Fl. & Fr.: Jan. - Dec.

Habitat: Grassy slopes, 1600 - 2500 m, rare.

Distrib.: Idukki, Malappuram and Palakkad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. *Ranunculus subpinnatus* Wight & Arn., Prodr. Fl. Ind. Orient.: 4. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 19. 1872, pro syn. under *R. diffusus* DC.; Dunn in Gamble, Fl. Madras: 5(4). 1915; M.A. Rau in B.D. Sharma & al., Fl. India 1: 129. 1993.

Perennial, erect herb, usually leafless when in flower, covered with spreading hairs. Leaves deeply 3-lobed; lobes cuneate, deeply incised; petioles dark violet. Flower solitary, 1.5 - 2.5 cm across, pale yellow; peduncle terminal or leaf-opposed. Sepals 5, ca 6 x 2 mm, spreading, hairy. Petals 5, free, obovate, ca 9 x 6 mm. Achenes ovate, acute, compressed, ribbed on either side of margin, finely and evenly pitted; beak short, straight or hooked.

Fl. & Fr.: Aug. - Oct.

Habitat: Grassy slopes, 1800 - 2500 m, common.

Distrib.: Palakkad (Silent Valley). Western Ghats of Tamil Nadu. Endemic.

3. *Ranunculus wallichianus* Wight & Arn., Prodr. Fl. Ind. Orient.: 4. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 20. 1872; Dunn in Gamble, Fl. Madras: 5(4). 1915; M.A. Rau in B.D. Sharma & al., Fl. India 1: 131. 1993.

Perennial, trailing, hairy herb, often rooting at nodes. Radical leaves 3-partite, 4 - 8 cm across; segments stalked, 3-lobed, crenate; petioles hairy; lamina hairy on both surfaces. Cauline leaf solitary with a flower opposite. Flowers ca

7.5 mm across, pale yellow; peduncles 4 - 8 cm long. Sepals reflexed, shorter than petals. Petals 5, free, obovate, ca 4 x 2 mm. Achenes 10 - 15, rounded, flat, ca 3 x 2 mm, margined, pitted, with a few tubercles; beak short, hooked.

Fl. & Fr.: June - Oct.

Habitat: Grassy slopes, ca 2000 m, rare.

Distrib.: Idukki. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

DILLENiaceae

(N.P. BALAKRISHNAN & G.V.S. MURTHY)

Trees, shrubs or twiners, rarely herbs. Leaves alternate, rarely opposite, simple, entire or dentate, rarely pinnatipartite or 3-lobed, usually with numerous parallel lateral nerves, mostly exstipulate, sometimes stipules wing-like and adnate to petiole forming a sheathing base or rarely lateral and caducous. Inflorescences cymes, racemes or panicles, or flower solitary. Flowers bisexual, rarely polygamodioecious, hypogynous. Sepals 5(4 - 6), free, imbricate or spiral, persistent, often accrescent, thickened and fleshy in fruit. Petals 5(- 3), free, imbricate, yellow or white, often crumpled in bud, caducous. Stamens numerous, rarely 7 - 10, free or basally connate, centrifugal in development, usually persistent; staminodes often present; filaments filiform or thickened above; anthers oblong, basifixed, dehiscing longitudinally or by apical pores; connectives sometimes apically produced. Carpels 1 or several, free or sometimes slightly connate; ovules 1 or several, basal, ventral or axile, ana-, campylo- or amphitropous; styles free, elongate, divergent; stigmas apical. Fruitlets follicled, dehiscing along ventral and rarely also dorsal suture or indehiscent and sub-baccate; seeds 1 or few, mostly with a crested or lacinate aril; testa crustaceous; raphe short; embryo minute, linear, straight, next to hilum; endosperm copious, fleshy, oily and proteinaceous.

Pantropical, centred in temperate and subtropical Australia, rare in Africa, 12 genera and ca 300 species, 3 and 12 in India and, 3 and 5 in Kerala.

Literature: Abedin, S. 1973. *Dilleniaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 42: 1 - 4. Hoogland, R.D. 1959. Additional notes on *Dilleniaceae*. *Blumea* 9: 577 - 589. Majumdar, N.C. 1979. *Dilleniaceae*. *Fasc. Fl. India* 2: 1 - 15. Sastry, R.L.N. 1958. Pollen morphology and embryology of some *Dilleniaceae*. *Bot. Not.* 111: 495 - 511.

Key to genera

- | | | |
|-----|---|---------------------|
| 1a. | Herbs, shortly stemmed or stemless with large radical leaves | 1. Acrotrema |
| b. | Trees, shrubs or woody climbers without radical leaves | 2 |
| 2a. | Trees; stamens with filiform filaments and parallel anther lobes; fruiting carpels enclosed in an enlarged fleshy calyx | 2. Dillenia |
| b. | Shrubs or woody climbers; stamens with filaments thickened above and divergent anther lobes; fruiting carpels not enclosed in an enlarged calyx | 3. Tetracera |

1. ACROTREMA Jack

Perennial herbs; stems short, woody. Leaves all radical or on a short stem, simple, dentate or pinnatisect; petioles with broad membranous caducous wings. Flowers in short terminal racemes; bracts membranous. Sepals 5. Petals 5, yellow. Stamens 15 - many in 3 bundles alternating with carpels. Carpels usually 3, slightly connate along axis; ovules 2 - 6 or 10 - 20; styles linear, recurved. Follicles dehiscent irregularly; aril membranous, white.

South and SE. Asia, ca 10 species and 1 in India.

Acrotrema arnottianum Wight, Ill. Ind. Bot. 1: 9, t. 3. 1840; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 32. 1872; Rama Rao, Fl. Pl. Travancore: 2. 1914; Dunn in Gamble, Fl. Madras: 6(5). 1915; Majumdar in B.D. Sharma & al., Fl. India 1: 151. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 41. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 49. 2002.

Mal.: *Nilampunna*

Herb; stems very short or absent. Leaves obovate-oblong, rounded or subcordate at base, more or less sharply dentate at margin, obtuse at apex, 15 - 30 x 7 - 12 cm, dull pinkish beneath; young leaves floccose, glabrescent at times; nerves depressed above; petioles 2 - 8 cm long, winged. Flowers many, on 9 - 14 cm long peduncles; pedicels 5 - 15 cm long, long-hairy, reddish brown. Sepals obovate, 8 - 9 mm long, scarlet or pink with long white hairs. Petals obovate, ca 8 mm long, yellow. Stamens many, yellow; anthers spatulate. Carpels ca 8 mm long, many-ovuled. Follicles many-seeded or by abortion few.

Fl.: April - Aug. *Fr.*: Sept. - Oct.

Habitat: Moist places under bushes and edges of puddles in moist deciduous and evergreen forests, to 700 m.

Distrib.: Kollam, Pathanamthitta and Thiruvananthapuram. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic.

2. DILLENIA L.

Trees. Leaves large, stipuled or not; petioles grooved above. Flowers showy, solitary or in terminal racemes, sometimes clustered on old branches or fascicled on short shoots; bracts and bracteoles if present caducous. Sepals 5, spreading, persistent, enlarged and fleshy in fruit. Petals 5, larger than sepals, yellow or white, caducous. Stamens numerous, almost free; filaments equal or not; anthers linear with parallel lobes; inner ones erect, introrse; outer ones recurved, extrorse. Carpels 5 - 20, on a conic receptacle; ovules 4 - 80. Fruiting carpels enclosed in globose pseudocarps, indehiscent, enclosed by enlarged calyx; seeds arillate or not.

Madagascar, S. and SE. Asia to the Fiji Islands and north to southern slopes of the Himalayas, 60 species, 8 in India and 4 in Kerala.

Literature: Brandis, D. 1900. The Indian species of *Dillenia*. *Indian Forester* 26: 429 - 431. Corner, E.J.H. 1978. The inflorescence of *Dillenia*. *Notes Roy. Bot. Gard. Edinburgh* 36: 341 - 353.

Key to species

- 1a. Petiole bases/leaf scars completely amplexicaul; petiolar wings present **4. *D. suffruticosa***
- b. Petiole bases/leaf scars not completely amplexicaul, clasping 3/4 of branch; petiolar wings absent **2**
- 2a. Flower solitary, terminal, 15 - 20 cm across; petals white; carpels 15 - 20 **2. *D. indica***
- b. Flowers in racemes or fascicles, 2.5 - 9 cm across; petals yellow; carpels 5 **3**
- 3a. Evergreen tree; flowers 6 - 9 cm across, in racemes on leaf-bearing branches; sepals silky-pubescent; seeds arillate **1. *D. bracteata***
- b. Deciduous tree; flowers 2.5 - 3 cm across, in fascicles of 2 - 7 on rounded projections of old branches; sepals glabrous; seeds exarillate **3. *D. pentagyna***

1. *Dillenia bracteata* Wight, *Icon. Pl. Ind. Orient.*: t. 358. 1840; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 37. 1872 p.p., excl. syn. *D. repanda* Roxb. 1832; Dunn in Gamble, *Fl. Madras*: 7(5). 1915; V.S. Ramach. & V.J. Nair,

Fl. Cannanore: 36. 1988; Majumdar in B.D. Sharma & al., Fl. India 1: 154. 1993. *Wormia bracteata* (Wight) Hook.f. & Thomson, Fl. Ind.: 68. 1855.

Mal.: *Kattupunna*

Evergreen tree, 10 - 15 m tall; young shoots densely tomentose with yellowish hairs; leaf scars clasping for 1/2 of branch. Leaves elliptic to oblong or obovate, decurrent, obtuse to acute at base, slightly undulate to dentate at margin, rounded-obtuse or acuminate at apex, 10 - 16 x 5 - 10 cm, glabrescent above, sparsely hirsute beneath; lateral nerves 14 - 20 pairs, curved upwards ending mostly in marginal teeth. Flowers 2 - 4, in terminal racemes, 6 - 9 cm across; bracts lanceolate or spatulate, acute, 8 - 12 x 3 - 4 mm, hirsute, caducous; bracteoles 1 or 2, lanceolate, ca 5 x 2 mm or absent; pedicels 4 - 10 mm long, thickened above, hirsute. Sepals ovate; outer pair ca 2 x 1.3 cm; inner 3 ovate, ca 2.5 x 1.6 cm, silky-pubescent outside. Petals obovate, rounded at apex, ca 4 x 2.5 cm, yellow. Stamens 220 - 230, ca 9 mm long, slightly curved in bud; anthers rounded or slightly emarginate at apex with linear lobes, pinkish blue. Carpels 5, around a narrow conic receptacle, each with ca 30 ovules, 2-seriate below; styles ca 9 mm long. Fruits subglobose, 2.5 - 3 cm across with enclosing sepals, indehiscent; fruiting carpels ca 9 x 6 mm, 1-seeded; seed ovoid, ca 5 x 4.5 mm, dark reddish brown to black, arillate.

Fl. & Fr.: Dec. - June.

Habitat: Evergreen or semievergreen forests, to 900 m.

Distrib.: Kannur, Kollam, Kozhikode, Palakkad and Wynad. Western Ghats of Tamil Nadu and E.Ghats of Andhra Pradesh. Endemic.

Use: Wood is used in construction work.

2. *Dillenia indica* L., Sp. Pl.: 535. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 36. 1872; Dunn in Gamble, Fl. Madras: 7(5). 1915; Nicolson & al. in *Regnum Veg.* 119: 100. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 36. 1988; Majumdar in B.D. Sharma & al., Fl. India 1: 155. 1993. *D. speciosa* Thunb. in *Trans. Linn. Soc. London* 1: 200. 1791; Wight, *Icon. Pl. Ind. Orient.*: t. 823. 1844 - 1845.

Mal.: *Chalita, Punna, Syalita*

Evergreen tree, to 20 m tall; bark smooth, peeling off in small thin hard

scales; young branches appressed-silky-hairy. Leaves oblong to oblanceolate or narrowly elliptic, rounded to acute at base, slightly to distinctly serrate at margin, obtuse or slightly acuminate at apex, 15 - 40 x 6 - 12 cm, glabrous, bright green shining above, appressed-strigose on nerves beneath; lateral nerves 30 - 50 pairs; petioles 3 - 8 cm long, glabrous above, more or less minutely silky-hairy below. Flower solitary, terminal, 15 - 20 cm across, fragrant; pedicel 4 - 8 x 4 - 5 mm, appressed-silky-hairy; bract solitary, median on pedicel, lanceolate, to 6 mm long, glabrous above, strigose beneath. Sepals 5, orbicular or obovate; outer pair 4 - 5 x 3 - 4 cm; inner ones 3.5 - 6 x 4 - 5 cm, to 1 cm thick at base. Petals 5, erecto-patent at base, recurved over sepals, obovate, narrow at base, rounded at apex, 7 - 9 x 5 - 6 cm, milky white. Stamens in 2 distinct groups, erecto-patent with incurved anthers; outer group of ca 500 slightly curved in bud, ca 1.5 cm long; inner group of ca 25 reflexed at apex, ca 2 cm long; filaments 5 - 10 mm long, white, flat in outer group, thick in inner group; anthers linear, ca 0.8 mm thick, opening by apical pores, yellow. Carpels 15 - 20, narrowly lanceolate, ca 1.4 cm long, connate with each other along receptacle, glabrous, yellowish green; ovules 40 - 80 in each locule in 2 adaxial placentae; styles linear-lanceolate, acute, ca 2.5 cm long, yellowish, white at base. Fruits globose, 8 - 12 cm (including fleshy sepals), yellowish; fruiting carpels ca 3.5 x 1.5 cm, each with 5 or more seeds embedded in pulp; seeds reniform, compressed, ca 4 x 6 mm, finely echinate-ciliate at margin, reddish or black, exarillate.

Fl.: June - Aug. *Fr.*: Jan. - April.

Habitat: Gravelly river banks in evergreen and semievergreen forests, to 800 m.

Distrib.: Kannur and Wynad. Gangetic Plains, NE. and S. India. South and SE. Asia.

3. *Dillenia pentagyna* Roxb., Pl. Coromandel 1: 21, t. 20. 1795; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 38. 1872; Bourd., Forest Trees Travancore: 1. 1908; Rama Rao, Fl. Pl. Travancore: 2. 1914; Dunn in Gamble, Fl. Madras: 7(5). 1915; Manilal & Sivar., Fl. Calicut: 25. 1982; Manilal, Fl. Silent Valley: 2. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 36. 1988; Vajr., Fl. Palghat: 44. 1990; Majumdar in B.D. Sharma & al., Fl. India 1: 156. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 42. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 25. 1996; Sivar. & P. Mathew, Fl. Nilambur: 34. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 49. 2002.

Mal.: *Kodapunna, Naithekk, Vazhapunna*

Deciduous tree, to 25 m tall; branches with leaf scars clasping for about 2/3 of branch. Leaves oblong-obovate, elliptic to oblanceolate, obtuse or cuneate at base, entire to serrate at margin, obtuse at apex, 20 - 60 x 10 - 20 cm, glabrescent above, thinly strigose beneath; lateral nerves 25 - 50 pairs, parallel, pubescent beneath with short tufts of hairs at ends of teeth; petioles 2 - 6 cm long, glabrous above, densely strigose below. Flowers 2.5 - 3 cm across, 2 - 7 in clusters, on rounded projections of old branches; pedicels 3 - 6 cm long. Sepals ovate, acute or obtuse at apex, 8 - 12 x 5 - 9 mm, ciliate at margin, glabrous on both sides, green or purplish. Petals obovate, rounded at apex, 15 - 20 x 5 - 10 mm, yellow. Stamens in 2 series; outer series to 90, erect; the inner with ca 10, reflexed; filaments of outer series flat, to 3 mm long, that of the inner thick, to 7 mm long; anthers opening by longitudinal slits. Carpels 5, on a narrow conic receptacle, oblong-lanceolate, 3 - 4 x 1.2 - 1.5 mm, glabrous, each with 5 - 20 ovules; styles ca 4 mm long, spreading. Fruits drooping, globose, ca 1.5 cm, fleshy, yellow, orange or red, 1- or 2-seeded; seeds ovoid, ca 5 x 3.5 mm, glabrous, black, exarillate.

Fl.: Jan. - May *Fr.*: March - June.

Habitat: Dry situations in tropical and subtropical open forests, to 950 m.

Distrib.: Almost throughout Kerala. Andaman & Nicobar Islands, Gangetic Plains, C., NE. and S. India. South and SE. Asia.

Uses: Timber, which is reddish brown, is valuable for construction work and furniture. Bark yields a fibre used for making ropes.

4. *Dillenia suffruticosa* (Griff.) Martelli in Becc., *Malesia* 3: 163. 1886; Hoogland in Steenis, *Fl. Males. I*, 4: 162. 1951 & *Blumea* 7: 70. 1952; G.V.S. Murthy in *Rheedea* 10: 77. 2000. *Wormia suffruticosa* Griff., *Not. Pl. Asiat.* 4: 70. 1854 & *Icon. Pl. Asiat.*: t. 649. 1854; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 35. 1872.

Evergreen, large shrub or small tree, to 10 m high; branches sympodial, glabrous to densely villous with 2 - 3 mm long hairs, more or less glabrescent; leaf scars amplexicaul, subfalcate. Leaves elliptic-ovate, obtuse at base, decurrent into petiolar wings, entire to dentate at margin, rounded to obtuse at apex, (10-)15 - 25(-45) x (5)8 - 12(-26) cm; lateral nerves 12 - 20 pairs, ending in teeth,

slightly to densely villous; petioles 2 - 6 cm long with amplexicaul wings; wings 4 - 10(-15) mm broad, persistent, faintly nerved in young leaf. Inflorescences terminal, leaf-opposed, (1-)6 - 10(-18)-flowered, simple or compound racemes, to 30 cm long; bracts 3-angled, 6 - 15 x 3 - 5 mm, caducous. Flowers 8 - 12 cm across; pedicels 0.8 - 3 x 2 - 3 mm, thickened above. Sepals 5, obovate, 15 - 22 x 8 - 12 mm, glabrous to rather densely villous outside, glabrous inside. Petals 5, obovate, narrowed towards base, rounded at apex, 40 - 50 x 25 - 30 mm, bright yellow. Stamens in 2 distinct groups; outer group with ca 100 staminodes; staminodes linear, obtuse at apex, 4 - 6 x ca 0.3 mm, yellow; fertile stamens ca 175, outer slightly curved in bud, ca 8 mm long, innermost reflexed outward in bud, ca 13 mm long; anthers linear, ca 0.5 mm broad, obtuse at apex, opening by a pore near apex outside. Carpels 5 - 8, usually 7, on conic receptacle, elliptic, ca 5 x 2 mm, glabrous, light green, each with 7 - 10 ovules; styles spreading, filamentous, ca 10 x 0.5 mm, yellowish white. Pseudocarps dehiscent, with accrescent sepals, 18 - 25 x 10 - 15 mm; fruiting carpels 20 - 25 x 10 - 16 mm, red, each with 1 - 4 seeds; seeds obovoid, ca 3 x 2 mm, brown or black, enclosed by scarlet membranous aril. *Fl.*: June - Aug. *Fr.*: Aug. - Nov.
Habitat: Evergreen forests, rare.
Distrib.: Pathanamthitta; elsewhere cultivated. Malesia.

3. TETRACERA L.

Shrubs, or woody climbers; branches flexuous. Leaves simple, often scabrid; petioles furrowed. Inflorescences few- to many-flowered terminal or axillary panicles. Flowers bracteoid or not, bisexual, actinomorphic, fragrant. Sepals 4 - 6, rarely to 15, imbricate, persistent, often reflexed in fruit. Petals 3 - 5, emarginate at apex, white or reddish white, caducous. Stamens numerous, subequal; filaments free, thickened above, with broad connectives; anther lobes divergent. Carpels 1 - 4, free, each bearing a straight short style and with 4 - 10 ovules in 1 row. Fruitling carpels 1 - 4, ovoid to globose with a short beak, coriaceous, dehiscent by longitudinal slits into 2 halves, 1- or 2-seeded; seeds shining, dark brown or blackish; aril fleshy, fimbriate or laciniate.

Tropics, ca 40 species, 4 in India and 1 in Kerala.

Literature: Hoogland, R.D. 1953. The genus *Tetracera* (*Dilleniaceae*) in the eastern Old World. *Reinwardtia* 2: 185 - 224.

Tetracera akara (Burm. f.) Merr. in Philipp. J. Sci. 19: 366. 1921; Nicolson & al. in Regnum Veg. 119: 101. 1988; Majumdar in B.D. Sharma & al., Fl. India 1: 158. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 42. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 25. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 50. 2002. *Calophyllum akara* Burm.f., Fl. Indica: 121. 1768. *Tetracera rheedei* DC., Syst. Nat. 1: 402. 1817 (as *rheedii*); Wight, Icon. Pl. Ind. Orient.: t. 70. 1838. *T. laevis* auct. non Vahl 1794: Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 31. 1872; Rama Rao, Fl. Pl. Travancore: 2. 1914; Dunn in Gamble, Fl. Madras: 7(5). 1915. *T. indica* sensu Manilal & Sivar., Fl. Calicut: 25. 1982, non (Houtt. ex Christm. & Panz.) Merr. 1917.

Mal.: *Akara-patsjoti*

Liana, to 25 m long; stems to 6 cm thick. Leaves elliptic-oblong to lanceolate, entire, slightly undulate or dentate with mucronate teeth at margin, acute to acuminate at apex, 6 - 15 x 3 - 8 cm, coriaceous, glabrous, shining green above; lateral nerves 6 - 10 pairs, sparsely strigose; petioles 5 - 8 mm long. Flowers 2.5 - 3 cm across, white turning maroon when old, usually 5 - 8 in axillary or terminal to 8 cm long panicles; peduncles 5 - 20 mm long; pedicels 10 - 25 mm long; bracts lanceolate, acute, ca 2 x 1 mm; bracteoles lanceolate, ca 1 x 0.5 mm. Sepals 4, 8 - 10 x 6 - 8 mm, ciliate at margin, glabrous outside, densely whitish yellow sericeous inside, green or reddish green, often reflexed in fruit. Petals 3 or 4, 12 - 15 x 6 - 8 mm, white or greenish white. Stamens ca 230, 7 - 8 mm long, yellowish white with grey tips. Carpels 3(or 4), glabrous, ca 1.5 x 1 mm with ca 5 mm long style, each with ca 10 ovules. Fruiting carpels follicled, almost globose, ca 10 mm with 1 - 3 mm long beak, glabrous, shining, 1- or 2-seeded; seeds ovoid, 2 - 3 x 1 - 2 mm, shining, black; aril ca 6 mm long, fimbriate.

Fl.: Dec. - May *Fr.*: Jan. - July.

Habitat: Partially shaded places in moist evergreen forests, to 750 m.

Distrib.: Kollam, Kottayam, Kozhikode, Pathanamthitta, Thiruvananthapuram, Thrissur and Malabar (Dunn, *l.c.*). Western Ghats of Tamil Nadu. South and SE. Asia.

Use: Stem bark is used in making ropes.

MAGNOLIACEAE

(N.P. BALAKRISHNAN)

Evergreen or deciduous trees or shrubs. Leaves alternate, simple, rarely lobed, subcoriaceous, pinnately nerved; stipules large, convolute, enclosing terminal vegetative bud, later splitting into 2 caducous lobes leaving a circular scar on twigs, sometimes adnate to petiole and have a scar on petiole, or free. Flower solitary, large, terminal or axillary, peduncled, bisexual, hypogynous, fragrant; bracts 1 or more, spathaceous, caducous. Receptacle elongate, columnar. Perianth parts spiral or in 1 whorl of sepals and 2-4 whorls of petals, fleshy, 3- or 5-merous, caducous. Stamens many, usually 30-50, spiral, free, sometimes not differentiated into anther and filament; anthers oblong-linear, flat, basifixed; connectives usually apically produced. Carpels 12-60, rarely 1, spiral, free, sometimes concrescent; ovules 1-several on ventral suture in each carpel, anatropous; stigma ventrally decurrent. Fruitlets follicled, samaras or rarely woody capsules (*Pachylarnax*), indehiscent or dehiscing septi- or loculicidally; seeds 1-many in each locule, suspended by a silky thread-like funicle, usually with an outer lenticelled woody testa; cotyledons small; embryo minute; endosperm copious, fleshy, oily.

Tropics to warm temperate regions, 7 genera and ca 165 species, 3 and 24 in India and, 1 and 2 in Kerala.

Literature: King, G. 1891. The *Magnoliaceae* of British India. *Ann. Roy. Bot. Gard. (Calcutta)* 3: 197-226. Nootboom, H.P. 1987. *Magnoliaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 6: 152-156. Nootboom, H.P. 1988. *Magnoliaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 10: 561-605.

MICHELIA L.

Evergreen or deciduous trees. Leaves alternate, closely placed, coriaceous, glabrous or pubescent on nerves beneath; stipules adnate to or free from petiole. Flowers large, axillary or subaxillary, solitary or paired on short small-leaved branches (brachyblasts) in axils of main leaves, fragrant. Tepals 6-20 in 2 or more series, subequal, fleshy. Stamens 20 or more, sometimes numerous, many-seriate, flat; anthers linear, introrse or latrorse; connectives produced into a short or elongated appendage. Carpels many or few, free, sometimes connate,

loosely spiral on an elongated receptacle, compressed, white-speckled outside, stipitate; ovules 1 or 2, or many in each locule; style subulate, decurrent. Fruiting carpels free or rarely conerescent, follied, woody, dehiscing by dorsal suture; seeds pendulous and protruding from carpel valves by long elastic funicles.

China and tropical Asia, ca 30 species, 12 in India and 2 in Kerala.

Key to species

- 1a. Leaves elliptic-lanceolate to ovate-lanceolate, gradually narrowing upwards from middle, 10 - 30 x 5 - 10 cm; petioles 1.5 - 4 cm long; stipular scar on petioles more than 6 mm long; flowers yellow or deep cream-yellow to orange **1. *M. champaca***
- b. Leaves narrowly elliptic or ovate-lanceolate, short-acuminate at apex, 6 - 8 (- 10) x 2 - 4.5 cm; petioles to 1 cm long; stipular scar on petioles less than 6 mm long; flowers white or light cream-yellow **2. *M. nilagirica***

1. *Michelia champaca* L., Sp. Pl.: 536. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 42. 1872; Bourd., Forest Trees Travancore: 2. 1908; Rama Rao, Fl. Pl. Travancore: 3. 1914; Dunn in Gamble, Fl. Madras: 9(6). 1915; Manilal & Sivar., Fl. Calicut: 26. 1982; Nicolson & al. in Regnum Veg. 119: 169. 1988; Vajr., Fl. Palghat: 45. 1990; Raju in B.D. Sharma & al., Fl. India 1: 175. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 43. 1994. *M. rheedii* Wight, Ill. Ind. Bot. 1: 14, t. 5, f. 6. 1840.

Mal.: *Champakam*

Evergreen tree, 10 - 20 m tall; trunk straight, to 35 cm across; bark pale brown to grey; branches ascending; young branchlets appressed-pubescent. Leaves elliptic-lanceolate to ovate-lanceolate, widest below middle, cuneate at base, acute or short-acuminate at apex, 10 - 30 x 5 - 10 cm, thinly appressed-pubescent beneath when young; lateral nerves 14 - 25 pairs; stipules 1.5 - 2.5 cm long, adnate to petiole for about 1/2 its length; petioles 1.5 - 4 cm long. Flower solitary, axillary, 4 - 6 cm across, golden yellow to deep cream-yellow to orange, fragrant; pedicels to 1.5 cm long, tomentose; bracts spathaceous, caducous. Tepals 10 or more, oblong, acute, 2 - 4 cm long, fleshy; inner ones linear, narrower. Stamens 6 - 8 mm long; connective appendages to 1 mm long. Fruiting carpels ovoid or ellipsoid, 2 - 3 cm across, woody, warty, dark brown, irregularly spaced on a ca 12

cm long woody receptacle; seeds 1–12, angled, shining, brown; aril fleshy, red.
Fl.: March–June *Fr.*: June–Sept.

Habitat: Subtropical and tropical forests, to 1500 m, often cultivated in gardens and temples.

Distrib.: Idukki, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad; also cultivated in most other districts. Cultivated in most states. South and SE. Asia.

Uses: The fragrant flower is offered in religious ceremonies and also used by women to adorn their hair. Timber is useful for furniture. An aromatic oil is extracted from the flower which is used in creams and scents.

2. *Michelia nilagirica* Zenker, Pl. Ind.: t. 20. 1835; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 44. 1872; Bourd., Forest Trees Travancore: 3. 1908; Dunn in Gamble, Fl. Madras: 9(7). 1915; Vajr., Fl. Palghat: 45. 1990; Raju in B.D. Sharma & al., Fl. India 1: 179. 1993. *M. pulneyensis* Wight, Ill. Ind. Bot. 1: 14. 1840.

Mal.: *Kattu-champakam*

Tree or large shrub, 8–12 m tall with a rounded crown; bark smooth, grey; young parts silky. Leaves elliptic to ovate-lanceolate, cuneate at base, entire with horny margin, acute to acuminate and mucronate at apex with to 6 mm long acumen, 6–8 (-10) x 2–4.5 cm, bright green above, glaucous and finely silky-pubescent on nerves beneath; lateral nerves 7–10 pairs, distinct on both surfaces; stipules densely appressed-silky-hairy, adnate to petiole for 2–6 mm; stipular scars 2–6 mm long; petioles to 1 cm long. Flowers on short lateral twigs, 6–9 cm across, pedicelled or not; brachyblasts 6–7 mm long, stout, densely silky-hairy. Tepals usually 9–12, narrowly obovate, spatulate or strap-shaped, 1.5–3 x 0.7–1.8 cm, white or light cream-coloured; inner ones narrower. Stamens many, ca 8 mm long; connective appendages ca 1.5 mm long. Carpels ca 30, silky-pubescent; ovules 2 or, 4 or 5 in each locule, superposed. Fruiting carpels irregularly spaced on much elongated receptacle, ovoid, bluntly apiculate, 1–1.5 cm long, pale yellow tinged with purple, spotted with small distant warts, dehiscing dorsally by 2 leathery valves; seeds 1 or 2, subglobose or flat on one side, bright scarlet.

Fl.&Fr.: March - Aug.

Habitat: Subtropical forests to sholas, 1200 - 2300 m.

Distrib.: Idukki and Palakkad. Western Ghats. Endemic.

Use: Wood is pale yellowish or brownish, fine-grained and durable and is useful for carpentry work.

Note: *Michelia nilagirica* var. *walkeri* Hook.f. & Thomson occurs in Sri Lanka.

SCHISANDRACEAE

(N.P. BALAKRISHNAN)

Climbing or scrambling, woody shrubs. Leaves alternate, simple, exstipulate, entire or crenate-serrate, often pellucid-punctate, pinnately nerved. Flowers unisexual, small, axillary, in axils of fallen leaves or from old wood, usually solitary or fascicled, hypogynous. Perianth parts 9 - 15, spiral, imbricate in ca 3 rows with gradual transition from sepals to petals, fleshy. Receptacle globose or broadly columnar. Male flowers: Stamens 5 - 60, partially or wholly connate into a fleshy globose mass, spiral or in 1 or more whorls; filaments short; anthers small, basifixed, ext- or introrse, dehiscing longitudinally; connectives widened separating lobes, not apically produced. Female flowers: Carpels (12-) 20 - 30 (- 120), spiral, partially closed; ovules 2 - 5, ventral, ana- or campylotropous; style short; stigma ventrally decurrent. Fruitlets drupaceous or baccate, indehiscent, arranged in globose heads or elongate spikes, juicy; seeds 1 - 5; embryo minute, straight; endosperm copious, oily.

East Asia and N. America, 2 genera and 47 species, 2 and 2 in India and, 1 and 1 in Kerala.

KADSURA Juss.

Climbing shrubs, glabrous. Flowers solitary, axillary or fascicled in axils of scales near base of short lateral leafy branches or from old wood. Perianth parts 9 - 12, imbricate in ca 3 rows, white, yellow or reddish. Male flowers with 5 - 15 or more stamens in a spiral series, on a columnar receptacle, covering up to apex; filaments very short, free or subconnate, often fleshy; anthers free or partially within a fleshy head of connate filaments; lobes small, distant. Female flow-

ers with many densely imbricate ovaries; ovules 2-4; stigmas sessile. Fruits globose, a head of indehiscent fleshy 1-seeded carpels; seeds suspended.

India to Japan and SE. Asia, 22 species and 1 in India.

Literature: Vijayaraghavan, M.R. & Dhar, U. 1975. *Kadsura heteroclita* Microsporangium and pollen. *J. Arnold Arbor.* 56: 176 - 182.

Kadsura heteroclita (Roxb.) Craib, *Fl. Siam.* 1: 28. 1925; R.R. Rao & Hajra in B.D. Sharma & al., *Fl. India* 1: 189. 1993. *Uvaria heteroclita* Roxb., *Fl. Ind.* 2: 663. 1832. *Kadsura roxburghiana* Arn. in *Mag. Zool. Bot.* 2: 546. 1838; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 45. 1872; Dunn in Gamble, *Fl. Madras*: 10(7). 1915. *K. wightiana* Arn. in *Mag. Zool. Bot.* 2: 546. 1838; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 45. 1872.

Climbing, evergreen shrub, glabrous; branches densely white-lenticelled. Leaves oblong-lanceolate or broadly elliptic-ovate, rounded or cuneate at base, distantly dentate-serrate at margin when young, entire when mature, acute to subacute at apex, 9 - 14 x 3 - 5 cm, glabrous, pale beneath, soft and fleshy when fresh; lateral nerves 10-15 pairs, obscure above, distinct beneath; petioles slender, 1-1.5 cm long. Flowers ca 1.3 cm across, white or yellowish; pedicels stout, 1-1.5 cm long; bracteoles many, ciliate, passing into tepals. Tepals 9-12, imbricate in ca 3 rows, orbicular, concave; outer ones ca 7 x 5 mm; inner ones smaller. Male flowers: Stamens 12-15, rarely more; outer filaments very short, free; inner ones longer, connate, fleshy; anthers free or partially within a fleshy head of connate filaments. Female flowers: Carpels many, imbricate; ovules 2-4 in each ovary; stigma sessile. Fruit a globose head of many 1-seeded carpels, 2.5-3.5 cm across; pedicels elongate in fruit, 4-6 cm; ripe carpels oblong or globose, cuneate and more or less coalescing at base, faceted, 8-10 mm across, fleshy, scarlet-red, indehiscent; seeds orbicular, compressed, ca 8 mm, suspended.

Fl. & Fr.: Aug. - Dec.

Habitat: Subtropical moist evergreen forests, 900 - 1500 m.

Distrib.: Malabar, Western Ghats of Tamil Nadu, E. Himalayas and NE. India, South and SE. Asia.

Note: Inclusion is based on Dunn (*l.c.*). There is no specimen from Kerala.

ANNONACEAE

(M. MOHANAN)

Shrubs, small trees or woody climbers; branches glabrous or pubescent; bark and leaves sometimes aromatic. Leaves alternate, sometimes distichous, exstipulate, simple, entire, pinnately nerved; petioles very short. Inflorescences cymes, umbels or of solitary flowers, terminal or axillary, sometimes extra-axillary or from old wood; bracts and bracteoles present, often caducous. Flowers bi-, rarely unisexual, actinomorphic; pedicels often jointed in middle or near base. Sepals 3, free or slightly connate at base, valvate or slightly imbricate. Petals 6 in 2 whorls of 3 each, similar to dissimilar, free or slightly connate, imbricate or valvate, rarely saccate at base, fleshy to membranous, greenish purple, red, brown or yellow; outer ones usually larger; the inner smaller, sometimes absent. Stamens many, spiral on a prominent convex, conic, flat or hollow receptacle, rarely few; filaments short or absent; connectives often produced beyond anther lobes, generally oblong, truncate; anthers adnate, sessile or subsessile, 2 - 4-loculed; locules sublateral, extrorse. Carpels many, rarely few or 1, free or rarely connate with distinct stigmas, pilose or glabrous; ovules 1 - many, anatropous, basal or parietal; styles short or absent; stigmas clavate or capitate. Fruit an aggregate of sessile or stalked, distinct or rarely united, dehiscent or indehiscent, woody or fleshy fruitlets; seeds ovoid or ellipsoid, large, glabrous with copious ruminant endosperm; embryo minute.

Chiefly in Old World tropics, 122 genera and 1200 species, 24 and 120 in India and, 17 and 49 in Kerala (8 species in 4 genera cultivated).

Literature: Bowden, W.M. 1948. Chromosome number in *Annonaceae*. *Amer. J. Bot.* 35: 377 - 381. Corner, E.J.H. 1949. The *Annonaceous* seed and its four integuments. *New Phytol.* 48: 332 - 346. Hutchinson, J. 1923. The genera of *Annonaceae*. *Bull. Misc. Inform.* 1923: 241 - 261. Mitra, D. 1982. *Annonaceae*. Tribe - Uvarieae. *Fasc. Fl. India* 10: 1 - 21. Raven, P.H., Kyhos, D.W. & Cave, M.S. 1971. Chromosome numbers and relationships in *Annoniflorae*. *Taxon* 20: 479 - 483. Sinclair, J. 1953. Notes on Indian and Burmese *Annonaceae*. *Gard. Bull. Straits Settlements* 14: 45 - 48. Wyk, R.W. van der & Carrington, J.E. 1956. The anatomy and relationships of the *Annonaceae*. *Trop. Woods* 104: 1 - 24. Walker, J.W. 1971. Unique type of angiosperm pollen from the family *Annonaceae*. *Science* 172: 565 - 567. Walker, J.W. 1971. *Annonaceae*: An angiosperm family with a unique type of pollen. *Amer. J. Bot.* 58: 467. Walker, J.W. 1971. Pollen morphology, phytogeog-

raphy and phylogeny of *Annonaceae*. *Contr. Gray Herb.* 202: 1 - 130. Walker, J.W. 1971. Contributions to the pollen morphology and phylogeny of the *Annonaceae* 1. *Grana* 11: 45 - 54. Walker, J.W. 1972. Contributions to the pollen morphology and phylogeny of the *Annonaceae* 2. *J. Linn. Soc., Bot.* 65: 173 - 178. Walker, J.W. 1972. Chromosome numbers, phylogeny and phytogeography of the *Annonaceae* and their bearing on the (original) basic chromosome numbers of angiosperms. *Taxon* 21: 57 - 65.

Key to genera

- | | | |
|------|---|------------------------|
| 1a. | Plants climbers or stragglers | 2 |
| b. | Plants erect shrubs or trees (excluding some <i>Desmos</i> spp.) | 3 |
| 2a. | Plants climbing by means of leaf-opposed hooks; inner petals valvate in bud | |
| | | 3. Artabotrys |
| b. | Plants climbing by means of tendrils; inner petals imbricate in bud | 16. Uvaria |
| 3a. | Flowers solitary or in pairs | 4 |
| b. | Flowers usually more than 2, in cymes or fascicles | 5 |
| 4a. | Carpel solitary | 5. Cyathocalyx |
| b. | Carpels many | 6 |
| 5a. | Inner petals as long as or shorter than outer ones | 7 |
| b. | Inner petals longer than outer ones | 8 |
| 6a. | Carpels less than 12 | 9 |
| b. | Carpels more than 12 | 10 |
| 7a. | Carpels 1 - 6 | 11 |
| b. | Carpels more than 6 | 12 |
| 8a. | Stamens 6 - 12; carpels 3 - 15 | 11. Orophea |
| b. | Stamens more than 12; carpels more than 15 | 13 |
| 9a. | Stamens usually 24 | 14. Popowia |
| b. | Stamens many | 8. Meiogyne |
| 10a. | Outer petals distinctly clawed; ovules 1 or 2; fruitlets ovoid, reddish or orange | |
| | | 7. Goniotalamus |
| b. | Outer petals not clawed; ovules many; fruitlets moniliform, scarlet | 6. Desmos |
| 11a. | Receptacle hollow | 17. Xylopia |
| b. | Receptacle not hollow | 14 |
| 12a. | Ovule 1 in each ovary | 2. Annona |
| b. | Ovules many in each ovary | 15 |

- | | | |
|------|---|-----------------------|
| 13a. | Outer petals similar and almost as long as sepals | 16 |
| b. | Outer petals neither similar nor as long as sepals | 13. <i>Polyalthia</i> |
| 14a. | Fruitlets woody | 1. <i>Alphonsea</i> |
| b. | Fruitlets not woody | 15. <i>Sageraea</i> |
| 15a. | Carpels glabrous except at base | 4. <i>Cananga</i> |
| b. | Carpels pubescent throughout | 10. <i>Mitrephora</i> |
| 16a. | Inner petals saccate; stigmas sessile or subsessile | 9. <i>Milusa</i> |
| b. | Inner petals flat; stigmas neither sessile nor subsessile | 12. <i>Phaeanthus</i> |

1. ALPHONSEA Hook.f. & Thomson

Trees, rarely erect or climbing shrubs. Leaves thick-coriaceous, glabrous or pubescent. Flowers few in sessile or short-peduncled axillary, extra-axillary or leaf-opposed fascicles; bracts few-many, ovate-triangular, pubescent outside, glabrous inside. Sepals 3, ovate, free or shortly connate at base, valvate in bud, pubescent or tomentose outside, glabrous inside. Petals 6 in 2 series, ovate, saccate at base, valvate in bud; outer ones spreading, pubescent outside, puberulous inside except at base; the inner similar but smaller. Receptacle cylindrical or hemispheric. Stamens 15–50, ovate or 3-angled; connectives slightly prolonged but not concealing anthers. Carpels (1-) 3–10, free, pubescent; ovules many along ventral suture; stigmas sessile or almost sessile, capitate or subglobose. Fruitlets globose, tomentose or glabrous, woody or succulent, many-seeded.

China to Indomalaysia, ca 30 species, 5 in India and 1 in Kerala.

Alphonsea sclerocarpa Thwaites, Enum. Pl. Zeyl.: 11. 1858; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 89. 1872; Dunn in Gamble, Fl. Madras: 23(16). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 211. 1993. *A. zeylanica* sensu Sivar. & P. Mathew, Fl. Nilambur: 36. 1997, non Hook.f. & Thomson 1855.

Tree, 7–10 m high; branchlets puberulous when young, glabrous when mature. Leaves elliptic or ovate, cuneate at base, acute or obtuse at apex, 4–11 x 1.5–4.5 cm, coriaceous, glabrous, shining above. Flowers 4 or 5 together in extra-axillary fascicles, yellow; bracts many, minute, ovate-triangular, ca 1 mm long, pubescent outside. Peduncles 3–4 mm long, densely pubescent. Sepals 3, ovate, 1–2 mm long, slightly connate at base, pubescent outside, glabrous inside, valvate in bud. Outer petals ovate, ca 6 x 4 mm, obtuse and recurved at apex, densely pubescent outside, puberulous inside, valvate in bud; the inner slightly

smaller, acuminate, puberulous outside, glabrous inside. Stamens 15 - 20 in 2 or 3 rows, ovate or 3-angled, 0.5 - 1.5 mm long; connectives small, obtuse. Carpels 1 - 5, sessile, oblong, ca 2 mm long, densely pubescent; ovules many, on ventral suture; stigmas sessile, capitate. Fruitlets globose, ca 2.5 cm, hard and woody, densely tomentose; stalks ca 1 cm long, woody; seeds 3 - 6.

Fl. & Fr.: March - Sept.

Habitat: Dry deciduous forests, rare.

Distrib.: Malappuram and Malabar (Dunn, *l.c.*). Andhra Pradesh and Tamil Nadu. Sri Lanka.

Excluded species

Alphonsea zeylanica Hook.f. & Thomson is excluded following Huber (in Dassan., *Rev. Handb. Fl. Ceylon* 5: 29, 1985) who considered it endemic to Sri Lanka and stated that this species has been erroneously reported from S. India due to confusion with *A. sclerocarpa* Thwaites.

2. ANNONA L.

Trees or shrubs. Flowers bisexual, axillary, leaf-opposed or terminal, solitary or fascicled. Sepals 3, small, valvate. Petals 6 (3 + 3), valvate, coriaceous; outer ones lanceolate or ovate, concave at base, fleshy; the inner rudimentary or absent. Stamens numerous; anthers narrow; connectives ovoid at top. Carpels many, subconnate; ovule 1, erect; style oblong. Ripe carpels confluent into a many-loculed ovoid or globose fruit, sometimes with spines; seeds many, enclosed by a membranous aril.

India, Africa, C. & S. America and the West Indies, 137 species and 5 in India.

Literature: Thakur, D.R. & Singh, R.N. 1965. Studies on pollen morphology, pollination and fruit set in some *Annona*. *Indian J. Hort.* 22: 10 - 19.

Key to species

- | | | |
|-----|---|-----------------------|
| 1a. | Leaves glabrous; petals 6 | 2 |
| b. | Leaves hairy beneath at least on nerves; petals 3 | 3 |
| 2a. | Leaves obovate; petioles 3 - 7 mm long; fruits spiny | 3. <i>A. muricata</i> |
| b. | Leaves elliptic or ovate; petioles 1 - 2 cm long; fruits smooth | 2. <i>A. glabra</i> |

- | | | |
|-----|--|-------------------------|
| 3a. | Leaves 4 - 9 cm wide, velvety beneath | 1. <i>A. cherimola</i> |
| b. | Leaves 2 - 5 cm wide, sparsely hairy beneath | 4 |
| 4a. | Petals to 2 cm long; fruits smooth | 4. <i>A. reticulata</i> |
| b. | Petals to 3 cm long; fruits furrowed | 5. <i>A. squamosa</i> |

1. ***Annona cherimola*** Mill., Gard. Dict. ed. 8, : No. 5. 1768; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 206. 1993.

Erect or spreading tree, 6 - 7 m high; young branches greyish-soft-pubescent. Leaves ovate to ovate-lanceolate, rarely obovate or elliptic, rounded at base, obtuse or subacute at apex, 6 - 25 x 4 - 9 cm, dull, sparsely pubescent above, velvety beneath; lateral nerves 11 - 14 pairs; petioles 6 - 12 mm long. Flowers solitary or, 2 or 3 together on short axillary peduncles, fragrant; pedicels 1 - 1.3 cm long, tomentose. Sepals 3 - 4 mm long, tomentose outside, glabrous inside. Outer petals linear-oblong, 1.5 - 3 cm long, greenish with brown or yellowish tomentum outside; the inner minute, scale-like, ovate to deltoid, pale yellow or whitish. Stamens 1.2 - 1.7 mm long; connectives convex at tip. Carpels numerous, linear-oblong, ca 1.5 mm long, strigose; stigmas sessile, spatulate. Fruits variable, globose, ovoid or conic, 7 - 20 x ca 15 cm, with conic tubercles or nearly smooth; pulp white, moderately juicy, subacidic in flavour; seeds numerous, brown.

Fl.: April - July *Fr.*: Aug. - Sept.

Native to the Andes of Peru and Ecuador. Cultivated throughout tropics and subtropics.

Note: The specific epithet *cherimola* is a modification of the Peruvian name cherimoya.

2. ***Annona glabra*** L., Sp. Pl.: 537. 1753; Kadavil & Antony in J. Swamy Bot. Club 5: 117. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 206. 1993. *A. palustris* L., Sp. Pl. ed. 2.: 757. 1762.

Mal.: *Kattutha*

Tree, 5 - 10 m high; branchlets glabrate. Leaves elliptic or elliptic-ovate, obtuse or rounded at base, acute, rarely obtuse at apex, 6 - 20 x 3 - 8 cm, thin-coriaceous, glabrous; lateral nerves 8 - 12 pairs; petioles 1 - 2 cm long. Flower solitary, extra-axillary, internodal or terminal; pedicel ca 2 cm long, glabrous.

Sepals ovate, 3 - 4 x ca 3 mm, glabrous. Petals 6, broadly ovate; outer ones obtuse, 1.5 - 3 x 1.3 - 2.5 cm, greenish and glabrous outside, yellow and puberulous inside; the inner smaller, minutely puberulous on both sides. Stamens 3 - 4 mm long; connectives slightly convex at apex. Carpels connate. Fruits ovoid, rounded at apex, 5 - 8 cm across, smooth, yellow to orange with yellow pulp; seeds 13 - 15 mm long, reddish brown.

Fl. & Fr.: Jan. - April.

Habitat: Banks of rivers and backwaters.

Distrib.: Alappuzha and Kottayam; naturalized. Tropical and subtropical America and W. Africa.

3. *Annona muricata* L., Sp. Pl.: 536. 1753; Rama Rao, Fl. Pl. Travancore: 9. 1914; J. Sinclair in Gard. Bull. Straits Settle. 14: 476, f. 46. 1955; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 206. 1993.

Mal.: *Mullaathi, Mullenchaka*

Tree, 5 - 12 m tall; branchlets pubescent when young, glabrous when old. Leaves obovate, rounded at base, abruptly short-acuminate at apex, 7 - 15 x 3 - 6.5 cm, glabrous above, sparsely pubescent beneath; lateral nerves 8 - 12 pairs; petioles 3 - 7 mm long. Flower solitary, axillary, terminal or leaf-opposed, greenish yellow; pedicel 1.2 - 1.5 cm long, glabrous with a few minute bracts at base or a little above. Sepals ovate, ca 4 mm long, puberulous outside, glabrous inside, persistent. Outer petals broadly ovate, subcordate at base, short-acuminate at apex, 2 - 3.5 x 1.5 - 2.5 cm, sparsely puberulous outside, glabrous inside; the inner slightly smaller, clawed, obtuse. Stamens linear, 4 - 5 mm long; filaments broad at base; connectives capitate at apex. Carpels many, oblong, ca 4 mm long, pubescent; ovule 1; stigmas conic. Fruits irregularly ovoid, 10 - 25 x 11 - 15 cm, spiny, dark green with white pulp; seeds blackish brown.

Fl.: April - July *Fr.*: Aug. - Nov.

Native to the W. Indies. Commonly cultivated for its fruit.

4. *Annona reticulata* L., Sp. Pl.: 537. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 78. 1872; Rama Rao, Fl. Pl. Travancore: 8. 1914; Dunn in Gamble, Fl. Madras: 20(14). 1915; Manilal & Sivar., Fl. Calicut: 27. 1982; Nicolson & al. in Regnum Veg. 119: 50. 1988; V.S. Ramach. & V.J. Nair, Fl.

Cannanore: 37. 1988; Vajr., Fl. Palghat: 49. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 207. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 44. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 52. 1996.

Mal.: *Manilanilam, Parankippazha, Ramachitha*

Tree, to 12 m tall; branchlets grey-sericeous when young, glabrous later. Leaves lanceolate, acute or obtuse at base, long-acuminate at apex, 9 - 20 x 1.5 - 2.5 cm, pubescent on both surfaces when young, glabrous when mature except nerves beneath; lateral nerves 9 - 18 pairs; petioles 8 - 12 mm long. Flowers 2 or 3 together in extra-axillary cymes, green; pedicels ca 2 cm long; bracts basal and median. Sepals ovate, 2 - 3 mm long, pubescent outside, glabrous inside. Petals 3, linear-oblong, obtuse, 1.5 - 2 cm long, puberulous on both sides. Stamens 1 - 1.3 mm long; connectives ovoid at apex. Carpels oblong, ca 1 mm long, pubescent; ovule 1; styles oblong; stigmas entire. Fruits globose or ovoid, ca 10 cm across, smooth, yellow with yellow pulp; seeds black.

Fl.: March - April *Fr.*: June - Sept.

Native to the W. Indies. Commonly cultivated for its fruit.

Use: All parts of the plant are used in various Ayurvedic medicines.

5. *Annona squamosa* L., Sp. Pl.: 537. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 78. 1872; Rama Rao, Fl. Pl. Travancore: 8. 1914; Dunn in Gamble, Fl. Madras: 20(14). 1915; Manilal & Sivar., Fl. Calicut: 27. 1982; Nicolson & al. in Regnum Veg. 119: 50. 1988; Vajr., Fl. Palghat: 49. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 207. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 44. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 52. 1996; Sivar. & P. Mathew, Fl. Nilambur: 45. 1997.

Mal.: *Aathi, Amirthunka, Athamaram, Seethapazham*

Tree, 3 - 6 m high; branches glabrous or slightly greyish-white-hairy when young. Leaves elliptic-lanceolate or oblong, obtuse or rounded at base, acute or obtuse at apex, 7 - 17 x 3 - 5 cm, thin-coriaceous, glabrous or sparsely pubescent; lateral nerves 5 - 10 pairs; petioles 0.5 - 1.5 cm long. Flowers solitary or 2 - 4 in leaf-opposed cymes; pedicels 1 - 2 cm long, glabrous or pubescent; bracts 1 - 3 mm long, pubescent. Sepals broadly ovate-triangular, 2 - 3 x 0.5 - 0.7 mm, glabrous or pubescent. Outer petals linear-oblong, 15 - 30 x 3 - 7 mm, pubes-

cent, green with purple base; the inner reduced to scales or absent. Stamens ca 1 mm long; connectives convex. Carpels ovoid, free or subconnate, ca 1 mm long, pubescent; ovule 1; styles oblong; stigmas entire. Fruits globose or ovoid, 5 - 10 x 5 - 7 cm, greenish yellow with white pulp; seeds ca 14 x 8 mm, blackish brown.

Fl.: March - May *Fr.*: July - Nov.

Native to the W. Indies. Widely cultivated throughout the tropics for its fruit.

Use: All parts of the plant are used in various Ayurvedic preparations.

3. ARTABOTRYS R. Br.

Woody, glabrescent shrubs, climbing by laterally compressed hooked peduncles; young branches ferruginous-pubescent. Leaves medium-sized, entire, acuminate at apex, thin-coriaceous, glabrous. Flowers solitary, sessile or in peduncled cymes opposite leaves, pale yellow, fragrant; bracts minute, ferruginous-pubescent on both sides. Sepals 3, ovate, connate at base, pubescent on both sides, valvate in bud. Petals 6 in 2 series, valvate in bud, often connate at base, curved over stamens and carpels and then spreading, oblong, acute at apex, flat, coriaceous, pubescent on both sides except at basal cavity; the inner slightly larger. Stamens numerous, closely arranged, narrowly cuneate; connectives broad, slightly convex at apex concealing anthers. Carpels numerous, glabrous or villous; ovules 2 in each carpel, erect, collateral; styles fusiform, spreading. Fruitlets 10 - 20, sessile, ellipsoid or obovoid, fleshy, blackish, indehiscent; seeds 2, ovoid, brown.

Old World tropics, ca 100 species, 6 in India and 2 in Kerala (1 cultivated).

Key to species

- 1a. Flowers mostly solitary or paired; sepals acute at apex; petals to 3 cm long; plant cultivated
1. *A. hexapetalus*
- b. Flowers more than 2 in a cyme; sepals caudate-acuminate at apex; petals 4 - 5 cm long; plant wild
2. *A. zeylanicus*

1. *Artabotrys hexapetalus* (L.f.) Bhandari in Baileya 12: 149. 1964; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 251. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 45. 1994. *Annona hexapetala* L.f., Suppl. Pl.: 270. 1782. *Artabotrys odoratissimus* R. Br. in Edwards, Bot. Reg. 5: t. 423 1820;

Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 54. 1872; Rama Rao, Fl. Pl. Travancore: 4. 1914; Dunn in Gamble, Fl. Madras: 12(10). 1915; Manilal & Sivar., Fl. Calicut: 27. 1982.

Mal.: *Madanakameswari, Manorangini*

Climbing shrub; branchlets slightly puberulous. Leaves elliptic-oblong, acute at base, short-acuminate at apex, 6 - 15 x 2 - 4.5 cm, glabrous; lateral nerves 6 - 18 pairs. Flowers solitary or paired on terminal or leaf-opposed hooked peduncles, ca 2 cm across, fragrant; pedicels ca 1 cm long, pubescent. Sepals ovate, recurved, 5 - 7.5 x 5 - 6 cm, pubescent. Petals lanceolate, saccate or concave below; outer ones 2 - 3 x 0.5 - 0.7 cm; the inner slightly smaller, appressed-villous. Stamens many; anthers beaked concealing anther lobes. Carpels many, oblong, pubescent or glabrous; ovules 2; stigmas clavate. Fruitlets 14 - 20, ovoid, apiculate, 3 - 4 cm long, glabrous; seeds brown.

Fl. & Fr.: Almost throughout the year.

Commonly cultivated for its flower. China, Indonesia and Sri Lanka.

2. *Artabotrys zeylanicus* Hook.f. & Thomson, Fl. Ind.: 128. 1855 & in Hook.f., Fl. Brit. India 1: 54. 1872; Bedd., Icon. Pl. Ind. Orient.: 1. 48. 1868 - 1874; Rama Rao, Fl. Pl. Travancore: 5. 1914; Dunn in Gamble, Fl. Madras: 14(10). 1915; Manilal & Sivar., Fl. Calicut: 26. 1982; Manilal, Fl. Silent Valley: 2. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 37. 1988; Vajr., Fl. Palghat: 45. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 253. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 45. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 26. 1996; Sivar. & P. Mathew, Fl. Nilambur: 36. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 51. 2002.

Straggling shrub; branchlets glabrous. Leaves elliptic-lanceolate or oblong-cuneate at base, abruptly acuminate at apex, 9 - 18(-25) x 4 - 8.5 cm, shining above, glabrous; lateral nerves 8 - 16 pairs; petioles 5 - 8 mm long. Flowers 4 - 6 together from a hook, 4 - 5 cm long, brown-pubescent, fragrant; peduncles ca 4 mm long, opposite leaves; pedicels 1 - 2 cm long. Sepals 3, orbicular or ovate, caudate-acuminate at apex, ca 6 x 4 mm, pubescent. Outer petals oblong-lanceolate, acute at apex, 4 - 5 x 0.5 - 0.8 cm, short-clawed, pubescent on both sides; the inner almost as long as the outer or slightly shorter and narrower. Receptacle convex or flat, villous. Stamens many, 1.5 - 2 mm long; connectives broad, obtuse

at apex. Carpels numerous, oblong; styles recurved. Fruitlets rounded-obovoid, apiculate, 2-3 cm long, pubescent; seeds ca 13 mm long, finely wrinkled, dark brown.

Fl. & Fr.: Dec. - Aug.

Habitat: Evergreen forests at low elevations, common.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Adjoining W. Ghats of Karnataka and Tamil Nadu. Sri Lanka.

Excluded species

Rama Rao (*l.c.*) recorded *Artabotrys suaveolens* (Blume) Blume from Paruthipally (Thiruvananthapuram). But then, there is no specimen.

4. CANANGA (A. DC.) Hook.f. & Thomson, nom. cons.

Tall trees. Leaves large, elliptic-ovate or oblong-lanceolate. Flowers bisexual, solitary, fascicled or in short axillary peduncles. Sepals 3, ovate or 3-angled, valvate. Petals 6 (3 + 3), valvate, flat, strap-shaped, subequal or the inner smaller, yellow, fragrant. Stamens many, ca 3 mm long; anthers linear, extrorse; connectives produced to an acute end. Carpels many, oblong; ovules numerous, 2-seriate; styles slender; stigma subcapitate. Ripe carpels stalked or not, oblong, pulpy; seeds pitted, ending in spinous processes into ruminant endosperm.

Tropical Asia to Australia, 2 species and 1 in India.

Cananga odorata (Lam.) Hook.f. & Thomson, Fl. Ind.: 130. 1855 & in Hook.f., Fl. Brit. India 1: 56. 1872; Rama Rao, Fl. Pl. Travancore: 5. 1914; Manilal & Sivar., Fl. Calicut: 27. 1982; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 254. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 45. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 34. 1996. *Uvaria odorata* Lam., Encycl. 1: 595. 1785.

Mal.: *Kattushembagam*

Tree, 20 - 25 m tall; young branchlets puberulous. Leaves elliptic or oblong-lanceolate, obtuse, acute or truncate at base, acuminate at apex, 15-21 x 5-7.5 cm, puberulous above on midnerve, glabrescent beneath; lateral nerves 8-10 pairs; petioles ca 1.5 cm long, grooved. Flowers few, in axillary peduncled cymes, yellowish green, fragrant; peduncles woody, to 1.8 cm long, pubescent;

pedicels 3 - 3.5 cm long, pubescent; bracts 3-angled, 1 - 2 mm long. Sepals shortly connate at base, ovate, acute, reflexed at apex, ca 8 x 5 mm, pubescent, valvate in bud. Outer petals oblong-lanceolate, acute, 5 - 6 x 1 - 1.3 cm, grey-pubescent; the inner shorter and narrower. Receptacle convex, pubescent. Stamens ca 3 mm long, closely arranged; connectives conic, acuminate at apex. Carpels oblong, 2.5 - 3 mm long, glabrous except at base; ovules many; styles short, slender. Fruitlets ovoid or globose, rounded at both ends, 1.5 - 2.5 x ca 1.5 cm, glabrous; seeds 2 - 12, transversely compressed, yellowish brown; stalks 1 - 2 cm long.

Fl. & Fr.: Almost throughout the year.

Commonly cultivated in gardens for the fragrant flower. Tropical Asia to Australia.

Uses: Flower is used in the preparation of a hair oil. Decoction of bark is used against rheumatism, ulcers, fever etc.

5. CYATHOCALYX Champ. ex Hook.f. & Thomson

Medium-sized or large trees; branchlets striate, minutely puberulous when young, glabrate when mature. Leaves large, elliptic, ovate or ovate-lanceolate, thin-coriaceous, glabrous when mature. Flowers solitary or paired in terminal or leaf-opposed fascicles; bracts small, ovate. Sepals connate into a cup, valvate in bud. Petals 6 in 2 series, ovate-lanceolate, unequal with base connivent and constricted above stamens and carpels, spreading above, valvate in bud. Stamens numerous, closely arranged, narrowly cuneate; connectives broad, flat, truncate, concealing anthers. Carpels 1, very rarely 2 or 3 with many ovules; styles short; stigmas large, disc-shaped. Fruits ovoid, rounded at both ends, glabrous, fleshy; seeds transversely compressed.

Indomalaysia, 15 species, 2 in India and 1 in Kerala.

Cyathocalyx zeylanica Hook.f. & Thomson, Fl. Ind.: 127. 1855 (as *zeylanicus*) & in Hook.f., Fl. Brit. India 1: 53. 1872; Bourd., Forest Trees Travancore: 4. 1908; Rama Rao, Fl. Pl. Travancore: 4. 1914; Dunn in Gamble, Fl. Madras: 13(9). 1915; Vajr., Fl. Palghat: 46. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 255. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 45. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 26. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 52. 2002.

Tree, 25 - 30 m tall; young branches drooping, pubescent, glabrous when

mature; bark smooth, dark brown; wood yellowish white. Leaves oblong-lanceolate, cuneate at base, abruptly acuminate at apex with ca 2.5 cm long acumen, 15 - 30 x 4.5 - 5 cm, coriaceous, glabrous on both surfaces, shining above; lateral nerves 12 - 15 pairs, oblique, incurved; petioles 1 - 1.3 cm long. Flowers 1 - 3 together in terminal or leaf-opposed fascicles, pale green; pedicels 1 - 2 cm long. Sepals connate into a subentire truncate or minutely 3 - 5-toothed cup, ca 6 mm across, pubescent. Outer petals ovate-lanceolate, constricted at base, acuminate at apex, 2 - 4 x 6 - 9 mm, golden-tomentose outside, puberulous inside; the inner equal or slightly longer and narrower than the outer, connate at base, constricted, covering stamens and carpels, pale white. Receptacle flat with a cavity in centre, glabrous. Stamens numerous, narrowly cuneate, 1.5 - 2.3 mm long; connectives broad, concealing anthers. Carpel 1, glabrous; ovules many; style short; stigma disc-shaped, dark red. Fruits ovoid, slightly constricted in middle, ca 6 x 4 cm, glabrous or slightly pubescent, yellowish turning black; seeds many, pale brown.

Fl.: April - May *Fr.*: June.

Habitat: Evergreen forests, 500 - 600 m, common.

Distrib.: Idukki, Kollam, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Karnataka (S. Canara) and Tamil Nadu (Coimbatore). Sri Lanka.

Use: Bark yields a strong fibre.

6. DESMOS Lour.

Trees or scandent shrubs. Leaves membranous or coriaceous, glabrous or pubescent. Flowers solitary or paired, large or medium-sized, axillary or extra-axillary, rarely terminal; bracts ovate or narrowly lanceolate, glabrous or pubescent outside, glabrous inside; pedicels shorter than flowers. Sepals free or connate at base, pubescent outside, glabrous inside, valvate in bud. Petals 6 in 2 series, free, ovate or lanceolate, flat, sparsely pubescent, valvate in bud; the inner shorter and narrower. Stamens numerous, linear or narrowly wedge-shaped; connectives broad, truncate or obtuse, concealing anthers. Carpels 20 - 60, pubescent; ovules many; styles short or absent; stigmas capitate. Fruitlets moniliform, apiculate, glabrate, succulent, short-stalked.

Indomalaysia to the W. Pacific, ca 30 species, 8 in India and 3 in Kerala.

Literature: Nguyen, T.B. 1974. Critical notes on some species of the genus *Desmos* Lour. (*Annonaceae*). *Bor. Žurn. (Moscow & Leningrad)* 59(12): 1766 -1780.

Key to species

- | | | | |
|-----|--|----|------------------------|
| 1a. | Erect shrub | 2 | <i>D. lawii</i> |
| b. | Climbing shrubs | 2 | |
| 2a. | Pedicels 2 - 2.5 cm long | 3. | <i>D. viridiflorus</i> |
| b. | Pedicels 5 - 5.5 cm long; plant cultivated (?) | 1. | <i>D. chinensis</i> |

1. *Desmos chinensis* Lour., Fl. Cochinch.: 352. 1790; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 257. 1993. *Unona discolor* Vahl, Symb. Bot. 2: 63, t. 36. 1791; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 59. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 51. 1868 - 1874; Rama Rao, Fl. Pl. Travancore: 5. 1914.

Scandent shrub; branchlets pubescent when young, glabrous later. Leaves elliptic, ovate or oblong-lanceolate, obtuse, truncate, rarely slightly cordate at base, acute or acuminate at apex, 6 - 9 (- 18) x 2 - 4.5(- 7) cm, membranous, glabrous above, pubescent beneath; lateral nerves 7 - 12 pairs; petioles ca 7 mm long, pubescent. Flowers extra-axillary or leaf-opposed, greenish yellow, fragrant; pedicels ca 5.5 cm long, slender, pubescent; bracts ovate, in middle of pedicel. Sepals ovate, acuminate, ca 7 x 5 mm, pubescent. Outer petals elliptic-lanceolate, acute, 3 - 8.5 x 1 - 1.5 cm, pubescent; the inner oblong-lanceolate, acute, 2 - 3.2 x 0.8 - 1 cm, pubescent. Receptacle convex, brown-pubescent. Stamens oblong, ca 1.5 mm long; connectives obtuse. Carpels oblong, ca 2 mm long, densely brown-tomentose; stigmas clavate, grooved. Fruitlets 1 - 1.4 cm long, ovoid, beaked; stalks to 1 cm long.

Fl. & Fr.: April - Oct.

Distrib.: Kannur and Kollam (Rama Rao, *l.c.*). Native to SE. Asia, grown in gardens. Assam, Maharashtra, Meghalaya, Mizoram, Orissa, Sikkim, Tamil Nadu and W. Bengal.

Use: Decoction of root is used in dysentery.

2. *Desmos lawii* (Hook.f. & Thomson) Safford in Bull. Torrey Bot. Club 39: 506. 1912; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 38. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 261. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 46. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 27. 1996; Sivar. & P. Mathew, Fl. Nilambur: 41. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 53. 2002. *Unona lawii* Hook.f. & Thomson, Fl. Ind.: 132. 1855 & in Hook.f., Fl. Brit. India 1: 59. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 73. 1868 - 1874; Rama Rao, Fl.

Pl. Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 15(10). 1915.

Shrub, 3 - 4 m high; branchlets pubescent when young, glabrous when old. Leaves oblong-lanceolate, rounded at base, acute or acuminate at apex, 4 - 11 x 1.5 - 3.5 cm, glabrous above, pubescent beneath; lateral nerves 7 - 9 pairs; petioles ca 5 mm long, pubescent. Flower solitary, extra-axillary, yellow; pedicel 2.5 - 4.5 cm long, sparsely pubescent with a ca 4 x 1.5 mm bract in middle. Sepals lanceolate, acuminate, ca 0.8 x 0.4 cm. Petals oblong, 5 - 5.5 x 0.3 - 0.4 cm, almost equal or the inner slightly shorter and narrower, sparsely pubescent, yellowish green. Receptacle convex, glabrous. Stamens ca 1.5 mm long; connectives truncate at apex. Carpels oblong, ca 1.5 mm long, densely pubescent; ovules 2 or 3; stigmas capitate. Fruits ellipsoid, 7 - 9 x 4 - 5 mm, beaked, glabrous, brown; stalks ca 1 cm long.

Fl.: Jan. - April *Fr.*: May - Nov.

Habitat: Evergreen forests, common.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Thiruvananthapuram, Thrissur and Wynad. Western Ghats. Sri Lanka.

3. *Desmos viridiflorus* (Bedd.) Safford in Bull. Torrey Bot. Club 39: 506. 1912; A.N. Henry & Chithra in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 24. 1987; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 262. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 27. 1996. *Unona viridiflora* Bedd., Icon. Pl. Ind. Orient.: t. 158. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 60. 1872; Rama Rao, Fl. Pl. Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 15(10). 1915.

Large, climbing shrub; branches densely pubescent when young, glabrous when old, lenticelled. Leaves oblong-lanceolate, obtuse at base, acuminate at apex, 6 - 15 x 2 - 4 cm, pubescent on midnerve on both surfaces. Flower solitary, leaf-opposed; pedicel pubescent with a foliaceous ovate-acuminate ca 1 x 0.8 cm densely pubescent bract in middle. Sepals narrowly ovate, acuminate, 1 - 1.5 x 0.5 - 0.7 cm, pubescent. Outer petals oblong-lanceolate, acuminate, ca 6.5 x 1.2 cm, pubescent, yellowish green; the inner narrower. Stamens 1.5 - 2 mm long; connectives broad. Carpels oblong, ca 2.5 cm long, densely pubescent. Fruit not seen.

Fl.: March - June *Fr.*: Sept. - Jan.

Habitat: Evergreen forests.

Distrib.: Idukki, Palakkad and Thrissur. Western Ghats of Tamil Nadu (Coimbatore). Endemic and endangered.

7. GONIOTHALAMUS (Blume) Hook.f. & Thomson

Trees or shrubs; branchlets puberulous or strigose when young, almost glabrous when mature. Leaves coriaceous or membranous, glabrous or with scattered hairs. Flowers solitary or paired in axillary or extra-axillary peduncles; bracts basal, ovate, elliptic or obovate, usually pubescent outside. Sepals 3, free or slightly connate at base, ovate, obtuse or acuminate, valvate in bud. Petals 6 in 2 series, valvate in bud; outer ones thick, flat, spreading, puberulous outside, sparsely puerulous or glabrous inside; the inner shorter, short-clawed, connate into a vaulted cap over stamens and carpels. Stamens numerous, closely arranged, linear-oblong; anther lobes remote, hidden by connectives produced into truncate or oblong processes. Carpels many, pubescent; ovules 1 or 2 (rarely 4), sub-basal; styles simple, entire or 2-fid, glabrous. Fruitlets many, 1- or 2-seeded, indehiscent.

Indomalesia, ca 100 species, 10 in India and 5 in Kerala.

Literature: Nguyen, T.B. 1974. On the taxonomy of the genus *Goniothalamus* (Bl.) Hook.f. & Thoms. I. *Bot. Žurn. (Moscow & Leningrad)* 39: 347 - 555. Nguyen, T.B. 1974. On the taxonomy of the genus *Goniothalamus* (Bl.) Hook.f. & Thoms. II. *Bot. Žurn. (Moscow & Leningrad)* 39: 660 - 672.

Key to species

- 1a. Styles simple, subulate 2
- b. Styles 2-fid 3
- 2a. Pedicels ca 3.5 cm long; connectives of anthers produced into a long subulate beak 2. *G. rhynchantherus*
- b. Pedicels ca 2.5 cm long; connectives of anthers broadly convex at apex 3. *G. thwaitesii*
- 3a. Leaves obovate-oblong; inner petals glabrous except in upper portion 5. *G. wynaadensis*
- b. Leaves ovate, oblong or lanceolate; inner petals densely pubescent 4
- 4a. Leaves to 16 cm long; flowers purple with yellow tinge; outer petals ca 2 cm long 4. *G. wightii*

- b. Leaves to 24 cm long; flowers yellowish green; outer petals ca 1.5 cm long

1. *G. cardiopetalus*

1. ***Goniothalamus cardiopetalus*** (Dalzell) Hook.f. & Thomson, Fl. Ind.: 107. 1855 & in Hook.f., Fl. Brit. India 1: 75. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 62. 1868-1874; Dunn in Gamble, Fl. Madras: 18(13). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 38. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 232. 1993; Sivar. & P. Mathew, Fl. Nilambur: 37. 1997. *Polyalthia cardiopetala* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 2: 39. 1850.

Shrub or small tree, 3-5 m high; young branches puberulous, glabrous when old. Leaves oblong, acute at base, acuminate at apex, 10-24 x 3.5-7.5 cm, coriaceous, glabrous, brownish beneath; lateral nerves 8-15 pairs, very prominently raised beneath, looping at margin; petioles ca 1 cm long. Flower solitary, axillary, yellowish green; pedicel ca 1 cm long, glabrous; bracts basal, minute. Sepals 3, suborbicular, ca 6 x 7 mm, brownish-pubescent on both sides. Outer petals elliptic-lanceolate, acute, ca 1.5 x 1 cm, clawed, densely pubescent on both sides; the inner 3-angled, ca 1 x 1 cm, clawed, densely yellowish-pubescent on both sides. Stamens numerous, ca 3 mm long; connectives produced into an obtuse apex. Carpels oblong, ca 2 mm long, densely brown-pubescent; styles 2-3 mm long, 2-fid. Fruitlets ellipsoid, ca 1.5 x 0.7 cm.

Fl. & Fr.: Dec. - July.

Habitat: Evergreen forests, rare.

Distrib.: Kannur, Kasaragod, Malappuram and Wynad (Dunn, *l.c.*). Western Ghats of Karnataka and Tamil Nadu. Endemic.

Use: Wood is used for posts.

2. ***Goniothalamus rhynchantherus*** Dunn in Bull. Misc. Inform. 1914: 182. 1914 & Gamble, Fl. Madras: 19(13). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 237. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananthapuram: 46. 1994; N. Mohanan & Sivadas, Fl. Agasthyamala: 54. 2002; Augustine in Indian J. Forest. 25: 339. 2002.

Tree, 10-15 m tall; branchlets glabrous. Leaves ovate or oblong, acute at base, obtusely acuminate at apex, 8-17 x 3-5 cm, coriaceous, glabrous; lateral nerves faint; petioles ca 1 cm long. Flower solitary, axillary, yellowish green; pedicels ca 3.5 cm long, glabrous; bracts 2-4, small, pubescent. Sepals 3, ovate, acute, ca

8 x 6 mm, brown-tomentose. Outer petals ovate-oblong, acute, ca 1.5 x 0.7 cm, brown-tomentose; the inner obovate, acute, 8 - 10 x 0.3 - 0.5 mm, tomentose on both sides. Stamens ca 4 mm long, densely hairy; connectives produced into a long subulate beak. Carpels oblong, ca 5 mm long, strigose; ovules 2; styles linear; stigmas pointed. Fruitlets obovate, obtuse, ca 1 x 0.5 cm, glabrous; stalks 2 - 3 mm long.

Fl.: June - Sept. *Fr.*: Oct. - Jan.

Habitat: Evergreen forests, 500 - 1600 m, rare.

Distrib.: Idukki and Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

3. *Goniothalamus thwaitesii* Hook.f. & Thomson, *Fl. Ind.*: 106. 1855 & in Hook.f., *Fl. Brit. India* 1: 72. 1872; Bedd., *Icon. Pl. Ind. Orient.*: t. 58. 1868 - 1874; Bourd., *Forest Trees Travancore*: 88. 1908; Rama Rao, *Fl. Pl. Travancore*: 7. 1914; Dunn in Gamble, *Fl. Madras*: 19(13). 1915; Vajr. in S.K. Jain & Sastry, *Indian Pl. Red Data Book*: 9. 1984; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 239. 1993; N. Mohanan & Sivad., *Fl. Agasthyamala*: 54. 2002.

Tree, 6 - 20 m tall; young branches appressed-yellowish-pubescent, glabrous when old. Leaves elliptic or oblong-lanceolate, cuneate at base, obtusely acuminate at apex, 10 - 16 x 4 - 5 cm, thin-coriaceous, glabrous, shining above; midnerve raised beneath; lateral nerves 8 - 12 pairs, faint, looping at margin; petioles ca 1 cm long, slightly swollen. Flowers axillary, solitary or rarely paired, greenish yellow; pedicels ca 2.5 cm long; bracts basal, caducous. Sepals free or slightly connate at base, valvate, broadly ovate, acute or obtuse at apex, ca 5 x 4 mm, sparsely pubescent outside, glabrous inside. Outer petals ovate-lanceolate, tapering to an obtuse tip, short-clawed at base, ca 2 x 0.6 cm, appressed-yellowish-brown-pubescent on both sides, rarely subglabrous; the inner 3-angled, 5 - 9 mm long, forming an obtuse cone. Stamens closely arranged, linear, 0.8 - 1.5 mm long; connectives broadly convex at apex. Carpels numerous; styles filiform; stigmas simple, subulate. Fruitlets sessile or short-stalked, ovoid, obtuse or rounded at apex, ca 1 cm long, 1-seeded.

Fl. & Fr.: Aug. - Oct.

Habitat: Evergreen forests, above 800 m, rare.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Sri Lanka.

4. *Goniothalamus wightii* Hook.f. & Thomson, Fl. Ind.: 106. 1855 & in Hook.f., Fl. Brit. India 1: 76. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 58. 1868 - 1874; Bourd., Forest Trees Travancore: 8. 1908; Rama Rao, Fl. Pl. Travancore: 7. 1914; Dunn in Gamble, Fl. Madras: 18(13). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 240. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 56. 2002.

Tree, 5 - 7 m high; young branches puberulous, glabrous when old; bark fibrous, black. Leaves linear-lanceolate, cuneate at base, acuminate at apex, 7 - 16 x 2 - 4 cm, coriaceous, glabrous on both surfaces; lateral nerves not very prominent; petioles ca 0.7 cm long. Flower solitary, axillary, purple with yellow tinge; bracts 4, ovate, 3 - 4 mm long, densely brown-pubescent; pedicel 1 - 1.4 cm long, densely brown-pubescent. Sepals 3, ovate or orbicular, ca 3 x 4 mm, slightly puberulous outside turning glabrous later. Outer petals ovate, acute, ca 2 x 1.4 cm, densely brown-tomentose on both sides; the inner similar, ca 8 x 5 mm. Stamens ca 3 mm long; connectives produced into a convex apex. Carpels 14 - 18, ovoid, ca 3 mm long, densely hairy; stigmas ca 2 mm long, 2-fid. Fruitlets ellipsoid, apiculate at apex, ca 1.8 x 0.5 cm, orange.

Fl.: April - May *Fr.*: July - Aug.

Habitat: Evergreen forests, 1000 - 1500 m, frequent.

Distrib.: Idukki, Kollam, Kottayam and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

5. *Goniothalamus wynaadensis* (Bedd.) Bedd., Icon. Pl. Ind. Orient.: t. 61. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 74. 1872; Dunn in Gamble, Fl. Madras: 19(13). 1915; Vajr. in S.K. Jain & Sastry, Indian Pl. Red Data Book: 10. 1984; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 39. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 240. 1993; Sivar. & P. Mathew, Fl. Nilambur: 39. 1997. *Atrutegia wynaadensis* Bedd. in Madras J. Lit. Sci. 3, 1: 37, f. 1. 1864.

Small tree, ca 5 m high; young branches pubescent, glabrous when old. Leaves obovate-oblong, acute at base, abruptly acuminate at apex, 10 - 20(-35) x 2.5 - 5(-7) cm, membranous, glabrous, shining above, pale beneath; lateral nerves 10 - 15 pairs, very prominent, looping at margin; petioles 1.5 - 2 cm long, grooved. Flower solitary, axillary or from old wood, ca 1.5 cm long, yellowish green; pedicel ca 4 mm long; bracts 2 or 3, basal. Sepals ovate or orbicular, obtuse or acute at

apex, ca 5 x 4 mm, magenta. Outer petals broadly ovate, acute, ca 1.5 x 0.5 cm, conspicuously nerved; the inner ca 7 x 0.3 mm, vaulted. Sepals and petals pubescent in bud turning glabrous later. Receptacle hairy. Stamens numerous; connectives prolonged into a blunt point. Carpels many, oblong, ca 4 mm long, densely villous; ovule 1, on ventral suture; styles elongate, 2-fid. Fruitlets short-stalked, ellipsoid, mucronate at apex, ca 1.5 x 1 cm, 1-seeded.

Fl.: Jan. - July *Fr.*: Aug. - Nov.

Habitat: Evergreen forests, occasional.

Distrib.: Idukki, Kannur, Malappuram and Wynad. Endemic.

Excluded species

Goniothalamus salicina Hook.f. & Thomson was reported from Chemungi by Rama Rao (*l.c.*). But then, there is no specimen. This species, according to Huber (in Dassan., *Rev. Handb. Fl. Ceylon* 5: 68. 1985), is endemic to Sri Lanka.

8. MEIOGYNE Miq.

Large shrubs or small trees; young branches hirsute. Leaves entire, coriaceous, glabrous above. Flower solitary, subsessile, axillary or leaf-opposed, rarely terminal. Sepals 3, ovate, acute, tomentose outside. Petals 6 in 2 series, similar, oblong to lanceolate, acute, flat, spreading, villous, valvate. Stamens many; connectives truncate, concealing anthers. Carpels strigose; ovules few - many, 1-seriate, on ventral suture; stigmas capitate. Fruitlets clustered, subsessile, slightly moniliform, few - many-seeded.

Indomalaysia to the Pacific, 9 species and 2 in India.

Key to species

- | | | |
|-----|---|------------------------|
| 1a. | Sepals ca 1 x 0.4 cm; carpels and fruitlets densely pubescent | 1. <i>M. pannosa</i> |
| b. | Sepals ca 3 x 2 mm; carpels and fruitlets glabrescent | 2. <i>M. ramarowii</i> |

1. ***Meiogyne pannosa*** (Dalzell) J. Sinclair in Sarawak Mus. J. 5: 604. 1951; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 39. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 266. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 46. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 27. 1996; Sivar. & P. Mathew, Fl. Nilambur: 39. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 56. 2002. *Unona pannosa* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 207. 1851; Bedd., Icon.

Pl. Ind. Orient.: t. 52. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 58. 1872; Bourd., Forest Trees Travancore: 4. 1908; Rama Rao, Fl. Pl. Travancore: 5. 1914; Dunn in Gamble, Fl. Madras: 14(10). 1915.

Tree, 5 - 10 m high; branchlets pubescent when young, glabrous when old; bark smooth. Leaves ovate-lanceolate or elliptic- obtuse or acute at base, obtusely acuminate at apex, 5 - 17 x 2 - 4 cm, glabrous and shining above, pale, pubescent on nerves beneath; lateral nerves ca 8 pairs, distant; petioles 0.7 - 1 cm long. Flower solitary, axillary, yellowish green or dirty white; pedicel ca 4 mm long, pubescent. Sepals linear-lanceolate, ca 1 x 0.4 cm, villous, green. Outer petals linear-oblong, acute or obtuse at apex, ca 4 x 0.8 cm, pubescent on both sides; the inner similar, ca 3 x 0.4 cm. Stamens ovate-cuneate, ca 1.5 mm long; connectives capitate, subtruncate. Receptacle elevated, convex, densely villous. Carpels 8 - 12, oblong, ca 2 mm long, densely pubescent; ovules 2 or 3; styles short; stigmas capitate. Fruitlets short-stalked, ellipsoid, ca 1.5 x 1 cm, pubescent, yellowish brown. *Fl.*: Jan. - Feb. (-July) *Fr.*: Nov.

Habitat: Evergreen forests, 900 - 1500 m, frequent.

Distrib.: Idukki, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats. Endemic.

Use: Bark yields a strong fibre.

2. *Meiogyne ramarowii* (Dunn) Gandhi in C.J. Saldanha & Nicolson, Fl. Hassan: 38. 1976; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 39. 1988; Vajr., Fl. Palghat: 46. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 266. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 27. 1996. *Unona ramarowii* Dunn in Bull. Misc. Inform. 1914: 183. 1914 & Gamble, Fl. Madras: 14(10). 1915. *Desmos ramarowii* (Dunn) D. Das in Bull. Bot. Surv. India 5: 42. 1963.

Tree, 7 - 10 m high; branchlets pubescent when young, glabrous when old. Leaves elliptic or oblong-lanceolate, obtuse at base, acuminate at apex, 5 - 14 x 3 - 5 cm, coriaceous, pellucid-punctate, glabrous above, pubescent on nerves beneath; lateral nerves 5 or 6 pairs, impressed above, raised beneath. Flower solitary, axillary, yellow; pedicel ca 3 mm long, pubescent. Sepals ovate, ca 3 x 2 mm, pubescent. Petals oblong-lanceolate, ca 2 x 0.5 cm, pubescent; the inner slightly shorter and broader. Stamens many, oblong, 1.5 - 2 mm long; connectives truncate at apex. Receptacle slightly convex. Carpels ovoid-oblong, ca 2 mm

long, glabrescent; styles short; stigmas capitate. Fruitlets oblong, acuminate, ca 2 x 1 cm, glabrescent, red; seeds 1-3, ca 4 mm across.

Fl.: Feb. - April *Fr.*: May - Sept.

Habitat: Evergreen forests, fairly common.

Distrib.: Almost throughout Kerala. Western Ghats of Karnataka and Tamil Nadu.

Endemic.

9. MILIUSA Lesch. ex A. DC.

Trees or shrubs, erect or sometimes scandent; young branches tomentose. Leaves ovate or elliptic, membranous, pubescent or glabrate. Flowers usually bi-, sometimes unisexual or polygamous, solitary, axillary or a few together in axils of fallen leaves, very rarely terminal; bracts ovate, elliptic or obovate; upper ones often foliaceous. Sepals 3, ovate or lanceolate, free, valvate in bud. Petals 6 in 2 series, ovate or lanceolate, saccate at base, free, valvate in bud; the inner rarely connate by their margins. Receptacle elongate. Stamens numerous, loosely arranged, ovate, obtuse; connectives slightly prolonged but not concealing anthers. Carpels numerous; ovules 1-many; stigmas conic or capitate. Fruitlets stalked or not, ovoid or globose, indehiscent.

Indomalesia to Australia, 40 species, 14 in India and 6 in Kerala.

Key to species

- | | | |
|-----|--|-------------------------|
| 1a. | Pedicels less than 1 cm long | 2 |
| b. | Pedicels 2 - 9 cm long | 3 |
| 2a. | Stamens 8 | 3. <i>M. nilagirica</i> |
| b. | Stamens many | 4 |
| 3a. | Bracts foliaceous | 4. <i>M. tomentosa</i> |
| b. | Bracts not foliaceous | 5 |
| 4a. | Bracts in middle of pedicel; sepals ca 3 mm long; fruitlets obliquely ellipsoid, densely pubescent | 1. <i>M. eriocarpa</i> |
| b. | Bracts in lower half of pedicel; sepals ca 1 mm long; fruitlets ovoid, glabrous | 2. <i>M. indica</i> |
| 5a. | Leaves densely tomentose beneath | 5. <i>M. velutina</i> |
| b. | Leaves glabrous | 6. <i>M. wightiana</i> |

1. **Milium eriocarpa** Dunn in Gamble, Fl. Madras: 21(15). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 214. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 47. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 57. 2002. *M. indica* Lesch. ex A. DC. var. *tomentosa* Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 86. 1872.

Erect or scandent shrub, 2 - 3 m high; young branches pubescent, glabrous when old. Leaves elliptic or elliptic-lanceolate, obtuse at base, acute or slightly acuminate at apex, 3 - 9 x 2 - 3 cm, pubescent on midnerve on both surfaces otherwise glabrescent; petioles ca 2 cm long, pubescent. Flower solitary, axillary, pink; pedicel ca 3 mm long, pubescent, reddish; bracts in middle of pedicel, 3-angled, ca 2 mm long, pubescent. Sepals 3-angled or ovate, ca 3 mm long, glabrous. Outer petals lanceolate, ca 1 x 0.6 cm, puberulous; the inner smaller. Receptacle pubescent. Stamens many, ovate, ca 1 mm long; connectives obtuse at apex. Carpels ellipsoid, ca 2.5 mm long, slightly pubescent. Fruitlets obliquely ellipsoid, apiculate, ca 1 x 0.8 cm, densely pubescent.

Fl.: Sept. - Dec. *Fr.*: Jan. - March.

Habitat: Evergreen forests, rare.

Distrib.: Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. **Milium indica** Lesch. ex A. DC. in Mem. Soc. Phys. Genève 5: 213, t. 3. 1832; Hook.f. & Thomson, Fl. Ind.: 148. 1855 & in Hook.f., Fl. Brit. India 1: 86. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 85. 1868 - 1874; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 217. 1993. *M. montana* Gardner ex Hook.f. & Thomson, Fl. Ind.: 148. 1855; Bedd., Icon. Pl. Ind. Orient.: t. 84. 1868 - 1874; Dunn in Gamble, Fl. Madras: 22(15). 1915. *M. montana* Gardner ex Hook.f. & Thomson var. *tomentosa* Thwaites, Enum. Pl. Zeyl.: 10. 1858.

Small tree or shrub, 2 - 7 m high; branchlets densely fulvous- or appressed-pubescent. Leaves elliptic-lanceolate, obtuse or subcordate at base, obtusely acute or slightly acuminate at apex, 3 - 9 x 2.5 - 3 cm, pubescent, densely so on midnerve on both surfaces; petioles ca 1 mm long, swollen at base, pubescent. Flower solitary, axillary, pale purple or yellow; pedicel drooping, ca 7 mm long, pubescent; bracts 2, in lower half of pedicel, ca 2 mm long, pubescent outside, glabrous inside. Sepals ovate, ca 1 mm long, glabrous. Outer petals ovate-lanceolate, 1.5 - 2 x ca

0.8 cm, pubescent. Stamens many, ca 1 mm long; connectives obtuse at apex. Carpels linear-oblong, ca 2 mm long, pubescent or glabrous; ovules 1 or 2; stigmas conic. Fruitlets to 10, ovoid, beaked, ca 1 x 0.4 cm, glabrous, purple; stalks ca 5 mm long, slender; seeds smooth, yellow.

Fl. & Fr.: July - Nov.

Habitat: Higher elevations, fairly common.

Distrib.: Kasaragod and Wynad. Karnataka, Tamil Nadu and W. Bengal. Sri Lanka.

Note: A highly variable species with different densities of indumentum.

3. *Milium nilagirica* Bedd., *Icon. Pl. Ind. Orient.*: t. 88. 1868-1874; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 87. 1872; Rama Rao, *Fl. Pl. Travancore*: 9. 1914; Dunn in Gamble, *Fl. Madras*: 22(15). 1915; Vajr. in S.K. Jain & Sastry, *Indian Pl. Red Data Book*: 11. 1984; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 40. 1988; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 220. 1993.

Small tree or shrub, 3 - 5 m high; branchlets glabrous. Leaves elliptic or ovate, acute at base, caudate-acuminate at apex, 4 - 10 x 2 - 4 cm, coriaceous, puberulous on both surfaces; petioles 3 - 5 mm long. Flower solitary, axillary or extra-axillary, purplish green; pedicel ca 5 mm long; bracts 2 or 3, basal, minute, glabrous. Sepals and outer petals equal or not, ovate, 1.5 - 2 mm long, ciliate at margin, glabrous; inner petals ovate, 4 - 5 mm long, thick and ciliate at margin towards apex, glabrous. Stamens 8 in 1 series, ca 1 mm long; connectives slightly produced above anthers, blunt at apex. Carpels 13, oblong, ca 2 mm long, glabrous; ovules 1 or 2, on ventral suture; styles very short; stigmas oblong or globose. Fruitlets globose, apiculate, glabrous, red.

Fl.: March - June *Fr.*: July - Dec.

Habitat: Evergreen forests, ca 1500 m, rare.

Distrib.: Kannur, Kollam and Wynad. Western Ghats of Tamil Nadu. Endemic.

4. *Milium tomentosum* (Roxb.) Finet & Gagnep. in *Bull. Soc. Bot. France* 4: 153. 1906; J. Sinclair in *Gard. Bull. Straits Settlements*. 14: 378. 1955; Vajr., *Fl. Palghat*: 45. 1990; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 221. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 28. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 40. 1997. *Uvaria tomentosa* Roxb., *Pl. Coromandel* 1: 31, t. 35. 1795. *Saccopetalum tomentosum* (Roxb.) Hook.f. & Thomson, *Fl. Ind.*: 152. 1855 & in Hook.f., *Fl. Brit. India* 1: 88. 1872; Bedd., *Icon. Pl. Ind. Orient.*: t. 49. 1868-1874; Bourd.,

Forest Trees Travancore: 10. 1908; Rama Rao, Fl. Pl. Travancore: 9. 1914; Dunn in Gamble, Fl. Madras: 22(16). 1915.

Tree, 15 - 20 m tall; branches densely pubescent. Leaves ovate, obtuse, rounded or truncate at base, obtuse or short-acuminate at apex, 5 - 23(-30) x 4 - 12 cm, sparsely pubescent above, densely velutinous beneath; lateral nerves 8 - 11 pairs; petioles 4 - 6 mm long, pubescent. Flowers few together in leaf-opposed or subterminal racemes, greenish yellow, streaked brown; pedicels slender, 2 - 9 cm long; bracts many, foliaceous, pubescent. Sepals and outer petals lanceolate, 0.5 - 1 cm long, pubescent; inner petals lanceolate, 12 - 15 x 4 - 5 mm. Stamens many, ovate, ca 1 mm long. Carpels tomentose; ovules many; stigmas capitate. Fruitlets to 20, globose, ca 2.5 cm, pubescent, violet; stalks to 2.5 cm long; seeds greyish brown.

Fl.: April - May *Fr.*: June - July.

Habitat: Evergreen and semievergreen forests, ca 1500 m, fairly common.

Distrib.: Kannur, Kollam, Malappuram, Palakkad and Thrissur. Andhra Pradesh, Bihar, Karnataka, Maharashtra, Orissa and Rajasthan. Nepal and Sri Lanka.

5. *Miliusa velutina* (Dunal) Hook.f. & Thomson, Fl. Ind.: 151. 1855 & in Hook.f., Fl. Brit. India 1: 87. 1872; Bourd., Forest Trees Travancore: 10. 1908; Rama Rao, Fl. Pl. Travancore: 9. 1914; Dunn in Gamble, Fl. Madras: 21(15). 1915; Vajr., Fl. Palghat: 47. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 222. 1993. *Uvaria velutina* Dunal, Monogr. Anonac.: 91. 1817.

Mal.: *Kana-kaitha, Viluni*

Tree, 10 - 15 m tall; branchlets densely golden-tomentose. Leaves elliptic or ovate-lanceolate, obtuse or slightly cordate at base, acuminate at apex, 4 - 17(-22) x 3 - 7(-12) cm, sparsely tomentose above densely so beneath. Flowers 1 - 3 together in axillary or leaf-opposed cymes, greenish; peduncles to 1 cm long; pedicels 3 - 5 cm long, densely pubescent; bracts minute, basal. Sepals ovate, ca 4 mm long, densely pubescent. Outer petals similar to sepals; the inner ovate, acute, ca 9 x 4 mm, tomentose outside, glabrous inside. Receptacle densely pubescent. Stamens oblong, ca 2 mm long. Carpels many, oblong, densely pubescent, 2-ovuled; styles short, slightly bent; stigmas capitate. Fruitlets ellipsoid, ca 2.5 x 2 cm, tomentose, purplish black; seeds 1 or 2.

Fl.: Jan. March *Fr.*: June Oct.

Habitat: Deciduous forests, rare.

Distrib.: Kollam, Palakkad and Pathanamthitta. Throughout India. South and SE. Asia.

6. *Milium wightiana* Hook.f. & Thomson, Fl. Ind.: 149. 1855 & in Hook.f., Fl. Brit. India 1: 87. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 86. 1868 - 1874; Bourd., Forest Trees Travancore: 9. 1908; Rama Rao, Fl. Pl. Travancore: 9. 1914; Dunn in Gamble, Fl. Madras: 21(15). 1915; Vajr., Fl. Palghat: 47. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 223. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 47. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 58. 2002.

Tree, 10 - 15 m tall; branchlets glabrous. Leaves lanceolate or oblong-lanceolate, acute at base, obtusely acuminate at apex, 4 - 10.5 x 1.5 - 4 cm, coriaceous, glabrous; petioles ca 3 mm long. Flower solitary, axillary or extra-axillary, pink; pedicel 2.5 - 3.5 cm long, slender, glabrous; bracts 3, basal and 1 below middle of pedicel, ovate, ca 3 mm long, densely pubescent. Sepals and outer petals similar, very small, ciliate; inner petals ovate, 1 - 2 x 0.6 - 0.8 cm, puberulous outside, glabrous inside. Stamens 22 in 3 series, ovate, ca 1 mm long. Carpels 20, oblong, ca 2 mm long, glabrous; ovules 1 or 2, on ventral suture; styles as long as carpels, slightly bent. Fruitlets globose, mucronate, ca 1 cm, glabrous, 1-seeded; stalks ca 5 cm long.

Fl. & Fr.: Jan. May.

Habitat: Evergreen forests, common.

Distrib.: Palakkad and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

10. MITREPHORA Hook.f. & Thomson

Trees. Leaves coriaceous, glabrous above, sparsely pubescent or glabrous beneath; nerves finely prominent on both surfaces. Flowers bi-, very rarely unisexual, solitary or a few together in sessile or peduncled densely bracteate terminal or leaf-opposed cymes. Sepals 3, orbicular-ovate or broadly 3-angled, shortly connate at base, valvate in bud. Petals 6 in 2 series, valvate in bud; outer ones elliptic or obovate, not clawed, thinly nerved; the inner lozenge-shaped, abruptly long-clawed at base, connate in their distal third into a vaulted cone. Stamens

numerous, oblong-cuneate; connectives broad, truncate, concealing anthers. Carpels many, stalked or sessile, oblong or clavate, ventrally furrowed, many-ovuled; stigmas sessile. Fruitlets ovoid or globose, indehiscent, 2- or 3-seeded.

South and SE. Asia. 40 species, 10 in India and 2 in Kerala.

Key to species

- 1a. Leaves minutely pubescent on nerves; outer petals to 3 cm long; styles present; stigmas club-shaped **1. *M. grandiflora***
- b. Leaves glabrous throughout on both surfaces; outer petals less than 1.5 cm long; styles absent; stigmas globose **2. *M. heyneana***

1. *Mitrephora grandiflora* Bedd., Fl. Sylv. S. India: t. 75. 1871 & Icon. Pl. Ind. Orient.: t. 101. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 78. 1872; Rama Rao, Fl. Pl. Travancore: 8. 1914; Dunn in Gamble, Fl. Madras: 19(14). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 243. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 29. 1996.

Tree, 7 - 12 m tall; branchlets minutely golden-pubescent when young. Leaves ovate or lanceolate, rounded at base, gradually acuminate at apex, 5 - 14 x 2.5 - 6 cm, coriaceous, pubescent on nerves beneath; petioles ca 8 mm long. Flowers solitary or, 2 or 3 together in leaf-opposed cymes; pedicels ca 1 cm long, densely brown-pubescent; bract 1, basal, 3-angled, cupular, ca 3 mm long. Sepals orbicular, ca 4 mm, densely tomentose, yellow. Outer petals broadly ovate, acute, 1.5 - 3 x 0.5 - 0.8 cm, velutinous outside, subglabrous inside, white turning yellow; the inner 3-angled with a long broad claw, 1 - 1.5 x 0.3 - 0.5 cm, pubescent above, glabrous below, connate by their margins forming a hood-like structure over stamens and carpels, caducous. Receptacle convex. Stamens many; connectives obtuse at apex. Carpels 20 - 30, oblong, ca 2 mm long, strigose; ovules 4 - 6 in 2 series; stigmas club-shaped. Fruitlets globose or oblong, densely velvety when young, 1- or 2-seeded.

Fl. & Fr.: Dec. - April.

Habitat: Evergreen forests, very rare.

Distrib.: Kollam (*Bourdillon s.n.*; *Vencoba Rao s.n.* UCT, TBGT), Thrissur and Wynad (Dunn, *l.c.*). Western Ghats of Karnataka (S. Canara) and Tamil Nadu. Endemic.

2. *Mitrephora heyneana* (Hook.f. & Thomson) Thwaites, Enum. Pl. Zeyl.: 8. 1858; Bedd., Icon. Pl. Ind. Orient.: t. 77. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 77. 1872; Bourd., Forest Trees Travancore: 8. 1908; Rama Rao, Fl. Pl. Travancore: 8. 1914; Dunn in Gamble, Fl. Madras: 19(14). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 244. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 58. 2002. *Orophea heyneana* Hook.f. & Thomson, Fl. Ind.: 110. 1855.

Tree, 10 - 16 m tall; branchlets puberulous when young, glabrous when old. Leaves ovate-lanceolate, obtuse at base, gradually acuminate at apex, 6 - 10 x 2.5 - 4 cm, coriaceous, glabrous on both surfaces; petioles 3 - 6 mm long. Flowers solitary or, 2 or 3 together in axillary or terminal peduncled cymes, yellowish with pink tinge; peduncles ca 5 mm long; pedicels 5 - 6 mm long, pubescent; bracts many, the uppermost near middle of pedicel. Sepals 3-angled or ovate, acute or obtuse, ca 3 x 2.5 mm, densely brown-pubescent. Outer petals ovate-lanceolate, elliptic or slightly obovate, 7 - 15 x 3 - 5 mm, pubescent outside, glabrous or minutely puberulous inside; the inner smaller, trapezoid, acute, ca 5 x 3 mm, villous, yellow streaked pink. Receptacle strigose. Stamens many, oblong, ca 1 mm long. Carpels many, pubescent; ovules 2 or 3. Fruitlets sessile, 8 or 9 together, globose or ellipsoid, ca 1.5 x 0.8 cm, densely yellow-tomentose.

Fl.: Feb. - March *Fr.*: Sept. - Oct.

Habitat: Evergreen forests.

Distrib.: Kollam (Aryankavu, Bourdillon, *l.c.*; Rama Rao, *l.c.*; Chokkampatty, Vencoba Rao *s.n.* UCT, TBGT), Travancore (Dunn, *l.c.*) and Thiruvananthapuram. Adjoining W. Ghats of Tamil Nadu. Sri Lanka.

11. OROPHEA Blume

Trees or shrubs; branches pubescent or glabrous, deeply fissured when dry. Leaves small, membranous. Flowers axillary or extra-axillary, solitary or several in peduncled or sessile cymes; bracts sometimes foliaceous, pubescent outside, glabrous inside. Sepals 3, shortly connate at base, valvate in bud. Petals 6 in 2 series, valvate in bud; outer ones broadly ovate or obovate; the inner longer, oblong or lozenge-shaped, clawed, connate by their margins into a cap over stamens and carpels. Stamens 6 - 12, ovoid, fleshy; anthers dorsal; connectives prolonged into a conic point but not concealing anthers. Staminodes absent or 3 - 6.

Carpels 3-15; ovules 4; styles short or absent; stigmas clavate. Fruitlets few, short-stalked, globose or oblong, 1- or more-seeded.

India and China to the Moluccas, 41 species, 10 in India and 5 in Kerala.

Key to species

- | | | |
|-----|---|---------------------------|
| 1a. | Stamens 6 in 1 series | 5. <i>O. zeylanica</i> |
| b. | Stamens 12 in 2 series | 2 |
| 2a. | Outer stamens imperfect | 1. <i>O. erythrocarpa</i> |
| b. | All stamens perfect | 3 |
| 3a. | Carpels glabrous | 4 |
| b. | Carpels strigose | 3. <i>O. thomsonii</i> |
| 4a. | Flower solitary; pedicel pubescent; nectary on petals 1 | 4. <i>O. uniflora</i> |
| b. | Flowers 2 or 3, rarely solitary; pedicels glabrous; nectaries on petals 2 | 2. <i>O. sivarajanii</i> |

1. *Orophea erythrocarpa* Bedd. in Trans. Linn. Soc. London 20: 5. 1846 & Icon. Pl. Ind. Orient.: t. 68. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 91. 1872; Bourd., Forest Trees Travancore: 12. 1908; Rama Rao, Fl. Pl. Travancore: 10. 1914; Dunn in Gamble, Fl. Madras: 24(17). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 40. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 224. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 29. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 59. 2002.

Tree, 7 - 9 m high; branchlets slender, soft-pubescent. Leaves elliptic or oblong, rounded or narrow at base, short-acuminate at apex, 5-15 x 2-6 cm, coriaceous, glabrous above, softly pubescent on midnerve beneath; lateral nerves raised beneath; petioles ca 5 mm long, pubescent. Inflorescences axillary or supra-axillary 3- or 4-flowered cymes, to 4 cm long, densely pubescent; pedicels ca 1 cm long, pubescent; bracts 2, 1 at base and other in middle of pedicel; bracteoles many. Flowers ca 5 mm across. Sepals 3, orbicular, ca 3 mm, pubescent. Outer petals ovate, acute, ca 4 x 3 mm, pubescent outside; the inner trapezoid with a long glabrous claw, 5 - 6 cm long, pubescent. Stamens 12 in 2 series, ca 1.5 mm long; connectives apiculate; outer 6 imperfect. Carpels 6, oblong, densely strigose; ovules 2; stigmas sessile. Fruitlets ca 2.5 x 1 cm, red; seed 1, scrobiculate. *Fl. & Fr.*: Jan. - July.

Habitat: Evergreen forests, rare.

Distrib.: Kannur, Thiruvananthapuram and Thrissur. Andaman & Nicobar Islands(?) and Tamil Nadu (Coimbatore). Endemic.

2. *Orophea sivarajanii* Sasidh. in Nord. J. Bot. 19: 341, f.1. 1999.

Shrub, 2 - 3 m high; young branches glabrous. Leaves oblong to elliptic-oblong, obtuse at base, acuminate at apex, 7 - 12 x 3 - 6 cm, glabrous; lateral nerves 7 - 15 pairs; petioles 2 - 3 mm long, glabrous. Flowers 2 or 3 in axillary or lateral racemes, 1.5 - 2 cm long; pedicels 8 - 12 mm long, glabrous; bract in upper half of pedicel, ovate-acute, ca 0.5 mm long. Sepals ovate-deltoid, acute, ca 2 x 2.5 mm, ciliolate at margin, jointed at base. Outer petals ovate-orbicular, ca 4 mm across, tomentose at margin; the inner ovate, ca 7 mm long, tomentose at margin, greenish towards upper half, white in the lower; nectaries 2, distinct. Stamens 12 in 2 series. Carpels 6, glabrous; ovules 2; styles hairy. Fruitlets globose when young.

Fl. & Fr.: Nov. - Feb.

Habitat: Evergreen forests above 800 m, common.

Distrib.: Wynad.

3. *Orophea thomsonii* Bedd. in Trans. Linn. Soc. London 20: 5. 1846 & Icon. Pl. Ind. Orient.: t. 67. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 91. 1872; Dunn in Gamble, Fl. Madras: 24(17). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 228. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 29. 1996.

Small tree; branchlets slender, pubescent when young, glabrous when old. Leaves ovate, narrow at base, obtusely acuminate at apex, 4 - 11 x 2 - 4 cm, coriaceous, glabrous above, pubescent on midnerve beneath; petioles ca 5 mm long, glabrous. Inflorescences axillary 3-flowered pubescent sessile or short-peduncled cymes; pedicels ca 1 cm long, strigose; bracteoles minute, basal. Flowers ca 5 mm across. Sepals 3, ovate, strigose. Outer petals ca 4 x 5 mm, strigose outside; the inner ovate, acute, short-clawed, ca 4 mm long, pubescent. Stamens 10 - 12 in 2 series; staminodes absent. Carpels 5 or 6, ovoid, strigose; ovules 2; styles short; stigmas produced. Fruits few, pisiform.

Fl. & Fr.: Jan. - June.

Habitat: Semievergreen forests, rare.

Distrib.: Thrissur. Western Ghats of Tamil Nadu. Endemic.

Note: Though included by Bourdillon (*l.c.*) and Rama Rao (*l.c.*) there is no specimen from Travancore.

4. *Orophea uniflora* Hook.f. & Thomson, Fl. Ind.: 111. 1855 & in Hook.f., Fl. Brit. India 1: 90. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 69. 1868 - 1874; Bourd., Forest Trees Travancore: 11. 1908; Rama Rao, Fl. Pl. Travancore: 10. 1914; Dunn in Gamble, Fl. Madras: 24(17). 1915; Vajr. in S.K. Jain & Sastry, Indian Pl. Red Data Book: 13. 1984; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 40. 1988; Vajr., Fl. Palghat: 47. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 229. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 32. 1996; Augustine in Indian J. Forest. 25: 339. 2002.

Tree, 3 - 5 m high; branchlets slightly puberulous when young, glabrous when old. Leaves elliptic or oblong-lanceolate, subacute or rounded at base, caudate-acuminate at apex, 4 - 6.5 x 1.5 - 2.5 cm, coriaceous, glabrous; petioles ca 3 mm long. Flower solitary, axillary, ca 6 mm across; pedicel ca 1 cm long, filiform, pubescent; bracteoles many, basal, subulate, ca 2 mm long. Sepals small, ovate or orbicular, ca 3 mm, ciliate at margin. Outer petals ovate or orbicular, ca 4 x 3 mm, membranous, glabrous; the inner trapezoid, ca 8 x 4 mm, tapering into a narrow claw below; limbs coherent by their thick tips. Stamens 12; staminodes absent. Carpels 6, glabrous; ovules 2. Fruitlets globose, ca 1.5 cm, brownish; stalks ca 0.4 mm long.

Fl. & Fr.: Feb. Oct.

Habitat: Evergreen forests, rare.

Distrib.: Idukki, Kannur, Kollam (*Bourdillon* 231 UCT, TBGT), Palakkad and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

5. *Orophea zeylanica* Hook.f. & Thomson, Fl. Ind.: 111. 1855 p.p., excl. ref. to Ceylon & in Hook.f., Fl. Brit. India 1: 90. 1872; emend. Keble in Blumea 33: 62. 1988; Bedd., Icon. Pl. Ind. Orient.: t. 70. 1868 - 1874 p.p., excl. ref. to Ceylon; Bourd., Forest Trees Travancore: 12. 1908; Rama Rao, Fl. Pl. Travancore: 10. 1914; Dunn in Gamble, Fl. Madras: 24(17). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 229. 1993. *O. malabarica* Sasidh. & Sivar. in Blumea 35: 269, f. 1. 1990 & Fl. Pl. Thrissur: 29. 1996.

Shrub or small tree; young parts fuscous-pubescent. Leaves elliptic-oblong, rounded, slightly oblique or narrow at base, short-acuminate at apex with an

obtuse tip, 3-9 x 4-5 cm, coriaceous, glabrous but pubescent on midnerve; petioles ca 3 mm long, glabrous. Flowers 2 or 3 together in axillary or extra-axillary cymes, green; peduncles 1-2.5 cm long; pedicels short, very slender; bracts 1 or 2, 1 basal and other, if present, in middle of pedicel. Sepals orbicular, ca 3 mm, tomentose. Outer petals similar to sepals but larger, broadly ovate, acute, ca 8 x 4 mm; the inner trapezoid, ca 10 x 4 mm, ciliate at margin, glabrous. Stamens 6 in 1 series; connectives pointed at apex; staminodes absent. Carpels 9, obovoid, ca 1.5 mm long, glabrous; ovules 2; stigmas subsessile, oblong. Fruitlets short-stalked, globose, ca 1 cm, smooth, glabrous, 1- or 2-seeded.

Fl.: May - July *Fr.*: Sept. - Nov.

Habitat: Evergreen forests, fairly common.

Distrib.: Kollam and Thrissur. Western Ghats of Karnataka and Maharashtra. Endemic.

Note: *Orophea zeylanica* auct. (Hook.f. & Thomson 1855 & 1872 p.p.; Beddome, 1868-1874 p.p.) consists of 2 different species. The Sri Lankan material has since been identified as *O. polycarpa* A. DC. (Huber in Dassan., *Rev. Handb. Fl. Ceylon* 5: 43. 1985) and the Western Ghats' one as *O. zeylanica*.

12. PHAEANTHUS Hook.f. & Thomson

Climbing shrubs or trees. Leaves obovate or oblong-lanceolate, glabrous; lateral nerves looping at margin. Flowers solitary, terminal or in extra-axillary fascicles. Sepals 3, small, valvate in bud. Petals 6 in 2 series, valvate in bud; outer ones smaller, similar to sepals; the inner larger, flat, coriaceous. Stamens numerous, oblong, quadrate; connectives truncate; anther lobes dorsal, distant, not fully concealed; filaments as long as anthers. Carpels many; ovules 1 or 2, sub-basal, erect; styles cylindrical or clavate, sometimes ventrally grooved. Fruitlets 1- or 2-seeded.

Indomalaysia, 12 species and 1 in India.

Phacanthus malabaricus Bedd., *Icon. Pl. Ind. Orient.*: t. 76. 1868-1874; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 72. 1872; Dunn in Gamble, *Fl. Madras*: 18(12). 1915; Vajr. in S.K. Jain & Sastry, *Indian Pl. Red Data Book*: 14. 1984; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 41. 1988; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 230. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 32. 1996; N. Mohanan & Sivad., *Fl. Agasthyamala*: 59. 2002.

Shrub or tree, 2 - 5 m high; branchlets ferruginous-pubescent when young, glabrous when old. Leaves obovate or oblong-lanceolate, rounded or slightly cordate at base, caudate-acuminate at apex, 7 - 17 x 2 - 5.5 cm, glabrous except on midnerve beneath; lateral nerves 5 - 10 pairs, looping at margin; petioles 3 - 4 mm long, pubescent. Flowers ca 1 cm across, solitary or in pairs, extra-axillary, rarely terminal, reddish; pedicels ca 1 cm long, ferruginous; bracts 2, basal, minute, pubescent. Sepals 3, ovate, acute or orbicular, ca 3 mm, pubescent, valvate in bud. Outer petals similar to sepals, ovate, acute, concave, ca 7 x 4 mm, pubescent; the inner oblong, acute, ca 1 x 0.5 cm, thick, fleshy, pubescent. Receptacle flat. Stamens numerous, ca 1 mm long; connectives truncate at apex. Carpels oblong, ca 1.5 mm long, densely pubescent; ovules 1 or 2, basal, erect; styles cylindrical; stigmas hairy. Fruitlets globose, ca 8 mm, wrinkled, rarely puberulous; stalks ca 15 mm long.

Fl.: Feb. - May *Fr.*: Aug. - Sept.

Habitat: Evergreen forests, very rare.

Distrib.: Idukki, Kannur, Thiruvananthapuram, Thrissur and Wynad. Endemic.

13. POLYALTHIA Blume

Trees or shrubs, rarely climbers; young branches pubescent, glabrous when old. Leaves membranous or thin-coriaceous. Flowers solitary or few - many, axillary, extra-axillary or terminal; bracts small, rarely foliaceous. Sepals 3, free, valvate or subimbricate. Petals 6 in 2 series, free, ovate or elongate, flat or the inner concave, valvate in bud. Receptacle convex. Stamens many, closely arranged; anthers remote, extrorse; connectives truncate, flat, overlapping anthers. Carpels many, free, mostly pubescent; ovules 1 or 2, basal; styles usually oblong; stigmas mostly dilated, sometimes sessile. Fruit a ring of 1-seeded globose fleshy indehiscent berries.

Old World tropics, ca 100 species, 14 in India and 8 in Kerala.

Key to species

- | | | |
|-----|--|-----------------------|
| 1a. | Petals narrowly linear, 1 - 6.5 cm long | 2 |
| b. | Petals not linear, less than 1 cm long | 3 |
| 2a. | Leaves brown-tomentose beneath; pedicels less than 2 cm long | 3. P. fragrans |
| b. | Leaves glabrous beneath; pedicels more than 2 cm long | 4 |

- | | | |
|-----|---|--------------------------|
| 3a. | Leaves obtuse, acute or rarely short-acuminate at apex | 8. <i>P. suberosa</i> |
| b. | Leaves acuminate at apex | 5 |
| 4a. | Sepals orbicular, ca 4 mm | 2. <i>P. coffeoides</i> |
| b. | Sepals ovate or 3-angled, ca 2 x 1.5 cm | 6 |
| 5a. | Petioles less than 4 mm long | 7 |
| b. | Petioles ca 1 cm long | 4. <i>P. korintii</i> |
| 6a. | Petals appressed-tomentose | 7. <i>P. shendurunii</i> |
| b. | Petals puberulous or glabrescent | 5. <i>P. longifolia</i> |
| 7a. | Leaves densely pubescent beneath; pedicels ca 2.5 cm long | 1. <i>P. cerasoides</i> |
| b. | Leaves glabrous beneath; pedicels ca 3 mm long | 6. <i>P. rufescens</i> |

1. *Polyalthia cerasoides* (Roxb.) Bedd., Fl. Sylv. S. India: t. 1. 1869; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 63. 1872; Bourd., Forest Trees Travancore: 7. 1908; Rama Rao, Fl. Pl. Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 17(12). 1915; Vajr., Fl. Palghat: 48. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 270. 1993. *Uvaria cerasoides* Roxb., Pl. Coromandel 1: 30, t. 33. 1795. *Guatteria cerasoides* (Roxb.) Dunal, Monogr. Anonac.: 127. 1817.

Mal.: *Narela*

Tree, 15 - 20 m tall. Leaves elliptic-lanceolate or oblong-, obtuse at base, acuminate at apex, 6 - 16 x 1.5 - 5 cm, glabrous, shining above, densely pubescent beneath; lateral nerves 12 - 16 pairs; petioles ca 4 mm long, pubescent. Flowers solitary or, 2 or 3 together, axillary, pale green; pedicels ca 2.5 cm long, densely pubescent; bracts 2 - 5 mm long, basal, rarely foliaceous, glabrous inside, pubescent outside. Sepals free, ovate-triangular, ca 3 x 2 mm, densely pubescent. Outer petals ovate-lanceolate, ca 7 x 5 mm, inflexed, puberulous outside; the inner slightly longer. Stamens cuneate, 1 - 1.5 mm long; anthers extrorse; connectives flat at tip. Carpels numerous, oblong, ca 1.5 mm long, densely pubescent; ovules 2; styles short; stigmas clavate. Fruitlets ellipsoid, 7 - 9 x 3 - 5 mm, glabrous, dark red; stalks ca 1.5 cm long, pubescent.

Fl.: March - May *Fr.*: July - Aug.

Habitat: Evergreen forests, 600 - 1000 m.

Distrib.: Idukki, Kollam (*Bourdillon s.n.*; *Vencoba Rao s.n.* UCT, TBGT) and Palakkad. Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Orissa, Tamil Nadu and W. Bengal. Sri Lanka and Vietnam.

Use: Timber is used for carpentry and ship-building.

2. *Polyalthia coffeoides* (Thwaites ex Hook.f. & Thomson) Thwaites, Enum. Pl. Zeyl.: 339. 1864; Bedd., Icon. Pl. Ind. Orient.: t. 53. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 62. 1872; Bourd., Forest Trees Travancore: 5. 1908; Rama Rao, Fl. Pl. Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 16(11). 1915; Manilal, Fl. Silent Valley: 3. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 41. 1988; Vajr., Fl. Palghat: 48. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 270. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 47. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 33. 1996; Sivar. & P. Mathew, Fl. Nilambur: 41. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 60. 2002. *Guatteria coffeoides* Thwaites ex Hook.f. & Thomson, Fl. Ind.: 141. 1855.

Mal.: *Villa*

Tree, 20 - 25 m tall. Leaves elliptic or oblong-lanceolate, acute or subobtuse at base, acuminate at apex, 10 - 27 x 3.5 - 8.5 cm, chartaceous, shining, glabrous on both surfaces; lateral nerves 10 - 14 pairs, conspicuously raised beneath. Flowers in fascicles from old wood, greenish yellow; pedicels ca 4.5 cm long, slender, glabrous or puberulous; bracts basal, ca 1 mm long, tomentose. Sepals orbicular, ca 4 mm, densely pubescent. Outer petals oblong-lanceolate, acuminate at apex, slightly clawed at base, 5.5 - 6.5 x 0.6 - 1 cm, sparsely puberulous or glabrous; the inner narrower. Stamens numerous, ca 1 mm long; connectives subglobose at apex. Carpels 20, oblong, 3 - 4 mm long, densely pubescent; ovule basal; styles short; stigmas simple. Fruitlets ellipsoid, obtuse or slightly beaked, 2 - 3 x 1 - 1.5 cm, pubescent; stalks 1 - 1.5 cm long, woody, pubescent.

Fl.: March & Nov. *Fr.:* Jan.

Habitat: Evergreen forests, 500 - 1500 m, fairly common.

Distrib.: Idukki, Kannur, Malappuram, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Southern India. Sri Lanka.

Use: Bark is used for making ropes.

3. *Polyalthia fragrans* (Dalzell) Bedd., Fl. Sylv. S. India: t. 74. 1871 & Icon. Pl. Ind. Orient.: t. 54. 1868 - 1874; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 63. 1872; Bourd., Forest Trees Travancore: 6. 1908; Rama Rao, Fl. Pl.

Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 16(11). 1915; Vajr., Fl. Palghat: 48. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 271. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 33. 1996; Sivar. & P. Mathew, Fl. Nilambur: 41. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 61. 2002. *Guatteria fragrans* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 206. 1851.

Mal.: *Chella, Kodangi, Neddunar, Neduna, Pullarrei*

Tree, 15 - 25 m tall; branchlets glabrous; bark greenish grey blotched with white. Leaves elliptic or oblong-lanceolate, acute or obtuse at base, acuminate at apex, 9 - 27 x 3 - 12 cm, glabrous above except on midnerve, sparsely brown-tomentose beneath; lateral nerves 17 - 20 pairs, very prominent on both surfaces; petioles ca 1 cm long. Flowers in cymes from axils of fallen leaves, greenish yellow, fragrant; peduncles ca 8 mm long; pedicels 1.5 - 2 cm long, densely tomentose; bracts cupular, in middle of pedicel. Sepals orbicular, ca 4 mm, densely tomentose, green. Outer petals oblong, acuminate, 1.5 - 4 x 0.2 - 0.3 cm, tomentose; the inner slightly longer. Receptacle dilated, convex to globose. Stamens ca 1 mm long. Carpels oblong, ca 1.5 mm long, pubescent; ovule basal; styles short; stigmas slightly 2-fid. Fruitlets 15 - 17, obliquely ellipsoid or ovoid, 3 - 5 x 1.5 - 2 cm, densely tomentose, tubercled, 1-seeded; stalks ca 5 cm long, tomentose.

Fl.: Dec. - Jan. Fr.: May - Nov.

Habitat: Evergreen forests, 500 - 1000 m, common.

Distrib.: Ernakulam, Idukki, Kollam, Kottayam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Maharashtra and Tamil Nadu. Endemic.

4. *Polyalthia korintii* (Dunal) Benth. & Hook.f. ex Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 64. 1872; Rama Rao, Fl. Pl. Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 16(11). 1915; Manilal & Sivar., Fl. Calicut: 28. 1982; Nicolson & al. in Regnum Veg. 119: 50. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 273. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 61. 2002. *Guatteria korintii* Dunal, Monogr. Anonac.: 133. 1817; Wight, Icon. Pl. Ind. Orient.: t. 398. 1840.

Mal.: *Karuvall, Kurintipanel*

Tree, 3 - 5 m high; branchlets glabrous. Leaves ovate, lanceolate or ellip-

tic-lanceolate, acute at base, acuminate at apex, 5 - 14 x 2 - 5 cm, coriaceous, glabrous; petioles ca 1 cm long. Flowers solitary, axillary, rarely 1 - 3 together from tubercles on old wood; pedicels 2.5 - 2.8 cm long, pubescent; bracts in middle of pedicel, ovate, ca 2 x 1 mm, glabrous inside, pubescent outside. Sepals ovate, ca 4 x 2 mm, pubescent. Outer petals ovate, acute or subobtusate, 5 - 7 x 2 - 3 mm, pubescent on both sides less so on inside; the inner longer and broader. Stamens ca 1 mm long. Carpels 7 - 14, oblong, ca 1.5 mm long, pubescent; ovule 1; stigmas capitate, sessile. Fruitlets ellipsoid or globose, ca 6 x 5 mm, succulent, yellowish orange; stalks ca 7 mm long.

Fl.: Jan. - April *Fr.*: Aug. - Nov.

Habitat: Evergreen forests, occasional.

Distrib.: Kannur, Kollam, Kozhikode, Pathanamthitta and Thiruvananthapuram. Andhra Pradesh and Tamil Nadu. Sri Lanka.

5. *Polyalthia longifolia* (Sonn.) Thwaites, Enum. Pl. Zeyl.: 398. 1864; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 62. 1872; Bourd., Forest Trees Travancore: 5. 1908; Rama Rao, Fl. Pl. Travancore: 6. 1914; Dunn in Gamble, Fl. Madras: 16(11). 1915; Manilal & Sivar., Fl. Calicut: 28. 1982; Vajr., Fl. Palghat: 49. 1990; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 274. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 48. 1994; Sivar. & P. Mathew, Fl. Nilambur: 42. 1997. *Uvaria longifolia* Sonn., Voy. Indes Orient. 2: 233, t. 131. 1782; Bedd., Icon. Pl. Ind. Orient.: t. 38. 1868 - 1874.

Mal.: *Aranamaram, Assotham, Chorunna, Vancholam*

Tree, 15 - 20 m tall; branchlets sparsely puberulous when young. Leaves ovate-oblong or lanceolate, obtuse or rounded at base, undulate at margin, attenuate at apex, 10 - 22 x 2 - 5 cm, membranous, glabrous; lateral nerves 18 - 24 pairs. Flowers numerous, in axillary racemes, yellowish green; peduncles 5 - 7 mm long; pedicels 2 - 4 cm long; bract in middle of pedicel, to 1 mm long, tomentose. Sepals ovate or 3-angled, 1.5 - 2 x 1 - 1.5 mm, tomentose. Petals narrowly lanceolate, puberulous; outer ones ca 9 x 2.5 mm; the inner 10 - 12 x ca 3 mm. Stamens ca 1 mm long. Carpels few, ca 1 mm long, tomentose at apex; ovule 1; stigmas sessile. Fruitlets 4 - 8, globose or ovoid, ca 2.5 x 1.5 cm, glabrous, purple; seeds 2, pinkish; stalks to 1 cm long.

Fl.: March - May *Fr.*: July - Aug.

Planted in avenues throughout Kerala. Kollam (*Vencoba Rao s.n.* UCT, TBGT), Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thiruvananthapuram. Planted throughout the hotter parts of India. Native to Sri Lanka (?)

Uses: Fruit is edible; bark yields a fibre.

6. *Polyalthia rufescens* Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 66. 1872; King in *Ann. Roy. Bot. Gard. (Calcutta)* 4: 83, t. 116. 1894; Rama Rao, *Fl. Pl. Travancore*: 7. 1914; Dunn in *Gamble, Fl. Madras*: 16(12). 1915; Vajr. in S.K. Jain & Sastry, *Indian Pl. Red Data Book*: 15. 1984; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 276. 1993.

Tree; branchlets densely tomentose when young, puberulous when old. Leaves oblong-lanceolate, obtuse or slightly cordate at base, short-acuminate at apex, 8 - 13 x 3.5 - 5.5 cm, glabrous on both surfaces, shining above, pale beneath; midnerve grooved above, raised beneath; lateral nerves to 16 pairs, faint above, prominent beneath; petioles ca 2 mm long, swollen, glabrous. Flowers solitary or a few together, leaf-opposed, ca 1 cm across, brown-tomentose; pedicels ca 3 cm long, puberulous; bracts basal, minute. Sepals small, broadly ovate, acute, 2 - 3 x ca 2 mm, pubescent. Outer petals ovate-oblong, subacute, 8 - 12 x 5 - 7 mm, tomentose; the inner smaller. Carpels many, linear, ca 1 mm long, densely silky; ovules 2; styles short; stigmas capitate. Fruitlets globose, ca 6 mm.

Fl.: Jan. - April *Fr.:* June - July.

Habitat: Evergreen forests, very rare.

Distrib.: Kollam (*Bourdillon s.n.* UCT, TBGT). Western Ghats of Tamil Nadu (Tirunelveli) and Andaman & Nicobar Islands.

Note: There is no specimen from Kerala at MH. Represented by only one collection from Tamil Nadu (Tirunelveli).

7. *Polyalthia shendurunii* Basha & Sasidh. in *Rheedea* 4: 21, f.1. 1994.

Tree, to 15 m tall; bark smooth, brownish black; young branchlets puberulous. Leaves oblong or elliptic-lanceolate, rounded or truncate at base, acuminate at apex, 15 - 26 x 6 - 8.5 cm, glabrous; petioles ca 0.5 mm long. Flowers solitary or in fascicles from tubercles on old wood; pedicels ca 5 cm long, densely hairy; bracts in lower half of pedicel, ovate, acute, tomentose. Sepals connate at base, deltoid-ovate, acuminate, 1.5 - 2 x 1 - 1.3 cm, reflexed. Outer petals oblong,

acute to acuminate, smaller than the inner; the inner oblong, 8-9 x 1-2 cm, appressed-tomentose on both sides, greenish yellow. Stamens ca 3 mm long; anthers and connectives hirsute. Carpels ca 50, cylindrical, ca 2.5 mm long; ovule 1, basal; style indistinct; stigma orbicular, depressed in middle, shortly lobed at margin, glabrous. Fruitlets oblong-ovoid, ca 3 x 2.5 cm, glabrous.

Fl. & Fr.: May.

Habitat: Evergreen forests, occasional.

Distrib.: Kollam (Shendurney).

8. *Polyalthia suberosa* (Roxb.) Thwaites, Enum. Pl. Zeyl.: 398. 1864; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 66. 1872; Bourd., Forest Trees Travancore: 7. 1908; Rama Rao, Fl. Pl. Travancore: 7. 1914; Dunn in Gamble, Fl. Madras: 16(12). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 278. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 48. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 62. 2002. *Uvaria suberosa* Roxb., Pl. Coromandel 1: 31, t. 34. 1795.

Tree, 4-6 m high; young branches brown-pubescent; bark corky, rough. Leaves oblong, rarely obovate, obtuse or rounded at base, obtuse, acute or rarely short-acuminate at apex, 4-10 x 1.5-3 cm, glabrous above, slightly pubescent on midnerve beneath; lateral nerves not very conspicuous. Flowers solitary, rarely paired, usually leaf-opposed or extra-axillary, greenish yellow; pedicels ca 1.5 cm long, slender, pubescent; bracts 2, 1 basal, other in middle of pedicel, ovate or 3-angled, acuminate, ca 2 mm long, pubescent. Sepals ovate, acuminate, ca 3 x 2 mm, pubescent. Outer petals ovate-lanceolate, acute, incurved, ca 6 x 4 mm, pubescent; the inner longer. Carpels densely pubescent; ovules 2; stigmas 3-angled; styles short. Fruitlets to 18, globose, ca 5 mm, puberulous, purple; seeds 1 or 2, roundish, smooth; stalks ca 1.3 cm long.

Fl.: April - May *Fr.*: Feb. - March.

Habitat: Evergreen forests, common.

Distrib.: Idukki, Kollam and Thiruvananthapuram. Tamil Nadu and NE. India. South and SE. Asia.

Excluded species

Polyalthia persicaefolia (Hook.f. & Thomson) Thwaites was reported by Rama Rao (*l.c.*) without a specific locality. There is no specimen from India. It

has since been treated as endemic to Sri Lanka (Huber in Dassan., *Rev. Handb. Fl. Ceylon* 5: 39. 1985).

14. POPOWIA Endl.

Trees. Leaves entire, coriaceous. Flowers small, bisexual or polygamous, extra-axillary or leaf-opposed. Sepals 3, connate, valvate, ovate. Petals 6 in 2 series, valvate or the inner rarely imbricate, orbicular, the outer spreading, the inner thick, concave, connivent, acute with inflexed tips. Stamens numerous, short, cuneate; anthers dorsal, remote, concealed by overlapping connectives. Carpels 6, ovoid; styles large, oblong or subclavate, straight or recurved; ovules 1 or 2 on ventral suture, rarely 1, basal. Fruit a ring of stalked globose or ovoid berries; seeds 1 or 2; testa shining.

Tropical Asia to Australia, ca 30 species, 3 in India and 1 in Kerala.

Popowia beddomeana Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 68. 1872; Bourd., *Forest Trees Travancore*: 7. 1908; Rama Rao, *Fl. Pl. Travancore*: 7. 1914; Dunn in Gamble, *Fl. Madras*: 17(12). 1915; A.N. Henry & Chithra in M.P. Nayar & Sastry, *Red Data Book Indian Pl.* 1: 28. 1987; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 245. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 48. 1994; N. Mohanan & Sivad., *Fl. Agasthyamala*: 63. 2002. *P. ramosissima* sensu Bedd., *Icon. Pl. Ind. Orient.*: t. 75. 1868 -1874, non Hook.f. & Thomson 1855.

Large shrub or small tree, 2 - 4 m high; branchlets densely brown-tomentose when young, almost glabrous when mature. Lower leaves ovate, acute; upper ones oblong-lanceolate or elliptic-, acute at base, caudate-acuminate at apex, 3 - 8 x 1.5 - 2.5 cm, coriaceous, tomentose on both surfaces. Flower solitary, leaf-opposed, ca 4 mm across, villous; bract in middle of pedicel. Sepals connate below, ovate, acute, ca 4 mm long, densely pubescent. Outer petals ovate, ca 5 x 4 cm, densely pubescent; the inner slightly longer, concave, inflexed at tip, thick. Stamens usually 24; connectives truncate or capitate. Carpels 4 - 7, oblong, hairy at base; ovule 1, on ventral suture; styles large; stigma obovate, recurved. Fruits globose, stalked.

Fl.: March - April *Fr.*:Sept.

Habitat: Evergreen forests, 700 - 1000 m, very rare.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

15. SAGERAEA Dalzell

Trees; branchlets glabrous. Leaves glabrous, coriaceous, shining above. Flowers uni- or bisexual, solitary or fascicled, axillary, terminal or from tubercles on old branches, globose in bud. Sepals 3, ovate or orbicular, free or slightly connate at base, imbricate, ciliate at margin. Petals 6 in 2 series, usually orbicular, subequal, concave, free, imbricate. Receptacle flat or convex. Stamens 6 - 28 in 2 or more series, thick, fleshy; anthers dorsal, oblong; connectives produced, not concealing anthers. Carpels 1 - 6; ovules 6 - 14, 2-seriate, on ventral suture; styles very short or absent; stigmas usually capitate or obtuse. Fruitlets 1 - 4, sessile to stalked, globose or ovoid, thin-walled, 4 - 8-seeded.

India and Sri Lanka to the Philippines, 9 species, 5 in India and 2 in Kerala.

Literature: Mitra, D. 1982. *Annonaceae: Tribe Uvarieae. Fasc. Fl. India* 10: 1 - 21.

Key to species

- 1a. Leaves elliptic to elliptic-oblong, subacute or obtuse at apex; inner petals smaller than the outer; stamens 25 - 28 **1. *S. dalzellii***
- b. Leaves oblong, short-acuminate at apex; inner petals larger than the outer; stamens 12 **2. *S. grandiflora***

1. *Sageraea dalzellii* Bedd., *Icon. Pl. Ind. Orient.*: t. 42. 1868 -1874; King in *Ann. Roy. Bot. Gard. (Calcutta)* 4: 8. 1893 p.p. *Bocagea dalzellii* (Bedd.) Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 92. 1872 p.p.; Bourd., *Forest Trees Travancore*: 12. 1908; Rama Rao, *Fl. Pl. Travancore*: 10. 1914; Dunn in Gamble, *Fl. Madras*: 12(8). 1915; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 281. 1993. *S. laurifolia* sensu Sasidh. & Sivar., *Fl. Pl. Thrissur*: 33. 1996, non (J. Graham) Blatt. 1930.

Mal.: *Kanakaiitha, Manja nara, Manyarei*

Tree, 15 - 18 m tall. Leaves elliptic to elliptic-oblong, rounded at base, subacute to obtuse at apex, 25 - 35 x 8 - 11 cm, glabrous, shining above, dull

beneath; lateral nerves 10 - 12 pairs, faint; petioles 1 - 1.5 cm long, stout. Flowers 4 - 8 in fascicles from woody tubercles on old branches; pedicels 2 - 3 cm long; bracts many, basal, scaly. Sepals connate at base, orbicular, 1.5 - 2 mm, ciliate at margin. Petals orbicular, 5 - 6 mm, concave, bright yellow. Stamens 25 - 28, ca 2 mm long, all fertile; anthers dorsal, distant; connectives produced to a thin flat apex in outer series, thick and quadrate in the inner. Carpels 3 - 5, oblong, pubescent; ovules ca 12 in 2 series; styles short; stigmas capitate, slightly curved. Fruitlets sessile, subglobose, ca 4 cm long, glabrous; seeds many, ca 2 mm long, transversely striate.

Fl.: March - May *Fr.*: Aug. - Sept.

Habitat: Dense evergreen forests, 750 - 1000 m, rare.

Distrib.: Ernakulam, Malabar and Travancore (Dunn, *l.c.*) and Thrissur. Western Ghats of Tamil Nadu (Coimbatore). Endemic.

Uses: Leaf is used in the treatment of rheumatism; wood is valued for building work.

2. *Sageraea grandiflora* Dunn in Bull. Misc. Inform. 1914: 182. 1914 & Gamble, Fl. Madras: 12(8). 1915; A.N. Henry & Chithra in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 30. 1987; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 282. 1993; Augustine in Indian J. Forest. 25: 339. 2002.

Tree, ca 20 m tall; branchlets glabrous. Leaves oblong, rounded at base, short-acuminate at apex, 25 - 35 x 7 - 8 cm, glabrous on both surfaces; petioles 8 - 9 mm long. Flowers clustered below leaf scars. Sepals connate at base, 2 - 3 mm long, ciliate at margin. Petals orbicular, ciliate at margin; outer ones ca 1.5 cm long; the inner slightly larger. Stamens 12, obovate; anthers distant. Carpels 3 - 5; ovaries strigose; ovules 12 - 14; stigmas almost sessile, entire. Fruitlets globose, yellowish green when immature.

Fl.: Nov. - Dec.

Habitat: Evergreen forests, very rare.

Distrib.: Idukki and Pathanamthitta. Endemic.

16. UVARIA L.

Scandent shrubs; branchlets sometimes modified into tendrils. Leaves simple, alternate, coriaceous, stellate-pubescent or glabrous; petioles often grooved

above. Flowers bi-, rarely unisexual, solitary or in few-flowered cymes, terminal or leaf-opposed; peduncles usually short and slender in flower, elongating and woody in fruit. Sepals 3, often connate below, entire, stellate-pubescent or tomentose outside, valvate in bud. Petals 6(-8) in 2 series, free or sometimes slightly connate at base; inner series imbricate in bud, equalling or the inner smaller, ovate to obovate, acute, puberulous or stellate-pubescent outside. Receptacle depressed, pubescent. Stamens numerous, ovoid-oblong, obovate or linear, all fertile or outer ones sometimes sterile; connectives obliquely truncate, concealing anthers; anther locules not septate. Carpels numerous, free, cylindric or funnel-shaped; ovules many, 2-seriate, rarely few and 1-seriate. Fruitlets stalked or not, obovoid to cylindric, torulose, pubescent or glabrous, succulent or dry; seeds few - many.

Old World tropics, ca 110 species, 10 in India and 3 in Kerala.

Key to species

- | | | |
|-----|---|------------------------|
| 1a. | Pedicels less than 1 cm long; fruitlet stalks 1 - 2 mm long | 3. <i>U. zeylanica</i> |
| b. | Pedicels more than 1 cm long; fruitlet stalks 4 - 8 cm long | 2 |
| 2a. | Fruitlets 1-seriate | 2. <i>U. narum</i> |
| b. | Fruitlets 2-seriate | 1. <i>U. hookeri</i> |

1. *Uvaria hookeri* King in Ann. Roy. Bot. Gard. (Calcutta) 4: 28, t. 22. 1893; Manilal, Fl. Silent Valley: 3. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 291. 1993. *U. narum* Wall. ex Hook.f. & Thomson, Fl. Ind.: 102. 1855 p.p. *U. narum* Wall. ex Hook.f. & Thomson var. *macrophylla* Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 50. 1872.

Mal.: *Kurilvalli*

Climbing shrub; branchlets glabrous. Leaves oblong or oblong-lanceolate, rounded at base, acute or acuminate at apex, 11 - 16 x 2.6 - 5.5 cm, coriaceous, glabrous, brown beneath when dry; petioles ca 5 mm long. Flower solitary, terminal or leaf-opposed; pedicel 1 - 1.5 cm long, pubescent. Sepals connate at base, broadly ovate, ca 1 cm long, pubescent, tubercled. Petals connate at base, ovate, 1 - 1.5 x 0.7 - 0.9 cm, reflexed at apex, tomentose outside, pubescent inside. Stamens linear, ca 2.5 mm long; connectives almost flat. Carpels many, linear-oblong, ca 1.5 mm long; ovules many, 2-seriate; styles short, thick. Fruitlets many,

2-seriate, ovoid or oblong, tapering at apex, 1.7 - 3 cm long, glabrous; seeds many, shining, reddish brown; stalks stout, 3.2 - 4.5 cm long.

Fl.: May - July *Fr.*: Sept. - Jan.

Habitat: Evergreen forests, occasional.

Distrib.: Kottayam and Palakkad (Silent Valley). Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. ***Uvaria narum*** (Dunal) Blume, *Fl. Javae* 21 22: 5. 1830; Wight, III. *Ind. Bot.* 1: t. 6. 1840; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 50. 1872 p.p.; Rama Rao, *Fl. Pl. Travancore*: 4. 1914 p.p.; Dunn in Gamble, *Fl. Madras*: 13(9). 1915 p.p.; Manilal & Sivar., *Fl. Calicut*: 26. 1982; Nicolson & al. in *Regnum Veg.* 119: 51. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 41. 1988; Vajr., *Fl. Palghat*: 49. 1990; Deb. Mitra in B.D. Sharma & al., *Fl. India* 1: 292. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth., Add.*: 48. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 34. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 42. 1997. *Unona narum* Dunal, *Monogr. Anonac.*: 99. 1817 p.p.

Mal.: *Narumpannal*

Woody, climbing shrub; branchlets stellate-tomentose when young, glabrous when old. Leaves oblong-lanceolate or elliptic, subobtuse to cuneate at base, acuminate at apex, 8 - 15 x 3 - 6 cm, coriaceous, glabrous, brownish beneath when dry; lateral nerves 8 - 19 pairs; petioles 2.5 - 5 mm long. Flower solitary, extra-axillary, leaf-opposed or terminal, ca 3 cm across; pedicel 2 - 3 cm long; bracts oblong, 1 - 3 mm long, glabrous, caducous. Sepals orbicular or ovate, obtuse, reflexed at apex, ca 5 mm, minutely tomentose outside, puberulous inside. Petals 6(-8) in 2 series, connate at base, orbicular or ovate, inflexed at apex, 1 - 2 x 0.8 - 1.5 cm, minutely tomentose, flesh-coloured. Receptacle slightly raised, ca 8 mm across. Stamens all fertile, ca 1.7 x 0.7 mm; connectives broad, truncate. Carpels many, oblong, ca 5 mm long, tomentose; ovules many; stigmas broad. Fruitlets many, ovoid-oblong or cylindrical, obtuse at both ends, scarlet, slightly constricted when dry; seeds 4 - 6, 1-seriate, ovoid, planoconvex, smooth, chestnut-brown; stalks 5 - 8 cm long.

Fl.: Feb. - April *Fr.*: Nov. - Dec.

Habitat: Banks of rivers and streams, coastal plains to low deciduous forests, frequent.

Distrib.: Alappuzha, Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Karnataka and Tamil Nadu. Sri Lanka.

Uses: Decoction of root bark is used against rheumatism, bowel-complaints and fits during delivery; leaf juice is used in rheumatic swellings, jaundice etc.

3. *Uvaria zeylanica* L., Sp. Pl.: 536. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 51. 1872; Rama Rao, Fl. Pl. Travancore: 4. 1914; Dunn in Gamble, Fl. Madras: 13(9). 1915; Nicolson & al. in Regnum Veg. 119: 51. 1988; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 295. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth., Add.: 48. 1994.

Slender, climbing shrub; young branches ferruginous-tomentose. Leaves elliptic or oblong-lanceolate, obtuse or cuneate at base, bluntly acuminate or rarely acute at apex, 5 - 9.5 x 2 - 3 cm. thin-coriaceous, glabrous; lateral nerves 7 - 15 pairs; petioles 3 - 4 mm long. Flowers solitary, rarely paired, terminal or leaf-opposed; pedicels 3 - 7 mm long, ferruginous-pubescent; bracts few, elliptic, 1.5 - 2.5 mm long, pubescent, caducous. Sepals 3, orbicular or ovate, subretuse and reflexed at apex, 4 - 5 x 5 - 6 mm, pubescent. Petals 6 in 2 series, elliptic or ovate-oblong, slightly reflexed at apex, 7 - 12 x 4 - 6 mm, pubescent outside, glabrous inside except margin, dull red or purple. Stamens all fertile, broadly oblong or obovate-cuneate, 1 - 1.5 x 0.5 - 0.7 mm; connectives obliquely truncate and flat. Carpels many, obovate-oblong, ca 1 mm long, pubescent; stigmas sessile, subcapitate. Fruitlets ovoid, rounded at both ends, ca 1 cm long, pubescent, brownish red; seeds 3 - 6, 1-seriate, ovoid, compressed, 6 - 7 x 4 - 5 mm, smooth; stalks 1 - 2 mm long.

Fl.: Oct. - Dec. *Fr.*: July - Aug.

Habitat: Near backwaters along seacoasts, occasional.

Distrib.: Kollam, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu (Madurai and Coimbatore). Sri Lanka.

17. XYLOPIA L., nom. cons.

Trees or shrubs. Leaves coriaceous, glabrous or pubescent on midnerve. Flowers solitary or a few together in cymes or fascicles, axillary or supra-axillary; buds conic, 3-quetrous, often slender; bracts many, ovate, the uppermost the larg-

est. Sepals 3, connate at base or free, valvate in bud. Petals 6 in 2 series, free, thick, valvate in bud; outer ones flat and concave above base, larger than the inner. Receptacle hollow, enclosing carpels. Stamens numerous, arranged closely, linear or oblong with large truncate convex or flat connectives concealing anthers; anther locules remote or continuous, usually septate with pollen grains united into large tetrads. Carpels 1 - 6, hairy; ovules 2 - 6 or more, 1- or 2-seriate; styles long-clavate. Fruitlets 1 or few, obovoid, cuneate, glabrate, few-seeded.

Tropics especially Africa, ca 160 species and 1 in India.

Xylopia parviflora (Wight) Hook.f. & Thomson, Fl. Ind.: 125. 1855 & in Hook.f., Fl. Brit. India 1: 84. 1872; Bedd., Icon. Pl. Ind. Orient.: t. 43. 1868 - 1874; Bourd., Forest Trees Travancore: 9. 1908; Rama Rao, Fl. Pl. Travancore: 9. 1914; Dunn in Gamble, Fl. Madras: 20(15). 1915; Deb. Mitra in B.D. Sharma & al., Fl. India 1: 305. 1993. *Patonia parviflora* Wight, Ill. Ind. Bot. 1: 19. 1840.

Mal.: *Kalpottan, Santhu*

Tree, 20 - 25 m tall, buttressed; branchlets ferruginous-pubescent. Leaves ovate or elliptic-lanceolate, acute at base, acuminate at apex, 2.5 - 10 x 1.5 - 4 cm, coriaceous, pellucid-dotted, shining, glabrous above, pale and sparsely puberulous beneath or glabrous; petioles 5 - 8 mm long. Flowers 2 - 4 together in axillary cymes, yellow; pedicels very short; bracts many, orbicular. Sepals ovate, acute, connate to middle, pubescent outside, glabrous inside. Outer petals linear, dilated at base, 10 - 13 x 1.5 - 2 mm; the inner linear, 3-quetrous, expanded and spoon-shaped at base, ca 10 x 0.7 mm, densely tomentose. Stamens ca 1.5 x 0.3 mm. Carpels 5, ovoid, hairy; ovules 4 - 6; styles elongate; stigmas fusiform. Fruitlets 1 - 4, obovoid, tapering at both ends, ca 3 x 2 cm, 4 - 6-seeded; stalks 1 - 2 mm long, woody.

Fl.: Aug. - Sept. *Fr.*: Nov. - Jan.

Habitat: Evergreen forests at low elevations, rare.

Distrib.: Kollam. Western Ghats of Tamil Nadu (Madurai). Sri Lanka.

Use: Timber is used for house construction.

MENISPERMACEAE

(M. MOHANAN)

Herbaceous twiners, shrubby climbers, large lianas, rarely erect shrubs or small trees, dio- rarely monoecious. Leaves alternate, simple, exstipulate, entire or palmately lobed, often peltate, usually palmately nerved. Flowers usually 3-merous, solitary or fascicled, capitate, cymose, racemose or paniced, axillary, from old wood or leafless branches; bracts and bracteoles present or not. Sepals 6(1-12), in 1-4 whorls, sometimes spiral, imbricate, inner whorl sometimes valvate, free or connate into a cup; outer ones often smaller. Petals 6(-9), rarely less, free or connate, sometimes enclosing stamens, rarely absent. Stamens in male flowers usually 6 (or 4-8, rarely more); filaments free, sometimes connate with anthers forming a synandrium; anthers often 4-lobed, basifixed, extrorse, dehiscing longitudinally or transversely; staminodes in female flowers 6 or absent. Carpels usually 3, sometimes 1, very rarely 6-12; styles simple or divided, terminal or sub-basal; stigmas capitate or discoid, entire or lobed; ovules 1 or 2, ventral, amphitropous; pistillode in male flowers, if present, small. Fruits drupaceous, stalked or not; druplets 2-6, often compressed; styler scars sub-basal, rarely subterminal; endocarp variously ornamented; seeds reniform, globose or horseshoe-shaped; endosperm copious, moderate or absent, fleshy, smooth or ruminant; embryo linear; cotyledons semiterete or flat.

Tropics and subtropics, a few temperate, ca 72 genera and ca 450 species, 20 and 43 in India and, 10 and 16 in Kerala.

Literature: Ernst, W.R. 1964. The genera of *Berberidaceae*, *Lardizabalaceae* and *Menispermaceae* in the South Eastern United States. *J. Arnold Arbor.* 45: 1-35. Ferguson, I.K. 1975. Pollen morphology of the Tribe Triclisieae of the *Menispermaceae* in relation to its taxonomy. *Kew Bull.* 30: 49-75. Forman, L.L. 1956. The *Menispermaceae* of Malaysia I. *Kew Bull.* 11: 41-69. Forman, L.L. 1958. The *Menispermaceae* of Malaysia II. *Kew Bull.* 12: 447-459. Forman, L.L. 1982. The correct names for the tribes of *Menispermaceae*. *Kew Bull.* 37: 367-368. Forman, L.L. 1988. A synopsis of Thai *Menispermaceae*. *Kew Bull.* 43: 369-407. Harley, M.M. & Ferguson, I.K. 1982. Pollen morphology and taxonomy of Menispermaceae (*Menispermaceae*). *Kew Bull.* 37: 353-366. Kunitomo, J.I. 1961. Studies in the alkaloids of Menispermaceous plants. *J. Pharm. Soc. Japan* 81: 1253-1266. Lien, W.N. 1975. A preliminary study of Menispermaceous

medicinal plants in China. *Acta Phytotax. Sin.* 13: 32 - 55. Pramanik, A. & Thoathathri, K. 1987. Miscellaneous notes on two Indian moonsceds (*Menispermaceae*). *Kew Bull.* 42: 705 - 706. Santapau, H. & Janardhanan, K.P. 1968. Critical notes on the nomenclature of some *Menispermaceae*. *Bull. Bot. Surv. India* 10: 367 - 368. Thanikaimoni, G. 1968. Morphologie des pollens des *Menispermaceae*. *Tr. Sect. Sci. Techn., Inst. Franc., Pondicherry* 5: 1 - 56. Thanikaimoni, G. 1986. Evolution of *Menispermaceae*. *Canad. J. Bot.* 64: 3130 - 3133. Wilkinson, H.P. 1989. Leaf anatomy of the *Menispermaceae* tribe *Tiliacoreae* Miers. *J. Linn. Soc., Bot.* 99: 125 - 174.

Key to genera (male specimens)

- | | | |
|-----|--|------------------------|
| 1a. | Stamens connate at least at base or inner ones connate | 2 |
| b. | Stamens free | 3 |
| 2a. | Anthers in a horizontal ring | 4 |
| b. | Anthers not in a horizontal ring | 5 |
| 3a. | Inner 3 sepals valvate | 9. <i>Tiliacora</i> |
| b. | Inner 3 sepals imbricate | 6 |
| 4a. | Flowers in umbelled cymes or disciform capitula | 8. <i>Stephania</i> |
| b. | Flowers in thyrsoid cymes or pseudoracemes | 7 |
| 5a. | Flowers in racemose heads | 4. <i>Coscinium</i> |
| b. | Flowers in fascicles, cymes or panicles | 1. <i>Anamirta</i> |
| 6a. | Main basal nerves with lateral ones ending at margin of leaves | 8 |
| b. | Main basal nerves breaking up and anastomosing in leaves | 9 |
| 7a. | Inflorescences corymbose cymes | 2. <i>Cissampelos</i> |
| b. | Inflorescences thyrsoid or pseudoracemes | 5. <i>Cyclea</i> |
| 8a. | Inflorescences arising from old leafless stems | 6. <i>Diploclisia</i> |
| b. | Inflorescences axillary | 7. <i>Pericampylus</i> |
| 9a. | Petals 2-fid | 3. <i>Cocculus</i> |
| b. | Petals entire | 10. <i>Tinospora</i> |

Key to genera (female specimens)

- | | | |
|-----|---------------------|---------------------|
| 1a. | Staminodes absent | 2 |
| b. | Staminodes present | 3 |
| 2a. | Stigmas entire | 9. <i>Tiliacora</i> |
| b. | Stigmas 3 - 6-lobed | 4 |
| 3a. | Drupes curved | 5 |
| b. | Drupes not curved | 6 |

4a.	Petals free	8. <i>Stephania</i>
b.	Petals connate	7
5a.	Stigmas dentate at margin	6. <i>Diploclisia</i>
b.	Stigmas entire or 2-fid at margin	8
6a.	Carpels glabrous	9
b.	Carpels densely pilose	4. <i>Coscinium</i>
7a.	Bracts foliaceous, accrescent; drupes pubescent	2. <i>Cissampelos</i>
b.	Bracts neither foliaceous nor accrescent; drupes glabrous	5. <i>Cyclea</i>
8a.	Petals 2-fid	3. <i>Cocculus</i>
b.	Petals entire	7. <i>Pericampylus</i>
9a.	Petals absent	1. <i>Anamirta</i>
b.	Petals present	10. <i>Tinospora</i>

1. ANAMIRTA Colebr.

Large, glabrous lianas. Leaves broadly ovate, palmately nerved with hairy domatia in axils of main nerves. Inflorescences cauliflorous or male ones sometimes axillary, paniced. Male flowers: Outer tepals 2, minute; inner ones 6 in 2 whorls, imbricate, concave, larger, reflexed; stamens connate into a stalked globose cluster; anthers 30 - 35, dehiscing transversely. Female flowers: Tepals as in male ones; staminodes 6 in 1 whorl, clavate, minute; carpels 3(or 4) on a short conic gynophore; stigmas subcapitate, reflexed; drupes on a 3-fid carpophore, subreniform or obliquely ovoid to globose, compressed; endocarp woody, reticulate; seeds globose.

Indomalesia, unispecific.

Literature: Ferguson, I.K. 1978. Pollen morphology of tribe Coscinieae of *Menispermaceae* in relation to taxonomy. *Kew Bull.* 32: 339 - 343. Forman, L.L. 1978. A revision of the tribe Coscinieae Hook.f. & Thoms. (*Menispermaceae*). The *Menispermaceae* of Malaysia and adjacent areas IX. *Kew Bull.* 32: 323 - 338. Wilkinson, H.P. 1978. Leaf anatomy of the tribe Coscinieae Hook.f. & Thoms. (*Menispermaceae*). *Kew Bull.* 32: 347 - 360.

Anamirta cocculus (L.) Wight & Arn., Prodr. Fl. Ind. Orient.: 446. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 98. 1872; Rama Rao, Fl. Pl. Travancore: 11. 1914; Dunn in Gamble, Fl. Madras: 27(19). 1915; Manilal & Sivar., Fl. Calicut: 29. 1982; Vajr., Fl. Palghat: 50. 1990; A. Pramanik in B.D.

Sharma & al., Fl. India 1: 311. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 50. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 35. 1996; Sivar. & P. Mathew, Fl. Nilambur: 46. 1997. *Menispermum cocculus* L., Sp. Pl.: 340. 1753.

Mal.: *Polla*

Large, woody climber. Leaves broadly ovate, cordate to truncate at base, entire, acute to obtusely acuminate at apex, 9 - 25 x 7 - 21 cm, coriaceous, glabrous above, hairy on nerve axils beneath, 3 - 5(-7)-nerved at base; petioles 4 - 19 cm long, swollen at both ends, striate. Inflorescences drooping panicles from old stems and branches, 16 - 40 cm long; lateral branches 2 - 5 cm long, glabrous; bracteoles to ca 0.5 mm long. Male flowers 2 - 3 mm long, glabrous; outer tepals 2, yellow to pale green; inner ones 6, elliptic, to 3 x 2 mm, glabrous, white or yellow; synandrium ca 2 mm long. Female flowers: Tepals as in male ones; staminodes 6, club-shaped, minute; carpels 3(or 4), curved, ellipsoid; stigmas subcapitate, recurved; drupes globose, 9 - 11 mm, glabrous, white; endocarp subreniform to globose, reticulate.

Fl. & Fr.: March - May.

Habitat: Low level evergreen and moist deciduous forests.

Distrib.: Almost throughout Kerala. Almost throughout India. South and SE. Asia.

Uses: Fruit is used for poisoning fish and game. An ointment made from the plant is used in skin diseases.

2. CISSAMPELOS L.

Scandent shrubs or lianas. Leaves peltate. Male flowers in axillary peduncled corymbose cymes, sometimes solitary or fascicled; sepals 4, obovate, free; petals 4, connate into a 4-lobed cupular corolla; stamens 4, connate into a peltate synandrium; anthers dehiscing transversely. Female flowers in thyrsoid elongate fascicles in axils of accrescent orbicular bracts; sepals 1(or 2); petal 1; staminodes absent; carpel 1; drupes ovoid with sub-basal stylar scar; endocarp hairy, horseshoe-shaped, dorsally tubercled; seeds curved.

Tropics, 20 species and 1 in India.

Literature: Mukherjee, B. & Bhandari, R. 1959. *Cissampelos pareira* L. as a source of a new curariform drug. *Pl. Med.* 7: 250 - 259. Kupchan, S.M.C.S. 1960. *Menispermaceae* alkaloids. 1. The alkaloids of *Cissampelos pareira* Linn. and the origin of *Radix pareirae* bravae. *J. Amer. Pharm*

Assoc. 49: 721 - 731. Rhodes, D.G. 1975. A revision of the genus *Cissampelos*. *Phytologia* 30: 415 - 484.

***Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman** in Kew Bull. 22: 356. 1968; Manilal, Fl. Silent Valley: 4. 1988; Vajr., Fl. Palghat: 50. 1990; M. Gangop. in B.D. Sharma & al., Fl. India 1: 317. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 50. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 35. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 64. 2002. *C. hirsuta* Buch.-Ham. ex DC., Syst. Nat. 1: 535. 1817 & Prodr. 1: 101. 1824. *C. pareira* L., Sp. Pl.: 1031. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 103. 1872 p.p.; Rama Rao, Fl. Pl. Travancore: 12. 1914; Dunn in Gamble, Fl. Madras: 30(21). 1915.

Mal.: *Kattuvalli, Malathangi*

Herbaceous, tomentose climber; stems wiry, twining, striate, pubescent. Leaves reniform or orbicular, truncate, cordate or peltate at base, entire, acute or retuse and apiculate at apex, 2.5 - 7 x 3.5 - 8 cm, chartaceous, pubescent, 5 - 7-nerved at base; petioles 4 - 7 cm long, pubescent. Male flowers in axillary pendulous to 6 cm long subcorymbose cymes; bracts obovate to orbicular; bracteoles linear; sepals 4, free, obovate, pilose outside; petals 4, connate into a 4-lobed cup; stamens 4, connate into a peltate synandrium; anthers dehiscing transversely. Female flowers in thyrsoid clusters on pendulous 4 - 10 cm long racemes; bracts large, foliaceous, ovate-reniform, tomentose, greenish; sepal 1, broadly ovate, ca 1.5 mm long; petal 1, obovate, cuneate, ca 0.8 mm long; carpel pilose; stigma 3-fid; drupes ovoid or subglobose, 3 - 5 mm long with sub-basal stylar scar, hirsute, scarlet red.

Fl.: Dec. - May *Fr.*: June.

Habitat: Fences in cultivated lands in plains, fairly common.

Distrib.: Kollam, Kottayam, Kozhikode, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Pantropical.

Uses: Dried root is diuretic. Leaf with coconut milk is used in venereal diseases. Decoction of the whole plant is used in cough.

3. COCCULUS DC., nom. cons.

Erect or climbing shrubs, or small trees. Leaves entire or lobed. Inflores-

cences cymose, thyrsoid, or in axillary fascicles. Male flowers: Sepals 6(- 9) in 2(or 3) whorls, imbricate; outer ones smaller; petals 6, usually 2-fid at apex, auricled at base, smaller than sepals; stamens 6, free, sometimes embraced by petals; anthers subglobose, dehiscing transversely. Female flowers: Sepals and petals as in male ones; staminodes 6 or absent; carpels 3 or 6; styles cylindrical, reflexed; drupes curved, obovate or globose, laterally compressed with sub-basal stylar scar; endocarp bony, horseshoe-shaped; seeds curved.

Tropics and subtropics excluding Australia and S. America, 8 species, 5 in India and 2 in Kerala.

Literature: Ferguson, I.K. 1974. The significance of leaf epidermis for the taxonomy of *Cocculus*. *Kew Bull.* 29: 483 - 492. Forman, L.L. 1961. The *Menispermaceae* of Malaysia IV. *Cocculus* DC. *Kew Bull.* 15: 479 - 487. Forman, L.L. 1974. The endocarps of *Cocculus*. *Kew Bull.* 29: 477 - 481. Rao, K.V.J. & Row, L.R. 1961. Chemical examination of *Cocculus hirsutus* DC. *J. Sci. Industr. Res. C, Biol. Sci.* 20: 125 - 126.

Key to species

- 1a. Twining shrub; branchlets puberulous; female flowers solitary or in pairs; petals entire
2. *C. pendulus*
- b. Tree; branchlets glabrous; female flowers neither solitary nor paired; petals emarginate or 2-lobed
1. *C. laurifolius*

1. *Cocculus laurifolius* DC., Syst. Nat. 1: 530. 1817; Deless., Icon. Sel. Pl. 1: 25, t. 97. 1820; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 101. 1872; Rama Rao, Fl. Pl. Travancore: 12. 1914; Dunn in Gamble, Fl. Madras: 29(21). 1915; Vajr., Fl. Palghat: 51. 1990; M. Gangop. in B.D. Sharma & al., Fl. India 1: 319. 1993.

Tree, 4 - 6 m high; branchlets glabrous. Leaves elliptic or oblanceolate, cuneate or acute at base, acute or attenuate at apex, 3 - 6 (- 11) x 3 - 5.5 cm, glabrous on both surfaces, 3-nerved at base; petioles ca 5 mm long. Male flowers in axillary thyrsoid ca 4 cm long glabrous cymes, yellow; bracts subulate, puberulous; sepals 6 in 2 whorls, broadly elliptic; petals 6, emarginate or 2-lobed; lateral lobes clasping stamens; stamens 6. Female flowers similar to male ones but fewer; staminodes 6, minute; carpels 3; styles reflexed; drupes globose, 3 - 4 mm, glabrous; endocarp ridged on upper surface.

Fl. & Fr.: March - June.

Habitat: Evergreen forests, to 1500 m, occasional.

Distrib.: Kottayam and Palakkad. Western Ghats of Karnataka and Tamil Nadu and subtropical Himalayas. China, Japan, Nepal, Taiwan and SE. Asia.

2. **Cocculus pendulus** (J.R. Forst. & G. Forst.) Diels in Engl., Pflanzenr. 46: 237. 1910; Dunn in Gamble, Fl. Madras: 29(21). 1915; M. Gangop. in B.D. Sharma & al., Fl. India 1: 320. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 64. 2002. *Epibatium pendulum* J.R. Forst. & G. Forst., Char. Gen. Pl.: 108, t. 54. 1776. *Menispermum leaeba* Delile, Descr. Egypte, Hist. Nat.: 140, t. 51. ff. 2 & 3. 1813. *Cocculus leaeba* (Delile) DC., Syst. Nat. 1: 529. 1817; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 102. 1872.

Twining shrub; stem to 15 cm thick; branches 5 - 6 m long, puberulous. Leaves oblong-lanceolate to -ovate, truncate, cuneate, rounded or 3-lobed-hastate at base, obtuse, mucronate or emarginate at apex, 1.5 - 5 x 0.5 - 3 cm, glabrous to slightly puberulous, 3 - 5-nerved at base. Male flowers sessile or subsessile, in axillary 5 - 20 mm long fascicles; peduncles ca 1.5 cm long; sepals ovate-elliptic, fleshy or membranous; outer 3 sepals 1 - 1.5 x 0.4 - 0.7 mm, sparsely puberulous; inner 3 larger, puberulous to glabrous, shining; petals ovate to obovate, 0.8 - 2 x 0.5 - 1 mm; stamens 0.8 - 1.5 mm long. Female flowers axillary, solitary, rarely in pairs; peduncles 0.7 - 1.3 cm long; sepals and petals as in male ones; carpels ca 1 mm long; drupes ovoid to obovoid or reniform, compressed, 4 - 7 x 4 - 5 mm, reddish, black when dry; endocarp ribbed on lateral faces, not crested, not perforated in middle.

Fl. & Fr.: Almost throughout the year.

Habitat: Scrub and deciduous forests, to 700 m.

Distrib.: Thiruvananthapuram. Gujarat, Jammu & Kashmir, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. Pakistan to Africa.

4. COSCINIUM Colebr.

Large lianas. Leaves peltate, palmately nerved, whitish-tomentose beneath. Inflorescences racemes of peduncled globose heads of bracteate flowers, supra-axillary or ramiflorous. Male flowers: Tepals 9 in 3 whorls, imbricate, sericeous; stamens 6; outer 3 free, with 1-loculed introrse anthers; inner 3 with connate filaments and 2-loculed anthers. Female flowers: Tepals as in male ones;

staminodes 6; carpels 3, densely pilose; styles subulate, recurved; drupes subglobose; endocarp with fibrous ridges; seeds globose.

South and SE. Asia, 2 species and 1 in India.

Literature: Singh, G.B. & al. 1990. Hypotensive action of a *Coscinium fenestratum* stem extract. *J. Ethnopharmacol.* 30: 151.

Coscinium fenestratum (Gaertn.) Colebr. in Trans. Linn. Soc. London 13: 65. 1822; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 99. 1872; Rama Rao, Fl. Pl. Travancore: 12. 1914; Dunn in Gamble, Fl. Madras: 27(19). 1915; A. Pramanik in B.D. Sharma & al., Fl. India 1: 313. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 36. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 65. 2002. *Menispermum fenestratum* Gaertn., Fruct. Sem. Pl. 1: 219, t. 45, f. 5. 1788.

Mal.: *Maramanjil*

Branchlets tomentose when young, glabrous when old. Leaves ovate-cordate, rounded or truncate at base, acuminate at apex, 11–20 x 8–13 cm, glabrescent above, tomentose beneath, 5–7-nerved at base; petioles 2–4 cm long, swollen at both ends. Flowers in globose peduncled heads of racemes on older leafless stems; bracts subulate, 4–5 mm long. Male flowers: Tepals elliptic or obovate, ca 2 mm long, densely pilose outside, glabrous inside, yellow; stamens 6. Female flowers: Tepals as in male ones; staminodes 6, clavate; carpels 3, ellipsoid, curved, densely pilose; styles filiform, recurved; drupes subglobose, 2.5–3 cm across, tomentose, yellowish brown or orange; endocarp bony; seeds subglobose, white.

Fl. & Fr.: March - Aug.

Habitat: Evergreen and semievergreen forests, to 1500 m.

Distrib.: Idukki, Thiruvananthapuram and Thrissur. Southern India. Cambodia, Malaysia and Sri Lanka.

Note: Reportedly extremely rare due to over-exploitation for medicinal uses (Sasidharan & Sivarajan, *l.c.*).

Uses: Root antiseptic and is used for dressing wounds. Wood yields a yellow dye (Jewers & al. in *Phytochemistry* 9: 663. 1970). Singh & al. (*l.c.*) found that 50% ethanol extract of the stem to possess hypotensive action in anaesthetised dogs, rats and guinea pigs.

5. CYCLEA Arn. ex Wight

Climbing shrubs. Leaves peltate, palmately nerved. Flowers in axillary or cauliflorous racemes or panicles. Male flowers: Sepals 4 or 5, free or connate; petals 4 or 5, connate; stamens 4 - 6, connate into a peltate synandrium; anthers 4 - 6, dehiscing transversely. Female flowers: Sepals 1 or 2, connate into a globose or campanulate calyx; petals 1 or 2, connate, globose; carpel 1; style very short; stigma 3 - 5-lobed with radiating lobes; drupes ovoid or obovoid, with sub-basal stylar scar, sometimes pubescent; endocarp horseshoe-shaped, laterally convex, dorsally tubercled; seeds curved.

Tropical Asia, ca 30 species, 8 in India and 4 in Kerala.

Key to species

- | | | |
|-----|--|-------------------------|
| 1a. | Calyx in male flowers divided almost to base | 3. <i>C. fissicalyx</i> |
| b. | Calyx in male flowers divided only to 1/4 of tube | 2 |
| 2a. | Sepals in female flowers 2 | 2. <i>C. barbata</i> |
| b. | Sepal in female flowers 1 | 3 |
| 3a. | Male inflorescences to 11 cm long; calyx globose | 4. <i>C. peltata</i> |
| b. | Male inflorescences to 30 cm long; calyx campanulate | 1. <i>C. arnottii</i> |

1. *Cyclea arnottii* Miers in Ann. Mag. Nat. Hist. 3, 18: 19. 1866; Dunn in Gamble, Fl. Madras: 31(22). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 42. 1988. *C. peltata* sensu Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 104. 1872 p.p.

Herbaceous twiner; stems hirsute. Leaves ovate-deltoid, peltate, truncate, cordate or rounded at base, acuminate at apex, 7 - 13.5 x 3.5 - 6.5 cm, coriaceous, glabrous above or hirsute on both surfaces, 5 - 7-nerved at base; petioles to 6 cm long. Male inflorescences axillary, pseudoracemose, to 30 cm long, hirsute. Male flowers: Sepals 4 or 5, connate to 1/4 of tube into a campanulate calyx; petals 4 or 5, connate, unequal; stamens 4, connate into a peltate synandrium; anthers dehiscing transversely. Female flowers in axillary, to 16 cm long pseudoracemes; sepal 1, hirsute outside; petal 1; carpel 1; styles 2- or 3-fid; staminodes 6; drupes ovoid; endocarp tubercled.

Fl.: March Fr.: Aug. Sept.

Habitat: Low level moist deciduous and semievergreen forests, rare.

Distrib.: Kannur, Kottayam, Palakkad, Pathanamthitta and Wynad. Western Ghats of Tamil Nadu. Endemic.

2. *Cyclea barbata* Miers, Contr. Bot. 3: 237. 1871; Forman in Kew Bull. 14: 76. 1960; Manilal & T. Sabu in Anc. Sci. Life 4: 229. 1985; Manilal, Fl. Silent Valley: 4. 1988; M. Gangop. in B.D. Sharma & al., Fl. India 1: 322. 1993. *Cyclea peltata* Miq., Fl. Ned. Ind. 1: 86. 1855, non (Lam.) Hook.f. & Thomson 1855, nec Miers 1874.

Slender, climbing shrub, to 5 m long; stems herbaceous or woody, hispid when young, glabrous when old. Leaves ovate or deltoid-ovate, truncate or rounded at base, obtuse or acuminate at apex with a mucronate acumen, 6 - 15.5 x 4 - 12.5 cm, hispid to subglabrous above, tomentose beneath; petioles 3 - 6 cm long, hispid. Male inflorescences axillary or cauliflorous 7 - 10 cm long puberulous cymes; flowers 1 - 2 mm long, pedicelled, with turbinate puberulous greenish calyx lobes and gamopetalous obtusely lobed glabrous corolla; synandrium 1 - 2 mm long, exserted. Female inflorescences similar to male ones but broader; flowers sessile, in dense heads; sepals 2, obovate or rhomboid, pilose outside; petals 2, reniform, broader than sepals, glabrous; ovary ellipsoid, curved, densely pilose; stigma 3-laciniate; drupes obovoid to globose, 4 - 7 x 4 - 5.5 mm, puberulous; endocarp with 3 rows of papilliform tubercles on both faces; seeds curved.

Fl. & Fr.: Jan. - April.

Habitat: Moist deciduous forests, common.

Distrib.: Palakkad (Manilal, l.c.). Andaman & Nicobar Islands, Assam and Sikkim. South and SE. Asia.

3. *Cyclea fissicalyx* Dunn in Gamble, Fl. Madras: 31(22). 1915; Manilal, Fl. Silent Valley: 5. 1988; M. Gangop. in B.D. Sharma & al., Fl. India 1: 324. 1993. *C. peltata* Miers, Contr. Bot. 3: 236. 1871, non (Lam.) Hook.f. & Thomson 1855.

Herbaceous twiner; stems puberulous when young, glabrous when old. Leaves deltoid or ovate, truncate or slightly sinuate at base, acuminate or mucronate at apex, 8 - 16 x 5 - 10.5 cm, ciliate at margin, puberulous on nerves; petioles 3 - 6 cm long. Male inflorescences axillary much branched panicles; flowers subsessile; calyx divided almost to base into 4(or 5) pilose lobes; petals connate,

glabrous; synandrium 1 - 1.5 mm long. Female inflorescences racemose, shorter than male ones; sepals 2, oblong, glabrous; petal 1, orbicular, shorter than sepals; ovary ovoid-oblong, pilose; drupes sessile, ovoid, ca 4 mm long, pilose; seeds curved.

Fl. & Fr.: June - Sept.

Habitat: Evergreen forests.

Distrib.: Kannur, Palakkad and Wynad (Dunn, *l.c.*). Endemic and rare.

4. *Cyclea peltata* (Lam.) Hook.f. & Thomson, *Fl. Ind.*: 201. 1855 & in Hook.f., *Fl. Brit. India* 1: 104. 1872 p.p.; Rama Rao, *Fl. Pl. Travancore*: 13. 1914; Dunn in Gamble, *Fl. Madras*: 31(22). 1915; Santapau & K.P. Janardh. in *Bull. Bot. Surv. India* 10: 363. 1969; Manilal & Sivar., *Fl. Calicut*: 29. 1982; Manilal, *Fl. Silent Valley*: 5. 1988; Nicolson & al. in *Regnum Veg.* 119: 179. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 42. 1988; Vajr., *Fl. Palghat*: 5. 1990; M. Gangop. in B.D. Sharma & al., *Fl. India* 1: 325. 1993, excl. syn. *C. arnottii* Miers 1866; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 50. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 36. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 46. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 66. 2002. *Menispermum peltatum* Lam., *Encycl.* 4: 96. 1797. *Cocculus burmannii* DC., *Prodr.* 1: 96. 1824. *Cyclea burmannii* (DC.) Hook.f. & Thomson, *Fl. Ind.*: 201. 1855 & in Hook.f., *Fl. Brit. India* 1: 104. 1872; Rama Rao, *Fl. Pl. Travancore*: 13. 1914.

Mal.: *Padakizhengu, Padathali, Padavalli*

Herbaceous twiner; stem sparsely pubescent or glabrous. Leaves peltate-cordate, subtriangled, truncate or hastate at base, entire, acute and mucronate at apex, 6 - 13 x 4 - 8 cm, coriaceous, glabrous, shining above, pubescent beneath, 5 - 7-nerved at base; petioles 3 - 5 cm long. Male flowers in axillary pubescent 7 - 11 cm long pseudoracemes or panicles; calyx globose, 5(- 8)-lobed, pilose inside, puberulous outside; petals 4(- 8), connate at base, greenish; stamens 4, connate into a peltate synandrium; anthers 6 - 8-loculed. Female flowers similar to male ones; sepal 1, linear, pilose; petal 1, subulate, glabrous; carpel 1, gibbous at base; styles 2- or 3-fid; drupes subglobose or ovoid, 3 - 4 mm across, wrinkled, with sub-basal stylar scar, milky white; endocarp dorsally tubercled.

Fl.: March - June *Fr.*: Aug. - Oct.

Habitat: Plains and low elevations of hills, fairly common.

Distrib.: Almost throughout Kerala, Gujarat, Maharashtra and Tamil Nadu.

Sri Lanka.

Uses: Root is used for treating dysentery and piles. A shampoo, called 'thali' in Malayalam, made from the leaf, is used for bathing newborn babies.

6. DIPLOCLISIA Miers

Climbing shrubs. Leaves peltate-cordate, entire. Inflorescences paniced, pendulous, on leafless old stems. Sepals 6, free; inner ones larger. Petals 6, free, smaller than sepals, auricled at base, enclosing stamens or staminodes. Stamens 6, free; anthers globose, dehiscing by transverse slit. Carpels in female flowers 3, free, glabrous on a short gynophore; styles eccentric; stigmas recurved, flat, dentate at margin. Drupes compressed; endocarp ridged on sides, with a septum-like structure in middle of locule; seeds curved.

South and SE. Asia, 2 species and 1 in India.

Diploclisia glaucescens (Blume) Diels in Engl., Pflanzenr. 46: 225, t. 77. 1910; Dunn in Gamble, Fl. Madras: 28(20). 1915; Manilal & Sivar., Fl. Calicut: 28. 1982; Manilal, Fl. Silent Valley: 6. 1988; Nicolson & al. in Regnum Veg. 119: 179. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 43. 1988; A. Pramanik in B.D. Sharma & al., Fl. India 1: 327. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 51. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 36. 1996; Sivar. & P. Mathew, Fl. Nilambur: 48. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 66. 2002. *Cocculus glaucescens* Blume, Bijdr.: 25. 1825. *C. macrocarpus* Wight & Arn., Prodr. Fl. Ind. Orient.: 13. 1834; Wight, Ill. Ind. Bot. 1: t. 7. 1840; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 101. 1872; Rama Rao, Fl. Pl. Travancore: 12. 1914.

Liana, ca 25 m long, glabrous. Leaves suborbicular to broadly ovate, rounded to cordate at base, entire, obtuse and mucronate at apex, 4 - 13 x 4 - 14 cm, subcoriaceous; petioles 8 - 14 cm long. Male flowers in to 30 cm long pendulous panicles on old leafless branches, yellow; sepals 6 in 2 whorls; outer ones obovate; the inner broader; petals 6, free, obovate, auricled at base, emarginate; stamens 6, free, enclosed by petals; anthers dehiscing transversely. Female panicles similar to male ones; flowers ca 4 mm across; sepals 6; petals 6; staminodes 6; carpels 3; drupes obovate, compressed, dorsally keeled and tubercled, with sub-basal styler scar, yellowish orange; endocarp elongate, transversely ridged.

Fl.: April - May *Fr.*: June - Sept.

Habitat: Evergreen and semievergreen forests, 200 - 1000 m.

Distrib.: Almost throughout Kerala. Andaman Islands, Arunachal Pradesh, Karnataka, Maharashtra and Tamil Nadu. South and SE. Asia.

Use: Leaf is used in Ayurvedic medicines for venereal diseases.

7. PERICAMPYLUS Miers, nom. cons.

Woody, climbing shrubs. Leaves palmately nerved. Inflorescences axillary, cymose or subumbelled; cymes solitary or in fascicles. Male flowers: Sepals 9 in 3 whorls; outermost 3 narrow, minute; the inner concave, imbricate; the innermost broader than the rest; petals 6, cuneate; stamens 6, free; anthers dehiscing longitudinally. Female flowers: Sepals and petals as in male ones; staminodes 6, filamentose; carpels 3; stigmas recurved, deeply 2-fid; drupes purple to black; endocarp rotund, laterally concave; seeds curved.

Tropical and subtropical Asia, 7 species and 1 in India.

Pericampylus glaucus (Lam.) Merr., *Interpr. Rumph. Herb. Amboin.*: 212. 1917; A. Pramanik in B.D. Sharma & al., *Fl. India* 1: 330. 1993. *Menispermum glaucum* Lam., *Encycl.* 4: 100. 1797. *Cocculus incanus* Colebr. in *Trans. Linn. Soc. London* 13: 57. 1822. *Pericampylus incanus* (Colebr.) Hook.f. & Thomson, *Fl. Ind.*: 194. 1855 & in Hook.f., *Fl. Brit. India* 1: 102. 1872; Rama Rao, *Fl. Pl. Travancore*: 13. 1914.

Woody climber; stems ridged, yellowish-tomentose when young, glabrous when old. Leaves ovate-triangular, shallowly cordate or truncate at base, crenate at margin, rounded, obtuse or acute at apex with an apiculus, 5 - 10 x 5 - 8 cm, pubescent above, yellowish-tomentose beneath, 5-nerved at base; petioles 3 - 7 cm long. Inflorescences 2 - 4 cm long, yellowish-tomentose. Male flowers white or yellow; sepals 9, hairy outside; outer 3 narrow, minute; middle 3 oblanceolate; inner 3 obovate; petals 6, obcuneate, glabrous; stamens 6. Female flowers: Sepals and petals as in male ones; staminodes 6; carpels 3, ca 0.5 mm long; stigmas recurved, 2-fid; drupes subglobose, echinate, glabrous, red-purple or black; endocarp rotund, ca 5 mm, with ridges and projections on dorsal surface.

Fl. & Fr.: May - June.

Distrib.: Travancore. Assam, Meghalaya and Sikkim. Bangladesh, China, Malay-

sia, Myanmar, Taiwan, Thailand and Vietnam.

Note: Inclusion is based on Rama Rao's (*l.c.*) report from Aryankavu and Puliyaara (Kollam District). There is no specimen from Kerala or S. India at MH.

8. STEPHANIA Lour.

Slender, herbaceous or suffruticose climbers; stems grooved; roots tuberous. Leaves peltate, ovate or orbicular, usually entire, glabrous or hairy. Flowers pedicelled or not, in umbelled cymes or heads, either solitary or paniced. Male flowers: Sepals 6 - 10, free, imbricate, in 2 equal or unequal series; petals 3 - 5, free, smaller than sepals; stamens 2 - 6, connate into a peltate synandrium; anthers dehiscing transversely. Female flowers: Sepals 3 - 5, free; petals 3 - 5, free, smaller than sepals; carpels ellipsoid, glabrous; styles 3-fid; stigmas radiating; drupes obovoid with basal styler scar; endocarp bony, horseshoe-shaped with transverse ridges on sides; seeds curved.

Old World tropics, ca 35 species, 8 in India and 2 in Kerala.

Literature: Kupchan, S.M.C.S. 1961. *Menispermaceae* alkaloids. Alkaloids of *Stephania hernandifolia*. *J. Amer. Pharm. Assoc.* 50: 819 - 822.

Key to species

- | | |
|-------------------|-----------------------|
| 1a. Heads paniced | 1. <i>S. japonica</i> |
| b. Head solitary | 2. <i>S. wightii</i> |

1. *Stephania japonica* (Thunb.) Miers in *Ann. Mag. Nat. Hist.* 3, 18: 14. 1866; Dunn in *Gamble, Fl. Madras*: 29(21) 1915; Manilal, *Fl. Silent Valley*: 6. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 43. 1988; M. Gangop. in B.D. Sharma & al., *Fl. India* 1: 335. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 52. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 37. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 49. 1997. *Menispermum japonicum* Thunb., *Fl. Jap.*: 193. 1784. *Cissampelos hernandifolia* Willd., *Sp. Pl.* 4: 861. 1806. *Clypea hernandifolia* (Willd.) Wight & Arn., *Prodr. Fl. Ind. Orient.*: 14. 1834; Wight, *Icon. Pl. Ind. Orient.*: t. 939. 1845. *Stephania hernandifolia* sensu Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 103. 1872 p.p., non Walp. 1842.

Slender, herbaceous climbers. Leaves ovate or subdeltoid, peltate, cordate, obtuse or broadly rounded at base, acuminate and mucronate at apex, 5 - 8 x 5

7.5 cm, ciliate at margin, chartaceous, glabrous, 9 - 11-nerved at base; petioles 2.5 - 4.5 cm long. Male flowers in axillary 6 - 8 cm long umbels, sessile or subsessile, greenish or white; sepals 8 in 2 whorls of 4 each, free, oblanceolate, ca 1.5 mm long, glabrous or puberulous outside; petals 3 - 5, suborbicular, ca 0.8 mm long, greenish; stamens 6 - 8, connate into a peltate synandrium; anthers dehiscing transversely. Female inflorescences similar to male ones; sepals 3 - 5, oblong or elliptic; petals 3 - 5, suborbicular; staminodes absent; carpel 1, ovoid; stigmas 3-lobed; drupes globose or obovoid, ca 6 x 8 mm, with basal styler scar, red; endocarp transversely ridged.

Key to varieties

- | | |
|-------------------------------|---------------------------|
| 1a. Leaves puberulous beneath | 1.1. var. <i>discolor</i> |
| b. Leaves glabrous beneath | 1.2. var. <i>japonica</i> |

1.1. var. **discolor** (Blume) Forman in Kew Bull. 11: 49. 1956 & Steenis, Fl. Males. I, 10: 242. 1986; M. Gangop. in B.D. Sharma & al., Fl. India 1: 337. 1993. *Clypea discolor* Blume, Bijdr.: 26. 1825.

Fl.: Feb. - March *Fr.*: Aug.

Habitat: Evergreen forests, rare.

Distrib.: Idukki. Arunachal Pradesh, Assam, Meghalaya, Nicobar Islands and Sikkim. South and SE. Asia to Australia.

1.2. var. *japonica*

Fl. & Fr.: March - Aug.

Habitat: Moist deciduous forests, wasteland scrubs and also on hedges in cultivated lands.

Distrib.: Kannur, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Karnataka and Tamil Nadu. China, Japan, Korea, Malesia, Sri Lanka and Taiwan.

Use: Called 'patha' it is used in Ayurveda.

2. **Stephania wightii** (Arn.) Dunn in Gamble, Fl. Madras: 30(21). 1915; Manilal, Fl. Silent Valley: 7. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 44. 1988; Vajr., Fl. Palghat: 51. 1990; M. Gangop. in B.D. Sharma & al., Fl. India 1: 338. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 52. 1994; Sasidh. &

Sivar., Fl. Pl. Thrissur: 37. 1996; Sivar. & P. Mathew, Fl. Nilambur: 49. 1997. *Clypea wightii* Arn. in Wight, Ill. Ind. Bot. 1: 22. 1840. *Stephania rotunda* sensu Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 103. 1872 p.p., non Lour. 1790.

Climbing shrub; branchlets glabrous; roots tuberous. Leaves peltate, subdeltoid, broadly ovate or suborbicular, truncate at base, dentate or sinuate at margin, acute to acuminate at apex, 3 - 6 x 3 - 7 cm, glabrous; petioles 3 - 7 cm long. Male inflorescences axillary lax peduncled cymes; bracts subulate; flowers 3 - 6 mm across, yellow; sepals 6 - 8, free, narrow, cuneate, puberulous; petals 4, free, oblong or obovate, shorter than sepals; stamens 6 - 8, connate into a peltate synandrium; anthers dehiscing transversely. Female flowers: Sepals and petals as in male ones; carpels ovoid; drupes globose or ovoid, ca 7 x 5 mm, with basal stylar scar; endocarp transversely ridged.

Fl. & Fr.: April - Aug.

Habitat: Moist deciduous forests and margins of evergreen forests, occasional.

Distrib.: Kannur, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu. Endemic.

9. TILIACORA Colebr., nom. cons.

Lianas; branchlets with discoid petiole scars. Leaves pinnately nerved. Inflorescences cauliflorous or axillary, pseudoracemose, reduced to a solitary flower in female inflorescence. Male flowers: Sepals 6 - 12 in 3 rows, free, fleshy; outermost the smallest; innermost 3 larger, valvate; petals 3 - 6, free, minute; stamens 3 - 9, free; anthers introrse, dehiscing by oblique or longitudinal slits. Female flowers: Sepals and petals as in male ones; staminodes absent; carpels (3-) 8 - 12, on a gynophore; styles recurved; drupes subovoid, with basal stylar scar; endocarp subovoid with a groove, dorsally ornamented with transverse branched ridges; endosperm ruminant; embryo horseshoe-shaped.

Old World tropics, 22 species, 2 in India and 1 in Kerala.

Literature: Kundu, B.C. & Guha, S. 1975. *Tiliacora acuminata* (Lam.) Miers. *Bull. Bot. Surv. India* 17: 147 - 156.

Tiliacora acuminata (Lam.) Hook.f. & Thomson, Fl. Ind.: 187. 1855; Dunn in Gamble, Fl. Madras: 28(20). 1915; Manilal & Sivar., Fl. Calicut: 30. 1982; Nicolson & al. in Regnum Veg. 119: 180. 1988; Vajr., Fl. Palghat: 52. 1990; A.

Pramanik in B.D. Sharma & al., Fl. India 1: 342. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 52. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 37. 1996; Sivar. & P. Mathew, Fl. Nilambur: 50. 1997. *Menispermum acuminatum* Lam., Encycl. 4: 101. 1797. *Tiliacora racemosa* Colebr. in Trans. Linn. Soc. London 13: 67, t. 6. 1821; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 99. 1872; Rama Rao, Fl. Pl. Travancore.: 12. 1914.

Mal.: *Karpuravalli, Vallikanjiram*

Climbing shrub; stems striate, sparsely puberulous or glabrous. Leaves ovate or lanceolate, truncate, cordate, rarely acute at base, acuminate at apex, 8 - 14 x 3.5 - 8 cm, chartaceous, glabrous, 3 - 5-nerved at base; petioles 1.5 - 3 cm long, sulcate, glabrous. Inflorescences axillary, paniced, 3.5 - 10 cm long, pubescent. Male flowers 2 - 7 at apex of inflorescence, yellow; sepals 9 in 3 rows; inner ones broadly elliptic, glabrous; petals 6, obovate, glabrous; stamens 6, cylindric. Female flower solitary; sepals and petals as in male ones; carpels 8 - 12, glabrous, on stalked puberulous gynophore; drupes on branched carpophores, oblong to obovoid, 10 - 15 x 6 - 7 mm, glabrous, red when ripe; endocarp reticulate.

Fl. & Fr.: Aug. - Dec.

Habitat: River banks in midland and low level forests, frequent.

Distrib.: Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Throughout tropical India. Bangladesh, Myanmar, Nepal and Sri Lanka.

Uses: Root is used as an antitode to snakebite, and stem for making baskets. Pharmacological properties were reported by Boormsa (*Bull. Inst. Bot. Buitenzorg* 14: 15. 1902) and phytochemistry by Thornber (*Phytochemistry* 9: 157 - 187. 1970).

10. TINOSPORA Miers, nom. cons.

Woody climbers. Leaves cordate, entire, sometimes dentate or lobed, 3 - 5-nerved at base with domatia in main nerve axils. Inflorescences thyrsoid, pseudo-racemose, -paniced or -spicate. Male flowers: Sepals 6, usually free, rarely connate at base; outer 3 smaller, elliptic, membranous; petals 6, rarely 3, ovate, glandular-papillose outside at base; stamens 6, free. Female flowers: Sepals and petals as in male ones; staminodes 6, subulate; carpels 3, ellipsoid, curved; stigmas reflexed with pointed lobes; drupes 3, on a short columnar carpophore; en-

docarp bony, tubercled on dorsal surface; endosperm ruminant.

Old World tropics, 32 species, 4 in India and 2 in Kerala.

Literature: Ahamed, A.M.F. 1981. Seenthil kodi - a cure for diabetes. *Kisan World* 8: 61 - 62. De, P. & Maiti, C.G. 1989. Study of Indian *Tinospora* Miers (*Menispermaceae*): Petal venation of *Tinospora cordifolia*. *J. Econ. Tax. Bot.* 13: 241 - 245. Forman, L.L. 1981. A revision of *Tinospora* (*Menispermaceae*) in Asia to Australia and the Pacific. *Kew Bull.* 36: 375 - 421. Kundu, B.C. 1976. *Tinospora fosbergii*. A new *Tinospora* from Sri Lanka. *Ceylon J. Sci., Biol. Sci.* 12: 49 - 53. Mathur, S.L. 1975. Abnormal meiosis in *Tinospora cordifolia* Miers. *Acta Bot. Ind.* 3: 82 - 84.

Key to species

- 1a. Leaves cordate, glabrous on both surfaces; endocarp rounded at both ends **1. *T. cordifolia***
- b. Leaves ovate, puberulous above, tomentose beneath; endocarp obtusely pointed at base, broadly keeled at apex **2. *T. sinensis***

1. *Tinospora cordifolia* (Willd.) Miers in Ann. Mag. Nat. Hist. 2, 7: 38. 1855; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 97. 1872; Rama Rao, Fl. Pl. Travancore: 11: 1914; Dunn in Gamble, Fl. Madras: 26(19). 1915; Manilal & Sivar., Fl. Calicut: 29. 1982; Nicolson & al. in Regnum Veg. 119: 180. 1988; Vajr., Fl. Palghat: 52. 1990; A. Pramanik in B.D. Sharma & al., Fl. India 1: 347. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 53. 1994. *Menispermum cordifolium* Willd., Sp. Pl. 4: 826. 1806. *Cocculus cordifolius* (Willd.) DC., Syst. Nat. 1: 517. 1817 & Prodr. 1: 97. 1824; Wight, Icon. Pl. Ind. Orient.: II. 485 & 486. 1841.

Mal.: *Chittamruthu, Sidhamirthu*

Woody climber with aerial roots, glabrous; bark grooved, corky. Leaves cordate, broadly ovate-triangular, sinuate at base, abruptly acuminate at apex, 6 - 15 x 6 - 10 cm, 5 - 7-nerved at base; petioles pulvinate, 2 - 7 cm long. Male inflorescences axillary or from axils of leaf scars on old stems, solitary, pseudoracemose, slender, to 12 cm long. Male flowers fascicled, yellow; sepals 6; outer 3 ovate, ca 1.5 mm long; the inner elliptic, concave, 3 - 4 mm long; petals 6, rhomboid, ca 2.5 mm long, papillose outside at base; stamens 6, free, clavate. Female inflorescences similar to male ones but flowers arising singly; sepals as in

male ones; petals spatulate; staminodes 6, subulate; carpels 3, ellipsoid; stigma capitate; drupes globose, 4–5 mm, radiating from a carpophore, red; endocarp bony, papillose.

Fl. & Fr.: Jan. - April.

Habitat: Plains and moist deciduous forests at low elevations, fairly common.

Distrib.: Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thiruvananthapuram. Tropical India. Bangladesh, Myanmar and Sri Lanka.

Uses: All parts are used in preparing several Ayurvedic medicines and tonics.

2. *Tinospora sinensis* (Lour.) Merr. in *Sunyatsenia* 1: 193. 1934 & *Trans. Amer. Philos. Soc. N.S.* 24: 158. 1935; Manilal & Sivar., *Fl. Calicut*: 30. 1982; Nicolson & al. in *Regnum Veg.* 119: 181. 1988; Vajr., *Fl. Palghat*: 12. 1990; A. Pramanik in B.D. Sharma & al., *Fl. India* 1: 349. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 39. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 51. 1997. *Campylus sinensis* Lour., *Fl. Cochinch.*: 113. 1790. *Menispermum malabaricum* Lam., *Encycl.* 4: 96. 1796. *Cocculus malabaricus* (Lam.) DC., *Syst. Nat.* 1: 518. 1817. *C. tomentosus* Colebr. in *Trans. Linn. Soc. London* 13: 59. 1822. *Tinospora malabarica* (Lam.) Miers ex Hook.f. & Thomson, *Fl. Ind.*: 183. 1855 & in Hook.f., *Fl. Brit. India* 1: 96. 1872. *T. tomentosa* (Colebr.) Hook.f. & Thomson, *Fl. Ind.*: 183. 1855 & in Hook.f., *Fl. Brit. India* 1: 96. 1872.

Mal.: *Kattamirthu, Paeamirthu*

Stems puberulous when young, glabrous when old, with aerial roots. Leaves ovate-suborbicular, cordate at base, rarely lobed or sinuate at margin, acuminate at apex, 7–12 x 4.5–10 cm, puberulous above, tomentose beneath; petioles to 10 cm long. Male inflorescences solitary or few together in axils of old leafless stems, pseudoracemose. Male flowers: Sepals glabrous, yellowish; outer 3 ovate, ca 1.5 mm long; the inner elliptic, ca 3 x 5 mm; petals spatulate, ca 4 mm long with lateral margin inflexed, papillose; stamens 6, clavate. Female inflorescences similar to male ones, to 14 cm long; sepals and petals as in male ones; carpels 3, ellipsoid; stigmas flat, lobed; drupes radiating from a branched carpophore, red; endocarp bony, irregularly tubercled or ridged.

Fl. & Fr.: March–June.

Habitat: Moist deciduous forests, occasional.

Distrib.: Kannur, Kasaragod, Kozhikode, Malappuram, Palakkad and Thrissur.

Northeast India. South and SE. Asia.

Note: Dunn (*l.c.*) did not include this species.

The generic name *Campylus* Lour. (1790), though older than *Tinospora* Miers (1851), is not synonymous with it as the generic description does not match with that of *Tinospora* Miers or the family *Menispermaceae*. But the only species described under *Campylus* Lour., viz., *C. sinensis* Lour. which is the basionym of *Tinospora sinensis* (Lour.) Miers certainly refers to *T. tomentosa* (Colebr.) Hook.f. & Thomson which is treated as a synonym of *T. sinensis* (*vide* Merrill (1934) and Forman (*Kew Bull.* 36: 375-377, 1981) for detailed taxonomic and nomenclatural discussions).

BERBERIDACEAE

(N.C. NAIR)

Rhizomatous herbs, shrubs or small trees, sometimes climbers; stem greenish when young, ripening to a brownish grey, red or yellow; spines present or not. Leaves alternate, sometimes whorled, stipuled or not, simple or imparipinnate, subcordate, truncate, rounded or broadly cuneate at base, spinulose or toothed at margin, acute, acuminate, obtuse or rounded at apex, more or less coriaceous or thick, usually pruinose beneath. Flowers often globose, axillary, solitary or in simple umbelled or pseudoumbelled racemes, bisexual, bracteate. Sepals petaloid, in 2 whorls of 3 each, ovate, acute or subacute, caducous. Petals in 2 whorls of 3 each, ovate, acute or subacute, caducous, shorter, as long as or longer than inner sepals, usually with nectariferous glands at cuneate truncate or clawed base, yellow, reddish yellow or white. Stamens (4-) 6 (-8) in 2 whorls of 3 each, antipetalous, often attached to petal base and slightly swollen below anthers; connectives slightly produced at apex or not; anthers 2-loculed, introrse, opening usually by lateral flaps. Ovary 1 - 3- or more-carpelled, 1-loculed; ovules (1 or) 2 - many on ventral suture or parietal covering whole wall, or few near base, anatropous; style short or absent; stigma dilated or conic, often persistent. Fruit a berry, rarely follicled, globose, ellipsoid or ovoid, soft in texture, often covered with bloom, black, dark red or reddish purple; seeds with a crustaceous reddish, purplish, black or pale testa; embryo minute or long, straight or curved; endosperm fleshy, copious or sometimes absent.

North temperate regions to tropical mountains, 15 genera and ca 680 species, 3 and 68 in India and, 2 and 2 in Kerala.

Literature: Chatterjee, R. 1953. Studies on Indian *Berberidaceae* from botanical, chemical and pharamacological aspects. *Rec. Bot. Surv. India* 16: 1 - 86. Janchen, E. 1949. Die systematische gleiderung der *Ranunculaceen* und *Berberidaceen*. *Akad. Wiss. Wien, Math.-Naturwiss. Kl., Denkschr.* 108: 1 - 82. Kumazawa, M. 1936. Pollen grain morphology in *Ranunculaceae*, *Lardizabalaceae* and *Berberidaceae*. *J. Jap. Bot.* 8: 29 - 46. Kumazawa, M. 1938. Systematic and phylogenetic considerations of the *Ranunculaceae* and *Berberidaceae*. *Bot. Mag. (Tokyo)* 52: 9 - 15. Meacham, C.A. 1980. Phylogeny of the *Berberidaceae* with an evaluation of classification. *Syst. Bot.* 5: 149 - 172. Nowicke, J.W. & Skvarla, J.J. 1981. Pollen morphology and phylogenetic relationships of the *Berberidaceae*. *Smithsonian Contr. Bot.* 50: 1 - 83. Singh, V., Jain, D.K. & Sharma, M. 1978. Leaf architecture in *Berberidaceae* and its bearing on the circumscription of the family. *J. Indian Bot. Soc.* 57: 272 - 280.

Key to genera

- | | | |
|-----|---|--------------------|
| 1a. | Leaves simple, fascicled in bunches just above a 3 - 5-forked spine | 1. Berberis |
| b. | Leaves pinnate, crowded and radiating usually from top of stem | 2. Mahonia |

1. BERBERIS L.

Shrubs; wood and inner bark yellow. Leaves simple, fascicled in axils of a 3 - 5-pronged (or very rarely simple) spines, glabrous. Flowers bisexual, solitary, fascicled, racemed, corymbose or paniced with 2 or 3 small appressed bracteoles, yellow or white. Sepals 6 in 2 whorls, imbricate. Petals 6 in 2 whorls, imbricate, usually with 2 nectariferous glands inside at base. Stamens 6, free, included, antipetalous, often adnate to petals at base (upper surface of base of each stamen is very sensitive to contact and when touched by an insect in search of honey the stamen springs violently upwards covering the side of the visitor's head with pollen which it may place on the stigma of the flower next visited); anthers introrse, opening by recurved valves. Ovary superior, sessile, simple, 1-loculed; ovules few, basal; style absent or very short; stigma peltate. Fruit a berry with 1 - few oblong seeds, attractively red, blue or black.

North temperate regions, subtropical Asia, Eurasia, N. Africa, the Andes and temperate S. America, ca 500 species, 54 in India and 1 in Kerala.

Note: An interesting point about *Berberis* is its connection with the black rust

(*Puccinia graminis*) whose two alternative stages in its life history pass through a grass and *Berberis*.

Berberis tinctoria Lesch. in Mem. Mus. Hist. Nat. 9: 306. 1822; Dunn in Gamble, Fl. Madras: 29(23). 1915; Ahrendt in J. Linn. Soc., Bot. 57: 95. 1961; R.R. Rao & B.D. Naithani in B.D. Sharma & al., Fl. India 1: 386. 1993.

Evergreen, erect shrub, variable in size and form, often 1 - 2 m high, in forests to 4 m high; stems furrowed, pale brown; wood very tough, bright yellow; spines 3-fid, 1.5 - 3 cm long. Leaves obovate, entire, rarely with 1 or 2 spinules, obtuse, mucronate, 1.5 - 3.5 x 0.7 - 1.3 cm, thick, purplish when young, papillose, dull above, pruinose beneath; petioles 2 - 5 mm long. Flowers in 10 - 20-flowered racemes or panicles, 3.5 - 5 cm long, yellow; pedicels 5 - 10 mm long, red. Prophylls ca 1 x 0.5 mm. Outer sepals obovate, acute, ca 7 x 5 mm; the inner ovate or obovate, obtuse, ca 4 x 2.5 mm. Petals obovate, ca 6 x 4.5 mm, clawed; claws glandular at base. Stamens ca 5 mm long, short-apiculate. Ovary stipitate. Berries spindle-shaped, 9 - 10 x ca 5 mm excluding 1 - 1.5 mm long dry style and large round stigma still attached, purplish red turning dark blue with glaucous bloom.

Fl.: Feb. - March *Fr.*: March - May.

Habitat: Roadsides and inside forests, 750 - 1500 m.

Distrib.: Idukki (High Ranges). Tamil Nadu (Pulneys, Nilgiris and Shevroys at high altitudes). Endemic. Once abundant, now rare.

Use: Root is medicinal and yields a yellow dye.

Note: Once thought to be conspecific with *B. aristata* DC. from which it differs in pedicels being slender and drooping and spindle-shaped fruits.

Rama Rao (*l.c.*) included *B. aristata* and *B. nepalensis* and Bourdillon (*l.c.*) included *B. nepalensis*. But there are no specimens.

2. MAHONIA Nutt., nom. cons.

Shrubs or small trees with persistent leaf bases; branches slender, spineless. Leaves in whorls at ends of branches, unequally pinnate; leaflets opposite, polygonal, spinous-toothed and lobed, close to base (like a pair of stipules) becoming ovate at outer end, coriaceous, jointed with petiole; stipules filiform. Flowers in dense erect racemes or spikes arising from axils of bud-scales, bracteate, yellow. Sepals spreading. Petals notched or not, with distinct basal glands. Stamens scarcely

produced, usually 2-toothed below anther; filaments sensitive to contact like *Berberis*, springing inwards when touched. Berries elliptic or globose, glaucous, purple, 4- or 5-seeded; stalks slender.

Temperate regions and in high altitudes in tropics in northern hemisphere, ca 100 species, 13 in India and 1 in Kerala.

Literature: Fedde, F 1901. Versuch einer monographie der gattung *Mahonia*. *Bot. Jahrb. Syst.* 31: 30 - 133.

Mahonia leschenaultii (Wight & Arn.) Takeda in Notes Roy. Bot. Gard. Edinburgh 6: 223. 1907; Dunn in Gamble, Fl. Madras: 32(23). 1915; Guha Bakshi in B.D. Sharma & al., Fl. India 1: 410. 1993. *Berberis leschenaultii* Wight & Arn., Prodr. Fl. Ind. Orient.: 16. 1834; Rama Rao, Fl. Pl. Travancore: 14. 1914. *B. nepalensis* Spreng. var. *leschenaultii* (Wight & Arn.) Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 109. 1872.

Shrub, to 4 m high. Leaves ca 30 x 10 cm; leaflets ca 6 pairs, overlapping, inequilateral, oblong, ovate-lanceolate or spatulate, obtuse and auricled at base, serrately spiny at margin, acute at apex, ca 8.5 x 4.5 cm, coriaceous, glabrous, shining above; stipules subulate. Racemes terminal, ca 20 cm long; peduncles to 2.5 cm long; pedicels to 1 cm long. Sepals in 2 whorls of 3 each, subequal, oblong, notched at apex, ca 6 x 1.5 mm. Petals 5 or 6, emarginate with rounded lobes at apex, ca 4 mm long, with distinct basal glands, yellow. Stamens 6, united with petals at base; filaments ca 2 mm long, flat, thick; anthers ca 2 mm long, dehiscing by recurved valves. Ovary oblong, ca 4 mm long, 1-loculed; ovules 4, ascending; stigma discoid, subsessile. Berries globose or subglobose, ca 8 mm long, with persistent style, glaucous, pruinose, blue, 1-seeded.

Fl. & Fr.: April - May.

Habitat: Hills above 1200 m.

Distrib.: Idukki (High Ranges). Tamil Nadu (Nilgiris). Endemic.

NYMPHAEACEAE

(N.P. BALAKRISHNAN & P. VENU)

Perennial, rhizomatous, freshwater herbs. Leaves simple, alternate, cordate or peltate, floating or submerged, palmately nerved, stipuled; margin involute in

vernation. Flower axillary, solitary, bisexual, actinomorphic, hypo- to perigynous, on long peduncles, floating or emersed, showy. Sepals 4 - 8, free, adnate at base with receptacle, green or petaloid. Petals many, free, showy, sometimes transitional to stamens. Stamens numerous, free, in whorls, dorsiventrally flattened, introrse. Carpels many, fully fused with receptacular tissue forming syncarpous many-loculed ovary; styles short or absent; stigmas curvate and radiating in a cup-like depression; ovules many in each locule, parietal, on walls or abaxial suture of carpel. Fruit a spongy many-seeded berry dehiscent irregularly; seeds operculate, arillate; embryo small with abundant perisperm and scanty endosperm.

Cosmopolitan, 6 genera and ca 75 species, 2 and 7 in India and, 1 and 3 in Kerala.

NYMPHAEA L., nom. cons.

Rhizome subterranean, creeping or erect. Leaves polymorphic, long-petioled, floating, orbicular or elliptic, deep-cordate with a deep narrow fissure at base, subpeltate, dentate at margin, leathery, prominently nerved beneath. Flowers floating in deep water, often emersed in shallow water, long-peduncled. Sepals 4, free, adnate to receptacle at base, coloured as petals inside. Petals 8 many, multi-seriate; inner ones diminishing in size. Stamens many, perigynous, dorsiventrally flattened, inflexed; outer ones with broad petaloid filaments. Ovary semi-inferior, composed of 8 - many radiating united carpels within a flat-topped cup-shaped receptacle; upper surface of each carpel with stigmatic ridge and inwardly curved linear appendage at outer margin; ovules many in each locule, anatropous and laminar. Fruit a globose berry; seeds enclosed in bell-shaped aril, indurate.

Cosmopolitan, ca 50 species, 6 in India and 3 in Kerala.

Key to species

- 1a. Mature leaves entire-irregularly sinuate, glabrous on both surfaces; sepals not distinctly nerved, persistent in fruit; stamens invariably yellow; connectives appendaged, caudate; fruits green **J. N. nouchali**
- b. Mature leaves sinuate-dentate or repand-dentate, pubescent beneath; sepals distinctly nerved.

not persistent in fruit; stamens yellow or red; connectives not appendaged; fruits green or red 2

2a. Leaves and petioles green when young; leaves punctate when mature; petioles pubescent; petals white-rose to pale pink; filaments pale brown or rose; anthers yellow; fruits and fruit stalks green 2. *N. pubescens*

b. Leaves and petioles red when young; leaves not punctate when mature; petioles glabrous; petals crimson red; filaments and anthers red; fruits and fruit stalks red 3. *N. rubra*

1. *Nymphaea nouchali* Burm.f., Fl. Indica: 120. 1768; Backer & Bakh.f., Fl. Java 1: 149. 1964; Maheshw. in Manilal, Bot. Hist. Hort. Malab.: 125. 1980; Manilal & Sivar., Fl. Calicut: 31. 1982; Nicolson & al. in Regnum Veg. 119: 198. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 44. 1988; Vajr., Fl. Palghat: 53. 1990; R.L. Mitra in B.D. Sharma & al., Fl. India 1: 430. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 53. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 69. 2002. *N. stellata* Willd., Sp. Pl. 2: 1153. 1799; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 114. 1872; Rama Rao, Fl. Pl. Travancore: 14. 1914; Dunn in Gamble, Fl. Madras: 33 (24). 1915.

Mal.: *Ambel, Sitambal, Vellambel*

Rhizomes often producing long runners. Leaves elliptic or orbicular, elliptic-sagittate when young, entire or irregularly sinuate at margin, rounded-acute at apex, (6-)10-35(-45) x (5-)8-28(-40) cm, reddish purple beneath; main nerves 7-15, palmate; midnerve grooved above, prominently angled beneath; lateral nerves 4-7 pairs, slightly grooved above; petioles terete, 2-5 mm thick, glabrous. Flowers 6-14 cm across, slightly fragrant. Sepals lanceolate to oblong-lanceolate, obtuse, 2.5-7.5 x 0.7-2.5 cm, green, streaked purple outside. Petals 8-15, elliptic-lanceolate, 2.5-6 x 0.5-1.2 cm, mauve. Stamens 20-60, yellow; outer ones 1.5-2.5 cm long; the inner shorter; connective appendages 1.5-3 mm long, blue; anthers 0.5-1.5 cm long. Ovary urceolate, sunken in middle, 10-20-loculed; ovules numerous on superficial placentae; stigmas 8-20, radiating, connate at base. Fruits globose, 1.5-3.5 cm, with remnants of sepals, petals and stamens; seeds ellipsoid-globose, 8-10 mm long, vertically fine-lined, ciliate on ribs, becoming glabrate with growth of aril.

Fl. & Fr.: July - Jan.

Habitat: Freshwater ponds, lakes, ditches, marshy areas and occasionally rice

fields, to 2300 m.

Distrib.: Throughout Kerala. Throughout India. Widespread in S. and SE. Asia.

Uses: Flower is medicinally useful as a tonic and as a promoter of hair growth. Rhizome and pedicel are eaten as a vegetable. Seed on frying is eaten as puffed grain.

2. *Nymphaea pubescens* Willd., Sp. Pl. 2: 1154. 1799; Dunn in Gamble, Fl. Madras: 43(24). 1915; Manilal & Sivar., Fl. Calicut: 31. 1982; Nicolson & al. in Regnum Veg. 119: 198. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 44. 1988; Vajr., Fl. Palghat: 53. 1990; R.L. Mitra in B.D. Sharma & al., Fl. India 1: 431. 1993. *N. lotus* L. var. *pubescens* (Willd.) Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 114. 1872.

Mal.: *Alli, Ambel, Neerambel*

Perennial herb; rhizomes ovoid, ca 3 x 2 cm. Leaves peltate or subpeltate, orbicular, hastate, sharply sagittate or cordate at base, repand-dentate at margin, subacute, obtuse or rounded at apex, 15 - 40 x 12 - 35 cm, finely punctate and glabrous above, shortly hairy and purplish green beneath; petioles smooth, ca 5 mm thick, purplish. Flowers 8 - 15 cm across, opening at night, closing from noon to evening; peduncles ca 15 mm thick. Sepals 4, ovate-lanceolate or elliptic-oblong, subacute at apex, 2.5 - 8 x 1 - 3 cm, puberulous, green, 5 - 9-ribbed outside, white and glabrous inside. Petals 10 - 25, oblanceolate, obtuse or acute at apex, 2 - 7 x 1 - 3 cm, white-rose to pale pink. Stamens 25 - 70, separated from petals by an empty space, pale yellow; filaments 1.5 - 3.5 cm long, dilated at base, yellow. Ovary 12 - 22-loculed; stigmatic appendages 5 - 10 mm long, incurved, closing over stigmas, yellow. Fruits globose, 3 - 4 cm, fleshy with remnants of stamens and appendaged stigmatic rays; seeds ellipsoid, ca 1.5 x 1 mm, longitudinally marked with rows of irregular papillae.

Fl. & Fr.: June - Feb.

Habitat: Shallow ponds, pools and ditches, to 500 m.

Distrib.: Kannur, Kozhikode, Palakkad and plains of almost all districts. Throughout India. South and SE. Asia.

Uses: Root and flower are used in Ayurvedic medicines.

3. *Nymphaea rubra* Roxb. ex Andrews, Bot. Repos. 8 (104): t. 503. 1808; Sims in Curtis, Bot. Mag. 31: 33, t. 1280. 1810; Wight, Ill. Ind. Bot. 1: t. 10.

1840; Conard, Publ. Carnegie Inst. Wash. 4: 199, tt. 1 - 8. 1905; R.L. Mitra in B. D. Sharma & al., Fl. India 1: 432. 1993. *N. lotus* sensu Hook. f. & Thomson, Fl. Ind.: 241. 1855 & in Hook.f., Fl. Brit. India 1: 114. 1872, non L. 1753, uterque p.p. quoad syn. *N. rubra*. *N. pubescens* sensu Dunn in Gamble, Fl. Madras: 34(24). 1915 p.p., non Willd. 1799.

Perennial herb; rhizomes irregular, stoloniferous. Juvenile leaves membranous, subulate in beginning, hastate-sagittate later; mature leaves floating on long green petioles, suborbicular, sinuate-dentate at margin, 16 - 25 cm across, waxy, faintly fleshy, olive green and glabrous above, pubescent, strongly nerved and glaucous beneath; petiole attachment to lamina subpeltate-peltate. Flower usually solitary on a long naked red scape, 9 - 10 cm across. Disc fleshy. Sepals 4, ovate-lanceolate, acute, ca 5.5 x 2 cm, green with faint pink tinge outside, cream-coloured or pale pink inside, nerved. Petals 12 - 15 in 4 or 5 series, ca 5 x 2 cm, crimson or dark red, adnate to disc, gradually turning into petaloid stamens. Stamens 30 in 3 or 4 series, rimming disc; outer ones with petaloid filaments, longer, ca 3 x 0.8 cm; inner ones shorter, ca 1.5 x 0.3 cm; anthers of outer stamens short, of the inner long, distinct, erect, introrse, dehiscing longitudinally; connectives not prolonged. Carpels 16 - 20, membranaceous with equal number of locules arranged radially around central core in fleshy disc with adjacent walls of carpels fused into many-loculed ovary; ovules very numerous, arising all over septa, anatropous; ovary topped by a cup-shaped depression of connate pale yellow and furrowed stigmas; stigmatic appendages free, slightly bulged at end, dark pink. Fruits globose to subglobose, ca 3 x 4 cm, red, fleshy, crowned by persistent stigmatic appendages, retract and ripen under water, breaking irregularly; seeds numerous, elliptic-globose, ca 3 x 1.5 mm, sea green, lined with tubercles in longitudinal rows, attached to partitions in a gelatinous bell-shaped transparent aril. *Fl.*: Throughout the year but profuse during rains (July - Oct.) *Fr.*: Jan. - June. *Habitat*: Stagnant ponds and tanks, usually with *N. pubescens*.

Distrib.: Palakkad. Likely to occur in other districts. Throughout plains in India. South and SE. Asia.

Notes: Flowers in S. Indian plants are smaller compared to that of W. Bengal (*cf.* Mitra, *l.c.*). These populations are distinct. Whereas those of W. Bengal have larger flowers, more floral parts and inward stamens having a purple band outwardly near the base and do not produce fruits, those from the south have smaller

flowers, without purple band in the inner staminal filaments and produce fruits and viable seeds rather prolifically.

CABOMBACEAE

(R.L. MITRA & N.P. BALAKRISHNAN)

Aquatic herbs, caulescent, rhizomatous, with laticiferous tubes or sacs in parenchyma, mucilaginous, usually stoloniferous, with air canals and scattered vascular bundles devoid of cambium; roots adventitious in groups at base of rhizomes and nodes of stolons. Leaves simple, exstipulate, usually long-petioled, heterophyllous, submerged and floating, spiral on rhizome, on one side on stolons and 2- or 3-stichous, even opposite or ternate on floating shoots. Flowers small, axillary, solitary at nodes of floating shoots, usually long-peduncled, bisexual, 3-merous, hypogynous, with floral appendages arranged in low spirals. Sepals (2-) 3 (-4), free or slightly connate at base. Petals 3, free or slightly connate at base. Stamens 3 - 36, cyclic, free, more or less flat with paired anther lobes arranged laterally or abaxially, basifixed, extrorse, dehiscent longitudinally; pollen 1-sulcate. Carpels (1-) 2 - 18, free; ovules 1 - 4 in each, ana- or orthotropous, 2-tegmic, crassinucellate on laminar to submarginal placentation; stigma apical on short style. Fruits pods or nutlets, ripening under water, indehiscent, 1 - 4-seeded; seeds exarillate, operculate with minute embryo, scanty endosperm and copious starchy perisperm; cotyledons slightly differentiated.

Tropical and warm temperate regions, 2 genera and 8 species, 2 and 2 in India and, 1 and 1 (introduced) in Kerala.

Literature: Ito, M. 1986. Studies in the floral morphology and anatomy of Nymphaeales III. Floral anatomy of *Brasenia schreberi* Gmel. and *Cabomba caroliniana* A. Gray. *Bot. Mag. (Tokyo)* 99: 169 - 184. Mitra, R.L. 1990. Cabombaceae. *Fasc. Fl. India* 20: 20: 3 - 7. Ramji, M.V. & Padmanabhan, D. 1965. Developmental studies on *Cabomba caroliniana* Gray. 1. Ovule and carpel. *Proc. Indian Acad. Sci.* 62B: 215 - 223. Schneider, E.L. & Jeter, J.M. 1982. Morphological studies on the *Nymphaeaceae*. XII. The floral biology of *Cabomba caroliniana*. *Amer. J. Bot.* 69: 1410 - 1419.

CABOMBA Aubl.

Perennial herbs, slender, completely submerged except during flowering;

rhizomes dark brown, fragile, easily broken; adventitious roots in groups at lower nodes of stems trailing through mud; internodes more or less pubescent, to 20 cm long. Leaves dimorphic, petioled; submerged leaves opposite-decussate or ternate, circular or flabellate in outline, pinnately divided from apex of petiole into 3-9 opposite parts, each part palmately divided di- or trichotomously several times into many long narrow filiform segments forming a dissected blade; floating leaves if present alternate, peltate. Flower usually 1 in each node, 3-merous, white to yellow or purple, immersed on peduncles of unequal length. Sepals 3, petaloid, slightly connate at base. Petals 3, clawed, auricled and free or slightly connate at base. Stamens 3-6, free, single or paired, opposite petals, without distal sterile appendages; filaments slightly flat; anthers oblong, basifixed, extrorse, dehiscing longitudinally; locules 2, lateral to abaxial. Carpels 1-4, apocarpous, each with 3 pendulous ovules in laminar placentation; style short; stigma capitate. Fruits indehiscent with coriaceous disintegrating wall, usually 3-seeded; seeds covered with hygroscopic hairs; embryo minute, lenticular; endosperm thin.

Tropical and temperate America, 7 species and 1 in India.

Cabomba caroliniana A. Gray in Ann. Lyceum Nat. Hist. New York 4: 46. 1837; Gardner in Hooker's Icon. Pl. 7: t. 642. 1844; Fassett in Castanea 18: 120. 1953; Orgaard in Nord. J. Bot. 11: 199, f. 2D. 1991; R.L. Mitra in B.D. Sharma & al., Fl. India 1: 939. 1993. *C. aquatica* auct. non Aubl. 1775: Aleykuty & Inamdar in Curr. Sci. 47: 136, ff. 1-5. 1978; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 54. 1994.

Stems to 2 m long, branched, thinly mucilaginous; shoots green, sometimes reddish brown. Leaves dimorphic; petioles 1-3 cm long, pubescent; submerged leaves finely dissected, flabellate in outline, 2-5 cm wide; terminal segments slightly spatulate, 0.3-0.8 mm broad with an obscure midnerve; floating leaves peltate, linear-oblong to elliptic-, often emarginate at one end, obtuse and rounded at the other, 5-20 x 1.5-3 mm, pubescent beneath, green. Flowers 1-1.5 cm across, 6-12 mm long, milky white to creamy with a pair of yellow spots at base of each petal, rising above water on peduncles from upper leaf axils; peduncles 2-8 cm long, pubescent. Sepals and petals 3 each, the former elliptic, the latter obovate, obtuse or emarginate at apex, auricled near base, 5-12 x 2-7 mm. Stamens 3-6. Carpels 2-4, elongate, divergent at maturity, puberulous;

seeds ovoid, 1.5 - 3 x 1 - 5 mm, covered with hygroscopic hairs.

Fl. & Fr.: May - Aug.

Habitat: Freshwater ponds and ditches.

Use: Grown as an oxygenator in aquaria.

Distrib.: Ernakulam (Kochi) and Thiruvananthapuram. North America.

Note: Aleykutty and Inamdar (*l.c.*) recorded it as an addition to the Indian flora from Kochi.

NELUMBONACEAE

(R.L. MITRA & N.P. BALAKRISHNAN)

Aquatic herbs; rhizome creeping, stout, long-jointed. Leaves simple, large, peltate, floating or emersed. Flower solitary on a long peduncle borne above water surface, bisexual, rose-pink, white or yellow, fragrant. Sepals 4 or 5, petaloid, subequal, early caducous. Petals numerous, free, inserted at receptacle base; the outer smaller, middle ones larger. Stamens numerous, not petaloid, free, each with a fleshy terminal clavate appendage; filaments narrow. Carpels 12 - 30, free, wide apart, within pits on a large flat-topped receptacle; ovules 1 or 2 in each carpel, pendulous; style short, exserted; stigma terminal, peltate. Nuts 12 - 30, 1-seeded, indehiscent; seeds exarillate; cotyledons large, fleshy, enclosing plumule.

East Asia to Australia and NE. America, 1 genus and 2 species, 1 and 1 in India.

Literature: Mitra, R.L. 1990. *Nelumbonaceae. Fasc. Fl. India* 20: 8 - 10. Simon, J.P. 1971. Comparative serology of the order Nymphaeales 2. Relationships of *Nymphaeaceae* and *Nelumbonaceae*. *Aliso* 7: 325 - 350.

NELUMBO Adans.

(Characters as for family)

Nelumbo nucifera Gaertn., *Fruct. Sem. Pl.* 1: 73, t. 19, f.1. 1788; Maheshw. in *Manilal, Bot. Hist. Hort. Malab.*: 123. 1980; Nicolson & al. in *Regnum Veg.* 119: 197. 1988; Vajr., *Fl. Palghat*: 53. 1990; R.L. Mitra in B.D. Sharma & al., *Fl. India* 1: 441. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 53. 1994. *Nelumbium speciosum* Willd., *Sp. Pl.* 2: 1258. 1799; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 116. 1872; Rama Rao, *Fl. Pl. Travancore*: 14. 1914;

Dunn in Gamble, Fl. Madras: 33(24). 1915.

Mal.: *Chenthamara*, *Tamara*

Leaves orbicular, entire or wavy at margin, 20 - 90 cm across, glaucous on both surfaces, dark green above, flat when floating, concave or bowl-shaped when emersed; petioles 60 - 180 cm long, weak, often minutely prickly. Flowers projecting above water level, 10 - 25 cm across, rose-pink, white or white at base and pink at tips, rarely cream-yellow; peduncles to 180 cm long, minutely prickly. Sepals ovate or elliptic, concave, 2 - 5 x 1 - 3.5 cm, green when petals white or pinkish green when petals rose-pink. Petals numerous, obovate or elliptic-oblong, obtuse or subacute, concave, (2-) 8 - 10 x (1-) 3 - 5 cm. Receptacle obconic, 9 - 11 cm high, 2 - 4 cm across at top, yellow in flower turning dark brown in fruit. Stamens ca 200, 2 - 4.5 cm long; anthers yellow or orange; connective appendages recurved, white or yellow. Carpels oblong-cylindric, ca 8 x 3 mm; stigmas protruding from receptacle. Fruiting carpels(nuts) ellipsoid, 1.5 - 2 x ca 1 cm; seeds ovoid-oblong, black.

Fl.: May - Sept. *Fr.*: July - Dec.

Habitat: Freshwater ponds and marshes, to 1500 m.

Distrib.: Almost throughout Kerala. Throughout Indian plains. East and SE. Asia to N. Australia.

Uses: The sacred lotus is often cultivated as an ornamental. Flower is offered to Hindu Gods. Tuber, young leaf, flower bud and fruit are eaten cooked. Floral parts are used in indigenous systems of medicine.

PAPAVERACEAE

(N.P. BALAKRISHNAN)

Annual, biennial or perennial herbs or shrubs with milky latex or yellowish juice; hairs simple, barbellate or stellate. Leaves exstipulate, mostly basal in a rosette, simple, pinnatifid, -sect or palmately lobed; cauline leaves usually few, alternate, rarely opposite. Flowers in leafless scapes, leafy racemes or panicles, bisexual, actinomorphic, nodding in bud, showy. Sepals 2 (or 3), free, rarely connate at base, imbricate, caducous. Petals 4 - 6 (rarely 8 - 12, or absent) in 1 or 2 (-3) whorls, free, imbricate, often crumpled in beginning. Stamens many, free; filaments filiform or winged; anthers dehiscent longitudinally. Ovary superior, 1- or apparently 2 - 10-loculed by intrusive placentae; ovules many on parietal pla-

centae, rarely 1 and basal; style usually 1 or absent; stigmas of different forms, usually connate, capitate, rarely free or sessile on ovary as a lobed-disc. Fruit a capsule, dehiscent by 2 - 10 pores or valves; seeds small, numerous.

Mostly north temperate, 23 genera and ca 230 species, 5 and 27 in India and, 1 and 1 in Kerala.

Literature: Debnath, H.S. & Nayar, M.P. 1984. *Papaveraceae & Hypericaceae. Fasc. Fl. India* 17: 1 - 48.

ARGEMONE L.

Annual or perennial herbs, erect, prickly, often glabrous, with yellowish juice. Leaves sessile, pinnatifid or sinuate-lobuled, glaucous, middle and upper ones elliptic-oblong, lower ones obovate or oblanceolate, spiny-toothed at margin. Flower solitary, terminal or axillary, peduncled, white, yellow or orange; flower buds globose, elliptic or oblong. Sepals 3, bearing a horn below apex, caducous. Petals 6 in 2 whorls, obovate. Stamens many; filaments filiform; anthers linear, 2-loculed, basifixed. Ovary ovoid-oblong or subfusiform, 1-loculed; placentae 3 - 5, parietal; ovules numerous; styles very short or obsolete; stigmas sessile, radiating, 3 - 7-lobed; lobes opposite placental strands. Capsules ellipsoid to oblong, 4 - 6-ribbed, prickly or not, dehiscent along sutures by 3 - 6 short valves in upper part; seeds numerous, subglobose or globose, pitted.

An American genus with 28 species, 3 in India and 1 in Kerala; an introduced weed, now naturalized.

Argemone mexicana L., Sp. Pl.: 508. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 117. 1872; Dunn in Gamble, Fl. Madras: 35(25). 1915; Vajr., Fl. Palghat: 54. 1990; Debnath & M.P. Nayar in B.D. Sharma & N.P. Balakr., Fl. India 2: 2. 1993; Sivar. & P. Mathew, Fl. Nilambur: 51. 1997.

Mal.: *Brahmadanti, Ponnammatham*

Annual herb, 30 - 120 cm high, glaucescent, with yellow juice. Leaves elliptic-obovate, cordate or semiamplexicaul at base, pinnatifid or sinuate-lobuled, 6 - 22 x 2 - 9 cm; segments incised-dentate, acute or spiny-toothed at margin, glaucous green with pale markings on nerves, smooth above, prickly beneath. Flowers 4 - 7 cm across, sessile, subtended by 2 or 3 foliaceous bracts. Sepals

elliptic, 8 - 15 x 5 - 10 mm, with 6 - 9 mm long acute horns, sparsely prickly outside. Petals 4 - 6, imbricate, obovate, cuneiform, 2 - 3 x 1.5 - 2.5 cm, bright yellow, crumpled in bud. Stamens many, 8 - 10 mm long; filaments yellow; anthers ca 2 mm long, yellow. Ovary ovoid, 8 - 15 x 3 - 6 mm. Capsules ellipsoid to oblong, 10 - 38 x 8 - 20 mm, spiny, dehiscent by valves; larger spines 4 - 9 mm long; seeds many, suborbicular, 1.5 - 2 mm long, deeply reticulate, blackish or deep brown.

Fl. & Fr.: Aug. - April.

Habitat: Wastelands and roadsides, to 1500 m.

Distrib.: Idukki, Kollam, Malappuram, Palakkad and most other districts. Naturalized throughout India.

Uses: The yellow juice of the plant is used as a medicine in dropsy, jaundice and cutaneous infections. Root is used in scorpion sting. Seed oil is used in ulcers and eruptions, and also for burning lamps.

CRUCIFERAE

(BRASSICACEAE)

(A.N. HENRY & T. RAVISHANKAR)

Terrestrial or aquatic herbs, rarely shrubs, with pungent watery juice; trichomes simple or variously branched, unicellular, rarely multicellular. Leaves alternate, sometimes confined to a basal rosette, exstipulate, simple, very rarely pinnate or palmate or reduced to scales. Inflorescences terminal or axillary, racemose, corymbose or paniced. Flowers bisexual, hypogynous, mostly actino-, rarely zygomorphic. Sepals 4, usually free, in decussate pairs, erect or spreading, usually caducous; lateral ones often saccate at base. Petals 4, decussate, cruciform, alternating with sepals, usually clawed, entire, sometimes lobed, rarely absent. Stamens 6, sometimes 2 or 4, rarely more than 6, 4-dynamous in 2 rows or 2-dynamous, rarely equal; filaments filiform, sometimes winged or appendaged at base, free or median pair connate; anthers mostly sagittate, 2(or 1)-loculed, dehiscent longitudinally. Nectar glands receptacular, subtending or surrounding bases of some or all filaments. Ovary superior, 2-carpelled, syncarpous, 2-loculed by a false septum connecting the 2 parietal placentae; ovules 1 - many, ana- or campylotropous; style distinct, persistent or obsolete; stigma entire or 2-lobed, capitate or

discoid. Fruit a dry bivalvately dehiscent siliqua or schizocarp, indehiscent and becoming lomentaceous, achene-like or samaroid, usually beakless, rarely with seedless or 1- few-seeded beak; replum persistent; septum complete or incomplete, usually membranous; seeds 1- or 2-seriate, usually wingless, often mucilaginous when wet, nonendospermous; embryo large, usually strongly curved or folded; germination epigeal.

Primarily in temperate regions, 365 genera and ca 3250 species, 64 and 207 in India and, 8 and 14 in Kerala.

Literature: Grierson, A.J.C. 1984. *Cruciferae*. In: Grierson, A.J.C. & Long, D.G (ed.), *Fl. Bhutan* 1(2): 416 - 445. Jafri, S.M.H. 1973. *Brassicaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 55: 1 - 308. Schulz, O.E. 1936. *Brassicaceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2, 17b: 227 - 658.

Key to genera

- | | | |
|-----|---|----------------------|
| 1a. | Fruits beaked; beak 1- or few-seeded, sometimes transversely jointed; cotyledons conduplicate | 2 |
| b. | Fruits not beaked, rarely with a seedless styler beak, never jointed; cotyledons acumbent or incumbent | 3 |
| 2a. | Fruits lomenta, transversely jointed with 2 or more 1-seeded segments; upper part with 2 - 3 cm long beak | 7. Raphanus |
| b. | Fruits siliqua-capsules, dehiscent along 2 longitudinal sutures, sometimes with a replum inside; upper part with 1 - 2 cm long beak | 1. Brassica |
| 3a. | Fruits compressed at right angles to septum; replum much narrower than fruit | 4 |
| b. | Fruits compressed parallel to septum; replum as broad as fruit | 6 |
| 4a. | Fruits erect or spreading, 2-loculed | 4. Coronopus |
| b. | Fruits pendant, 1-loculed | 5 |
| 5a. | Petals equal; style short and included within notch | 5. Lepidium |
| b. | Petals unequal; style prominent | 2. Capsella |
| 6a. | Plants aquatic or semiaquatic, rooting at nodes | 6. Nasturtium |
| b. | Plants terrestrial, not rooting at nodes | 7 |
| 7a. | Fruits cylindric; seeds subglobose, more or less 2-seriate | 8. Rorippa |
| b. | Fruits linear, tapering at both ends; seeds compressed, 1-seriate | 3. Cardamine |

1. BRASSICA L.

Herbs, glabrous, sparsely hirsute or hispid; rootstock slender or tuberous. Leaves alternate, the lower sometimes rosulate, pinnatifid or lyrate, rarely entire. Racemes usually short, corymbose. Sepals unequal, erect or spreading; the inner larger, usually pouched. Petals clawed, yellow or white. Stamens 6. Ovary cylindrical, 5 - 45-ovuled. Fruit a siliqua, linear or oblong, terete or angled, with a long or short seedless or, 1- or 2-seeded narrow beak; valves convex with a prominent median nerve; seeds few many, 1- or rarely 2-seriate (in some extra-Indian species).

Mostly Mediterranean, ca 35 species, 6 in India and 1 naturalized and 3 (+2 infraspecific taxa) cultivated in Kerala.

Literature: Schulz, O.E. 1919. *Cruciferae* - I. In: Engler, A.G.H. (ed.), *Pflanzenr.* 70 (IV. 105): 1 - 290.

Key to species

- | | | |
|-----|---|-----------------------|
| 1a. | Upper leaves stalked or narrowed at base | 2 |
| b. | Upper leaves usually amplexicaul, rounded or deeply cordate at base | 3 |
| 2a. | Beak of fruits to 4 mm long; cultivated | 2. <i>B. nigra</i> |
| b. | Beak of fruits 5 - 10 mm long | 1. <i>B. juncea</i> |
| 3a. | All leaves glabrous; cultivated | 3. <i>B. oleracea</i> |
| b. | Lower leaves always bristly or ciliate-hairy; cultivated | 4. <i>B. rapa</i> |

1. *Brassica juncea* (L.) Czern., Consp. Fl. Chark.: 8. 1859; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 157. 1872; Dunn in Gamble, Fl. Madras: 38(28). 1915; Manilal, Fl. Silent Valley: 7. 1988; Vajr., Fl. Palghat: 54. 1990; Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 134. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 54. 1994. *Sinapis juncea* L., Sp. Pl.: 668. 1753.

Eng.: *Indian red mustard*

Annual herb, erect, 20 - 100 cm high, branched, glabrous. Basal leaves petioled, oblong-lanceolate, lyrate-pinnatifid, toothed, 6 - 10 x 2 - 5 cm; upper ones somewhat stalked, narrow-lanceolate, entire. Racemes many-flowered. Flowers ca 7 mm across. Sepals ca 5 mm long, spreading. Petals obovate, rounded at apex, clawed, ca 8 mm long, bright yellow. Stamens ca 5 mm long; anthers oblong.

Fruits suberect, torulose, 2 - 5 cm long; beak long, seedless; valves with a prominent midnerve; seeds 10 - 20 in each locule, globose, reddish brown.

Fl. & Fr.: March - Sept.

Distrib.: Idukki, Kollam, Kottayam, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Cultivated in India for its oil-yielding seed. Often an escape. Central & E. Asia and Europe.

2. ***Brassica nigra*** (L.) W.D.J. Koch in Röhl., *Deutsch. Fl. ed.* 3, 4: 713. 1833; Hook.f. & T. Anderson in Hook.f., *Fl. Brit. India* 1: 156. 1872; Rama Rao, *Fl. Pl. Travancore*: 16. 1914; Manilal, *Fl. Calicut*: 31. 1982; Hajra & al. in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 186. 1993. *Sinapis nigra* L., *Sp. Pl.*: 668. 1753.

Mal.: *Kadugu*

Annual, rigid, erect herb, 40 - 90(- 120) cm high, branched, more or less hispid. Lower leaves lyrate, deeply pinnatifid or -sect, 6 - 20 x 4 - 12 cm; the upper smaller, sessile or short-stalked, narrowly elliptic or lanceolate, entire. Inflorescence a branched raceme, densely 40 - 50-flowered. Flowers ca 1.2 cm across; pedicels 3 - 5 mm long, ebracteate. Sepals erect-spreading, oblong, obtuse, 4 - 5 mm long, glabrous. Petals obovate, long-clawed, 8 - 10 mm long, bright yellow. Stamens ca 4 mm long. Fruits oblong, 1 - 2 cm x 1 - 2.5 mm; beak 2 - 3 mm long, seedless; valves keeled, torulose, 3 - 5-seeded in each locule; seeds ca 1 mm across, glabrous, dark brown.

Fl. & Fr.: March - May.

Cultivated in hills; sometimes an escape. Introduced and cultivated in most parts of N. India. Throughout Europe, N. Africa, SW. Asia and in most temperate countries.

Uses: Seed yields an edible oil (mustard oil); also used as a condiment.

3. ***Brassica oleracea*** L., *Sp. Pl.*: 667. 1753; Hajra & al. in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 136. 1993.

Glabrous herb; stems 30 - 100 cm high. Leaves fleshy; lower ones petioled, lyrate-pinnatifid, 15 - 40 cm long; terminal lobe broadly ovate or suborbicular, cordate at base, broadly dentate or crenate at margin, rounded at apex; lateral lobes 2 or 3(-5) pairs, smaller than terminal one; upper ones sessile, simple,

oblong-lanceolate, rounded-cordate or often subamplexicaul at base. Racemes simple or often paniced, ebracteate, elongating to 30 cm in fruit; pedicels 1.5 - 2 cm long, to 2.5 cm in fruit. Sepals erect, oblong, obtuse, 8 - 12 x 2 - 3 mm. Petals obovate, clawed, 15 - 20 x 4 - 6 cm. Stamens erect. Fruits on erect or erecto-patent stalks, 6 - 10 cm long including 1 - 2 cm long often 1-seeded beak; seeds reticulate.

The following varieties are cultivated for vegetables in hill stations.

3.1. var. botrytis L., Sp. Pl.: 667. 1753; Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 137. 1993.

Eng.: *Cauliflower*

Stems moderately high. Leaves usually shallowly lobed; upper ones usually enclosing inflorescence; rachises of young inflorescences and pedicels incrassate forming a dense yellowish white head with abortive flowers and buds.

3.2. var. capitata L., Sp. Pl.: 667. 1753; Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 137. 1993.

Eng.: *Cabbage* Mal.: *Muttakhose*

Stems stout until flowering. Leaves concave, densely crowded and overlapping into a subglobose ellipsoid terminal bud with very stout nerves forming the edible cabbage.

4. Brassica rapa L., Sp. Pl.: 66. 1753; Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 138. 1993.

Annual or biennial; roots slender or tuberous. Basal leaves lyrate, hispid or with striate hairs, bright green; upper cauline leaves glabrous, glaucous. Flowers in terminal racemes, overtopping buds. Sepals patent. Petals 5 - 10 mm long, yellow. Fruits 3.5 - 10.5 cm long, glabrous; seeds small, smooth, pale or dark.

Key to subspecies

- | | | |
|-----|--------------------------------------|-------------------------------|
| 1a. | Roots slender | 4.1. subsp. campestris |
| b. | Roots tuberous, globose or nearly so | 4.2. subsp. rapa |

4.1. subsp. campestris (L.) A.R. Clapham in A.R. Clapham & al., Fl.

Brit. Isles ed. 2, : 124. 1962; Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 138. 1993. *B. campestris* L., Sp. Pl.: 666. 1753; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 156. 1872; Rama Rao, Fl. Pl. Travancore: 16. 1914.

Eng.: *Sweedish turnip*

Annual, simple or branched, 30 - 100 cm high, glabrous or slightly hispid; roots slender. Basal leaves pinnatifid or more or less so, often auricled, petioled; the upper oblong or lanceolate. Flowers yellow. Pods to 10.5 cm long; seeds ca 1.5 mm across.

Fl. & Fr.: Jan. - March.

Cultivated in hills.

Use: Root and tender leaf are used as a vegetable.

4.2. subsp. **rapa**: Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 138. 1993. *B. campestris* L. subsp. *rapa* (L.) Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 156. 1872.

Eng.: *Common turnip*

Biennial; roots tuberous; stems branched, to 1 m high, hairy below, glabrous above. Basal leaves 5-jugate, lyrate-pinnatifid, 10 - 30 x 5 - 10 cm; middle and upper ones oblong-lanceolate, clasping stem with cordate base, glabrous, glaucous. Racemes 30 - 40-flowered. Flowers ca 1 cm across, yellow. Fruits linear, subtorulose, 3.5 - 8 cm long; seeds 8 - 12 in each locule, yellow-brown.

Fl. & Fr.: Oct. - Dec.

Cultivated in hills.

Use: The tuberous taproot is used as a vegetable.

2. CAPSELLA Medik., nom. cons.

Annual or biennial herbs, glabrous or with simple or branched and often stellate hairs; stems mostly erect, branched or not. Basal leaves mostly rosulate, entire or lobed; cauline ones sessile, amplexicaul-sagittate at base, subentire. Inflorescences racemose; pedicels slender. Sepals erect, not saccate, equal at base. Petals obovate, rounded or truncate at base, white, pink or yellowish. Stamens free; filaments linear; style short; stigma minute, capitate. Fruit an angustiseptate siliqua, obcordate-triangular, laterally compressed; valves boat-shaped, keeled.

reticulately nerved; septum narrow, membranous; seeds many in each locule, 2-seriate, ellipsoid; cotyledons incumbent.

Temperate regions, ca 5 species and 1 in India.

Literature: Almquist, E. 1907 & 1923. *Studies uber die Capsella bursa-pastoris* (L.) Medik. *Acta Horti Berg.* 4(6): 3 - 91. 1907. *Acta Horti Berg.* 7(2): 41 - 95.

Capsella bursa-pastoris (L.) Medik., Pfl.-Gatt. 1: 85. 1792; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 159. 1872; Dunn in Gamble, Fl. Madras: 38(27). 1915; Bhaumik in B.D. Sharma & N.P. Balakr., Fl. India 2: 189. 1993. *Thlaspi bursa-pastoris* L., Sp. Pl.: 647. 1753.

Eng.: *Shepherd's purse*

Annual herb, sparsely branched, erect, to 30 cm high, glabrous. Basal leaves short-stalked, rosulate, oblong-lanceolate or spatulate, pinnatipartite, 6 - 14 x 2 - 3.5 cm; cauline ones ovate-lanceolate, amplexicaul, serrate-dentate or entire, acute at apex, 1 - 7 x 0.2 - 2 cm. Racemes congested at anthesis, much elongate at maturity, to 25 cm long in fruit; pedicels spreading to horizontal. Sepals oblong, obtuse, ca 2 x 1 mm, usually green. Petals 4, spreading, lanceolate, 2 - 3 x 0.5 - 1 mm, white. Fruits obcordate to 3-angled, laterally compressed, scarcely attenuate at base, slightly emarginate at apex with a wide apical notch, 5 - 9 x 3.5 - 6 mm; seeds numerous, minute, ca 1 mm long, reddish brown to black.

Fl. & Fr.: March - Oct.

Habitat: A weed of cultivation especially at higher elevations.

Distrib.: Idukki. Himalayas and Nilgiris. Cosmopolitan except the tropics.

3. CARDAMINE L.

Annual, biennial or perennial herbs; stems erect, diffuse, flaccid, branched or not, glaucous, pubescent or with simple hairs. Leaves simple, ternate, alternate, rarely verticillate, pinnate or pinnatisect. Racemes usually many-flowered, ebracteate; pedicels filiform, erect or upcurved. Sepals nearly equal at base, oblong or ovate; the inner somewhat pouched at base. Petals clawed, obovate or subspatulate, rounded or emarginate, white, pale purple, mauve, pale violet or pale yellow, rarely absent. Stamens 4 - 6; filaments subulate, erect; anthers oblong. Ovary cylindrical; ovules 4 - 40, 1-seriate; style often filiform; stigma simple,

more or less 2-lobed. Fruits narrow or broadly linear, tapering at both ends; valves rounded with indistinct nerves, dehiscing exclusively and becoming coiled; style short; seeds compressed, few many; cotyledons acumbent.

Mostly temperate, ca 200 species, 14 in India and 3 in Kerala.

Key to species

- | | | |
|-----|---|--------------------------|
| 1a. | Leaves 3-foliolate | 1. <i>C. africana</i> |
| b. | Leaves 5 - 13-foliolate | 2 |
| 2a. | Inflorescences few-flowered; fruits 4 - 10-seeded | 3. <i>C. trichocarpa</i> |
| b. | Inflorescences many-flowered; fruits 12 - 24-seeded | 2. <i>C. hirsuta</i> |

1. *Cardamine africana* L., Sp. Pl.: 655. 1753; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 137. 1872; Dunn in Gamble, Fl. Madras: 38(27). 1915; Hajra & H.J. Chowdhery in B.D. Sharma & N.P. Balakr., Fl. India 2: 109. 1993.

Erect herb, to 50 cm high, sparsely hispid or glabrous. Leaves mostly radical, 3-foliolate; petioles 2 - 16 cm long; leaflets broadly ovate; lateral ones oblique at base, crenate-serrate at margin, acute or obtuse at apex, to 7 x 3 cm; petiolules to 2 cm long. Racemes few-flowered. Flowers to 5 mm across. Sepals oblong, ca 3 mm long. Petals oblong to obovate, ca 5 mm long, dull white. Filaments 3 - 5 mm long. Ovary 8 - 16-ovuled; style ca 1 mm long; stigma globose. Fruits crowded or subtax, erect or ascending, tapering at both ends, 2.5 - 4 cm long; seeds 8 - 10.

Fl. & Fr.: Oct. - Jan.

Habitat: Undergrowth in semievergreen and evergreen forests.

Distrib.: Idukki and Kottayam. Arunachal Pradesh, Karnataka and Tamil Nadu. Africa, Indonesia and Sri Lanka.

2. *Cardamine hirsuta* L., Sp. Pl.: 655. 1753; Dunn in Gamble, Fl. Madras: 38(27). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 45. 1988; Hajra & H.J. Chowdhery in B.D. Sharma & N.P. Balakr., Fl. India 2: 112. 1993. *C. hirsuta* L. var. *sylvatica*. (Link) Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 138. 1872 p.p.

Herb, to 30 cm high; stems erect or creeping at base, glabrous or sparsely hairy. Leaves very variable, 3 - 25 x 1 - 20 mm, glabrous or hairy. Basal leaves in a rosette, imparipinnate, petioled; leaflets 5 - 13, orbicular or ovate, irregularly

toothed or lobed, 5 - 15 mm across. Cauline ones petioled or subsessile; leaflets lanceolate, narrowly oblong or obovate, toothed or irregularly lobed, rounded at apex, 5 - 25 x 1 - 15 mm. Inflorescences racemose or subcorymbose, 10 - 20-flowered, to 20 cm long. Flowers 3 - 5 mm across. Sepals oblong, obtuse, ca 2 mm long. Petals ovate, cuneate, rounded, 2.5 - 5 mm long, white. Stamens 4, rarely 6. Ovary many-ovuled. Fruits cylindrical, somewhat compressed, 15 - 25 x ca 1 mm; seeds 6 - 12 on either side of septum, ca 1 mm long.

Fl. & Fr.: Nov. - May.

Habitat: Open moist situations in ghats, ca 800 m, occasional.

Distrib.: Kannur and Wynad. Arunachal Pradesh, Karnataka, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Uttar Pradesh and W. Bengal. Cosmopolitan.

3. *Cardamine trichocarpa* Hochst. ex A. Rich., Tent. Fl. Abyss. 1: 18. 1847; Dunn in Gamble, Fl. Madras: 38(27). 1915; Hajra & H.J. Chowdhery in B.D. Sharma & N.P. Balakr., Fl. India 2: 117. 1993. *C. subumbellata* Hook. f. & T. Anderson in Hook.f., Fl. Brit. India 1: 138. 1872.

Erect herb, to 30 cm high. Leaves 4 - 7 cm long; petioles 0.6 - 2.2 cm long; leaflets 5 - 7, subsessile, ovate or suborbicular, irregularly crenate or lobed, 2 - 2.5 x 0.8 - 1.2 cm, sparsely hairy. Inflorescences corymbose, few-flowered. Flowers small; pedicels slender, ca 2 mm long. Sepals oblong, obtuse, with long bristly hairs. Petals oblong, ca 2 mm long, yellowish white. Ovary linear-elongate; style short; stigma globose. Fruits linear-lanceolate, 0.8 - 2.5 cm long; seeds 4 - 10, oblong.

Fl. & Fr.: July - Oct.

Habitat: Shades on hill slopes at higher elevations.

Distrib.: Idukki. Karnataka, Maharashtra and Tamil Nadu. Africa and Asia.

4. CORONOPUS Zinn, nom. cons.

Annual or biennial herbs, glabrous or pubescent with branched hairs, foetid. Leaves entire, irregularly lobed or deeply pinnatifid. Racemes usually short, apparently leaf-opposed. Sepals short, patent, not saccate. Petals minute, scarcely longer than sepals, white, or absent. Stamens 6 or 2, free. Ovary 2-ovuled; style very short; stigma capitate. Fruits didymous, more or less laterally compressed; valves 2, rugose or tubercled, separating into closed indehiscent 1-seeded valves; style pyramidal; seeds globose or reniform.

Almost cosmopolitan, ca 10 species and 1 in India.

Coronopus didymus (L.) Sm., Fl. Brit. 2: 691. 1800; Bhaumik in B.D. Sharma & N.P. Balakr., Fl. India 2: 192. 1993. *Lepidium didymum* L., Mant. Pl.: 92. 1767. *Senebiera didyma* (L.) Pers., Syn. Pl. 2: 185. 1807; Dunn in Gamble, Fl. Madras: 39(28). 1915.

Diffuse or procumbent herb, 15 - 40 cm long; stems angled, sulcate, much branched from base, spreading and ascending. Lower leaves long-petioled, deeply pinnatipartite, 7 - 10 x 1.5 - 2 cm, often glabrous; segments lobed, few-toothed; cauline ones much smaller. Racemes 30 - 60-flowered, dense, 3 - 5 cm long in fruit. Flowers small; pedicels filiform, to 5 mm long. Sepals ovate-orbicular, minute. Petals linear, ca 0.5 mm long, greenish white. Fertile stamens 2. Fruits emarginate at base, notched at apex, reticulate, 1.5 - 1.7 x 2 - 2.5 mm; style much included within notch; seeds reniform, ca 1 mm long, punctate-striate, pale brown.

Fl. & Fr.: Feb. - April & Aug. - Oct.

Habitat: A weed of cultivation at higher elevations.

Distrib.: Idukki and Kottayam. Almost throughout India. Native to S. America, widely naturalized in Afghanistan, C. & W. Europe, Iran and Pakistan.

Use: A good fodder.

5. LEPIDIUM L.

Annual or perennial herbs or subshrubs, erect, prostrate or spreading, glabrous or pubescent, sometimes glandular-hairy. Leaves entire or, 2- or 3-pinnatifid, sessile or the lower petioled. Flowers inconspicuous, usually in elongating ebracteate racemes. Sepals oblique, oblong-ovate or orbicular, slightly concave, not saccate. Petals to 3 mm long, scarcely longer than sepals, sometimes absent or mere vestiges, white, pink or sulphur yellow. Stamens 6, 4 or 2; filaments free; anthers nearly globose. Ovary sessile, flat, 2-ovuled; style short; stigma capitate. Fruit a siliqua or silicula, flat, 2-valved; valves winged, usually rounded or keeled on back, glabrous to hirsute; apex scarcely notched and barely winged to deeply notched and prominently winged; septum narrow; seeds usually 1, rarely 2 in each locule, pendulous; cotyledons mostly incumbent.

Cosmopolitan especially temperate, ca 140 species, 10 in India and 1 in Kerala.

Lepidium sativum L., Sp. Pl.: 644. 1753; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 159. 1872; Dunn in Gamble, Fl. Madras: 38(28). 1915; Bhaumik in B.D. Sharma & N.P. Balakr., Fl. India 2: 206. 1993.

Eng.: *Garden cress*

Annual herb, to 50 cm high; stems erect, unbranched, glabrous. Basal leaves long-petioled, irregularly pinnatifid, drying early; cauline ones sessile, pinnate, less incised with oblong-linear segments, sparsely pubescent with simple hairs; upper ones linear, entire. Flowers white, in elongating racemes; pedicels cylindrical, ascending or subappressed, to 3.5 mm long in fruit, glabrous. Sepals 1.5 - 1.75 mm long, sparsely pubescent outside. Petals spatulate, somewhat clawed, 2.5 - 2.75 mm long, sometimes reddish and distinctly nerved. Fruits broadly elliptic to suborbicular, narrowly winged, deeply notched at apex, 4.5 - 7 x 3.5 - 5 mm, glabrous; style short and included in notch; seeds ovoid, ca 3 x 1.5 mm; cotyledons incumbent, deeply 3-fid.

Fl. & Fr.: Dec. - March.

Habitat: Cultivated in hills and also found as an escape.

Use: Leaf is consumed raw in salads and also used in medicine.

6. NASTURTIUM W.T. Aiton, nom. cons.

Terrestrial or aquatic herbs, branched, glabrous or hairy. Leaves entire, lobed or pinnate. Racemes lax in fruit, ebracteate. Flowers small. Sepals short; inner ones slightly pouched at base. Petals spatulate, white. Stamens 6. Ovary oblong, many-ovuled. Fruits linear, subcylindrical, 2-loculed, dehiscent; valves membranous, faintly 1-nerved, glabrous; seeds 1- or 2-seriate.

Europe to C. Asia and Afghanistan, 6 species, 2 in India and 1 in Kerala.

Nasturtium officinale W.T. Aiton, Hort. Kew. ed. 2, 4: 110. 1812; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 133. 1872; Dunn in Gamble, Fl. Madras: 37(27). 1915; Hajra & H.J. Chowdhery in B.D. Sharma & N.P. Balakr., Fl. India 2: 125. 1993. *Sisymbrium nasturtium-aquaticum* L., Sp. Pl.: 657. 1753. *Rorippa nasturtium-aquaticum* (L.) Hayek, Sched. Fl. Stiriac.: 22. 1905.

Eng.: *Common watercress*

Perennial herb; stems stout, much branched, creeping or floating, rooting

at nodes, usually to 40 cm long. Leaves petioled, lyrate-pinnate, 4 - 12 cm long; lower ones with 1 - 7 leaflets; the upper with 5 - 9 leaflets; terminal leaflets suborbicular or broadly ovate-cordate, entire or sinuate at margin, acute or obtuse, to 2.5 x 1.5 cm; lateral ones elliptic, entire or sinuate-toothed, to 2 x 1 cm. Racemes 5 - 20-flowered, 4 - 10 cm long. Flowers ca 3 mm across. Sepals oblong, 1 - 2 x ca 1 mm, white. Petals obovate, narrowly clawed at base, 3 - 5 x ca 2 mm, white. Stamens ca 3 mm long. Fruits spreading, slightly upcurved, 0.8 - 2.5 cm long, on 6 - 12 mm long stalks; seeds 2-seriate, ovoid-rounded, red.

Fl. & Fr.: March - Sept.

Habitat: An escape in hill stations especially along water courses and ditches, to 3000 m.

Distrib.: Idukki. Throughout India. Temperate Asia and Europe.

7. RAPHANUS L.

Annual or biennial herbs, rarely short-lived perennials, more or less with stiff simple hairs; taproot fusiform, sometimes fleshy. Leaves pinnatisect, lyrate; the uppermost often simple-toothed. Racemes corymbose, becoming lax in fruit. Flowers ebracteate. Sepals usually erect, oblong; outer ones slightly hooded below tip; the inner a little broader, somewhat saccate at base. Petals oblanceolate or obovate, abruptly long-clawed, white, yellow or violet, reticulately nerved. Stamens 6; filaments unappendaged. Ovary awl-shaped, transversely 2-partite; lower portion shorter than the upper, 2 - 12-ovuled; stigma small, more or less 2-lobed. Fruit an elongate cylindric lomentum, 2-jointed; lower portion very short, inconspicuous, stalk-like, usually empty, rarely 1- or 2-seeded, persistent; upper portion cylindric, 1 - many-seeded, indehiscent or breaking into 1-seeded segments, sometimes curved or constricted between seeds; beak long; seeds pendulous from short funicles; cotyledons conduplicate.

Europe, Mediterranean to C. Asia, 8 species, 2 in India and 1 in Kerala.

Raphanus sativus L., Sp. Pl.: 669. 1753; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 166. 1782; Rama Rao, Fl. Pl. Travancore: 16. 1914; Dunn in Gamble, Fl. Madras: 38(28). 1915; Hajra & al. in B.D. Sharma & N.P. Balakr., Fl. India 2: 145. 1993.

Eng.: *Radish* Mal.: *Mullangi*

Annual or biennial herb; taproot thick, tuberous; stems erect, branched, hispid below, glabrous above. Lower leaves long-petioled, lyrate-pinnatifid, ovate-oblong in general outline, 3 - 5-jugate; terminal lobes suborbicular, rounded at apex, crenate at margin; upper ones sessile or subsessile, much smaller, oblong to lanceolate, entire, dentate or few-lobed. Racemes many flowered, to 40 cm long in fruit; pedicels 1 - 2 cm long in fruit. Sepals oblong, subequal, 5 - 8 x 1.5 - 2 mm; inner pair somewhat saccate at base. Petals obovate, long-clawed, submarginate at apex, 12 - 20 x 5 - 7 mm. Fruits lanceolate-oblong or oblong-ellipsoid, terete, 2 - 6 cm x 4 - 5 mm; beak conic, 1 - 2 cm long, seedless.

Fl. & Fr.: Jan. - April.

Cultivated in hills. Widely cultivated throughout the world.

Uses: Root, leaf, flower-top and young fruit are eaten as salad. Root and seed yield an oil used for burning and for culinary purposes. Root juice is sometimes used in urinary disorders and piles.

8. RORIPPA Scop.

Annual or perennial herbs, erect, branched, glabrous or with simple hairs; taproot slender. Leaves simple to deeply lyrate-pinnate, glabrous or sparsely pilose. Racemes bracteate or not. Sepals scarcely saccate at base; the inner pouched at base. Petals yellow, as long as or longer than sepals or absent. Stamens 6, sometimes 4. Ovary oblong to suborbicular, many-ovuled; stigma slightly 2-lobed. Fruits linear, cylindrical or ellipsoid, 2-loculed, dehiscent; valves with indistinct midnerve; style short; stigma rounded; seeds few numerous, more or less 2-seriate, reddish brown.

Subcosmopolitan, ca 80 species, 7 in India and 2 in Kerala.

Key to species

- | | | |
|-----|--|--------------------------------------|
| 1a. | Fruits to 2.5 cm long; pedicels 5 - 7 mm long in fruit | 1. <i>R. indica</i> |
| b. | Fruits to 1.5 cm long; pedicels ca 3 mm long in fruit | 2. <i>R. madagascariensis</i> |

1. *Rorippa indica* (L.) Hiern, *Cat. Afr. Pl.* 1: 26. Add. & Corr. 1896; Manilal & Sivar., *Fl. Calicut*: 31. 1982; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 45. 1988; Vajr., *Fl. Palghat*: 54. 1990; Hajra & H.J. Chowdhery in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 129. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 39. 1996;

Sivar. & P. Mathew, Fl. Nilambur: 52. 1997. *Sisymbrium indicum* L., Mant. Pl.: 93. 1767. *Nasturtium indicum* (L.) DC., Prodr. 1: 139. 1824; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 134. 1872 p.p.; Dunn in Gamble, Fl. Madras: 38(27). 1915.

Slender, glabrous herb, to 50 cm high. Lower leaves lyrate-pinnatifid or -fid with 1-4 segments on either side, 6-10 x ca 2.5 cm; upper ones sessile, ovate-lanceolate to lanceolate-oblong, entire, lyrate-pinnatifid or dentate above base. Racemes terminal, to 25 cm long, many-flowered. Flowers ca 2.5 mm across; pedicels 5-7 mm long in fruit. Sepals oblong-ovate, 2-3 mm long. Petals 3-4 mm long, yellow. Stamens ca 2 mm long. Stigma subsessile. Fruits on patent or erecto-patent 4-8 mm long stalks, slightly curved, beaked, 12-25 x 1-1.5 mm; seeds 2-seriate, minute, globose, rugose, reddish brown.

Fl. & Fr.: April-June (Aug.-Jan.)

Habitat: Wet fields and stream sides, common.

Distrib.: Kannur, Kottayam, Kozhikode, Malappuram, Palakkad and Thrissur. Almost throughout India. Africa, S. and SE. Asia.

2. *Rorippa madagascariensis* (DC.) H. Hara in J. Jap. Bot. 30: 198. 1955; Hajra & H.J. Chowdhery in B.D. Sharma & N.P. Balakr., Fl. India 2: 129. 1993. *Nasturtium madagascariensis* DC., Syst. Nat. 2: 192. 1821; Dunn in Gamble, Fl. Madras: 38(27). 1915. *N. indicum* sensu Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 134. 1872 p.p., non (L.) DC. 1824.

Herb, to 35 cm high. Leaves sessile, obovate or oblong, deeply pinnatifid, auricled-amplexicaul at base, acutely toothed at margin, 5-12 cm long, sparsely hairy. Flowers small; pedicels to 3 mm long in fruit. Petals narrowly oblong, 2-2.5 x 0.7-0.8 mm, yellow. Stamens 6; filaments 1.6-2 mm long; anthers ca 0.5 mm long. Ovary ellipsoid, ca 1.5 x 0.8 mm; style stout. Fruits cylindrical, upcurved, 7-15 x 1-2 mm, on 2-4 mm long pedicels, with to 1 mm long style; seeds 2-seriate, lenticular, ca 0.7 mm across.

Fl. & Fr.: Feb.-May.

Habitat: Stream sides in lower Ghats.

Distrib.: Thrissur. Andhra Pradesh, Orissa and Tamil Nadu. Africa, Bhutan, Madagascar and Pakistan.

CAPPARACEAE

(R. SUNDARARAGHAVAN & N.P. BALAKRISHNAN)

Herbs, shrubs or trees. Leaves alternate, subopposite, rarely opposite, occasionally crowded on abbreviated shoots, simple or digitately 1 - many-foliolate, rarely poorly developed and caducous, entire, pinnately nerved; stipules 1 or 2, setaceous or spinescent. Inflorescences axillary or terminal, racemose, corymbose or paniced, sometimes flowers solitary or in fascicles on short shoots. Flowers bisexual (rarely unisexual and plants dioecious), actino- to slightly zygomorphic, pedicelled, bracteate; receptacle cupular, infundibuliform, campanulate or cylindric with an entire, undulate or fimbriate margin; disc various or absent. Sepals 4, sometimes 6 or reduced to 3, 2-seriate, free or connate below, equal or not, valvate or imbricate. Petals 4 (2 or 8, rarely absent), clawed or not. Stamens 4 many, usually borne on a short or elongate androphore; filaments free, sometimes connate at base or adnate to gynophore; anthers 2-loculed, basifixed, dehiscing longitudinally. Ovary superior, sessile or supported by a short or long gynophore, 1-loculed or by spurious dissepiments divided into 2 or more locules; ovules few - many on 2 - 6 parietal placentae, if 3-loculed then placentae axile; style short or absent; stigma simple or capitate. Fruits capsular or baccate, of various shapes, oblong-cylindric, sometimes torulose or lobed, 1 many-seeded; seeds orbicular to reniform, embedded in pulp or free; endosperm absent or scanty; embryo arcuate or incurved; cotyledons folded or convolute.

Mostly in tropics and subtropics, few in temperate arid regions, 39 genera and 650 species, 7 and 55 in India and, 4 and 27 in Kerala.

Key to genera

- | | | |
|-----|---|--------------------|
| 1a. | Herbs or woody undershrubs; fruit a capsule | 3. Cleome |
| b. | Shrubs or trees; fruit a berry | 2 |
| 2a. | Leaves simple | 2. Capparis |
| b. | Leaves 2 - 5-foliolate, rarely simple | 3 |
| 3a. | Stamens 4 - 8; berries oblong-cylindric | 1. Cadaba |
| b. | Stamens 12 - 50; berries globose or ellipsoid | 4. Crataeva |

1. CADABA Forssk.

Unarmed scandent shrubs to small trees; branches tapering, thorn-like; young branches hoary-pubescent or glandular-hairy, often covered with waxy scales. Leaves simple to 2 - 5-foliolate, stipuled. Flowers irregular, in axillary or terminal racemes or corymbs, rarely solitary or fascicled. Sepals 4, unequal; outer 2 enclosing the inner. Petals 4, clawed, rarely absent or 2. Disc spatulate, infundibular or trumpet-shaped, nectary often petaloid and toothed. Stamens 4 - 8, exserted, on a short androphore or not. Ovary cylindric, on an elongate androgynophore, 1- or 2-loculed; ovules many, 2-seriate; stigma capitate. Fruits oblong-cylindric, dehiscent or tardily so; seeds subglobose, embedded in scarlet pulp.

Old World tropics especially Africa, 30 species, 2 in India and 1 in Kerala.

Cadaba trifoliata (Roxb.) Wight & Arn., Prodr. Fl. Ind. Orient.: 24. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 171. 1872; Gamble, Fl. Madras: 42(31). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 252. 1993; E.S.S. Kumar & al. in J. Econ. Tax. Bot. 26: 142. 2002. *Stroemia trifoliata* Roxb., Fl. Ind. 2: 79. 1824 (as *Stroemia*).

Branched shrub, erect or straggling, 2 - 3 m high; stem white-tubercled; young parts scabrous. Leaves mostly 3-foliolate; petioles 1 - 4 cm long, shorter than leaflets; leaflets elliptic, oblong-lanceolate, ovate-elliptic or obovate, cuncate at base, acuminate at apex, 4 - 10 x 1.5 - 5 cm, distinctly reticulately nerved; petiolules 1.5 - 3 mm long. Racemes corymbose, 4 - 10-flowered. Sepals 4; outer 2 ovate, 2 - 2.5 x 0.8 - 1 cm; inner 2 elliptic, ca 1.5 x 5 mm. Petals 2, suborbicular, 3.5 - 5 x 2.5 - 3 cm, white or cream-coloured; claw as long as limb. Disc appendage spatulate, toothed at apex, ca 15 mm long, shorter than claw, yellow. Androphore absent. Stamens 6 or 7, inserted in middle of gynophore, reflexed; filaments to 2.5 cm long. Gynophore 4 - 5 cm long. Ovary linear, 7 - 8 x ca 1 mm. Fruits terete, 8 - 10 cm x 6 - 8 mm, black; seeds many, reniform, ca 3.5 x 3 mm, black.

Fl. & Fr.: Oct. - Nov.

Habitat: Deciduous forests at low levels.

Distrib.: Thiruvananthapuram. Eastern Ghats of Andhra Pradesh, Karnataka

and Tamil Nadu. Endemic.

2. CAPPARIS L.

Erect, scandent or straggling shrubs, rarely trees, generally with stipular spines or thorns, bases of shoots sometimes surrounded by cataphylls; indumentum simple or with stellate hairs. Leaves alternate, simple, petioled, entire, rarely reduced and apparently leafless. Flowers bisexual, in panicles, racemes, corymbs or umbels, sometimes solitary, axillary or supra-axillary in vertical series of 3 or 4 conferted on condensed lateral shoots; bracts caducous. Sepals 4, mostly caducous after anthesis, in 2 unequal whorls of 2 each; the outer concave and overlapping, the inner imbricate or valvate, free or almost so, rarely outer pair connate in bud, inner pair always free and flat. Petals 4, caducous after anthesis, mostly unequal, oblong or obovate, not clawed; upper pair cohering around disc but not connate; lower pair free. Receptacle flat with small adaxial disc. Stamens 8 many, inserted on receptacle; androphore absent. Ovary ovoid or globose, on a gynophore not much elongating but often incrassate in fruit, 1-loculed, 4 - many-ovuled; placentae 2 - 6; style short; stigma obscure to capitate. Berries on a slender or incrassate stalk, globose, elongate or ovoid; pericarp leathery, corky or smooth, ribbed or sculptured, indehiscent or tardily dehiscent; seeds 1 - many, reniform, embedded in pulp; embryo convolute.

Pantropic, sometimes in temperate regions, ca 250 species, 29 in India and 14 in Kerala.

Note: Even though 14 species have been collected and/or reported from Kerala, none, except *C. rheedei*, is common in the state, as can be expected due to the preference of the genus for a comparatively drier climate. Most of the species are poorly represented in herbaria by a few scattered and particularly old collections. Hence, most of the species can be considered threatened in Kerala.

Key to species

- | | | |
|-----|--|---|
| 1a. | Flowers solitary, axillary (rarely 2 - 4 conferted together on lateral axis as in <i>C. brevispina</i>) | 2 |
| b. | Flowers generally neither solitary nor axillary but variously arranged (rarely a few flowers axillary if inflorescence a corymb or in supra-axillary series) | 5 |
| 2a. | Upper petals with a yellow or purplish blotch; ovary densely hairy | 3 |

- b. Upper petals not blotched as above; ovary glabrous 4
- 3a. Leaves with 2 basal pairs of nerves confluent towards base 10. *C. rheedei*
- b. Leaves with arching nerves never confluent towards base 1. *C. brevispina*
- 4a. Outer sepals connate in bud with free tips; inner sepals petaloid; fruits with sculptured pericarp 3. *C. divaricata*
- b. All sepals free, none petaloid; fruits with ribbed pericarp 7. *C. grandiflora*
- 5a. Flowers in supra-axillary vertical series of 2 - 10 or even more (rarely solitary, axillary) 6
- b. Flowers otherwise, never in supra-axillary vertical series 7
- 6a. Flowers appearing before leaves, hence flowering shoots apparently leafless 14. *C. zeylanica*
- b. Flowers not appearing before leaves, hence flowering shoots always leafy 13. *C. tenera*
- 7a. Inflorescences racemose or paniced, if umbelled umbels arranged to form a panicle 5. *C. floribunda*
- b. Inflorescences neither racemose nor paniced; flowers either in solitary umbels, subumbels or corymbs 8
- 8a. Flowers in corymbs (with a few subterminal solitary flowers intermixed at base) 9
- b. Flowers umbelled or subumbelled 10
- 9a. Leaves with olive green velvety indumentum; nerves close, more or less parallel, mostly without intermediary nerves 8. *C. grandis*
- b. Leaves neither with velvety indumentum nor with close parallel nerves 11
- 10a. Stamens 80 - 170; fruits more than 10 cm across when mature 9. *C. moonii*
- b. Stamens 60 - 85; fruits less than 6 cm across when mature 2. *C. cleghornii*
- 11a. Cataphylls conspicuous at least at base 12
- b. Cataphylls absent 13
- 12a. Leaves linear to oblong-lanceolate; flowers reddish purple or violet; fruits ellipsoid, 8- or more-seeded 4. *C. diversifolia*
- b. Leaves elliptic to oblong; flowers greenish white; fruits spindle shaped, 1 or 2 seeded 6. *C. fusifera*
- 13a. Plant densely armed; spines uniformly recurved 11. *C. sepiaria*
- b. Plant mostly unarmed, if armed spines few, straight and short 12. *C. shevaroyensis*

1. *Capparis brevispina* DC., Prodr. 1: 246. 1824; Dunn in Gamble, Fl. Madras: 45(32). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 260. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 55. 1994; Sasidh. & Sivar., Fl. Pl. Thissur: 40. 1996. *C. zeylanica* sensu Hook.f. & Thomson in Hook.f.,

Fl. Brit. India 1: 174. 1872, non L. 1762

Shrub or small tree, to 4 m high; young parts somewhat stellate-hairy, soon glabrescent; branches low, radiating; thorns 2 - 4 mm long, straight or slightly curved at tip; cataphylls conspicuous. Leaves elliptic to oblong, acute or cuneate at base, recurved at margin, obtuse or subacute at apex, 3 - 6(-12) x 1.5 - 2.5(-3.6) cm, stiff, coriaceous, shining above, dull beneath, drying brown; lateral nerves 4 - 6 pairs; petioles 2 - 7 mm long. Flowers solitary and axillary or 2 - 4 conferted on lateral axes, 3.5 - 4 cm across, showy, white or pale creamy, drying pink; buds obovoid, covered only half by sepals at anthesis; pedicels 1.5 - 4 cm long, puberulous. Sepals subequal, tomentose to villous; outer pair orbicular, boat-shaped, 6 - 10 x 3 - 5 mm; inner pair ovate, slightly larger. Petals oblong or obovate, 2 - 2.5 x 0.7 - 1 cm, sparsely pubescent; upper pair with yellow or brownish blotch at base. Receptacle ca 2 mm across. Stamens 25 - 35; filaments ca 2.5 cm long, exerted. Gynophore 18 - 25 cm long, glabrous, slightly incrassate in fruit. Ovary ovoid, angled, long-beaked, 5 - 6 x 1.5 - 1.8 mm, tomentose during anthesis; ovules many. Fruits ovoid or ellipsoid, apiculate, 3 - 4.5 x 1.5 - 2.5 cm, orange-red to purple, tardily dehiscent; pericarp thin, smooth; seeds to 15, 6 - 8 x 3 - 6 mm, brown, embedded in foetid creamy white pulp; stalks 4.5 - 5.5 x ca 1.5 mm.

Fl.: Feb. - April, Nov. - Dec. *Fr.*: June - Sept.

Habitat: Inland scrub forests of low elevations and coastal belts.

Distrib.: Thiruvananthapuram (especially Kovalam coast) and Thrissur. Andhra Pradesh, Karnataka, Maharashtra, Orissa and Tamil Nadu. Sri Lanka.

Use: The green fruit is sliced, dried, cooked and eaten.

Note: In a specimen collected by Ananthakrishnan at Manakad in Kerala (RHT) cataphylls are absent and leaves are chartaceous and gynophore puberulous.

2. *Capparis cleghornii* Dunn in Bull. Misc. Inform. 1916: 61. 1916, descr. & Gamble, Fl. Madras: 46(33). 1915; R.S. Rao & Sundararagh. in Blumea 12: 313. 1964; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 46. 1988; Vajr., Fl. Palghat: 55. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 263. 1993. *C. roxburghii* sensu Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 175. 1872 p.p., excl. syn., non DC. 1824.

Scandent shrub, ca 2 m high; twigs purplish, flagellate, fulvous-pubescent, densely armed with sharp recurved thorns. Leaves elliptic or obovate, acute at

base, abruptly blunt-acuminate at apex, 3.5 - 10 x 2 - 5 cm, subcoriaceous, pinkish when tender, dull greenish when dry; lateral nerves 4 - 6 pairs with obscure reticulations; petioles 6 - 10 mm long. Flowers showy, white, purple on ageing, to 5 x 3.5 - 4.5 cm, in terminal 6 - 10-flowered corymbs, rarely solitary, axillary or conferted in subterminal shoots; pedicels 2.5 - 4 cm long, pubescent; buds tomentose. Sepals subequal, concave, 10 - 12 x 7 - 8 cm, pubescent outside, glabrous inside. Petals obovate or oblong, unequal; upper pair 2.2 - 2.5 x 1 - 1.2 cm; lower pair 1.6 - 1.8 x 1.2 - 1.4 cm, puberulous at base. Receptacle 2.5 - 3 mm across. Stamens 65 - 80, white turning pink or scarlet; filaments 2.5 - 2.8 cm long. Gynophore 2.5 - 3.5 cm long, glabrous. Ovary ovoid, 3 - 3.5 x ca 2 mm, glabrous, purple; placentae 3 or 4. Fruits on slender stalks, ovoid or subglobose, umbonate, 6 - 8.5 cm long, dark purplish to violet; seeds 1 - 4, obovoid or orbicular, dorsally compressed, 1.5 - 1.8 x 1.4 - 1.5 cm, embedded in scarlet pulp.

Fl.: Dec. - May *Fr.*: April - Oct.

Habitat: Lateritic soil on fringes of evergreen forests, 500 - 1400 m.

Distrib.: Kannur and Palakkad. Western Ghats of Karnataka. Endemic.

3. *Capparis divaricata* Lam., *Encyl.* 1: 606. 1785; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 174. 1872; Sundararagh. in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 266. 1993. *C. stylosa* DC., *Prodr.* 1: 246. 1824; Dunn in Gamble, *Fl. Madras*: 45(32). 1915.

Shrub or small tree, 2 - 6 m high, much branched; innovations whitish or fulvous-tomentose with stellate hairs; twigs slender, zigzag, stellate-pubescent, green; thorns variable, divaricate, straight or curved; cataphylls absent. Leaves variable, dimorphic, either linear to linear-oblong or oblong-lanceolate to elliptic, cuneate or rounded at base, acute-mucronate at apex, 4 - 7 x 0.1 - 2.5 cm, coriaceous, dull, pubescent; midnerve somewhat raised; lateral nerves 3 - 5 pairs, more or less conferted towards base; reticulations obscure; petioles 2 - 4 (- 8) mm long. Flower solitary, axillary, 3 - 5.5 cm across, odorous; buds ovoid, beaked, greyish- to brown-pubescent; pedicel 1.8 - 2 cm long. Sepals elliptic-orbicular, thick, pubescent on both sides: outer pair boat-shaped, 11 - 16 x 4 - 7 mm, connate in bud, irregularly splitting; inner pair petaloid, equalling petals, 15 - 27 x 3 - 9 mm. Petals linear, oblong, obovate-spatulate or strap-shaped, acute to rounded at apex, 2.5 - 3.8 x 0.8 - 1.2 cm, tomentose at margin and tip, greenish yellow,

creamy or white. Stamens 45 - 65; filaments yellowish, purplish red at base, longer than petals. Gynophore 2 - 2.2 cm long, incrassate in fruit. Ovary ovoid, beaked, 5- 6 mm long, reddish. Fruits globose or ellipsoid, beaked, 3.5 - 5 x 2.5 - 4 cm, 6 - 10-ribbed, warted and tubercled in between, reddish; seeds 6 - 8, 8 - 10 x 5 - 6 mm, embedded in white or creamy pulp; stalks 3 - 4.5 cm x 3 - 6 mm, woody.

Fl.: March - April *Fr.*: June - Sept.

Habitat: Lateritic soil in deciduous, rarely in scrub forests, 300 - 600 m.

Distrib.: Kasaragod and Palakkad (*Beddome s.n.* MH). Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. Sri Lanka.

Note: It often attains a girth of 60 - 75 cm, with drooping branches. This species is the only Indian representative of the Australian section *Busbeckea* of the genus.

4. *Capparis diversifolia* Wight & Arn., Prodr. Fl. Ind. Orient.: 27. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 175. 1872; Dunn in Gamble, Fl. Madras: 45(33). 1915; Sundararagh. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 102. 1987 & B.D. Sharma & N.P. Balakr., Fl. India 2: 267. 1993.

Erect shrub, ca 2 m high; twigs flexuous, stellate-hairy, early glabrescent; thorns few, straight or slightly curved, 2 - 2.5 mm long. Leaves dimorphic, linear-oblong or oblong-lanceolate to elliptic-ovate, acute to rounded at base, acute-mucronate at apex, 2.5 - 9 x 0.3 - 3.5 cm; lateral nerves 5 - 7 pairs; petioles 2 - 6 mm long. Flowers showy, reddish purple to violet, 3.5 - 4.5 cm across, conferted in 3 - 8-flowered subumbels; pedicels 6 - 8 mm long, puberulous but early glabrescent. Sepals subequal, ovate, 7 - 8 x 3.5 - 4 cm, minutely puberulous outside, densely tomentose inside. Petals ovate or obovate, subequal, 1.8 - 2 x 0.6 - 0.9 cm, glabrous but tomentellous at base. Stamens 40 - 60, exceeding pistil. Gynophore bent, 5 - 9 mm long, to 11 mm in fruit, hardly incrassate. Ovary fusiform, ca 6 cm long (including beak), smooth, glabrous, often abortive; placentae 4. Fruits ovoid or ellipsoid, apiculate, 3 - 3.5 x ca 2 cm, smooth; seeds 8 - 10, 6.5 - 7 x ca 6 mm; stalks thin.

Fl.: Sept. - Dec., April - July *Fr.*: July - Sept.

Habitat: Rocky slopes in moist forests, 600 - 900 m.

Distrib.: Kerala and Tamil Nadu. Endemic and vulnerable.

Note: There is a specimen at CAL collected by Calder & Ramaswamy in Kerala. It is often confused with *C. divaricata* Lam. but can be easily distinguished by

the reticulation and nerves not conferting towards base. Besides, leaves are not narrowly linear as in *C. divaricata*.

5. *Capparis floribunda* Wight, Ill. Ind. Bot. 1: 33, t. 14. 1840; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 177. 1872; Dunn in Gamble, Fl. Madras: 46(33). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 271. 1993.

Scandent, woody shrub, 2 - 4 m high; twigs straight, glabrous, rarely puberulous with simple fulvous hairs; thorns small, recurved, often absent. Leaves oblong or elliptic, tapering at base, entire, recurved, rarely crenate at margin, rounded to obtuse at apex, 4 - 8 (- 13) x 3.5 - 5 cm, shining; lateral nerves 7 - 10 pairs, faint with obscure reticulations; petioles 8 - 12 (- 15) mm long. Inflorescences terminal paniced subumbels, 12 - 18 cm long; peduncles 10 - 15 mm long, 8 - 25-flowered; flowers 6 - 10 mm across, white, fragrant; buds globose, ca 2.5 mm; bracts linear, 3 - 4 mm long, caducous; pedicels 6 - 10 mm long, slender, glabrous, not incrassate in fruit. Sepals subequal, deflexed, persistent; outer pair ovate, concave, 3 - 3.5 x 1.5 - 2 mm, valvate; the inner orbicular, ca 4 mm, imbricate. Gynophore 4 - 6 (- 10) mm long, glabrous, not incrassate in fruit. Ovary ovoid, apiculate, ca 1.5 x 1 mm, glabrous. Fruits globose, short-beaked at apex, 1.8 - 2 cm; pericarp smooth, orange-red, leathery outside, fleshy inside; seeds 1 - 3, ca 12 x 10 mm; stalks thin, 1.2 - 2 cm long.

Fl.: Jan. - April *Fr.*: May - June.

Habitat: Evergreen lowland forests and along coastal belts, to 600 m.

Distrib.: Kerala (exact locality not known). Andaman & Nicobar Islands, Andhra Pradesh, Karnataka, Orissa and Tamil Nadu. South and SE. Asia.

Note: Not collected in Andhra Pradesh, Kerala and Tamil Nadu in the last 50 years.

6. *Capparis fusifera* Dunn in Bull. Misc. Inform. 1914: 377. 1914 & Gamble, Fl. Madras: 45(32). 1915; J. Joseph & V. Chandras. in Bull. Bot. Surv. India 20: 156, ff. 1 - 7. 1979; Sundararagh. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 104. 1987 & B.D. Sharma & N.P. Balakr., Fl. India 2: 271. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 55. 1994. *C. parviflora* sensu Bedd., Icon. Pl. Ind. Orient.: t. 276. 1868 - 1874, non Boiss. 1843, nec. Hook.f. & Thomson, 1872; Rama Rao, Fl. Pl. Travancore: 20. 1914. *C. tomentella*

Dunn in Gamble, Fl. Madras: 45(32). 1915.

Much branched, spreading shrub, to 3 m high; thorns mostly absent, if present, 1 - 1.5 mm long; cataphylls confined to base. Leaves elliptic-oblong or ovate, acute or obtuse at base, abruptly acuminate at apex, 11 - 16 x 4.5 - 7.5 cm, chartaceous, glabrous, drying greenish yellow; midnerve grooved above; lateral nerves 8 - 11 pairs, looped at margin; petioles 4 - 6 mm long, puberulous. Inflorescences umbelled on condensed, 3 - 6-flowered, axillary or subterminal 4 - 6 cm long peduncles, puberulous; bracts setaceous, 1.5 - 2 mm long, persistent. Flowers 1.2 - 1.5 cm across, greenish white, fragrant; pedicels filiform, to 1.6 cm long, puberulous. Sepals subequal, ovate, deeply concave, 6 - 8 x 3.5 - 5 mm, thick, membranous towards tip. Petals oblong, gradually attenuate at base, obtuse at apex, 8 - 10 x 3.5 - 4 mm, distinctly nerved. Stamens 42 - 48, exserted; filaments 10 - 14 mm long, exceeding pistil; anthers 1 - 1.5 mm long. Gynophore 6 - 7 mm long, much incrassate in fruit. Ovary ellipsoid to ovoid, 1.7 - 2.2 x ca 0.6 mm, glabrous, 1-, rarely 2-loculed through a false septum; placentae 2; stigma terete. Fruits spindle-shaped, beaked, 4 - 4.5 x 2.2 - 2.5 cm, warty; seeds 1 (or 2), 1.8 - 2 x 0.8 - 1.2 cm; stalks 1 - 1.4 cm x ca 3 mm, not callose at tip.

Fl.: Oct. - Dec. *Fr.*: Nov. - Feb.

Habitat: Semievergreen forests, 700 - 1000 m.

Distrib.: Idukki, Palakkad (Silent Valley) and Thiruvananthapuram (Bonaccord Estate). Western Ghats of Tamil Nadu. Endemic and rare.

7. *Capparis grandiflora* Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 174. 1872; Dunn in Gamble, Fl. Madras: 45(32). 1915; Vajr., Fl. Palghat: 56. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 273. 1993.

Erect or low, scrambling and spreading shrub, 0.5 - 2 m high; twigs coarsely stellate-pubescent; spines copious, 2 - 3 mm long, recurved; cataphylls absent. Leaves elliptic-ovate to suborbicular, subcordate to rounded at base, acute or obtuse-mucronate at apex, 1.5 - 3.5 x 1.2 - 2 cm, subcoriaceous, shining, glabrous above, pubescent beneath; midnerve sunken; lateral nerves 3 or 4 pairs; petioles 1.5 - 3 mm. Flower solitary, axillary, showy, 1 - 1.5 cm long, puberulous. Sepals subequal, 12 - 18 x 5 - 8 mm, tomentose; outer pair boat-shaped, glabrous outside, villous inside towards margin; inner pair ovate to obovate, villous outside, glabrous inside. Petals obovate-triangular, subtruncate, 2.5 - 3 x 0.9 - 1.4 cm,

glabrous, white. Stamens 65 - 100, exceeding pistil; filaments white; anthers blue to pinkish. Gynophore 2 - 2.5 cm long, glabrous. Ovary oblong to ovoid-ellipsoid, beaked, 6 - 8 mm long, glabrous; stigma cushion-shaped, 1.5 - 2 mm across, puberulous. Fruits ellipsoid or ovoid, beaked, 5 - 7.5 x 2 - 4 mm, 5- or 6-ribbed, red; pericarp adhering to seed; seeds many, 5 - 7 x 5.5 - 6.5 mm; stalks 3.5 - 4 cm x ca 2 mm.

Fl.: Feb. - June *Fr.*: July - Oct.

Habitat: Deciduous and scrub forests, 500 - 1000 m.

Distrib.: Palakkad (Silent Valley). Western Ghats of Karnataka and Tamil Nadu.

Endemic.

Use: Fruit is edible.

8. **Capparis grandis** L.f., *Suppl. Pl.*: 263. 1782; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 176. 1872; Rama Rao, *Fl. Pl. Travancore*: 20. 1914; Dunn in Gamble, *Fl. Madras*: 46(33). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 274. 1993.

Shrub or crooked tree, erect with almost unbranched bole, 5 - 10 m high, to 45 cm across with fissured bark; thorns straight, rarely recurved, 5 - 6(- 9) mm long in older branches but often absent in flowering and tender shoots; young parts with olive green velvety tomentum. Leaves obovate, suborbicular or elliptic-ovate, cuneate or acute at base, acute, retuse, obtuse-mucronate at apex, 4 - 8 x 2.5 - 5 cm, dull green above, pale and grey-pubescent beneath; lateral nerves 5 - 9 (- 12) pairs, close together, parallel and with distinct reticulations; petioles 8 - 14 mm long. Flowers 2.2 - 2.8 cm across, in terminal 25 - 30-flowered corymbs or subumbels, white to creamy, fragrant; pedicels 10 - 25 mm long, densely pubescent. Sepals sparsely puberulous; outer pair boat-shaped, orbicular, ca 8 x 6 mm; inner pair linear-oblong or obovate, 10 - 11 x 6 - 8 mm. Petals oblong to narrowly obovate, 9 - 16 x 3 - 10 mm. Stamens 35 - 50 (rarely 12 - 15). Gynophore 1.3 - 2.8 cm long, hairy towards base, incrassate in fruit. Ovary ovoid, 1.8 - 2.2 x ca 1.5 mm, glabrous; placentae 2. Fruits subglobose, somewhat umbonate, 2.2 - 2.8 cm across; pericarp coriaceous, smooth, orange-red to purple; seeds 2 - 6. 10 - 12 x 8 - 12 mm, embedded in pink pulp; stalk incrassate, 3 - 4.5 cm x 3 - 4 mm.

Fl.: Feb. - July *Fr.*: July - Jan.

Habitat: Deciduous and other dry forests, to 1000 m.

Distrib.: Travancore (without precise locality, *Bourdillon s.n.* MH). Andhra Pradesh, Goa, Gujarat, Karnataka, Maharashtra, Rajasthan and Tamil Nadu. Myanmar, Sri Lanka and Vietnam.

Use: Fruit is edible.

9. *Capparis moonii* Wight, Ill. Ind. Bot. 1: 35. 1840; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 175. 1872; Rama Rao, Fl. Pl. Travancore: 20. 1914; Dunn in Gamble, Fl. Madras: 45(33). 1915; Vajr., Fl. Palghat: 56. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 277. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 40. 1996.

Woody, erect or scandent shrub, ascending to 10 m; twigs flagellate, brown-puberulous, glabrescent later; thorns recurved, 2 - 3 mm long, absent in young twigs. Leaves elliptic-oblong, rounded at base, with a twisted acumen at apex, 5 - 18 x 3 - 5.5 cm, coriaceous, glabrous, shining; midnerve shallowly sunken; lateral nerves 6 - 16 pairs with indistinct reticulations; petioles 1 - 1.8 cm long. Flowers in 6 - 12-flowered, terminal or subterminal corymbs, showy, white, purplish on ageing, fragrant; buds 2 - 3 cm across; pedicels to 5.5 cm long. Sepals subequal, 15 - 18 x 12 - 16 mm; outer pair cupular, concave, smaller than the inner, glabrous; inner pair flat, fulvous-puberulous outside. Petals obovate or oblong, truncate at apex, unequal, nerved; upper pair 3 - 3.5 x 2 - 2.5 cm; lower pair 2.8 - 3 x 2.2 - 2.5 cm, puberulous inside. Stamens 100 - 170; filaments 5.5 - 7 cm long, white turning rosy or brick red. Gynophore 5 - 8 cm long, much incrassate in fruit. Ovary ovoid or ellipsoid, 3.5 - 5 x 2 - 3.5 mm, glabrous, green with purple tinge; stigma discoid. Fruits 1 - 4 maturing in an inflorescence, pendent, subglobose or spindle-shaped, to 16 x 12 cm long; pericarp woody, green turning reddish brown; endocarp viscous-pulpy, lemon yellow turning scarlet; seeds 50 - 60, obovoid, 1.6 - 1.8 x 1.2 - 1.5 cm, pink.

Fl.: Feb. - April *Fr.*: March - Oct.

Habitat: Rocky slopes in moist deciduous and semievergreen forests, to 1300 m.

Distrib.: Idukki, Kollam, Palakkad and Thrissur. Goa, Karnataka, Maharashtra and Tamil Nadu. Sri Lanka.

Uses: Fruit is used in treating skin ailments, jaundice etc. and is also reported to be useful against tuberculosis.

10. *Capparis rheedei* DC., Prodr. 1: 246. 1824 (as *rheedii*); Sundararagh.

in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 107. 1987; Nicolson & al. in Regnum Veg. 119: 77. 1988; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 285. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 45. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 26. 1996. *C. heyneana* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 25. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 174. 1872; Rama Rao, Fl. Pl. Travancore: 19. 1914; Dunn in Gamble, Fl. Madras: 45(33). 1915. *C. baducca* auct. non L. 1753; M. Jacobs in Blumea 12: 435. 1965; Vajr., Fl. Palghat: 55. 1990.

Erect or scandent, much branched shrub, 2 - 4 m high; twigs brown-pubescent, early glabrescent; cataphylls many at base. Leaves elliptic-ovate to lanceolate, acute to rounded at base, acute-mucronate at apex, 8 - 19 x 4 - 7.5 cm, coriaceous, glabrous, shining above, drying brownish; lateral nerves 2 - 5 pairs, oblique and confluent towards base, distinctly reticulate; petioles 8 - 12 mm long. Flowers mostly solitary, axillary, 8 - 12 cm across, showy (rarely 2 - 6 on a condensed leafless axillary shoot); bracts linear, pubescent, reddish; pedicels 6 - 20 mm long. Sepals elliptic, obtuse, sparsely pubescent outside, villous inside; outer pair 11 - 14 x 5 - 6 mm; inner pair 12 - 16 x 6 - 8 mm. Petals pale blue or white; upper pair obovate, 3.5 - 5 x 2.5 - 3.5 cm, with a yellowish blotch, glabrous. Stamens more than 80, exserted. Gynophore 2 - 4 cm long, glabrous, slightly incrassate in fruit. Ovary oblong, 4-angled, 5 - 7 mm long, furrowed, densely pubescent. Fruits oblong to ovoid-fusiform, beaked, 5.5 - 7 x 2 - 3.5 cm, pubescent, faintly ribbed when fresh; seeds 18 - 22; stalks slender, 5 - 7.5 cm long.

Fl.: Dec. *Fr.*: July - Nov.

Habitat: Lateritic soil in moist forests, to 700 m.

Distrib.: Kannur, Kasaragod, Kollam, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats. Endemic and rare.

Use: Leaf is used against rheumatic pain in joints.

11. Capparis sepiaria L., Syst. Nat. ed. 10, 2: 1071. 1759; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 177. 1872; Rama Rao, Fl. Pl. Travancore: 20. 1914; Dunn in Gamble, Fl. Madras: 46(33). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 289. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 56. 1994.

Shrub or rarely tree, erect or scandent, 2 - 6 m high, much branched,

densely armed; twigs zigzag, flexuous, hoary or appressed-grey-pubescent; thorns many, 3 - 5 mm long, recurved. Leaves ovate-elliptic, oblong-lanceolate, suborbicular or exceptionally linear, acute, blunt, rounded or rarely subcordate at base, acute, often rounded and always emarginate or retuse at apex, 1.5 - 5.5 x 0.4 - 3.5 cm, herbaceous to subcoriaceous, pubescent, dull and glaucous when dry; midnerve slightly sunken at base above; lateral nerves 4 - 6 (- 8) pairs with obscure reticulations; petioles ca 2.5 mm long. Flowers in terminal 8 - 30-flowered corymbose subumbels or on short lateral twigs, 5 - 8 mm across, white, creamy or even greenish white, fragrant; peduncles to 1.5 cm long; pedicels 8 - 12 mm long. Sepals subequal, ovate or suborbicular, ciliate at margin; outer pair 3.5 - 4 x 2 - 3 mm, coriaceous; inner pair smaller, membranous. Petals obovate or oblong-spatulate, rounded at apex, 5 - 6 x 2 - 3 mm, puberulous at base, white. Stamens 25 - 40; filaments 10 - 14 mm long, exserted; anthers brown. Gynophore 5 - 6(- 10) mm long, slender, slightly incrassate in fruit, puberulous towards base. Ovary ovoid, 1.5 - 2 x 0.8 - 1 mm, glabrous. Fruits globose, 8 - 12 mm, yellow turning black or dark violet; seeds 1 (or 2), discoid, ca 6 x 4 mm, brown, embedded in a sticky pulp; stalks thin, 1.4 - 2 cm long.

Fl.: March - July *Fr.*: Oct. - Nov.

Habitat: Deciduous and scrub forests and on hedges, to 350 m.

Distrib.: Thiruvananthapuram. Almost throughout India except NE. Africa and South and SE. Asia to Australia.

Uses: Can be used as a hedge plant since it can be raised by cuttings. The plant has febrifugal properties. Fruit is edible.

12. *Capparis shevaroyensis* Sundararagh. in Kew Bull. 37: 72. 1982; M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 108. 1987 & B.D. Sharma & N.P. Balakr., Fl. India 2: 290. 1993; Manilal, Fl. Silent Valley: 8. 1988. *C. parviflora* Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 176. 1872, non Boiss. 1843; Dunn in Gamble, Fl. Madras: 46(33). 1915; M. Jacobs in Blumea 12: 477. 1965.

Erect or scandent shrub, to 3 m high, irregularly and profusely branched; twigs wiry, puberulous when young, glabrescent early; spines, if present, few, ca 1 mm, straight; cataphylls absent. Leaves lanceolate or oblong-lanceolate, narrow, cordate at base, acute to caudate-acuminate at apex with to 1.2 cm long acumen, 5 - 12 x 1.6 - 4.8 cm, subcoriaceous, glabrous, dull green above, yellow-

ish green beneath; lateral nerves 6 - 9 pairs forming an intramarginal loop; reticulations distinct above, obscure beneath; petioles 0.5 - 2.5 mm long. Flowers 6 - 8 mm across, in terminal, subterminal or upper axillary, 5 - 10-flowered umbels, white or creamy white, fragrant; bracts subulate, ca 1.5 mm long; pedicels filiform, 4 - 5 mm long, glabrous. Sepals subequal, ca 3.5 x 1.5 - 1.8 mm. Petals oblong to obovate, 3 - 4 x ca 2 mm, puberulous at base. Stamens 20 - 42. Gynophore filiform, 4 - 5 mm long, not incrassate in fruit. Ovary ovoid, ca 1.5 x 0.8 - 1 mm, glabrous. Fruits globose or pisiform, 8 - 10 mm, smooth, 1-seeded; stalks slender, 1.3 - 1.6 cm long.

Fl.: Aug. - Oct. *Fr.*: Nov. - March.

Habitat: Moist forests, 400 - 800 m.

Distrib.: Palakkad (Silent Valley). Western Ghats of Tamil Nadu (Tirunelveli). Endemic and vulnerable.

13. *Capparis tenera* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 2: 41. 1850; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 179. 1872; Dunn in Gamble, Fl. Madras: 46(34). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 297. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 40. 1996.

Straggling shrub, to 4 m high, with spreading branches, glabrous; thorns strongly recurved, sharp, 2 - 4 mm long. Leaves distichous, ovate-elliptic or obovate-oblong, rounded or subcordate at base, acute to abruptly caudate-acuminate with 8 - 10 mm long blunt tip at apex, 4 - 7 (- 10) x 2.5 - 4 (- 5) cm, membranous, herba- to subcoriaceous, glaucous; lateral nerves 4 or 5 pairs with obscure reticulations; petioles 2.5 - 6 mm long. Flowers in supra-axillary serial rows of 1 - 4 flowers, 8 - 12 mm across, white, fragrant; pedicels filiform, 1.5 - 5 mm long, glabrous, not incrassate in fruit. Sepals subequal, deflexed, green, purple-tinged; outer pair ovate, boat-shaped, acute, largely covering inner pair, 4.5 - 6 x 2.2 - 2.5 mm, ciliate at margin, pubescent inside; inner pair elliptic-lanceolate, puberulous towards base. Petals oblong or ovate-oblong, acute, 5.5 - 7 x 1.8 - 2 mm, white with a red basal blotch on upper pair, tomentose. Stamens 8 - 15 (- 18); filaments 14 - 20 mm long, white; anthers bluish. Gynophore filiform, 14 - 20 mm long, glabrous, white, not incrassate. Ovary pyriform, 1.5 - 1.8 x 5 - 8 mm, purple-tinged; stigma knob-like. Fruits pisiform or subglobose, sometimes pointed at apex, 8 - 12 mm long; pericarp thin, deep orange or red

when ripe; seeds 3 or 4, ca 5 x 4 mm.

Fl.: Feb. - May *Fr.*: May - June.

Distrib.: Kannur, Kasaragod, Thrissur and Wynad. Andaman & Nicobar Islands, Assam, Karnataka, Maharashtra, Manipur and Nagaland. Myanmar, Sri Lanka, Thailand and tropical Africa.

Note: Earlier collections are by Barber from Kannur and Beddome from Wynad only.

14. *Capparis zeylanica* L., Sp. Pl. ed. 2, : 720. 1762; Rama Rao, Fl. Pl. Travancore: 19. 1914; Dunn in Gamble, Fl. Madras: 46(33). 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 298. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 56. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 42. 1996. *C. horrida* L.f., Suppl. Pl.: 264. 1782; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 178. 1872.

Scandent or straggling shrub, ascending to 8 m, densely armed with 4 - 6 mm long recurved thorns; twigs densely covered with rufous or greyish-stellate scurfy deciduous tomentum; cataphylls absent. Leaves ovate, elliptic, lanceolate or obovate, rounded, subcordate or cuneate at base, acute, acuminate or obtuse, twisted with a callous recurved mucro at apex, 2 - 7 (- 11) x 2 - 5.5 (- 8) cm, coriaceous, glabrous or glabrescent, dull; lateral nerves 4 - 8 pairs; petioles 5 - 12 (- 20) mm long, pubescent. Flowers 3.5 - 5 cm across, in supra-axillary rows of 2 - 6, often developing before leaves, showy, white fading to pink or purple, fragrant; pedicels pubescent, 0.6 - 1.8 cm long, much incrassate and elongating to 3 cm in fruit. Sepals subequal; outer pair elliptic or orbicular, 8 - 12 x 6 - 8 mm; inner pair elliptic-oblong, slightly smaller. Petals oblong, rounded, subentire, repand, 1.5 - 1.8 x 5 - 8 mm, tomentose, white with a reddish spot inside. Stamens 30 - 50; filaments 3 - 4.5 cm long, creamy white turning pink to purple before dusk; anthers ca 2 x 1 mm. Gynophore 3 - 5.5 cm long, glabrous except at base, incrassate in fruit. Ovary ellipsoid to ovoid, 1.5 - 2.5 mm long, glabrous. Fruits globose or ellipsoid, ca 5 x 4 cm, pustulated; pericarp woody, to 2 mm thick, smooth, reddish orange to purple; seeds many, 5 - 7 x 4 - 6 mm, embedded in scarlet pulp; stalks 5 - 8 cm x 4 - 5 mm.

Fl.: Feb. - April *Fr.*: Aug. - Oct.

Habitat: Hedges, roadsides, scrub and edges of deciduous forests, to 1000 m.

Distrib.: Kannur, Palakkad, Thiruvananthapuram and Thrissur. Almost throughout India. South and SE. Asia.

Uses: Unripe fruit is pickled and mature one is edible. Pulverised fruit mixed with berries of *C. moonii* is reportedly effective in treating jaundice, liver ailments and even tuberculosis.

3. CLEOME L.

Mostly annual herbs, often woody at base; stem generally striate, glabrous to viscid-glandular, occasionally with scattered prickly appendages, foetid. Leaves spiral, simple or digitately 3–13-foliolate; lower leaves petioled; upper ones sessile or subsessile; stipules absent or obsolete, rarely with stiff spine-like recurved enations. Flowers actino- or slightly zygomorphic by displacement of petals, in terminal racemes or solitary, axillary, pedicelled; bracts foliaceous or membranous, persistent or not. Sepals 4, free or shortly connate at base, valvate, equal, often glandular-pubescent. Petals 4, mostly clawed at base, equal or not, longer than sepals. Stamens (4–) 6–many, usually all fertile, rarely with a few staminodes, borne on a short or long androgynophore; filaments equal or not, declinate. Ovary sessile or mostly on a short gynophore elongating in fruit, 1-loculed; ovules many on 2 parietal placentae; style short or absent; stigma sessile, capitate, discoid or truncate. Capsules siliquiform, linear, oblong, terete or flat, often beaked, striate, dehiscent by 2 valves with persistent seed-bearing replum in middle; seeds discoid, reniform or orbicular, the ends incurving or one of them free, sometimes with funicular elaiosome, smooth, reticulate-foveolate or transversely rugose, warty, crested or ridged on surface, glabrous or pubescent.

Tropics and subtropics, ca 150 species, 15 in India and 10 in Kerala.

Key to species

- | | | |
|-----|--|-------------------------|
| 1a. | Leaves simple | 6. <i>C. monophylla</i> |
| b. | Leaves compound, 3–9-foliolate | 2 |
| 2a. | Androgynophore conspicuous, ca 5 mm or longer | 3 |
| b. | Androgynophore usually absent, if present less than 3 mm long | 4 |
| 3a. | Plant pubescent with gland-tipped hairs, foetid; petals less than 15 mm long, white or yellowish, valvate in bud; androgynophore 9–16 mm long; gynophore 5–10 mm long in fruit | 5. <i>C. gynandra</i> |

- h. Plant glabrous or thinly and shortly hairy, neither glandular-pubescent nor foetid; petals 2.5 - 3.5 mm long, pink or reddish violet, imbricate in bud; androgynophore 5 - 7 mm long; gynophore ca 6 cm long in fruit **8. *C. speciosa***
- 4a. Plants with scattered soft linear prickly appendages **5**
- b. Plants without prickly appendages **8**
- 5a. Petals long-clawed; claw 1 - 1.2 cm long; filaments longer than petals; anthers 7 - 9 mm long **9. *C. spinosa***
- b. Petals usually not clawed, if present 2 - 3.5 mm long; filaments shorter than petals; anthers 1 - 2 mm long **6**
- 6a. Leaves simple and 3-foliolate on same plant; leaflets scabrid with tubercle-based hairs; flowers yellow or white **2. *C. aspera***
- b. Leaves 3 - 5-foliolate; leaflets glabrous except for scabrous nerves; flowers pink or purple **7**
- 7a. Petals 8 - 12 mm long; seeds with elaiosome **7. *C. rutidosperma***
- b. Petals 2 - 4 mm long; seeds without elaiosome **3. *C. burmannii***
- 8a. Plant glabrous; leaflets filiform, 12 - 20 x 1 - 2 mm; stamens 6 **1. *C. angustifolia***
- b. Plants not glabrous; leaflets obovate, elliptic-oblong or elliptic-lanceolate, 1.5 - 4 x 0.5 - 2 cm; stamens 12 - many **9**
- 9a. Plant pubescent with eglandular hairs; petals pinkish or purple **4. *C. chelidonii***
- b. Plant viscid with glandular hairs; petals not pinkish or purple **10. *C. viscosa***

1. *Cleome angustifolia* Forssk., Fl. Aegypt.-Arab.: 120. 1775; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 302. 1993. *C. tenella* L.f., Suppl. Pl.: 300. 1782; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 169. 1872; Rama Rao, Fl. Pl. Travancore: 17. 1914; Dunn in Gamble, Fl. Madras: 41(29). 1915.

Annual, slender, much branched, glabrous herb, 10 - 50 cm high; young stems filiform. Leaves 3-foliolate; petioles 6 - 10 mm long; leaflets sessile, mostly filiform, narrowly linear or oblanceolate, acute at apex, 1.2 - 2 cm x 1 - 2 mm; lowest leaf with oblanceolate leaflets. Flowers 3 - 3.5 mm across, in lax 2 - 5-flowered terminal and not clearly demarcated racemes, often solitary, axillary; pedicels to 6 mm long. Petals 3 - 4 mm long, yellow with purple nerves. Stamens 6. Capsules sessile or subsessile, linear-subterete, 1.5 - 5 cm x 1.5 - 2 mm, glabrous; seeds suborbicular, curved, 0.5 - 0.7 mm across, minutely rugulose with

an open cleft, brown.

Fl. & Fr.: June - July.

Habitat: Sandy soil in wastelands and rocky slopes, to 350 m.

Distrib.: Kollam. Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. Africa, Arabia and Sri Lanka.

2. **Cleome aspera** J. König ex DC., Prodr. 1: 241. 1824; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 169. 1872; Rama Rao, Fl. Pl. Travancore: 17. 1914; Dunn in Gamble, Fl. Madras: 41(29). 1915; Manilal & Sivar., Fl. Calicut: 34. 1982; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 303. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 56. 1994.

Annual, prostrate, decumbent or ascending herb; stems ribbed with scattered short compressed hooked soft minute prickles. Leaves basally 3-foliolate; uppermost ones simple; petioles 2 - 10 mm long (rarely to 2 cm long in basal leaves), almost absent in uppermost leaves; leaflets subsessile, linear-oblong or lanceolate, cuneate at base, subobtuse to retuse and mucronate at apex; midleaflets to 2.5 cm x 5 mm; lateral leaflets to 1.5 cm x 4 mm; lateral nerves 4 - 9 pairs. Flowers ca 3 mm across, solitary, in axils of higher leaves, often forming to 2.5 cm long leafy racemes, yellow or white with orange or red streaks; pedicels filiform, 3 - 5 mm long, elongating to 1.5 cm in fruit, puberulous. Sepals linear-lanceolate, obtuse, 1 - 2 mm long, thinly glandular-pubescent. Petals elliptic or oblanceolate, rounded at apex, 2.5 - 4 x 0.8 - 1.5 mm. Stamens 6; filaments ca 2.5 mm long; anthers linear, ca 1 mm long. Gynophore ca 1 mm long; styles slender, ca 1 mm long. Capsules subsessile or on to 3 mm long stalk, terete, narrow at both ends, slightly torulose, beaked, 2 - 3 cm x 1.5 - 2 mm; seeds 12 - 20, suborbicular, curved with a closed cleft, 1.7 - 2 x ca 1.5 mm, with prominent cross ribs and joined by obtuse concentric ribs, yellowish to dark brown.

Fl. & Fr.: Almost throughout the year.

Habitat: Sandy and gravelly soil in wastelands, to 400 m.

Distrib.: Kollam, Kozhikode, Malappuram and Thiruvananthapuram. Peninsular India. Sri Lanka.

3. **Cleome burmannii** Wight & Arn., Prodr. Fl. Ind. Orient.: 22. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 170. 1872; Rama Rao, Fl. Pl. Travancore: 17. 1914; Dunn in Gamble, Fl. Madras: 41(29). 1915; Sundararagh.

in B.D. Sharma & N.P. Balakr., Fl. India 2: 304. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 57. 1994.

Erect herb, to 50 cm high; stems much branched, somewhat flat, ribbed, clothed with scattered soft to 2.5 mm long prickles. Petioles of lower leaves 2.5 - 4 cm long; the upper smaller; leaflets 3 - 5, ovate-lanceolate or elliptic-, cuneate and webbed at base, faintly crenate-serrulate at margin, subacute or subrounded at apex, 2 - 6 x 0.4 - 1.8 cm, membranous, glabrous; petiolules to 1 mm long. Flower axillary, solitary; pedicel 5 - 18 mm long, glandular-hairy. Sepals lanceolate, acuminate. Petals elliptic-oblong, 2 - 4 x 0.8 - 1.2 mm, white, rarely purple. Gynophore 0.5 - 1.5 mm, elongating to 4 - 7 mm after fertilization. Ovary 1.5 - 2 mm long, glabrous. Capsules terete, torulose, narrow at both ends, beaked, 3.5 - 4.5 cm x 1 - 1.5 mm, glabrous; seeds 10 - 15, 1.2 - 1.4 mm across, with concentric ribs and closed cleft, reddish brown, without elaiosome.

Fl. & Fr.: May - June, Jan. - Feb.

Habitat: Wastelands, to 600 m.

Distrib.: Idukki, Kollam, Kottayam, Malappuram, Pathanamthitta and Thiruvananthapuram. Tamil Nadu. Indonesia and Sri Lanka.

4. *Cleome chelidonii* L.f., Suppl. Pl.: 300. 1782; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 170. 1872; Dunn in Gamble, Fl. Madras: 41(29). 1915; Vajr., Fl. Palghat: 56. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 306. 1993.

Suffrutescent herb, to 1.2 m high, strigose with bulbous-based hairs; stems subangled; taproot stout, whitish. Leaves 3 - 9-foliolate, densely appressed-pubescent to glabrate; lower ones subcoriaceous; upper ones chartaceous; petioles gradually decreasing in length upwards, 8 - 10 cm to almost absent; basal leaflets obovate, cuneate at base, obtuse to rounded at apex, 1.5 - 2 x 1.4 - 1.6 cm, strigose-hairy at margin, obscurely nerved; upper leaflets elliptic-lanceolate, lanceolate or even linear, rounded at base, crenate to wavy at margin, acute at apex; lateral nerves 3 or 4. Flowers 1.5 - 2 cm across, in lax terminal corymbiform to 10 cm long racemes, showy, white, pink or rosy purple; pedicels 2.5 - 4 cm long, elongating to 5 cm in fruit, hairy; bracts foliaceous; flower buds ellipsoid, acute, 6 - 9 mm long. Sepals elliptic to obovate, acuminate, 3.5 - 4.5 x 0.8 - 1.5 mm, sparsely pubescent outside. Petals 4(- 8), elliptic, ovate to obovate, narrow at

base, rounded at apex, 1 - 2 x 0.3 - 0.8 cm, glabrous. Stamens 35 - 60; filaments 8 - 12 mm long, swollen at tips, greenish white or purple-tinged; anthers ca 1 mm long, white. Ovary sessile, linear, 8 - 12 x ca 1 mm, glabrous. Capsules linear-cylindric, narrow at base, beaked at apex, to 9 cm x 3 mm; beak ca 3.5 mm long; valves striate, glabrous, parallel-nerved; seeds 40 - 50, orbicular with open cleft, 1.5 - 2.5 mm; testa not ridged but warty or muriculate on dorsal side, reddish brown, drying black.

Fl. & Fr.: Almost year round with peak during premonsoon period.

Habitat: Rice fields and moist areas, to 1200 m.

Distrib.: Palakkad (Walayar). Throughout India except the Himalayas and desert regions of Gujarat and Rajasthan. South and SE. Asia.

Use: Seed is used as a condiment.

Note: An extremely variable plant in height, size, shape and texture of leaves, number of leaflets, degree of pubescence etc.

5. *Cleome gynandra* L., Sp. Pl.: 671. 1753; Manilal & Sivar., Fl. Calicut: 33. 1982; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 309. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 57. 1994. *C. pentaphylla* L., Sp. Pl. ed. 2, : 983. 1762. *Gynandropsis pentaphylla* (L.) DC., Prodr. 1: 238. 1824, nom. illeg.; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 171. 1872; Rama Rao, Fl. Pl. Travancore: 17. 1914; Dunn in Gamble, Fl. Madras: 40(29). 1915. *G. gynandra* (L.) Briq. in Annuaire Conserv. Jard. Bot. Genève 17: 382. 1914; Nicolson & al. in Regnum Veg. 119: 79. 1988.

Mal.: *Karvela*, *Thaivela*

Annual, erect herb, to 1.2 m high, strongly foetid; stems branched, glandular-pubescent. Leaves 3 - 5 (- 7)-foliolate, ca 7.5 x 6.5 cm; leaflets unequal, obovate-elliptic, oblanceolate or rhombate, cuneate at base, entire to denticulate-serrulate at margin, acute at apex, glaucous when dry; midleaflets 1 - 7 x 0.4 - 4 cm; lateral ones to 3.5 x 1.5 cm; petioles 3 - 15 cm long, densely glandular-puberulous; petiolules webbed, to 3 mm long. Inflorescences lax many-flowered corymbose racemes, 10 - 30 cm long; bracts foliaceous, 3-foliolate, 8 - 25 mm long, much reduced and sessile upwards. Flowers 1 - 2 cm across; pedicels filiform, 0.2 - 2.5 cm long, pubescent. Sepals ovate, obovate, elliptic or oblanceolate, acuminate, 1.5 - 5 x 0.5 - 1.5 mm, puberulous, caducous. Petals

obovate to oblanceolate, subequal, 3 - 15 x 1 - 6 mm, white or creamy yellow, rarely pink; claw filiform, as long as limb. Androphore 6 - 25 mm long. Stamens 6, purple; filaments subequal, 1.5 - 2 cm long, stiff, somewhat spreading; anthers linear, ca 2 mm long. Gynophore to 2 cm long, elongating to 3.5 cm in fruit. Ovary sessile, among stamens or on to 2 cm long gynophore, oblong-cylindric, 2.5 - 4 mm long, green or purplish green; style ca 1 mm long; stigma discoid, depressed at apex, purple. Capsules erecto-patent, cylindric or compressed-terete, tapering at both ends, 3 - 12 x 0.4 - 0.8 cm, striate, sticky-glandular-pubescent; valves papery; seeds 15 - 40, reniform, compressed, 1 - 1.8 mm across, longitudinally and concentrically striate, with low cristate transverse ridges, rugulose to tubercled with shallow narrow and open cleft, dark brown or black; stalks 2 - 4 cm long.

Fl. & Fr.: Throughout the year.

Habitat: Weed on sandy soil in fallow, cultivated and wastelands, roadsides, railway tracks etc., to 1800 m.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad and Thiruvananthapuram. Throughout India. Pantropic.

Uses: Tender shoot and leaf are used as herbage and as a vegetable. Leaf is used in treating rheumatism and leaf juice for headache by applying on forehead and pouring into nostrils. Seed is anthelmintic, used as a substitute for mustard and also as a bird feed. Seed oil is efficacious in killing lice.

Note: Flowers in apical portion have almost sessile ovaries with hardly 1 - 2 mm long gynophores. About 50% of these ovaries are sterile whereas ovaries with longer gynophores are fertile.

6. *Cleome monophylla* L., Sp. Pl.: 672. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 168. 1872; Rama Rao, Fl. Pl. Travancore: 16. 1914; Dunn in Gamble, Fl. Madras: 41(29). 1915; Manilal & Sivar., Fl. Calicut: 34. 1982; Nicolson & al. in Regnum Veg. 119: 78. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 46. 1988; Vajr., Fl. Palghat: 57. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 312. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 42. 1996; Sivar. & P. Mathew, Fl. Nilambur: 53. 1997.

Annual, erect, herb, to 1 m high, glandular-pubescent; stems branching from base, angled, striate. Leaves simple, linear, linear-lanceolate, oblong or oblong-ovate, truncate at base, acute at apex, 2 - 10 x 1 - 3.5 cm, ciliate at margin;

petioles to 5 cm long, glandular-pubescent. Racemes terminal, lax, to 30 cm long; bracts sessile, foliaceous, cordate at base. Flowers 1 - 1.5 cm across, faintly odorous; pedicels to 10 mm long, glandular-pubescent. Sepals linear or lanceolate, acuminate, 3 - 5 x ca 1 mm. Petals oblong, obovate or spatulate, tapering and clawed at base, rounded at apex, 6 - 10 x ca 1.5 mm, light purple, pink to white. Stamens 6; filaments unequal, 5 - 8 mm long; anthers ca 2 mm long. Ovary linear, 5 - 8 mm long, sessile or on a ca 0.5 mm long gynophore. Capsules sessile or on to 3 mm long gynophore, subcylindric, linear, 7 - 11 cm x ca 3 mm, with a flat 3 - 9 mm long beak, strongly ribbed, glandular- or eglandular-hairy; seeds 35 - 40, suborbicular, ridged with longitudinal striations, closed at cleft, 1.8 - 2 x 1.6 - 1.8 mm, pubescent, dark brown.

Fl.: April - Aug. *Fr.*: June - Dec.

Habitat: Cultivated fields, roadsides, grasslands and wastelands, to 1300 m.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thrissur. Throughout India. Tropical Asia and Africa.

7. ***Cleome rutidosperma*** DC., Prodr. 1: 241. 1824; P.K. Mukh. in Indian Forester 95: 237. 1969; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 313. 1993. *C. burmannii* sensu Manilal & Sivar., Fl. Calicut: 34. 1982, non Wight & Arn. 1834.

Annual, erect or decumbent herb, to 1 m high; stems weak, ribbed, subglabrous to eglandular-pilose, clothed with soft recurved caducous to 2 mm long prickles. Leaves 3-foliolate; lower ones long-petioled; upper ones short-petioled or sessile; leaflets subsessile, rhombate-elliptic, obovate or oblong-lanceolate, attenuate or cuneate and webbed at base, obscurely crenulate-serrulate and purple at margin, acute or acuminate at apex, 1 - 6 x 0.2 - 2 cm, glabrous; lateral nerves 6 - 8 pairs, softly setose; petioles at base to 4 cm long, gradually diminishing upwards to nearly absent; petiolules less than 1 mm long. Racemes lax, few-flowered, leaf-bearing, not clearly demarcated, to 20 cm long. Flowers in axils of leaves below and in axils of foliaceous bracts above; pedicels filiform, 1 - 2 cm long, elongating to 3.5 cm in fruit, shortly glandular-hairy. Sepals linear or linear-lanceolate, acuminate, 2.5 - 4 x 0.3 - 0.8 mm, thinly clothed with short bristles. Petals oblong-elliptic to oblanceolate, clawed at base, apiculate at apex, 8 - 12 x 1.5 - 2.5 mm, showy, pink, bluish violet, rarely white with pink streaks;

claw 2 - 3.5 mm long. Stamens 6; filaments 6 - 9 mm long; anthers linear, ca 2 mm long, recurved after anthesis. Gynophore 1.5 - 2 mm long, elongating to 8 mm in fruit. Ovary linear, 7 - 12 mm long, slightly curved; stigma sessile, capitate. Capsules linear-cylindric, compressed, attenuate at both ends, ribbed, 4 - 7 cm x 2.5 - 4 mm; beak 1 - 4 mm long; valves glabrous, parallel-nerved; seeds many, suborbicular to reniform with prominent concentric and transverse ridges and open cleft, 1.5 x ca 1.5 mm, orange-brown, drying black; elaiosome conspicuous, white or creamy.

Fl. & Fr.: May - Nov.

Habitat: Wastelands, to 800 m.

Distrib.: Kannur, Kasaragod, Kollam, Kozhikode, Pathanamthitta and Thiruvananthapuram. Andaman & Nicobar Islands, Assam, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh and W. Bengal. Native to tropical Africa, introduced into many parts of S. & SE. Asia and tropical America.

Note: For more details (*vide* Sundararaghavan in *J. Econ. Tax. Bot.* 5: 463 - 465. 1984).

8. ***Cleome speciosa*** Raf., *Fl. Ludov.*: 86. 1817; Manilal & Sivar., *Fl. Calicut*: 33. 1982; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 47. 1988; Vajr., *Fl. Palghat*: 57. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 316. 1993. *Gynandropsis speciosa* (Raf.) DC., *Prodr.* 1: 238. 1824.

Annual, erect herb, to 1.5 m high, hardly branched; stems smooth or with scattered spine-like protuberances, glabrous, rarely glabrescent, whitish. Leaves 3 - 7-foliolate; petioles 4 - 15 cm long; leaflets sessile, ovate-lanceolate to elliptic - narrow and webbed at base, acuminate at apex, 9 - 15 x 1.5 - 4.5 cm, chartaceous; lateral nerves 7 - 20 pairs. Flowers ca 2.5 cm across, in 7 - 25 cm long racemes, showy, subtended by sessile foliaceous bracts; pedicels filiform, 2 - 3.5 cm x ca 3 mm. Sepals subulate to lanceolate, 2.5 - 5 x 0.8 - 1.5 mm, ciliate, puberulous. Petals imbricate, erect, lanceolate, narrowing into a claw at base, rounded at apex, 20 - 40 x 4 - 8 mm including claw, pink, rose or purple, rarely white. Androphore 5 - 9 mm long, slightly incrassate at base and top, glabrous. Stamens 6; filaments filiform, 5 - 6 cm long, glabrous; anthers 5 - 6 mm long, greenish. Gynophore 4 - 6 cm long, elongating to 9 cm in fruit, glabrous. Ovary linear-cylindric, 5 - 6 x ca 1 mm, glabrous. Capsules pendent,

linear-cylindric, 6 - 10 cm x ca 3 mm, longitudinally striate; valves parallel-nerved; seeds many, horseshoe-shaped with closed cleft, 2.5 - 3.5 mm across, tubercled, brown-scaly.

Fl. & Fr.: April - May, Sept. - Oct.

Habitat: Cultivated in gardens, often an escape, to 1500 m.

Distrib.: Kannur, Kasaragod, Kottayam, Kozhikode, Malappuram and Palakkad. Goa and Meghalaya. Native to tropical America, introduced and often naturalized in S. and SE. Asia.

9. *Cleome spinosa* Jacq., Enum. Pl. Carib.: 26. 1760; L., Sp. Pl. ed. 2, : 939. 1763; Paria in Sci. & Cult. 46: 27. 1980; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 321. 1993; Sivar. & Sunil in Rheedea 5: 184, f.1. 1995.

Erect herb, to 1.5 m high, not much branched, foetid, viscid-hairy when young. Leaves alternate, 5 - 9-foliolate; petioles 5 - 12 cm long, scattered-spinose beneath; leaflets sessile, elliptic to lanceolate, narrowing towards base, serrulate at margin, acute or acuminate at apex, 5 - 12 x 1 - 3 cm, glabrous above, pubescent and spinose on midnerve beneath. Flowers solitary in upper leaf axils and in apparent terminal racemes, 2 - 3 cm across, deep pink turning pale rose; bracts foliaceous, 1-foliolate, smaller above; pedicels 2.5 - 3.5 cm long, to 4.5 cm in fruit. Sepals 4, linear-lanceolate, 5 - 10 mm long, reflexed, persistent. Petals 4; claw to 1.2 cm long; limb elliptic to obovate, 1.5 - 2 x 1 - 1.3 cm. Stamens 6; filaments usually longer than petals, almost free from base, pink; anthers linear, ca 8 mm long, basifixed. Gynophore pink, 3.5 - 4.5 cm long, 6 - 8 cm in fruit. Ovary cylindric, 8 - 10 mm long; style short; stigma capitate. Capsules cylindric, 4 - 7 mm long, green; seeds many, globose-reniform, 2 - 2.5 mm across, pale, faintly tubercled.

Fl. & Fr.: March - Sept.

Habitat: Wet exposed river banks.

Distrib.: Thrissur. West Bengal. Tropical America; elsewhere in tropics cultivated and naturalized.

10. *Cleome viscosa* L., Sp. Pl.: 672. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 170. 1872; Rama Rao, Fl. Pl. Travancore: 17. 1914; Dunn in Gamble, Fl. Madras: 41(29). 1915; Manilal & Sivar., Fl. Calicut: 34. 1982; Nicolson & al. in Regnum Veg. 119: 78. 1988; V.S. Ramach. & V.J. Nair, Fl.

Cannanore: 47. 1988; Vajr., Fl. Palghat: 57. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 316. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 57. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 42. 1996; Sivar. & P. Mathew, Fl. Nilambur: 53. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 69. 2002. *C. icosandra* L., Sp. Pl.: 672. 1753.

Mal.: *Ariavella, Aryaval, Kattukadugu, Naikadugu*

Annual, erect herb, to 1.2 m high, viscid, glandular- or eglandular-hairy, foetid; stems woody, sparsely branched from base, striate, tomentose. Leaves 3-5- rarely to 7-foliolate; petioles to 7 cm long at base, decreasing upwards, striate, hairy; leaflets sessile, subequal, elliptic-oblong or obovate to spatulate, cuneate at base, entire and ciliate at margin, acute, rarely obtuse at apex, 1.5-4.5 x 0.6-2 cm, glandular-pubescent. Racemes laxly few-flowered, corymbiform, leaf-bearing, to 30 cm long. Flowers often solitary, axillary, at lower portion of racemes, 1-1.5 cm across, ephemeral; bracts sessile, foliaceous; pedicels 6-12 mm long, to 4 cm in fruit. Sepals 4, oblong to lanceolate, acute at apex, 5-12 x 2-4 mm, glabrous inside, glandular-hairy outside, reddish at base. Petals 4, subequal, obovate or oblanceolate to oblong-spatulate, cuneate with to 6 mm long claw at base, rounded at tip, 8-12 (-25) x 3-5 (-10) mm, orange-yellow to yellow or creamy white, distinctly nerved. Stamens (8-) 12-40, often intermixed with staminodes; filaments 4-8 (-20) mm long, broad at tip; anthers linear, 1.5-2.8 mm long, bluish. Ovary sessile, oblong-cylindric or linear-oblong, beaked, 6-8(-14) mm long, minutely glandular-hairy; style slender, to 10 mm long, puberulous; stigma capitate. Capsules on 2-3 cm long stalk, erect, rarely curved, terete, linear-oblong, slightly compressed, narrow at both ends, beaked at apex, 4-9 (-12) cm x 3-5 mm, obliquely striate; beak 4-20 mm long; valves centripetally nerved; seeds many, reniform or subglobose, 1-1.5 mm across, finely ridged, centrically ribbed, closed at cleft with a very narrow opening, glabrous, reddish brown to black.

Fl. & Fr.: Throughout the year.

Habitat: Moist places in wastelands, roadsides and cultivated fields, to 1000 m.

Distrib.: Almost throughout Kerala. Throughout India. Throughout tropics.

4. CRATAEVA L.

Trees, rarely shrubs, unarmed, glabrous, deciduous; branches lenticelled with distinct leaf scars. Leaves palmately 3-foliolate; stipules minute, caducous; leaflets short-stalked, often pellucid-dotted; terminal one equilateral, acuminate or caudate at apex; lateral ones oblique, asymmetric. Racemes terminal, corymbose; rachises to 25 cm long, either with arrested growth or growing through a leafy twig. Flowers showy, subtended by 3-foliolate or subulate bracts, long-pedicelled, uni- or bisexual, often polygamous. Receptacle patelliform with incurved margin, nectariferous. Sepals equal, ovate-spatulate, green. Petals unguiculate, long-clawed, subequal, white turning creamy; anterior pair slightly smaller, ovate to rhomboid, obtuse. Stamens 12-50, adnate to gynophore at base, sterile in female flowers. Gynophore 1.8 - 6 cm long, slender, incrassate in fruit. Ovary long-stipitate, ellipsoid or subglobose, 1- or seemingly 2-loculed; placentae 2; ovules in 4 or more rows; stigma subsessile, discoid. Fruits berry-like, pendulous, globose to ellipsoid, on woody incrassate stalk; rind spongy or hard, smooth or papillate, covered by flat whitish warts; seeds reniform or horseshoe-shaped, packed and embedded in a creamy foetid pulp; cotyledons convolute, one longer and curved around the other.

Tropics, ca 6 species, 4 in India and 2 in Kerala.

Key to species

- 1a. Plant leafless when in flower; leaflets abruptly acuminate at apex; fruits globose, orange-yellow turning reddish on maturity **1. *C. adansonii* subsp. *odora***
- b. Plant mostly leaf-bearing when in flower; leaflets gradually long-acuminate at apex; fruits ovoid to oblong-ellipsoid, greyish to brown on maturity **2. *C. magna***

1. *Crataeva adansonii* DC. subsp. *odora* (Buch.-Ham.) M. Jacobs in Blumea 12: 198. 1964; Manilal & Sivar., Fl. Calicut: 32. 1982; Vajr., Fl. Palghat: 57. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 322. 1993. *C. odora* Buch.-Ham. in Trans. Linn. Soc. London 15: 118. 1827. *C. roxburghii* R. Br., Narr. Travels Africa: 224. 1826; Wight & Arn., Prodr. Fl. Ind. Orient.: 23. 1834; Hook., Icon. Pl. 1: t. 278. 1837. *C. religiosa* G. Forst. var. *roxburghii* (R.Br.) Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 172. 1872. *C. religiosa* sensu Dunn in Gamble, Fl. Madras: 47(34). 1915 p.p., non G. Forst. 1786.

Tree, to 10 m tall. Leaves subcoriaceous when dry, dull greyish green; petioles 7 - 10 (-12) cm, gland-tipped; leaflets ovate-lanceolate to elliptic, 1.5 - 2 times as long as broad; midleaflets to 12 x 7 cm, abruptly acuminate at apex; lateral ones 6 - 8 x 3.5 - 5 cm, oblique, tapering at base, acute at apex; lateral nerves 4 - 6 pairs; petiolules 6 - 10 mm long. Corymbs 12 - 30-flowered; rachises 2 - 3 cm long, often growing through with a few axillary flowers. Flowers appearing before or with tender leaves, 2.5 - 3.5 cm across, fragrant; pedicels 3 - 7 cm long. Sepals elliptic, acuminate, 3.5 - 5 x 1.5 - 2 cm, petaloid. Petals initially greenish white turning yellowish, finally fading to pink; limb 9 - 18 x 6 - 10 mm; claw 3 - 6 mm long. Stamens 15 - 26; filaments 3 - 4.5 cm, white turning lilac or purple; anthers black. Gynophore 2.5 - 3.5 cm long, pinkish. Ovary ovoid or ellipsoid, ca 3 x 2 mm, often abortive; stigma small, knob-like. Fruits globose, 2.5 - 4 cm, orange-yellow or reddish brown; seeds 5 - 6 x ca 2 mm, smooth, brown, embedded in yellow pulp; stalks 3 - 4 mm thick.

Fl.: Feb. - April *Fr.*: May - Nov.

Habitat: Open and scrub forests, to 750 m.

Distrib.: Kollam, Kozhikode and Palakkad. Throughout the drier parts of India except NE. and Kashmir. Myanmar, Pakistan and Sri Lanka.

Uses: Wood is used for agricultural implements, toys and planks. Fresh leaf and bark are useful in treating rheumatic and urinary complaints. Fruit is edible when cooked. Bark is demulcent and antipyretic.

Note: *C. religiosa* sensu Dunn (*l.c.*) partly reflects subsp. *odora* and partly *C. magna*. Both are common in peninsular India.

For detailed discussions on reasons for rejecting the earlier name *C. roxburghii* R. Br. (1826) in favour of the next epithet *C. odora* Buch.-Ham. (1827) *vide* Jacobs (*l.c.*: 197 - 198).

2. *Crataeva magna* (Lour.) DC., Prodr. 1: 243. 1824; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 47. 1988; Vajr., Fl. Palghat: 58. 1990; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 342. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 42. 1996; Sivar. & P. Mathew, Fl. Nilambur: 54. 1997. *Capparis magna* Lour., Fl. Cochinch.: 331. 1790. *Crataeva nurvala* Buch.-Ham. in Trans. Linn. Soc. London 15: 121. 1827; Manilal & Sivar., Fl. Calicut: 32. 1982; Nicolson & al. in Regnum Veg. 119: 78. 1988. *C. religiosa* var. *nurvala* (Buch.-Ham.) Hook.f.

& Thomson in Hook.f., Fl. Brit. India 1: 172. 1872. *C. religiosa* auct. non G. Forst. 1786: Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 172. 1872; Bourd., Forest Trees Travancore: 14. 1908; Rama Rao, Fl. Pl. Travancore: 18. 1914; Dunn in Gamble, Fl. Madras: 47(34). 1915 p.p.

Mal.: *Killi, Neervalu, Nir-mathalam, Nirvalom*

Tree, to 10 m tall, rarely 2 - 3 m high shrub; trunk to 35 cm across; bark fissured, greyish black; branchlets lenticelled, smooth or verrucose, greyish brown. Petioles 4 - 12 cm long, gland-tipped; leaflets 8 - 25 x 1.5 - 6 cm, 2 - 4 times as long as broad, chartaceous, shining, glaucous beneath, brown-tinged above; midleaflets elliptic-lanceolate or oblanceolate; lateral ones ovate-elliptic or rhomboid, acute to cuneate at base, gradually long-acuminate with an acute tip at apex; petiolules 3 - 7 mm long. Corymbs terminal, many-flowered; rachises 10 - 15 cm long. Flowers 3 - 4 cm across, creamy white turning yellow, faintly fragrant; pedicels 3 - 7 cm long, leaving scars on falling off. Sepals oblong to ovate-oblong, acute, 2.5 - 3 x 1.3 - 1.5 cm. Petals obovate, obtuse, clawed; claw 4 - 8 mm long; limb 2 - 2.5 x 1.5 - 1.8 cm. Stamens more than 24; filaments 4.5 - 5 cm long, lilac or purple. Gynophore 4 - 6 cm long. Ovary oblong-ellipsoid, 4 - 5 x 2 - 2.5 mm, often abortive. Fruits ovoid to oblong-ellipsoid or -ovoid, 4 - 6 x 3 - 5 cm; pericarp woody with a powdery crust that soon withers off leaving it smooth, yellowish grey; seeds 8 - 12 x 5 - 9 mm, dorsally crested, tubercled, dark brown, embedded in creamy pulp.

Fl.: Jan. - April *Fr.*: April - Aug.

Habitat: Along streams in deciduous and semievergreen forests, to 1000 m.

Distrib.: Throughout Kerala. East, NE. and Peninsular India. South and SE. Asia.

Uses: Young fruit is edible. Leaf is bitter and used in treating skin ailments and rheumatism. Bark is used in snakebite. Wood is used for drums and models.

Note: For the taxonomy of this species *vide* Nicolson & al. (*l.c.*) and Sundararaghavan (*l.c.*).

VIOLACEAE

(K. VIVEKANANTHAN)

Herbs, undershrubs, shrubs or small trees, rarely lianas. Leaves alternate, rarely opposite, simple, entire or toothed, rarely lobed; stipules minute or

leafy. Flowers bi- or unisexual, rarely polygamous or dioecious, hypo- or slightly perigynous, zygo- or actinomorphic, solitary or in axillary or terminal racemes, spikes or panicles, often bracteoid. Sepals 5, free or slightly connate, imbricate, often ciliate, persistent. Petals 5, free, rarely connate shortly, imbricate, unequal, generally sessile; the lowermost often gibbous or spurred, larger than others and different-shaped. Stamens 5, mostly hypogynous; filaments free or connate, alternating with petals, closely connate around pistil; anthers 2-loculed, basifixed or adnate, introrse, one often spurred, dehiscent by longitudinal slits; connectives apically produced; 2 abaxial anthers sometimes spurred. Carpels 3-5; ovary superior, sessile, subglobose, 1-loculed; placentae parietal with 1- numerous ovules on each; ovules 2-tegmatic, crassinucellar, anatropous; style simple, mostly sigmoid or thick above; stigma various, usually truncate, lobed, beaked or simple. Fruit usually a loculicidal 3-valved capsule or a berry or nutlet; seeds smooth or rough, rarely tomentose, often arillate, sometimes winged in lianas; embryo straight; cotyledons thin, broader than radicle; endosperm moderate or copious, rarely scanty, fleshy.

Cosmopolitan but genus *Viola* temperate, 20 genera and ca 800 species, 3 and 41 in India and, 3 and 5 in Kerala.

Literature: Tennant, J.R. 1963. Notes on African *Violaceae*. *Kew Bull.* 16: 409 - 435. Jacobs, M. & Moore, D.M. 1972. *Violaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 7: 179 - 212. Grey-Wilson, C. 1981. Notes on African *Violaceae*. *Kew Bull.* 36: 103 - 126. Banerjee, S.P. & Pramanik, B.B. 1983. *Violaceae. Fasc. Fl. India* 12: 1 - 40. Qaiser, M. & Omer, S. 1985. *Violaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. Pakistan* 166: 1 - 28.

Key to genera

- 1a. Shrubs or small trees; flowers actinomorphic; abaxial stamens not spurred at base
 - 2. Rinorea**
- b. Herbs, sometimes suffruticose; flowers zygomorphic; abaxial stamens often spurred at base
 - 2
- 2a. Leaves sessile to subsessile; sepals not produced at base; petals unequal; seeds ribbed
 - 1. Hybanthus**
- b. Leaves long-petioled; sepals pouched or produced at base; petals subequal or equal; seeds smooth
 - 3. Viola**

1. HYBANTHUS Jacq., nom. cons.

Herbs or undershrubs, rarely small trees. Leaves alternate, rarely subopposite to opposite, mostly sessile, herbaceous, sometimes coriaceous; stipules small, mostly caducous. Flowers bisexual, zygomorphic, rarely cleistogamous, solitary in leaf axils, in more or less reduced axillary cymes, dichasia or in raceme-like elongate monochasia, rarely in a terminal leafy panicle; pedicels jointed, 2-bracteoid below joint. Sepals 5, subequal, more or less 3-angled, rarely deeply incised at margin, persistent. Petals 5, unequal, white to orange or purple, persistent; posterior ones small and straight; middle ones longer and falcate; anterior one expanded to a lip with a claw, more or less deeply saccate to short-spurred. Filaments free or partly connate; anthers free or more or less united, 2 (or rarely 4) of them gibbous or spurred; connectives prolonged into a distinct membranous appendage. Ovary ovoid, with 3 placentae bearing 3–24 ovules; style clavate, incurved; stigma oblique. Capsules elastically subglobose, 3-valved; valves coriaceous; seeds few, ellipsoid, mostly with a small caruncula.

Tropics and subtropics, ca 150 species, 2 in India.

Key to species

- 1a. Herb; sepals keeled; petals red; capsules ca 5 mm long; seeds conspicuously ribbed
1. *H. enneaspermus*
- b. Shrub; sepals not keeled; petals pink; capsules ca 10 mm long; seeds obscurely ribbed
2. *H. travancoricus*

1. *Hybanthus enneaspermus* (L.) F. Muell., *Fragm.* 10: 81. 1876; Manilal & Sivar., *Fl. Calicut*: 34. 1982; Nicolson & al. in *Regnum Veg.* 119: 267. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 47. 1988; S.P. Banerjee & Pramanik in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 343. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 58. 1994; Sivar. & P. Mathew, *Fl. Nilambur*: 55. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 70. 2002. *Viola enneasperma* L., *Sp. Pl.*: 937. 1753. *V. suffruticosa* L., *Sp. Pl.*: 937. 1753. *Ionidium suffruticosum* (L.) Roem. & Schult., *Syst. Veg.* 5: 394. 1819; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 1872; Rama Rao, *Fl. Pl. Travancore*: 21. 1914; Dunn in Gamble, *Fl. Madras*: 49(35). 1915.

Mal.: *Kalthamara, Nilamparanda, Orelathamara*

Annual or perennial herb, often woody at base, 15–60 cm high; stems simple or moderately branched, terete or ridged, subglabrous to densely pubescent, often becoming glabrescent. Leaves sessile to subsessile, very variable, linear to linear-lanceolate, elliptic- or oblong-cuneate at base, subentire to crenate-serrate or dentate-serrate at margin, acute or subobtuse and often mucronate at apex, 5–50 x 1–14 mm, glabrous to densely pubescent, hirsute or scabrid; lateral nerves 4–7 pairs; stipules linear-lanceolate to subulate, 1–4 cm long, usually ciliate at margin. Flower solitary, axillary; pedicel slender, 0.6–2 cm long, glabrous or pubescent with a pair of subulate bracteoles. Sepals subequal, lanceolate, acute, 2–4 x 0.75–1 mm, glabrous or ciliate. Petals unequal, red; upper 2 symmetric, elliptic, acuminate, 3–5 mm long; lateral 2 oblong-triangular, 4–6 mm long, rather expanded at apex and obtuse; lower one suborbicular to subcordate, 8–19 mm long. Stamens 2–3 mm long; anterior stamen with a small recurved fleshy appendage. Ovary globose, glabrous; style thick above. Capsules 3-lobed, glabrous; seeds ovoid-ellipsoid.

Fl. & Fr.: Throughout the year.

Habitat: Wastelands in plains, grasslands, cultivated fields, railway tracks and roadsides, common.

Distrib.: Almost throughout Kerala. Gangetic Plains, C., NE. and S. India. Tropics.

Uses: Considered to possess diuretic and demulcent properties. Decoction or powder of whole plant is taken to improve memory and vitality, and as a remedy in consumption, asthma, fever and leprosy. Shampoo made from the plant is effective in removing dandruff.

Note: It is a highly variable species with respect to growth, habit and foliage. Grey-Wilson (*l.c.*) recognized several distinct varieties. Kerala material compares well with var. *enneaspermus*.

2. *Hybanthus travancoricus* (Bedd.) Melch. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 21: 360. 1925; S.P. Banerjee & Pramanik in B.D. Sharma & N.P. Balakr., Fl. India 2: 345. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 58. 1994. *Ionidium travancoricum* Bedd., Icon. Pl. Ind. Orient.: t. 230. 1868 1874; Dunn in Gamble, Fl. Madras: 49(35). 1915.

Shrub, to 1.75 m high; branches erect, terete below, angled above, woody, glabrous. Leaves subsessile, linear-lanceolate, distantly serrate at margin, acumi-

nate at apex, 1 - 9 x 0.5 - 2.5 cm, glabrous; stipules subulate, glandular-puberulous. Peduncles 1 - 2 cm long, 2-bracteole towards apex. Sepals equal, subulate, recurved. Petals pink, variable; lower petal long-clawed, saccate, 2-spurred; others falcate; upper 2 ciliate. Stamens 5; anthers nearest large petal with a round gibbous spur at base; seeds 6 - 9, white.

Fl. & Fr.: Aug. - Sept.

Habitat: Hills, 650 - 1000 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

2. RINOREA Aubl., nom. cons.

Shrubs or small trees. Leaves alternate, rarely opposite or spiral, entire or serrate; lateral nerves numerous and parallel; petioles short or absent; stipules caducous to persistent, often longitudinally striate. Flowers bi-, rarely unisexual, sometimes dioecious, regular, solitary or usually racemose, cymose or paniced, rarely in axillary or terminal cymes; peduncles jointed. Sepals almost equal, rigid, ciliate. Petals isomorphic or subequal, free. Stamens inserted on margin of an annular disc; connectives produced into a long or short, often broad membranous appendage. Carpels 3; ovary 1-loculed with 3 parietal placentae; ovules 1 - 3 on each placenta, rarely numerous; style straight; stigma terminal, more or less distinctly 3-lobed. Fruits capsular, globose, 3-valved, subtended by floral parts; seeds sessile, 3 - 6, ellipsoid, glabrous, rarely woolly with a coriaceous testa.

Tropics, ca 200 species, 4 in India and 1 in Kerala.

Literature: Jacobs, M. 1967. *Florae Malesianae praecursores XLV. Notes on Rinorea (Violaceae) from Malesia and adjacent regions. Blumea* 15: 127 - 138.

Note: *Rinorea* Aubl. (1775) has long been known under its later synonym *Alsodeia* Thouars (1806).

Rinorea bengalensis (Wall.) Kuntze, *Revis. Gen. Pl.*: 42. 1891; S.P. Banerjee & Pramanik in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 348. 1993. *Alsodeia bengalensis* Wall. in *Trans. Med. Soc. Calcutta* 7: 224. 1835; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 186. 1872; Rama Rao, *Fl. Pl. Travancore*: 21. 1914. *Pertaloba zeylanica* Arn. in *Mag. Zool. Bot.* 2: 543. 1837. *Alsodeia zeylanica* (Arn.) Thwaites, *Enum. Pl. Zeyl.*: 21. 1858; Hook.f. & Thomson in

Hook.f., Fl. Brit. India 1: 187. 1872; Bourd., Forest Trees Travancore: 15. 1908; Rama Rao, Fl. Pl. Travancore: 21. 1914; Dunn in Gamble, Fl. Madras: 49(35). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 58. 1994. *A. griffithii* Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 187. 1872. *A. wallichiana* Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 187. 1872.

Shrub or small tree; branchlets glabrous or puberulous. Leaves elliptic-lanceolate or ovate, acute at base, crenate or serrate at margin, obtuse at apex, 6 - 18 x 2 - 9 cm, thin-coriaceous, glabrous except for bearded nerve axils beneath, greenish when dry; midnerve prominent; lateral nerves 10 - 12 pairs; petioles to 1 cm long; stipules appressed, linear-lanceolate to subulate, 5 - 8 x ca 1 mm, distinctly striate. Pedicels to 1 cm long; bracts basal, ovate, subacute, ca 1 mm long, brown. Flowers fascicled, ca 4 mm across. Sepals subequal, broadly ovate, ca 2 x 1 mm, ciliate. Petals subequal, oblong-ovate, ca 5 x 1 mm, fleshy, white. Stamens inserted on a thick 5-lobed disc, glabrous; filaments short, broad at base cohering into a tube; anthers free, oblong; appendage subapical, broad, hooded. Ovary oblong, sometimes hairy, 3-ovuled; style short, straight, glabrous. Capsules globose, to 1 cm, glabrous, 3-valved, dehiscing longitudinally; seeds 3 or 4, globose, ca 5 mm, glabrous.

Fl. & Fr.: Jan. - Sept.

Habitat: Evergreen forests, 350 - 850 m, rare.

Distrib.: Kollam, Pathanamthitta, Thiruvananthapuram and Wynad. Andaman & Nicobar Islands, Gangetic Plains, NE. and S. India. South and SE. Asia to Australia.

Note: There are specimens from Wynad collected by R.H. Beddome (MH), Colatourpolay and Arienkavu (Kollam) by T.F. Bourdillon (UCT) at the end of the 19th century. There are no recent collections.

Rama Rao (*l.c.*) reported *Alsodeia virgata* Thwaites from evergreen forests of Arienkavu. But then, there is no specimen.

3. VIOLA L.

Annual or perennial herbs, often suffruticose, rarely shrubby; rhizomes present or not; stem mostly present. Leaves alternate, entire to pinnatisect, ovate-triangular or reniform, cordate, serrate or crenate; petioles sometimes winged; stipules persistent, free or adnate to petiole, lanceolate-ovate, entire, dentate or fimbriate. Flowers actinomorphic, 1 or 2 on long axillary 2-bracteoid unjointed

peduncles, often dimorphic with cleistogamous flowers. Sepals persistent. Petals erect or spreading, subequal, flat; lateral ones larger than others; the lowermost spurred. Anthers subsessile, 2-loculed, connivent around ovary, tipped with a small 3-angled appendage; connectives of lower 2 often produced into spurs with spur of corolla. Ovary sessile; style straight or curved, often geniculate at base, filiform to clavate; stigma obtuse, lobed or 3-angled, straight or beaked. Fruit a 3-valved loculicidal capsule; seeds rounded-ovoid, shining.

Cosmopolitan, chiefly temperate, ca 400 species, 35 in India and 2 in Kerala.

Key to species

- 1a. Plant without stems or stolons; leaves linear-lanceolate to ovate-triangular, shallowly cordate; petioles winged 1. *V. betonicifolia*
- b. Plant with decumbent or ascending stems or stolons; leaves ovate to deltoid, deeply cordate; petioles not winged 2. *V. pilosa*

1. *Viola betonicifolia* Sm. in Rees, Cycl. 37(II): Viola No. 7. 1817; S.P. Banerjee & Pramanik in B.D. Sharma & N.P. Balakr., Fl. India 2: 355. 1993. *V. patrinii* auct. non DC. 1824; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 183. 1872 p.p.; Rama Rao, Fl. Pl. Travancore: 21. 1914; Dunn in Gamble, Fl. Madras: 48(35). 1915.

Perennial herb, 8 - 20 cm high; roots slender, unbranched; stem absent. Leaves in basal rosette, cuneate, truncate or shallowly cordate at base, usually decurrent into petiole, shallowly and distantly crenate, sometimes dentate on basal lobes or rarely serrate, acute or sometimes roundish obtuse at apex, 2 - 8 x 1 - 3 cm. glabrous to more or less pubescent; petioles longer than lamina. 3 - 12 cm long, usually winged above; stipules ovate-lanceolate, acuminate, 5 - 10 mm long, sparsely short-fimbriate. Peduncles 5 - 18 cm long, 2-bracteoid in middle. Flowers to 1.5 cm across. Sepals oblong, ca 4 - 8 x 1 - 2.5 mm, glabrous or ciliate with scarious margin, green. Petals oblong-ovate, to 1.5 cm long, lilac; spur cylindrical, straight or slightly upcurved, 2 - 4 mm long. Style almost geniculate at base, clavate above. Capsules ellipsoid to oblong, to 1 cm long, glabrous.

Fl. & Fr.: Jan. - Sept.

Habitat: Usually in moist places in savanna-scrubs, 1600 - 2100 m.

Distrib.: Idukki. Gangetic Plains, N., NE. and S. India. South and SE. Asia to Australia.

Use: Plant is bruised and applied to ulcers and foul sores.

2. *Viola pilosa* Blume, *Catalogus*: 57. 1823; Manilal, *Fl. Silent Valley*: 8. 1988; S.P. Banerjee & Pramanik in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 371. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 59. 1994; N. Mohanan & Sivad., *Fl. Agasthyamala*: 71. 2002. *V. serpens* Wall. ex Ging. in DC., *Prodr.* 1: 296. 1824; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 184. 1872; Rama Rao, *Fl. Pl. Travancore*: 21. 1914; Dunn in Gamble, *Fl. Madras*: 48(35). 1915.

Prostrate to subprostrate herb; stems or stolons usually long, leafy. Leaves basal and cauline, serrate, 1.5 - 4 x 1 - 4 cm, pilose to glabrous; petioles 2 - 12 cm long, pilose; stipules ovate-acuminate, subentire to dentate, 6 - 15 mm long. Peduncles 3 - 8 cm long, pilose; bracts 2, above middle, linear-lanceolate, entire, ca 6 mm long. Sepals linear-lanceolate, acute, entire or denticulate, 4 - 8 x 1 - 2 mm; appendage ca 3 mm long, pointed. Petals obovate-oblong, white or pale violet, 2 - 4 times as long as broad, 1 - 2 cm long; basal one obovate, slightly bearded; lateral ones oblanceolate, bearded at base only; spur ca 5 mm long, cylindrical. Style subclavate, subtruncate, short-beaked at apex, 1.5 - 3 mm long. Capsules ellipsoid, ca 5 mm across, glabrous.

Fl.: Jan. - June *Fr.*: June - July; often throughout the year.

Habitat: High altitude savanna-scrubs, 1500 - 2025 m.

Distrib.: Idukki and Thiruvananthapuram. Gangetic Plains, NE. and S. India. South and SE. Asia.

Viola tricolor L., as in other parts of India, is often grown in gardens (Calicut Distr., *T. Gopaul Rao s.n.* MH).

BIXACEAE

(N.P. BALAKRISHNAN)

Shrubs or small trees, often deciduous, with mucilaginous canals producing yellow, orange or reddish sap or gum. Leaves spiral, simple, entire or palmately partite or digitate, serrate, palmately or pinnately nerved; stipules small, caducous. Flowers bisexual, actinomorphic, showy, in terminal or axillary racemes, corymbs or panicles, often thyrsoid. Sepals 4 or 5, free, imbricate, caducous soon after anthesis leaving basal glands. Petals 4 - 7, free, imbricate or contorted. Stamens many; filaments free or basally connate; anthers 2-loculed, basi- or

Fl. India 2: 381. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 59. 1994; Sivar. & P. Mathew, Fl. Nilambur: 56. 1997.

Mal.: *Kunkumachedi*, *Kuppa-manjal*, *Kuranganka*

Shrub or small evergreen tree, 2 - 9 m high; young branches densely dark scaly; wood pale yellow, soft. Leaves ovate, subcordate or truncate at base, long-acuminate at apex, 7 - 24 x 4 - 16 cm, shining above, densely red-dotted, initially scaly beneath, glabrous later; lateral nerves 4 or 5 pairs; petioles slender, 4 - 10 cm long; stipules 5 - 6 mm long. Inflorescence a corymb or panicle, terminal, 8 - 50-flowered, scaly; pedicels 7 - 10 mm long. Flowers 3 - 5 cm across. Sepals broadly ovate to suborbicular, concave, scaly, purple. Petals 5 - 7, unequal, obovate, rounded at apex, 2 - 3 x 1 - 2 cm, pink. Filaments slender, yellow at base, red at apex; anthers purple. Ovary densely covered with thick red bristles; style 12 - 15 mm long, swollen above, red. Capsules globose or broadly ovoid, nearly truncate at base, abruptly short-acuminate at apex or elongate-ovate with narrowly long-acuminate apex, 2 - 4 x 1.5 - 3.5 cm, with dense long stiff but soft and flexible bristles, green when young, brownish red with age; seeds obpyramidal, ca 5 x 4 - 5 mm, orange-red.

Fl. & Fr.: June - Feb.

Habitat: Cultivated as an ornamental, sometimes naturalized in open wastelands, to 2000 m.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Wynad.

Uses: Seed provides a red dye used in colouring food stuffs, butter, cheese, chocolate, cosmetics, oils, varnishes, soap and in ancient times wool and silk. Leaf and root are used as a digestive tonic.

Note: There are 2 forms, one with white flowers and green capsules and the other with pink flowers and red capsules.

2. COCHLOSPERMUM Kunth, nom. cons.

Trees, shrubs or rarely somewhat herbaceous with slightly swollen subterranean stems, often deciduous, producing gum and orange sap. Leaves spreading, palmately lobed or digitate, pubescent or glabrous. Flowers in terminal, sub-terminal or axillary racemes, corymbs or panicles, appearing before leaves. Sepals 5, free, broadly ovate, obtuse, persistent or caducous. Petals 5, free, imbric-

cate or contorted, usually emarginate. Stamens many, equal or not; filaments free or shortly connate at base; anthers oblong to linear, basifixed, 2-loculed, dehiscing by confluent pore-like slits. Ovary 1-loculed above with 3 - 5 parietal laminate placentae or incompletely 3 - 5-loculed in basal half; style filiform; stigmas barely thicker than style, usually obscurely denticulate. Capsules 1-loculed, 3 - 5-valved, each inner endocarp bearing placentae along its centre; seeds reniform to somewhat horseshoe-shaped, wooly-pubescent.

Tropics, 12 species and 1 in India.

Cochlospermum religiosum (L.) Alston, Handb. Fl. Ceylon 6(Suppl.): 14. 1931; Manilal & Sivar., Fl. Calicut: 36. 1982; Vajr., Fl. Palghat: 58. 1990; N.P. Balakr. in B.D. Sharma & N.P. Balakr., Fl. India 2: 383. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 43. 1996. *Bombax religiosum* L., Sp. Pl.: 252. 1753. *Cochlospermum gossypium* DC., Prodr. 1: 527. 1824; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 190. 1872; Dunn in Gamble, Fl. Madras: 50(36). 1915.

Mal.: *Appakadukka, Cheemappanni, Chempanni*

Shrub or tree, often with crooked branches, to 6 m high, deciduous. Leaves orbicular in outline, 7 - 20 cm, 3 - 5-lobed to more than halfway down, cordate and 5 - 7-nerved at base, pubescent to subtomentose beneath; lobes undulate or obscurely crenate at margin, acuminate at apex; midlobe 5 - 11 x 1 - 9 cm; petioles 8 - 25 cm long, jointed. Flowers to 8 cm across, showy, golden yellow with distinct odour, in terminal racemes or loosely arranged panicles, shortly hairy, 1 flower opening at a time on each branch; pedicels ca 2 cm long; bracts 3-angled, acute, 4 - 5 mm broad at base, caducous. Sepals 2 - 2.5 x 1 - 2 cm, silky, partly purplish. Petals thick at base. Stamens slightly s-curved, unequal; filaments yellow; anthers linear, falcate, ca 1 mm broad, orange. Ovary globose, glabrous; style 1.5 - 2 cm long, glabrous. Capsules obovoid or pyriform, 5 - 10 x 2.5 - 8 cm, brown; valves 5, leathery, striate-ribbed; seeds reniform to cochleate, 5 - 6 mm across, densely brown-wooly-hairy.

Fl. & Fr.: Jan. - May (leafless when in flower; leaves appearing in May).

Habitat: Dry deciduous forests, to 1000 m, rare.

Distrib.: Kozhikode, Palakkad and Thrissur. Throughout India. South and SE. Asia.

Uses: Bark yields an edible gum, a substitute for tragacanth. Fibre covering seed is used for stuffing mattresses. Often planted in temple premises.

FLACOURTIACEAE

(incl. Samydaceae)

(N.P. BALAKRISHNAN)

Trees or shrubs, sometimes climbers; branches spine-tipped or with axillary spines. Leaves alternate, rarely verticillate or opposite, often distichous, simple, sometimes glandular at base, entire, rarely glandular-dentate; stipules caducous, rarely absent. Inflorescences axillary, terminal or below leaves, fascicled racemes or cymose panicles, rarely heads, sometimes catkin-like or flower solitary, rarely epiphyllous or cauliflorous. Flowers actinomorphic, bi-, unisexual or polygamous, hypo-, peri- or rarely epigynous. Perianth often not differentiated into sepals and petals, accrescent or not. Sepals (2 -) 3 - 6(- 15), free or connate, contorted or imbricate, rarely valvate, sometimes gradually merging into petals, rarely expanded and wing-like. Petals (0 -) 3 - 8(- 15), free, sometimes 2-seriate with inner series smaller, sometimes twice or thrice as many as sepals, rarely spiral, sometimes gradually transitional to stamens. Receptacle often expanded into annular or glandular disc; scales between corolla and stamens or between stamens and pistil, present or not. Stamens usually numerous (to 100), in 1 - several series, sometimes as many as petals and then opposite them, rarely only 1; filaments free or connate in antisepalous bundles, all connate into a tube or rarely into a column; staminodes present or not; anthers linear, as long as wide, 2-loculed, dorsi- or basifixed, opening by longitudinal slits or pores; connectives apically produced or not. Carpels 2 - 10. Ovary superior, rarely semi-inferior or inferior, usually 1- rarely 2- or 4- or imperfectly 2 - 6-loculed; placentae 2 - 10, usually parietal, rarely axile or apical, sometimes produced into middle of ovary; ovules usually numerous, sometimes 2 or 1 on each placenta, 2-tegmic, crassinucellar, ana-amphi- or orthotropous; styles 1 - 10- rarely more-branched, free or connate; stigma simple or numerous. Fruit usually a berry, sometimes a loculicidal capsule, drupe or samara, sometimes densely prickly or spiny; seeds many, rarely 1, sometimes winged or with sarcotesta, arillate or pulpy outside, rarely long-silk-hairy; embryo usually large, straight or curved; cotyledons thin, broad, 6 - 20 times wider than radicle, often cordate, rarely terete; endosperm copious, moderate or rarely scanty.

Tropical and subtropical, a few temperate, 86 genera and 875 species, 10 and 38 in India and, 7 and 20 in Kerala.

Literature: Mukherjee, N. 1972. Revision of the family *Flacourtiaceae* of India, Burma and Ceylon. *Bull. Bot. Soc. Bengal* 26: 31 - 45. Sleumer, H.O. 1954. *Flacourtiaceae*. In: Steenis, C.G.G.J. van (ed.). *Fl. Males.* 1, 5: 1 - 106.

Key to genera

- 1a. Petals absent 2
- b. Petals present though sometimes scarcely distinct from sepals 4
- 2a. Inflorescences glomeruled-fascicled; flowers bisexual; stamens 5 - 10 1. *Casearia*
- b. Inflorescences racemose or paniced; flowers unisexual; stamens numerous 3
- 3a. Anthers basifixed; ovary 1-loculed 7. *Xylosma*
- b. Anthers versatile or dorsifixed; ovary imperfectly 2 - 5-loculed 2. *Flacourtia*
- 4a. Petals with a scale at base inside 5
- b. Petals without a scale at base 6
- 5a. Flowers usually 5-merous; sepals and petals usually 5 (rarely 8 or 15); stamens 4 or 5; filaments broad at base 4. *Hydnocarpus*
- b. Flowers 4-merous; sepals 4; petals 8, 12 or 16; stamens many; filaments not broad at base 6. *Taraktogenos*
- 6a. Sepals, petals and stamens more or less perigynous; ovary semi-inferior or inferior; fruit a capsule 3. *Homalium*
- b. Sepals, petals and stamens hypogynous; ovary superior; fruit a berry 5. *Scolopia*

1. CASEARIA Jacq.

Trees or shrubs. Leaves alternate, entire or serrate, often with translucent dots or dashes, pinnately nerved; stipules early caducous. Flowers axillary, glomeruled-fascicled, usually bisexual, actinomorphic, yellowish green; pedicels jointed above base, surrounded by scaly bracts at base. Calyx deeply 4- or 5-lobed, persistent; lobes imbricate, obtuse. Petals absent. Stamens 5 - 10; filaments 1-seriate, united into a tube with free portions alternating with as many scaly disc lobes, rarely nearly free, hypo- or subperigynous; anthers introrse. Ovary superior, free, ovoid, glabrous or pubescent, 1-loculed; ovules few - numerous, usually on 3 or 4 parietal placentae; style simple; stigma punctate, capitate or, 3- or 4-lobed. Capsules globose, ovoid or ellipsoid, angled, 2- or 3-valved; valves with many seeds in middle; testa crusta- or coriaceous; aril fimbriate, fleshy, red or

orange-red; endosperm fleshy; embryo straight; cotyledons flat, oblong or orbicular.

Tropics, 186 species, 12 in India and 7 in Kerala.

Key to species

- 1a. Leaves and young twigs soft-pubescent (at least nerves and petioles) 2
 b. Leaves and young twigs glabrous 3
- 2a. Leaves, branchlets and inflorescences softly pale grey-pubescent; leaves oblong-lanceolate or elliptic, subcoriaceous; capsules distinctly longitudinally 6-ribbed 6. *C. tomentosa*
 b. Leaves, branchlets and inflorescences rufous-brown-pubescent; leaves oblanceolate, membranous; capsules not ribbed 7. *C. wynadensis*
- 3a. Leaves obovate, rarely oblanceolate, cuneate at base, obtuse, rounded or retuse at apex
 5. *C. thwaitesii*
 b. Leaves elliptic to lanceolate, cuneate, acute, obtuse or rounded at base, acute to acuminate at apex 4
- 4a. Leaves coriaceous, usually revolute at margin; acumen folded-twisted 3. *C. ovata*
 b. Leaves not necessarily coriaceous, not revolute at margin; acumen not folded-twisted 5
- 5a. Leaves brownish red beneath when dry; capsules ovoid to ellipsoid, black when dry
 4. *C. rubescens*
 b. Leaves pale brown or greyish brown when dry; capsules subglobose, reddish brown when dry 6
- 6a. Evergreen tree; leaves elliptic to oblanceolate, cuneate at base, entire, long-acuminate at apex; lateral nerves 9 - 11 pairs; capsules subglobose 1. *C. bourdillonii*
 b. Deciduous tree or shrub; leaves oblong-elliptic or broadly lanceolate, rounded at base, subentire or crenulate, acute or short-acuminate at apex; lateral nerves 7 - 9 pairs; capsules oblong-ellipsoid 2. *C. graveolens*

1. *Casearia bourdillonii* N. Mukh. in Bull. Bot. Soc. Bengal 19: 109. 1967; Manilal, Fl. Silent Valley: 8. 1988. *C. varians* auct. non Thwaites 1864; Bedd., Fl. Sylv. S. India: t. 208. 1872; Gamble, Fl. Madras: 521(368). 1919. *C. esculenta* auct. non Roxb. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 2: 592. 1879 p.p.; Bourd., Forest Trees Travancore: 201: 1908; Rama Rao, Fl. Pl. Travancore: 182. 1914. *C. championii* sensu R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 391. 1993, non Thwaites 1858.

Mal.: *Vella-kunnan*

Evergreen tree, ca 10 m tall; bark smooth, green; branchlets pubescent when young, glabrous when old; wood yellowish white, evenly grained. Leaves broadly elliptic-lanceolate to oblanceolate, cuneate at base, entire, acute to acuminate at apex, 5 - 16 x 2 - 5 cm, membranous when young, coriaceous when old, glabrous; nerves prominent beneath; reticulations subopaque; petioles 1 - 1.5 cm long; stipules foliaceous, early caducous. Flowers in axillary pubescent clusters; pedicels jointed above, to 2.5 mm long, pilose-hairy. Sepals 5, imbricate, ovate, ciliate at margin, pubescent, persistent. Stamens 6 - 8, alternating with equal number of ciliate scale-like staminodes, all in 1 series; filaments bearded at broad base, gradually tapering; anthers conic, basifixed. Disc lobes oblong, truncate, densely hairy at apex. Ovary ovoid, glabrous, 1-loculed with 3 parietal placentae, each with many ovules; styles indistinct; stigma notched at apex, reflexed at margin. Fruits subglobose, 1.5 - 2.5 cm, opening by 2 valves, bright orange; seeds ellipsoid. *Fl.*: Nov. - March *Fr.*: Dec. - May.

Habitat: Evergreen moist forests, to 1500 m.

Distrib.: Idukki, Kannur, Kozhikode, Palakkad, Thiruvananthapuram and Wynad. Western Ghats of Karnataka and Tamil Nadu (Tirunelveli). Endemic.

Uses: Root is used as a remedy for hepatic enlargement and for piles; promotes liver function and is considered specific for diabetes. Fruit is used for dyeing.

2. *Casearia graveolens* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 4: 107. 1852; C.B. Clarke in Hook.f., Fl. Brit. India 2: 592. 1879; Gamble, Fl. Madras: 520(367). 1919; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 394. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 60. 1994.

Shrub or small tree, to 8 m high, deciduous; branchlets angled at tips, glabrous. Leaves distichous, broadly elliptic, oblong-elliptic or ovate, rounded at base, subentire or crenulate, obtuse or shortly acute to acuminate at apex, 10 - 20 x 4 - 8 cm, stiff-coriaceous when old, glabrous; leaves at base of twigs smaller; lateral nerves 7 - 9 pairs, slender, raised and prominent beneath; petioles 6 - 19 mm long; stipules linear, acute, 2 - 4 mm long, caducous. Flowers in dense clusters from leaf axils or leafless axils, greenish; pedicels jointed at or above base, glabrous above point of joint, golden-pubescent below. Calyx gland-dotted, pubescent at base, sometimes golden-pubescent above, green; lobes 5, oblong-ovate,

concave. Stamens 6 - 8; filaments glabrous, alternating with linear-oblong villous disc lobes. Styles as long as stamens with discoid stigma. Fruits subglobose to broadly ellipsoid or oblong, 2 - 2.5 cm long, shining, smooth, orange-yellow, 3-valved; seeds 10 - 12, ovoid, ca 5 x 3 mm, compressed with scarlet aril.

Fl.: Nov. - June *Fr.*: June - July.

Habitat: Secondary open and scrub forests.

Distrib.: Kollam, Palakkad and Thiruvananthapuram. Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and Uttar Pradesh. Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Thailand and Vietnam.

Note: Flower emits an unpleasant odour.

3. *Casearia ovata* (Lam.) Willd., Sp. Pl. 2: 629. 1799; N. Mukh. in Bull. Bot. Surv. India 14: 184. 1972; Nicolson & al. in Regnum Veg. 119: 146. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 60. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 44. 1996. *Anavinga ovata* Lam., Encycl. 1: 148. 1783. *Vareca zeylanica* Gaertn., Fruct. Sem. Pl. 1: 290, t. 60. 1788. *Casearia anavinga* Pers., Syn. Pl. 1: 485. 1805. *C. esculenta* Roxb., Fl. Ind. 2: 422. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 2: 592. 1879 p.p.; Bourd., Forest Trees Travancore: 201: 1908; Rama Rao, Fl. Pl. Travancore: 182. 1914; Gamble, Fl. Madras: 521(369). 1918; Manilal, Fl. Silent Valley: 9. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 49. 1988; Vajr., Fl. Palghat: 59. 1990; N. Mohanan & Sivad., Fl. Agasthyamala: 73. 2002. *C. zeylanica* (Gaertn.) Thwaites, Enum. Pl. Zeyl.: 19. 1858; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 399. 1993.

Mal.: *Ana-vananki*, *Malampavatta*, *Panninurunga*

Small tree or large shrub, 3 - 8 m high; bark white, warty outside, granular, yellowish with vertical streaks inside. Leaves ovate-lanceolate to elliptic-, rounded or acute to tapering at base, entire and revolute at margin, acute to short-acuminate with folded-twisted acumen at apex, 5 - 20 x 3 - 8 cm, coriaceous, glabrous, shining; lateral nerves 7 - 12 pairs; reticulations distinct beneath; petioles 6 - 15 mm long, glabrous; stipules minute, scale-like. Flowers ca 3 mm across, in axillary fascicles, greenish yellow to white, foetid; bracts dense, subulate; pedicels to 4 mm long. Sepals imbricate, ovate, obtuse. Stamens 8; filaments pubescent. Disc lobes oblong, pilose at apex. Style indistinct. Fruits in clusters in leaf axils or leafless axils, subglobose or ovoid to ellipsoid, 1.5 - 2.5 x 1 - 1.6 cm, yellow to bright

orange-red, dehiscing by 2 or 3 thick valves; seeds many, covered with a large fleshy lacerate scarlet-red aril.

Fl.: Feb. - May *Fr.*: May - Aug.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Almost throughout Kerala. Assam, Gujarat, Karnataka, Maharashtra, Meghalaya and Tamil Nadu. Sri Lanka.

4. *Casearia rubescens* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 4: 108. 1852; C.B. Clarke in Hook.f., Fl. Brit. India 2: 593. 1879; Rama Rao, Fl. Pl. Travancore: 182. 1914; Gamble, Fl. Madras: 520(367). 1919; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 396. 1993 (as *rubens*), excl. syns.; Sasidh. & Sivar., Fl. Pl. Thrissur: 44. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 73. 2002.

Tree or shrub, to 12 m tall; trunk to 12 cm across; outer bark yellowish grey-brown; inner bark ca 5 mm thick, fibrous, creamy brown. Leaves elliptic-oblong, oblong-ovate, -lanceolate to broadly lanceolate, rounded, acute or obtuse at base, entire, acutely or obtusely acuminate to subacute at apex with acumen to 1.5 cm long, often folded, rarely twisted, 6 - 15(- 20) x 2 - 6 cm, coriaceous, drying brownish red; lateral nerves 6 - 11 pairs. Flowers in small fascicles or glomerules in leaf axils or leafless axils on branches, white; pedicels 1 - 5 mm long, jointed at base, minutely pubescent; buds subglobose. Calyx ca 4 mm long, thick, fleshy; lobes broadly elliptic-oblong, obtuse, ca 2.5 mm long, minutely pubescent. Stamens 5, alternating with oblong truncate apically villous disc lobes; filaments pubescent. Ovary conic; style indistinct. Fruits ovoid to ellipsoid, acute-apiculate at apex, ca 2 x 1.5 cm, smooth or slightly longitudinally ridged, glabrous.

Key to varieties

- 1a. Leaves broadly elliptic-lanceolate, acutely acuminate at apex; lateral nerves 9 - 11 pairs
4.1. var. *gamblei*
- b. Leaves narrowly oblong-ovate, obtusely acuminate at apex; lateral nerves 6 - 8 pairs
4.2. var. *rubescens*

4.1. var. *gamblei* N. Mukh. in J. Bombay Nat. Hist. Soc. 69: 393. 1972.

Fl. & Fr.: April - July.

Habitat: Evergreen forests, 700 - 1300 m.

Distrib.: Idukki and Kollam. Western Ghats of Karnataka. Endemic.

4.2. var. *rubescens*

Fl. & Fr.: Feb. - Aug.

Habitat: Evergreen forests, 300 - 1000 m.

Distrib.: Idukki, Kollam, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats. Endemic.

5. *Casearia thwaitesii* Briq. in *Annuaire Conserv. Jard. Bot. Genève* 2: 62. 1898; Alston, *Handb. Fl. Ceylon* 6(Suppl.): 131. 1931; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 397. 1993. *C. coriacea* Thwaites, *Enum. Pl. Zeyl.*: 20. 1858, non Vent. 1808; C.B. Clarke in Hook.f., *Fl. Brit. India* 2: 592. 1879; Gamble, *Fl. Madras*: 521(368). 1919; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 60. 1994; N. Mohanan & Sivad., *Fl. Agasthyamala*: 72. 2002.

Evergreen shrub or small tree, 4 - 7 m high; branches glabrous; bark smooth, yellowish white. Leaves obovate, rarely oblanceolate, narrow and cuneate at base, entire and slightly revolute at margin, obtuse, rounded and often retuse at apex, sometimes cucullate, 3 - 9 x 2 - 6 cm, coriaceous, glabrous, greyish brown to black when dry; lateral nerves 6 - 8 pairs, raised beneath; petioles 5 - 15 mm long. Flowers many, clustered in axillary glomerules; pedicels slender, glabrous. Calyx 5-lobed; lobes orbicular, glabrous. Stamens 6 (- 10). Disc lobes half as long as filaments, pilose at apex. Ovary glabrous. Fruits ovoid to ellipsoid, apiculate, 1.5 - 2 cm long, faintly ribbed, yellowish green to orange-yellow, 2-valved, with fleshy red aril.

Fl. & Fr.: March - July.

Habitat: Sholas, 800 - 1900 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu. Sri Lanka.

6. *Casearia tomentosa* Roxb., *Fl. Ind.* 2: 421. 1832; C.B. Clarke in Hook.f., *Fl. Brit. India* 2: 593. 1879; Nicolson & al. in *Regnum Veg.* 119: 146. 1988; Vajr., *Fl. Palghat*: 59. 1990; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 397. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 44. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 57. 1997. *Anavinga lanceolata* Lam., *Encycl.* 1: 148. 1783, non *Casearia lanceolata* Miq. 1844; Wight, *Icon. Pl. Ind. Orient.*: t. 1849. 1853;

Manilal & Sivar., Fl. Calicut: 36. 1982. *Casearia elliptica* Willd., Sp. Pl. 2: 628. 1800, nom. illeg. incl. type of *Anavinga lanceolata* Lam. 1783.

Mal.: *Anna-karana*, *Cheru-kanchi*

Bushy shrub or tree with a spreading crown, to 8 m high, deciduous; bark thick, pale; branchlets warty, densely and softly pale grey-pubescent. Leaves oblong-lanceolate or elliptic, unequally rounded to narrowly cuneate at base, entire or serrulate at margin, obtuse, acute to long-acuminate at apex, (4 -)7 14(- 17) x 2 5(- 7) cm, subcoriaceous, grey-pubescent especially on nerves beneath; midnerve pubescent above; lateral nerves 8 - 10 pairs, distinct beneath; leaves at base of twigs smaller; petioles to 1.5 cm long, reddish-pubescent. Flowers to 7 mm across, in dense axillary somewhat capitate clusters on new shoots, greenish yellow or white; pedicels to 4 mm long, jointed at base, tomentose. Sepals 5, ovate to lanceolate, to 4 mm long, pubescent, persistent. Stamens 6 - 10; filaments stout, to 2 mm long, pubescent. Disc lobes 6, clavate, to 1.5 mm long, densely pubescent at apex. Ovary ovoid, 1-loculed; ovules many on 2 parietal placentae; style attenuate, to 1.5 mm long; stigma disc-shaped. Capsules usually on leafless nodes, oblong-globose or obovoid to ellipsoid, 2 - 2.5 x ca 2 cm, 6-ribbed, greenish yellow, 3- or 4-valved; seeds many, yellowish brown with scarlet aril; stalks to 8 mm long.

Fl.: Aug. - March *Fr.*: Nov. - June.

Habitat: Semievergreen open secondary and scrub forests, to 800 m.

Distrib.: Kozhikode, Malappuram, Palakkad, Thrissur and Wynad. Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. Sri Lanka, Malesia to Australia.

Uses: Bark is bitter and applied in dropsy and sometimes used for tanning. Fruit pulp is diuretic. Fruit is used as a fish poison.

7. *Casearia wynadensis* Bedd., Icon. Pl. Ind. Orient.: t. 160. 1868 1874; C.B. Clarke in Hook.f., Fl. Brit. India 2: 594. 1879; Gamble, Fl. Madras: 521(368). 1915; Manilal, Fl. Silent Valley: 92. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 49. 1988; Vajr., Fl. Palghat: 60. 1990; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 399. 1993.

Mal.: *Karikunman*

Small tree or large shrub, 2–8 m high; branchlets slender, rufous-pubescent. Leaves oblanceolate, often subfalcate, rounded, acute to cuneate at base, minutely and sharply denticulate at margin except base, sharply acuminate, sometimes rounded, acute or obtusely acute at apex, 8–20 x 2–7 cm, membranous, sparsely pubescent on both surfaces densely so on nerves beneath, ultimately glabrous above except midnerve; lateral nerves 8–10 pairs; petioles 5–10 mm long, brown-tomentose; stipules linear, caducous. Flowers in axillary few-flowered fascicles; buds oblong or suborbicular, minutely pubescent; pedicels 2–3 mm long, slender, pubescent. Sepals 5, ovate-orbicular, pubescent outside, slightly hairy inside. Stamens 6, connate at base with 8 alternating disc lobes; filaments glabrous. Disc lobes oblong, blunt, plumose at apex. Ovary ovoid-oblong, attenuate in style; stigma 4-fid. Fruits ovoid to oblong-ellipsoid, not turgid, short-apiculate, 13–16 x 8–10 mm, orange.

Fl.: May–June *Fr.*: July–Dec.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Kannur, Palakkad and Wynad. Western Ghats of Tamil Nadu. Endemic.

2. FLACOURTIA Comm. ex L'Her.

Trees or shrubs; trunk thorny or not; branches often with axillary spines when young, unarmed when old. Leaves spiral, short-petioled, exstipulate, mostly crenate-serrate, pinnately nerved, rarely 3–5-nerved at base. Flowers in short racemes, terminal or axillary, uni- or bisexual. Sepals 3–7, nearly free, rarely slightly connate at base, imbricate, very obtuse, subpersistent, green. Corolla absent. Disc extrastaminal, entire, lobed or broken up into glands, mostly in 2s, more or less before each sepal. Stamens 15–many, free; anthers ellipsoid, glabrous, versatile or dorsifixed, extrorse; staminodes absent in female flowers. Ovary imperfectly 2–5-loculed by false septa; styles as many as locules, free or more or less connate, persistent; ovules 2 in each locule; pistillode absent in male flowers. Fruits indehiscent, berry-like, fleshy; pyrenes many, twice as many as styles in 2 superposed series; seeds 1 or 2, obovoid; testa thin-crustaceous; cotyledons orbicular.

Tropics and S. Africa to the Fiji Islands, ca 15 species, 5 in India and 3 in Kerala.

Key to species

- 1a. Leaves 12 - 25(- 28) cm long 3. *F. montana*
 b. Leaves 2.5 - 10 cm long 2
- 2a. Leaves obtuse, rounded or shortly blunt-acute at apex, often finely puberulous above; racemes terminal on short branchlets; disc entire; filaments hairy at base; styles shortly connate, recurved; fruits less than 1 cm across 1. *F. indica*
- b. Leaves long-acuminate at apex, glabrous above; racemes axillary; disc broken up into many glands; filaments glabrous; styles entirely connate into a distinct erect column; fruits more than 1.5 cm across 2. *F. jangomas*

1. *Flacourtia indica* (Burm.f.) Merr., *Interpr. Herb. Amboin.*: 377. 1917; Manilal & Sivar., *Fl. Calicut*: 35. 1982; Nicolson & al. in *Regnum Veg.* 119: 147. 1988; Manilal, *Fl. Silent Valley*: 9. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 49. 1988; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 402. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 61. 1994. *Gmelina indica* Burm.f., *Fl. Indica*: 132, t. 39, f. 5. 1768. *Flacourtia ramontchi* L'Her., *Stirp.* Nov. 3: 59, tt. 30 & 30B. 1786; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 193. 1872; Dunn in Gamble, *Fl. Madras*: 54(39). 1915; Nicolson & al. in *Regnum Veg.* 119: 147. 1988. *F. sepiaria* Roxb., *Pl. Coromandel* 1: 48, t. 68. 1795; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 194. 1872; Rama Rao, *Fl. Pl. Travancore*: 23. 1914; Gamble, *Fl. Madras*: 54(39). 1915.

Mal.: *Cherrumullikkachedi, Kuramullu, Kurumulli*

Small tree or shrub, 1 - 6(10) m high, bushy, deciduous, thorny at trunk bases and with axillary thorns on branchlets; thorns straight, often flower- and fruit-bearing. Leaves alternate in young branches, fascicled in older ones, ovate, obovate, oblong-elliptic or suborbicular, cuneate, rounded or rarely subcordate at base, crenate or serrate at margin, obtuse or bluntly acute at apex, 2.5 - 10 x 1.5 - 6.5 cm, glabrous, finely puberulous above; petioles 3 - 10 mm long, red. Racemes axillary or terminal, on short branchlets, few-flowered. Flowers ca 6 mm long, white or greenish yellow, male flowers in short clusters and female ones solitary or in pairs; pedicels 4 - 7 mm long. Sepals 4 - 6, connate at base, ovate, obtuse, ca 1.5 mm long. Male flowers: Stamens many; filaments 2 - 2.5 mm long, hairy at base; anthers versatile; disc lobed. Female flowers: Disc entire; ovary subglandular;

styles 4 - 8, shortly connate, each with faintly 2-lobed stigma; fruits drupaceous, ellipsoid or subglobose with 6 or 7 pyrenes, ca 7 mm across, dark red to purplish or blackish red; seeds 3-gonous, pale yellow to brown.

Fl.: April - Oct. *Fr.*: May - Dec.

Habitat: Deciduous and semievergreen forests, 200 - 1100 m.

Distrib.: Almost throughout Kerala. Almost throughout India in dry localities. South-east Asia and Africa.

Uses: Fruit is edible and also used in jaundice and enlarged spleen.

Note: Matthew and Britto (in K.M. Matthew, *Fl. Tamilnadu Carnatic* 3: 59 - 61. 1983) treated *F. indica* and *F. ramontchi* as distinct species based on field characters and local names. However, in its wider range of distribution these distinctions break down.

2. *Flacourtia jangomas* (Lour.) Raeusch., *Nomencl. Bot.* ed. 3, : 290. 1797; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 403. 1993. *Stigmaroia jangomas* Lour., *Fl. Cochinch.*: 634. 1790. *Flacourtia cataphracta* Roxb. ex Willd., *Sp. Pl.* 4: 830. 1806; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 193. 1872; Bourd., *Forest Trees Travancore*: 18: 1908; Rama Rao, *Fl. Pl. Travancore*: 23. 1914; Gamble, *Fl. Madras*: 54(39). 1915.

Mal.: *Thalira*, *Vayankatha*

Deciduous tree, 5 - 10 m high, dioecious; trunk and old branches thornless; young branches with simple or branched thorns, white-lenticelled, puberulous; bark pale brown to copper-red. Leaves oblong-ovate to -lanceolate, rounded to broadly cuneate at base, subserrate or crenate at margin, obtusely long-acuminate at apex, 4 - 9 x 2.5 - 5 cm, membranous to chartaceous, glabrous, pinkish brown when young; lateral nerves 4 or 5 pairs; petioles 4 - 7 mm long, glabrescent. Flowers in axillary, subcorymbose racemes; pedicels very slender, 5 - 10 mm long. Disc faintly lobed, fleshy, white or orange-yellow. Male flowers: Buds globose, ca 2 mm; stamens numerous, free; filaments ca 2.5 mm long, glabrous; anthers ellipsoid, versatile, extrorse; pistillode absent. Female flowers: Buds ovoid, ca 2.5 mm long; ovary flask-shaped to subglobose, incompletely 4 - 6-loculed by false septa; ovules 2 in each locule; styles as many as locules, connate at base, recurved and 2-lobed at apex; stigmas 4 - 6, dilated; fruit a berry, subglobose, angled, apiculate, 1.5 - 2.5 cm across, scarlet red or dark purple when ripe; stylar

column persistent, conic, terminating in 4 - 8 minute stigmatic points; seeds 8 - 12, flat.

Fl.: Nov. - March *Fr.*: Feb. - May.

Habitat: Moist deciduous forests; often cultivated (Bourdillon, *l.c.*).

Distrib.: Throughout Travancore (Bourdillon, *l.c.*; Rama Rao, *l.c.*). Meghalaya and Tripura. South and SE. Asia.

3. *Flacourtia montana* J. Graham, *Cat. Pl. Bombay*: 10. 1839; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 192. 1872; Gamble, *Fl. Madras*: 54(39). 1915; Manilal, *Fl. Silent Valley*: 10. 1988; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 406. 1993; N. Mohanan & Sivad., *Fl. Agasthyamala*: 74. 2002.

Mal.: *Chalirin pazham, Charalmaram*

Deciduous tree, often with 4 - 10 cm long thorns on trunks and a few on branches; branches softly pubescent; bark thin, smooth, grey. Leaves elliptic, oblong or ovate, acute or rounded at base, crenate at margin, obtusely acuminate at apex, 12 - 25 x 4 - 7 cm, glabrescent and shining above, pubescent on nerves beneath, 3 - 5-nerved at base; lateral nerves 6 - 8 pairs, prominent beneath; tertiaries rather straight and regular; petioles 6 - 8 mm long, pubescent. Flowers fascicled in densely pubescent racemes, in leaf axils or axils of fallen leaves, unisexual, dull white or pale yellowish green. Calyx 4- or 5-partite; lobes rusty-pubescent. Disc fleshy, annular in female flowers. Filaments ca 5 mm long. Ovary urceolate, glabrous; styles 5, reflexed, notched at apex. Fruit a berry, globose, obtusely ribbed, fleshy, brilliant scarlet red or pinkish red when ripe; seeds 6 in 2 rows, compressed, hard, woody and rough.

Fl.: Nov. - Feb. *Fr.*: Jan. - April.

Habitat: Semievergreen and moist deciduous forests, to 500 m.

Distrib.: Kannur, Palakkad and Thiruvananthapuram. Western Ghats. Endemic.

Uses: Fruit edible, makes an excellent jelly. Wood is used for house construction.

Flacourtia inermis Roxb. (*Pl. Coromandel* 3: 16, t. 222. 1815), native to Malesia, may be cultivated for the edible acidic fruit.

3. HOMALIUM Jacq.

Trees or shrubs. Leaves alternate, petioled, glandular-crenate-serrate, dentate or nearly entire, pinnately nerved; stipules minute, caducous or absent. Flowers bisexual, solitary or in fascicles of axillary many-flowered racemes, spikes or panicles, hairy; bracts often prominent, early caducous. Calyx tube obconic, partly produced beyond ovary; lobes 4 - 8, narrowly obovate or spatulate, flat, sometimes accrescent. Petals 4 - 8, linear-oblong, inserted at throat of calyx tube, persistent and enlarged in fruit. Stamens epipetalous, as many as petals and opposite them singly or in fascicles of 2 - 8 together at base of petals between disc lobes, sometimes alternating with staminodes; filaments filiform; anthers 2-loculed, dorsifixed, extrorse. Disc of tomentose glands opposite each sepal and alternating with fascicles of stamens. Ovary semi-inferior or inferior, 1-loculed; placentae 2 - 8, parietal, each with 1 - 7 pendulous ovules; styles 2 - 7, filiform, free or shortly connate; stigmas capitate or punctate. Capsules 2 - 8-valved; seeds 1 - many, minute, oblong, angled; endosperm fleshy; cotyledons foliaceous.

Tropics and subtropics, ca 180 species, 6 in India and 3 in Kerala.

Key to species

- | | | |
|-----|--|----------------------------|
| 1a. | Stamens many, in fascicles | 2 |
| b. | Stamens 4 or 5, not in fascicles | 1. <i>H. ceylanicum</i> |
| 2a. | Inflorescence a spike; flowers ca 5.5 mm across; styles 3 or 4 | 3. <i>H. travancoricum</i> |
| b. | Inflorescence a raceme; flowers ca 12 mm across; styles 6 - 9 | 2. <i>H. jainii</i> |

1. *Homalium ceylanicum* (Gardner) Benth. in J. Proc. Linn. Soc., Bot. 4: 35. 1860 (as *zeylanicum*); Bedd., Fl. Sylv. S. India: t. 210. 1872; C.B. Clarke in Hook.f., Fl. Brit. India 2: 596. 1879; Bourd., Forest Trees Travancore: 202. 1908; Rama Rao, Fl. Pl. Travancore: 182. 1914; Gamble, Fl. Madras: 522(368). 1919; Manilal, Fl. Silent Valley: 10. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 45. 1996; Sivar. & P. Mathew, Fl. Nilambur: 56. 1997. *Blackwellia ceylanica* Gardner in Calcutta J. Nat. Hist. 7: 452. 1846. *B. tetrandra* Wight, Icon. Pl. Ind. Orient.: t. 1851. 1852.

subsp. ***ceylanicum***: R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 411. 1993.

Tree, 10 - 20 m tall with spreading branches; trunk to 80 cm across; bark soft, lenticelled; wood brownish. Leaves ovate to elliptic, narrow-cuneate and obtuse at base, coarsely crenate-serrate at margin, acute to abruptly acuminate at apex, 5 - 22 x 3.5 - 6.5 cm, chartaceous, glabrous; lateral nerves 8 pairs; petioles ca 1 cm long, puberulous; stipules absent. Racemes axillary, simple, slender, sub-terminal, pendent, 10 - 12 cm long; peduncles pubescent; pedicels ca 2 mm long, jointed below calyx. Flowers fascicled, ca 1.5 cm long, pale green or greenish white, foetid. Calyx tube turbinate, adnate to ovary at base; lobes 4, ca 1.75 x 0.5 mm, ciliate at margin, with staminodal glands at base. Petals 4, obtuse, ca 2 x 0.5 mm, ciliate at margin, inserted at throat of calyx tube. Stamens 4 or 5, opposite petals, alternating with glandular staminodes. Ovary half-superior, globose, pubescent, 1-loculed; ovules many, on parietal palcenta; styles 4, filiform, connate at base, hairy; stigmas capitate. Fruit not seen.

Fl.: Feb. - July.

Habitat: Semievergreen and mixed deciduous forests.

Distrib.: Kollam, Malappuram, Palakkad, Parthanamthitta and Thrissur. Andhra Pradesh, Karnataka and Tamil Nadu. Sri Lanka.

Use: Powdered stem and leaf is used in skin eruptions (Yoganarasimhan, *Fl. Chickmagalur*: 34. 1981).

2. *Homalium jainii* A.N. Henry & Swamin. in J. Bombay Nat. Hist. Soc. 78: 570, f.1. 1981; S.R. Sriniv. in N.C. Nair & A.N. Henry, *Fl. Tamil Nadu* 1: 18. 1983; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 412. 1993; N. Mohanan & Sivad., *Fl. Agasthyamala*: 74. 2002.

Tree, to 30 m tall; young branches glabrous. Leaves elliptic to -oblong, cuneate or subobtuse at base, crenate-repand to subentire at margin, acuminate at apex, 5 - 12 x 2 - 5 cm, coriaceous, glabrous, shining above; lateral nerves 7 - 9 pairs with smaller nerves forming a distinct reticulum on both surfaces; petioles 6 - 12 mm long. Racemes to 20 cm long, grey-tomentose. Flowers 10 - 12 mm across, greenish yellow. Hypanthium ca 5 mm long, grey-tomentose. Sepals 6 - 9, oblong to spatulate, obtuse, 5 - 8 x 1.5 - 3 mm, tomentose. Petals as many as sepals, ovate-triangular, 4 - 7 x 1.5 - 3 mm, tomentose, connivent over ovary after anthesis. Stamens 6 or 7 in fascicles, on and in front of petals; filaments 4 - 5 mm long, pilose. Ovary tomentose; styles 6 - 9. Fruit not known.

Fl.: Oct.

Habitat: Rocky substratum along streams in evergreen forests, ca 1000 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic and critically endangered.

Note: The plant flowers once in few years. Not collected in fruit so far. Its reproductive biology needs to be studied.

3. **Homalium travancoricum** Bedd., Fl. Sylv. S. India: t. 211. 1872; C.B. Clarke in Hook.f., Fl. Brit. India 2: 598. 1879; Bourd., Forest Trees Travancore: 202: 1908; Rama Rao, Fl. Pl. Travancore: 183. 1914; Gamble, Fl. Madras: 523(369). 1919; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 415. 1993.

Trees, 10 - 15 m tall; bark rough, pale; wood yellowish brown. Leaves ovate, rounded at base, crenate-serrate at margin, obtuse or shortly and bluntly acute or acuminate at apex, 5 - 10 x 2.5 - 5 cm, glabrous on both surfaces; lateral nerves 4 - 8 pairs, irregular, prominent; petioles 6 - 16 mm long. Flowers small, subsessile, clustered on pendulous axillary 5 - 15 cm long spikes or simple racemes, greenish white. Stamens 15 - 20 in groups of 3 or 4 opposite each petal. Fruit not seen.

Fl.: Not known.

Habitat: Mixed forests at low levels.

Distrib.: Idukki (not collected recently) and S. Travancore (Bourdillon, *l.c.*; Rama Rao, *l.c.*). Western Ghats of Tamil Nadu (Tirunelveli). Endemic and endangered.

4. HYDNOCARPUS Gaertn.

Trees, dioecious. Leaves alternate, petioled, serrate or entire, pinnately nerved; stipules foliaceous, caducous. Racemes axillary, few-flowered; bracts small. Flowers uni- or bisexual, regular, 5-, rarely 4-merous. Sepals 5 or 4, free, imbricate, caducous. Petals 5, 8 or 12, with a fleshy pilose scale opposite each or with scales connate into a cup. Stamens 5, 15 or rarely 8; filaments flat at base; anthers oblong, reniform or sagittate, basifixed. Staminodes 5 or many. Ovary 1-loculed; ovules many in 6, 4 or 3 parietal placentae and with as many as sessile dilated stigmas on short styles. Fruit an indehiscent berry, large, globose with a woody pericarp; testa crustaceous, striate; endosperm fleshy, oily; cotyledons ovate, foliaceous, flat or subplicate.

Indomalesia, ca 40 species, 4 in India and 3 in Kerala.

Literature: Schaeffer, J. 1972. Pollen morphology of the genus *Hydnocarpus* (*Flacourtiaceae*). *Blumea* 20: 65 - 80.

Key to species

- 1a. Leaves entire; nervules reticulate; petals ciliate, greenish, twice as long as scales 1. *H. alpina*
- b. Leaves more or less serrate or entire; nervules parallel; petals not ciliate, greenish white, as long as scales 2
- 2a. Leaves acute at apex; flowers pendulous; petal scales oblong-linear, entire, ciliate-hairy at margin 2. *H. pendulus*
- b. Leaves long-acuminate at apex; flowers erect; petal scales ovate, fimbriate, woolly-hairy 3. *H. pentandra*

1. *Hydnocarpus alpina* Wight, *Icon. Pl. Ind. Orient.*: t. 942. 1845; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 197. 1872; Bourd., *Forest Trees Travancore*: 19: 1908; Rama Rao, *Fl. Pl. Travancore*: 24. 1914; Dunn in Gamble, *Fl. Madras*: 52(37). 1915; Manilal & Sivar., *Fl. Calicut*: 36. 1982; Manilal, *Fl. Silent Valley*: 11. 1988; Vajr., *Fl. Palghat*: 61. 1990; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 418. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 61. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 45. 1996; N. Mohanan & Sivad., *Fl. Agasthyamala*: 75. 2002.

Mal.: *Mala-maravatti*, *Malamarotti*

Evergreen tree, (15 -)20 - 30 m tall; trunk ca 30 cm across; outer bark cream-coloured; inner bark pinkish cream, ca 1 cm thick; branches glabrous or nearly so. Leaves elliptic-oblong or slightly oblong-lanceolate, entire, obtusely acuminate or subacute, (8 -)12 - 18 x (3 -)7.5 cm, glabrous, deep green, red when young; petioles ca 8 mm long. Flowers ca 2.5 cm across, in axillary fascicles, greenish, female flowers 1 or 2 together; pedicels 2.5 - 4.5 cm long. Sepals ovate, equal. Petals oblong-lanceolate, glabrous, with linear-pubescent scales inside half as long as petals. Stamens 4 or 5, shorter than petals; staminodes linear-oblong and obtuse in female flowers. Ovary pubescent; stigma irregularly 5-lobed. Fruits globose, pointed at tip, woody, velutinous, brown; seeds 12 - 18, embedded in

white pulp; testa hard.

Fl. & Fr.: Jan. - Dec.

Habitat: Evergreen forests, 800 - 2000 m.

Distrib.: Idukki, Kannur, Kozhikode, Palakkad, Thiruvananthapuram and Thrissur. Southern W. Ghats. Sri Lanka.

2. ***Hydnocarpus pendulus*** Manilal & al. in *Trop. Pl. Sci. Res.* 1: 355. 1983; Manilal, *Fl. Silent Valley*: 11, f. 10. 1988.

Tree. Leaves oblong-lanceolate, acute at apex, ca 15 x 5 cm, glabrescent on both surfaces. Flowers in axillary pendulous rusty-tomentose clusters, white; pedicels of male flowers very slender, to 3 cm long, those of bisexual ones stout, to 3.5 cm. Sepals 5, oblong, 11 - 13 mm long, subequal, reflexed, slightly pubescent. Petals ovate-lanceolate, ca 13 mm long, inwardly folded at margin, enclosing linear or oblong-linear scale with ciliate-hairy margin and as long as or slightly longer than petals. Stamens 5, erect, ca 3 mm long; filaments broad below, narrow above; pistillode absent in male flowers. Ovary ovoid, 7 - 8 mm long, faintly ribbed, rusty-tomentose. Fruits globose, to 8 cm, hard, woody, rusty-tomentose, ca 25-seeded.

Fl.: Jan. - April *Fr.*: May - Dec.

Habitat: Evergreen forests, ca 800 m.

Distrib.: Palakkad (Mukkali) and Pathanamthitta. Endemic and rare.

3. ***Hydnocarpus pentandra*** (Buch.-Ham.) Oken, *Allg. Naturgesch.* 3(2): 1381. 1841; N. Mukh. in *Bull. Bot. Surv. India* 14: 183. 1972; Nicolson & al. in *Regnum Veg.* 119: 147. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 50. 1988; Vajr., *Fl. Palghat*: 61. 1990; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 422. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 62. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 46. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 59. 1997. *Chilmoria pentandra* Buch.-Ham. in *Trans. Linn. Soc. London* 13: 501. 1822. *Marottia oleosa* Raf., *Sylva Tellur.*: 155. 1838. *Hydnocarpus wightiana* Blume, *Rumphia* 4: 22. 1849; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 196. 1872; Bourd., *Forest Trees Travancore*: 18: 1908; Rama Rao, *Fl. Pl. Travancore*: 24. 1914; Dunn in Gamble, *Fl. Madras*: 52(37). 1915. *Munniskia laurifolia* Dennst., *Schlüssel Hort. Malab.*: 22. 1818, nom. nud. *Hydnocarpus laurifolia* (Dennst.) Sleumer in *Bot. Jahrb. Syst.* 69: 33. 1938, nom. illeg.

Mal.: *Kodi, Koti, Maravetti, Marotti, Niraduvithu, Nirvetti*

Evergreen tree, to 15 m tall; trunk often fluted; bark rough, brownish; young branches brown-pubescent. Leaves ovate, elliptic or oblong-lanceolate, acute, rounded or subcordate at base, entire or subserrate at margin, long-acuminate at apex, 12-25 x 4-8 cm, nearly glabrous; lateral nerves 8 pairs, raised beneath with numerous cross nervules; petioles ca 1.3 cm long; stipules linear, pubescent, caducous. Flowers 9-15 mm across, dirty white tinged green. Sepals 5, unequal, inner 3 longest. Petals ovate, ciliate at margin, as long as ovate fimbriate basal wooly scales. Stamens 5, villous at base; anther lobes distinct. Ovary globose, densely wooly-pubescent; stigma 5-lobed. Fruits globose or obovoid, ca 6 x 5.5 cm, woody, brown-tomentose; seeds (6-)15-20, obtusely angled, embedded in pulp.

Fl.: Dec. *May Fr.*: April-Jan.

Habitat: Moist deciduous forests, to 1500 m, common.

Distrib.: Throughout Kerala. Western Ghats. Endemic.

Uses: Seed oil is used for various skin diseases, also in leprosy, arthritis and swellings. Fruit is used as a fish poison.

5. SCOLOPIA Schreb., nom. cons.

Trees or shrubs, often with spines on trunks and/or branches. Leaves spiral, petioled, rarely deciduous, entire or shallowly to rather deeply glandular-serrate-crenate, glabrous, reddish to purplish when young, pinnately or rarely palmately nerved, sometimes with 2 distinct marginal glands (hydathodes) at base of blade or at apex of petiole; stipules caducous. Racemes in leaf axils or axils of fallen leaves, simple or compound, rarely reduced to few-flowered fascicles or to a solitary flower. Flowers bisexual, rarely andromonoecious. Sepals 3-6(10), slightly imbricate or subvalvate, sometimes subconnate at base, persistent. Petals similar to and alternating with sepals, persistent, rarely caducous. Receptacle flat, usually hairy around base of ovary and in between base of filaments. Disc, if present, of 1 row of free short thick orange glands, 2 opposite each petal. Stamens many, in several series, incurved in bud, longer than petals; anthers ovoid, dorsifixed; connectives often produced into an apicular glabrous or sometimes hairy appendage. Ovary superior, sessile, 1-loculed, few-ovuled on deeply penetrating placenta; style long, sometimes 3- or 4-partite; stigmas entire or slightly 2- or 3-lobed. Fruit a berry, glabrous, with withered sepals, petals and stamens at base; style persis-

tent; seeds (1-2 or 3-6), rarely to 20, suspended on long funicle, with hard testa; endosperm abundant; cotyledons foliaceous, thin.

Old World tropics, 37 species, 4 in India and 2 in Kerala.

Literature: Sleumer, H. 1972. A taxonomic revision of the genus *Scolopia* Schreb. (*Flacourtiaceae*). *Blumea* 20: 25-64.

Key to species

- 1a. Leaves ovate to ovate-lanceolate or oblong-lanceolate, crenate-serrate at margin 1. *S. crenata*
- b. Leaves usually subovate or oblong-elliptic, entire or subentire at margin 2. *S. pusilla*

1. ***Scolopia crenata*** (Wight) Clos in Ann. Sci. Nat. Bot. 4, 8: 250. 1857, excl. Philippines spec.; Bedd., Fl. Sylv. S. India: t. 78. 1870; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 191. 1872; Bourd., Forest Trees Travancore: 17: 1908; Rama Rao, Fl. Pl. Travancore: 22. 1914; Dunn in Gamble, Fl. Madras: 52(38). 1915; Manilal, Fl. Silent Valley: 12. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 50. 1988; Vajr., Fl. Palghat: 62. 1990; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 430. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 62. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 46. 1996; Sivar. & P. Mathew, Fl. Nilambur: 61. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 75. 2002. *Phoberos crenatus* Wight in Wight & Arn., Prodr. Fl. Ind. Orient.: 29. 1834. *P. wightianus* Wight & Arn., Prodr. Fl. Ind. Orient.: 30. 1834.

Mal.: *Caralu, Sarelmaram*

Shrub or small tree, 2 - 6(12) m high; trunk straight, ca 20 cm across; trunks and branches with simple or branched to 2.5 cm long spines at base when young, unarmed when old; bark smooth, grey, rough and pustulate by lenticels; inner bark pale green to pale brown. Leaves ovate to ovate-lanceolate or oblong-, broadly cuneate or obtuse and often oblique at base, subcrenate to deeply or coarsely glandular-crenate-serrate at margin, acute or acuminate at apex, 4 - 15 x 1.5 - 7 cm, coriaceous, glabrous, shining, dark green above; lateral nerves 5 - 8 pairs, faintly raised on both surfaces; reticulations dense; petioles 6 - 12 mm long. Racemes simple or paniced, distally axillary and terminal, lax-flowered,

5-7 cm long; pedicels 2-6 (-8) mm long; bracts caducous. Flowers 5- or 6-merous, ca 1.5 cm long. Sepals 5, ovate-oblong or elliptic- obtuse, ca 2.5 mm long, ciliolate at margin, subglabrous. Petals 5, oblong to obovate, ca 2.5 mm long, white. Receptacle laxly to densely short-hairy. Disc glands absent. Stamens 60-100, longer than petals, shorter than style; connectives elongate, glabrous. Ovary glabrous; style erect, 5-6 mm long; stigma shortly 4-lobed or notched. Berries subglobose, apiculate by stylar base, 1.5-2 cm across, glabrous, shining, green; seeds 2-8, semilunar.

Fl.: Nov. - April *Fr.*: April - Aug.

Habitat: Mixed and moist deciduous forests, to 1500 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Andaman Islands, Andhra Pradesh, Goa, Karnataka, Maharashtra and Tamil Nadu.

Uses: Fruit is reportedly edible. Wood is said to be so hard as to resist saw and damage tools.

2. *Scolopia pusilla* (Gaertn.) Willd., *Sp. Pl.* 2: 981. 1799. *Limonia pusilla* Gaertn., *Fruct. Sem. Pl.* 1: 279, t. 58, f. 4. 1788. *Scolopia schreberi* J.F. Gmel., *Syst. Nat.*: 793. 1791; Bourd., *Forest Trees Travancore*: 17: 1908. *S. acuminata* Clos in *Ann. Sci. Nat. Bot.* 4, 8: 251. 1857; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 428. 1993. *Phoberos gaertneri* Thwaites, *Enum. Pl. Zeyl.*: 17. 1858. *Scolopia gaertneri* (Thwaites) Thwaites, *Enum. Pl. Zeyl.*: 400. 1864; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 191. 1872; Rama Rao, *Fl. Pl. Travancore*: 22. 1914.

Mal.: *Chera kanji*

Tree, 5-7 m high; trunk with strong compound divaricate spines; bark greyish; branches with or without simple slender to 4 cm long spines. Leaves variable, usually subobovate or oblong-elliptic, entire, sometimes faintly crenate, broadly acuminate at apex, 3-7 x 1.5-2(-4) cm, subcoriaceous, glabrous; lateral nerves 4-6 pairs, densely reticulate, raised on both surfaces; petioles 2-3(-4) mm long. Racemes 2-4 cm long with slender rachis, compactly 4-8(-10)-flowered, patently puberulous to subglabrous throughout; pedicels 1-1.3 cm long. Flowers 4-, rarely 5-merous, 7-8 mm across, white. Sepals ovate-oblong, 1.5-2 mm long. Petals oblong, 1.5-2 mm long, markedly thin at margin, ciliolate.

Receptacle densely hairy. Disc absent. Stamens 40–60; connectives glabrous. Ovary glabrous; style slender, 3–4 mm long; stigma obscurely 3- or 4-lobed. Berries ovoid or subglobose, apiculate, ca 1.3 cm across, bright scarlet when ripe.

Fl. & Fr.: March–June.

Habitat: Evergreen forests (Bourdillon, *l.c.*).

Distrib.: Kollam (Kulathurpuzha and Ayur, Rama Rao, *l.c.*). No specimen seen. Sri Lanka.

6. TARAKTOGENOS Hassk.

Trees. Leaves petioled, serrate or entire. Flowers polygamodioecious. Sepals 4, imbricate. Petals 12 or 8, with a scale opposite each inside at base. Stamens numerous; filaments and connectives not flat; anthers sagittate. Ovary with 4 placentae; ovules numerous; stigma sessile, peltate and disc-like, lobed. Fruits globose with a woody pericarp; seeds with a crustaceous testa and foliaceous cotyledons.

India (W. Ghats and NE. India) to Borneo and the Philippines, 14 species in India and 1 in Kerala.

Note: *Asteriastigma* Bedd. is included in this genus. Hutchinson (*Gen. Fl. Pl.* 2: 218. 1967) stated, “*Hydnocarpus* was united with *Taraktogenos* Hassk. by Warburg, followed by Gilg (in Engl. & Prantl, *Pflanzenfam.* ed. 2, 21: 407. 1925), but several authors have continued to maintain them as distinct; after a careful review of all the species represented in the Kew Herbarium, I do not consider a good case has been made out for uniting them” The 4-merous flowers and indefinite stamens with unflattened filaments and connectives are good characters to separate it from *Hydnocarpus*.

Taraktogenos macrocarpa (Bedd.) N.P. Balakr. in J. Bombay Nat. Hist. Soc. 67: 57. 1970. *Asteriastigma macrocarpa* Bedd., Fl. Sylv. S. India, For. Man.: t. 266. 1873 & Icon. Pl. Ind. Orient.: t. 242. 1868–1874; Bourd., Forest Trees Travancore: 17: 1908; Rama Rao, Fl. Pl. Travancore: 23. 1914; Dunn in Gamble, Fl. Madras: 52(37). 1915. *Hydnocarpus macrocarpa* (Bedd.) Warb. in Engl. & Prantl, Nat. Pflanzenfam. 3, 60: 21. 1893; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 421. 1993; Ahmedul. & M.P. Nayar in M.P. Nayar & Sastry,

Red Data Book Indian Pl. 3: 157. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 61. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 45. 1996; Sivar. & P. Mathew, Fl. Nilambur: 59. 1997.

Evergreen tree, to 25 m tall; outer bark light brownish grey with aromatic cyanide-like smell; inner bark ca 5 mm thick, pale purple pink. Leaves alternate, oblong-lanceolate to oblanceolate, acute to shortly rounded at base, entire, rounded and abruptly caudate-acuminate at apex, (10 -)15 - 20(25) x (5)7 - 10(12) cm, coriaceous, dark, shining, green above; lateral nerves 6 - 8 pairs, arched, distinct above, raised and prominent beneath; tertiary nerves subparallel and reticulations prominent beneath. Flowers polygamous, ca 2.5 cm across, in fascicles in leaf axils, leafless twigs or on old wood, greenish white, foetid. Petals shorter than sepals, ciliate, with 3-lobed scales at base inside. Stamens numerous, many-seriate. Ovary with many ovules on 6 or 7 parietal placentae and as many large sessile 2-lobed stigmas. Fruits globose, 12 - 16 cm, woody, dark brown; seeds many, oblong, angled, 3 - 3.5 x 2 - 2.5 cm, dark brown, embedded in pulp.

Fl.: Feb. - April *Fr.*: June - Feb.

Habitat: Evergreen forests, to 1200 m, rare.

Distrib.: Idukki, Malappuram, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic.

Editors' note: Subramanian (*Indian Forester* 96: 527. 1970) reported *Taraktogenos kurzii* King (*J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist.* 59: 123. 1890) (= *Hydnocarpus kurzii* (King) Warb. in Engl. & Prantl, *Nat. Pflanzenfam.* 3, 60: 21, f. M & N. 1893; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 421. 1993), earlier known to occur in NE. India, Bangladesh and Myanmar, as a new record for Kerala from Kollam District. He, however, did not provide a description. There are 2 specimens of *K.N. Subramanian* 1563 at FRC, one sterile and the other with a fruit. From the absence of flowers whether it is a species of *Hydnocarpus* or *Taraktogenos* could not be determined.

7. XYLOSMA G. Forst., nom. cons.

Shrubs or trees, deciduous, often spinescent, dioecious. Leaves alternate, exstipulate, entire, crenate-serrate or dentate, pinnately nerved. Inflorescences axillary panicles, short racemes, fascicles or reduced to a solitary flower, bracteate; pedicels jointed. Flowers unisexual. Sepals 4 - 8, imbricate, subconnate, scale-

like, often ciliate. Petals absent. Disc fleshy, more or less regularly 4 - 8-lobed or entire. Stamens many, often surrounded by a glandular disc, usually exerted; anthers subglobose, basifixed; pistillode absent in male flowers. Ovary sessile, inserted at annular disc, 2-loculed with 2 - 4 parietal placentae, rarely 3 - 6 with 2 - few ovules; styles entire or somewhat divided; stigma dilated, rarely 2- or 3-lobed, subsessile and peltate. Fruits rather dry berries, globose; pericarp thin-coriaceous; aril thin; seeds few, obovoid; testa smooth, crustaceous; cotyledons broad.

Tropics and subtropics except Africa, ca 85 species, 3 in India and 1 in Kerala.

Xylosma latifolia Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 194. 1872; Gamble, Fl. Madras: 53(38). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 50. 1988; Vajr., Fl. Palghat: 62. 1990; Sivar. & P. Mathew, Fl. Nilambur: 61. 1997.

Tree, to 8 m high, thorny; branches finely downy. Leaves broadly elliptic-oblong or ovate- acute or subcordate at base, crenate-serrate or subentire at margin, obtuse or acute at apex, 5 - 13 x 2 - 6 cm, subcoriaceous, glabrous, shining above; lateral nerves 4 or 5 pairs, very oblique, lowest pair running throughout; petioles 8 - 12 mm long, pubescent. Inflorescences sparingly branched panicles, slender, 1.5 - 2.5 cm long, few-flowered, pubescent; bracts linear-oblong, obtuse or acute. Flowers greenish. Sepals minute, orbicular, ciliate. Stamens many in male flowers. Female flowers without staminodes. Styles distinct; stigma capitate, 4-lobed. Berries globose, ca 2.5 cm, black.

Fl. & Fr.: May - Aug.

Habitat: Evergreen forests, 700 - 1000 m.

Distrib.: Kannur, Malappuram, Palakkad, Thrissur and Wynad. Western Ghats of S. Karnataka and Tamil Nadu (Nilgiris). Endemic.

Note: R.L. Mitra (in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 406. 1993) opined that *X. latifolia* Hook.f. & Thomson is perhaps conspecific with *Flacourtia latifolia* (Hook.f. & Thomson) T. Cooke and stated that examination of more authentic material is necessary to place it in *Xylosma*.

PITTOSPORACEAE

(N.P. BALAKRISHNAN)

Trees, shrubs, sometimes climbers, rarely epiphytes, evergreen, usually lenticelled, rarely spinose. Leaves spiral, alternate or whorled, often crowded at ends of branches, petioled, rarely sessile, exstipulate, simple, entire or rarely sinuate-toothed, pinnately nerved. Inflorescences axillary, terminal, pseudoterminal or lateral, mostly thyrses, rarely simple cymes or corymbs. Flowers actinomorphic, bi- rarely functionally unisexual. Sepals 3-5, free or connate to various degrees. Petals 3-5, free, rarely connate at base, imbricate. Stamens 3-5, free, erect, episepalous; filaments filiform-subulate, free or sometimes connivent below; anthers erect, oblong, basifixed, introrse; loculi 2, parallel, dehiscing by longitudinal slits, rarely by 2 apical pores. Disc rarely present. Carpels 2 (3-5); ovary superior, stipitate or not, 1-, sometimes completely or incompletely 2-5-loculed due to projection of placentae; placentae 2-5, parietal or basal, rarely axile; ovules 2-many in each locule, anatropous; style simple, short or long, glabrous; stigma apical, capitate, thick or obscurely 2-5-lobed. Fruits 2-several-valved loculi- or septicidal capsules or berries, rarely indehiscent dry fruits, usually containing a viscous pulp; seeds 2-many, erect, rarely winged; embryo minute, linear; endosperm copious, firmly fleshy.

Old World tropics and subtropics especially Australia, 9 genera and ca 240 species, 1 and 11 in India and, 1 and 4 in Kerala.

Literature: Nayar, M.P. & Giri, G.S. 1980. *Pittosporaceae. Fasc. Fl. India* 6: 1-15.

PITTOSPORUM Banks ex Gaertn., nom. cons.

Trees, shrubs or undershrubs, erect, sometimes epiphytic, often aromatic; branching forked or verticillate. Leaves exstipulate, simple, alternate or whorled, often crowded in pseudowhorls at ends of branches. Inflorescences umbels, corymbs or panicles, terminal, pseudoterminal, lateral or in axils of fallen leaves, rarely flower solitary. Flowers bi- or functionally unisexual. Sepals 5, free or connate at base, recurved above. Petals 5, generally ligulate, free or connivent to or beyond middle in lower part; free segments recurved or spreading. Stamens 5, free, alternating with petals, occasionally adnate with corolla tube; anthers much

shorter than filaments, dorsifixed, introrse, dehiscing by longitudinal slits. Ovary stipitate or not, 1- or incompletely 2 - 5-loculed with parietal placentae or rarely placentae intruding to middle; style glabrous; stigma capitate. Capsules globose, ellipsoid or obovoid, 2- or 3-valved; valves thin or woody of varying thickness, transversely ribbed or striate inside; seeds 2 - many, irregularly angled, compressed, wrinkled or smooth, reddish or blackish, embedded in a viscid resinous pulp.

Tropics and S. Africa to Australia and New Zealand and the Pacific, ca 150 species, 11 in India and 4 in Kerala.

Literature: Gowda, M. 1951. The genus *Pittosporum* in Sino-Indian region. *J. Arnold Arbor.* 32: 263 - 343.

Key to species

- | | | |
|-----|--|----------------------------|
| 1a. | Inflorescences glabrous | 3. <i>P. neelgherrense</i> |
| b. | Inflorescences puberulous | 2 |
| 2a. | Capsule valves thick and woody; funicles distributed to middle of placenta | 1. <i>P. dasycaulon</i> |
| b. | Capsule valves thin, coriaceous; funicles basal or suprabasal | 3 |
| 3a. | Flowers usually less than 10 in each inflorescence | 4. <i>P. tetraspermum</i> |
| b. | Flowers 10 - 50 or more in each inflorescence | 2. <i>P. napaulense</i> |

1. *Pittosporum dasycaulon* Miq., Anal. Bot. Ind. 3: 5. 1852; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 199. 1872; Dunn in Gamble, Fl. Madras: 54(40). 1915; Vajr., Fl. Palghat: 63. 1990; M.P. Nayar & G.S. Giri in B.D. Sharma & N.P. Balakr., Fl. India 2: 442. 1993.

Small tree; young branches densely tomentose. Leaves cuneate at base, entire at margin, acute at apex; petioles 8 - 18 mm long, puberulous. Inflorescences terminal or pseudoterminal, umbelled or racemose, densely brownish-tomentose. Sepals 2 - 3 x ca 1 mm, tomentose. Petals oblong, 10 - 12 x 2 - 2.5 mm, yellow. Filaments 6 - 7 mm long; anthers ca 2 mm long. Ovary ca 3 mm long, tomentose; style 4 - 5 mm long, glabrous. Capsules globose, 8 - 10 mm, woody; seeds 4 - 6, blackish pink.

Fl. & Fr.: Sept. - March.

Habitat: Sholas, 800 - 1500 m.

Distrib.: Idukki and Palakkad. Western Ghats of Karnataka and Maharashtra. Endemic.

Use: Extract from stem bark has antibacterial and antifungal properties (Bhatnagar & al. in *Indian J. Med. Res.* 49: 799, 1961).

2. *Pittosporum napaulense* (DC.) Rehder & E.H. Wilson in Sarg., Pl. Wilson. 3: 326. 1916; M.P. Nayar & G.S. Giri in B.D. Sharma & N.P. Balakr., Fl. India 2: 445. 1993. *Senacia napaulensis* DC., Prodr. 1: 347. 1824. *P. floribundum* Royle, Ill. Bot. Himal. Mts.: 77. June 1834. *P. floribundum* Wight & Arn., Prodr. Fl. Ind. Orient.: 154. Oct. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 199. 1872; Dunn in Gambe, Fl. Madras: 54(40). 1915. *P. wightii* A.K. Mukh. in J. Econ. Tax. Bot. 5: 50. 1984; Vajr., Fl. Palghat: 62. 1990.

Shrub or small tree, 2 - 8 m high; bark light grey with large warty lenticels; branchlets subverticillate, often whorled. Leaves crowded at ends of branches, sometimes subverticillate, oblong-lanceolate or oblanceolate, entire or slightly wavy at margin, acute to acuminate at apex, 5 - 20 x 2 - 8 cm, subcoriaceous, glabrous; nerves impressed above; lateral nerves 7 - 11 pairs, oblique, rather obscure; petioles 1 - 2 (- 3) cm long, channelled above. Inflorescences simple, umbelled, corymbose or paniced, tomentose with white or brown hairs, glandular; peduncles to 3.5 cm long; pedicels to 6 mm long; bracteoles ovate, oblong, ca 3 mm long. Flowers 6 - 8 mm long, fragrant. Sepals free, broadly ovate, oblong or elliptic, 1.5 - 2.5 mm long, ciliate or not. Petals narrowly oblong, obtuse at apex, 6 - 7 x ca 2 mm, pale yellow. Filaments ca 3 mm long; anthers ca 1.5 mm long. Ovary appressed-brownish-pubescent; style glabrous. Capsules globose, 6 - 8 mm, crowned by style remains, 2-valved, orange-yellow; valves striate with horizontal lines; seeds 4 - 8, covered by scarlet pulp.

Fl. & Fr.: Oct. - April.

Habitat: Subtropical evergreen forests, 900 - 1900 m.

Distrib.: Idukki, Palakkad and Wynad. Himalayas, NE. India and E. and W. Ghats. Bhutan, Madagascar, Nepal, Pakistan and Tibet.

Uses: Bark has ginger-like smell when cut fresh, hence called ginger-tree. Decoction of bark is used in skin diseases and chest infections (Krishna & Badhwar in *J. Sci. Industr. Res.* 6(3) (Suppl.): 41. 1947). Wood yields a useful timber.

Note: This is a highly variable species in size and shape of leaf and inflorescence.

The number of seeds varies from 4 to 8 and attachment of funicle is basal or suprabasal. There are several intermediate forms and the Himalayan (*P. floribundum* Royle) and peninsular Indian (*P. floribundum* Wight & Arn.) are considered to belong to the earlier *P. napaulense* (DC.) Rehder & E.H. Wilson.

3. *Pittosporum neelgherrense* Wight & Arn., Prodr. Fl. Ind. Orient.: 154. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 198. 1872 (as *nilghirense*); Bourd., Forest Trees Travancore: 20. 1908; Rama Rao, Fl. Pl. Travancore: 24. 1914; Dunn in Gamble, Fl. Madras: 54(40). 1915; Manilal, Fl. Silent Valley: 12. 1988; M.P. Nayar & G.S. Giri in B.D. Sharma & N.P. Balakr., Fl. India 2: 446. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 63. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 47. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 76. 2002.

Shrub or small tree, to 3 m high; twigs glabrous. Leaves oblong-lanceolate, entire, 3 - 8 x 2 - 4.5 cm, coriaceous, glabrous; petioles 5 - 15 mm long. Inflorescences subumbelled or simple-racemose, glabrous; peduncles slender, 2 - 2.5 cm long; pedicels 8 - 15 mm long. Flowers fragrant. Sepals subulate, 1.5 - 2 x ca 1 mm. Petals oblong-lanceolate, obtuse or rounded at apex, 1.5 - 2 mm long, pale yellow. Ovary densely brown-tomentose with 1 - 2 mm long hairs; style ca 3 mm long. Capsules 8 - 10 mm across, thick-valved; seeds 4 - 8; funicle basal to sub-basal.

Fl. & Fr.: Oct. - March.

Habitat: Sholas, 1400 - 1800 m.

Distrib.: Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

4. *Pittosporum tetraspermum* Wight & Arn., Prodr. Fl. Ind. Orient.: 154. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 198. 1872; Bourd., Forest Trees Travancore: 20. 1908; Rama Rao, Fl. Pl. Travancore: 24. 1914; Dunn in Gambe, Fl. Madras: 54(40). 1915; Manilal, Fl. Silent Valley: 14. 1988; Vajr., Fl. Palghat: 63. 1990; M.P. Nayar & G.S. Giri in B.D. Sharma & N.P. Balakr., Fl. India 2: 447. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 63. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 47. 1996; Sivar. & P. Mathew, Fl. Nilambur: 62. 1997.

Mal.: *Kaccapatta*, *Kachapatta*

Shrub or small tree, branching dichotomously or in a whorl at top; young branches puberulous; young leaves and inflorescences ferruginous-hirsute. Leaves densely crowded at ends of branches, subverticillate, ovate-oblong, acute at base, entire, sometimes revolute at margin, subacute or obtuse at apex, 4 - 8 x 1.5 - 4 cm, coriaceous, glabrous when mature; petioles 4 - 10 mm long, slender. Inflorescences pseudoterminal in umbelled or subumbelled cymes, 4 - 8-flowered, puberulous; peduncles to 10 mm long; buds oblong, 8 - 10 mm long; pedicels to 1 cm long, puberulent. Sepals free, triangled-subulate, 2 - 3 x ca 1 mm, ciliate at margin, pubescent. Petals linear-oblong or strap-shaped, 6 - 10 x ca 2.5 mm, yellowish green. Filaments erect, 2.5 - 3 mm long; anthers 1.5 - 2 mm long, yellowish green. Ovary oblong-ovoid, to 3 mm long, densely brown-tomentose, 4-ovuled; style to 2 mm long, glabrous. Capsules subglobose, tipped by withered style, ca 1 cm across; valves 2, rather thin, striate inside; seeds 4, subtrigonus, dark red with an orange-red aril and sticky pulp.

Fl.: Jan. - April *Fr.*: June - Nov.

Habitat: Sholas, 1500 - 2200 m.

Distrib.: Idukki, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

POLYGALACEAE

(R.N. BANERJEE & N.P. BALAKRISHNAN)

Herbs, shrubs, woody climbers, rarely small trees, saprophytes or parasites. Leaves simple, alternate, rarely opposite, distichous or rarely (partly) verticillate, rarely spinosely or discoidly stipuled or not, entire. Inflorescences axillary or terminal, racemose, spicate or paniced, rarely flower solitary. Flowers bisexual, zygomorphic, basically 5-merous, 3-bracteate. Sepals 5, rarely 4, free, sometimes partly or entirely connate, imbricate in bud; inner 2 mostly larger, petaloid, wing-like, persistent or not. Petals 3, free or variously connate, sometimes minute and scale-like or absent; upper 2 free or basally connate to staminal tube; lowermost one keeled, boat-shaped, often with a dorsal 2 - many-lobed crest or appendage beneath top. Stamens usually 8, rarely less in 2 rows, monadelphous; sheath often adnate to petals, split above; anthers 1- rarely 2-loculed, basifixed, sessile or not, dehiscing by apical or subapical pores or often by longitudinal or tangential slits. Disc, if present, annular or represented by intrastaminal glands.

Ovary 2-carpelled, 2- rarely 1-loculed; ovule 1 in each locule on pendulous or axile placenta; style 1, curved; stigma entire or lobed. Fruit a loculicidal capsule, 2-, rarely seemingly 1-loculed, samara, drupe, nut or berry; seeds 2, arillate, sometimes strophioled, often pilose; embryo straight, as long as endosperm; cotyledons moderately thick, 1.5 - 3 times wider than radicle; endosperm copious or moderate, rarely absent.

Cosmopolitan, centred in American and African tropics, 17 genera and ca 950 species, 4 and 31 in India and, 2 and 16 in Kerala.

Literature: Meijden, R. 1988. *Polygalaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males*, 1, 10: 459 - 482. Sumithraarachchi, D.D. 1987. *Polygalaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 6: 301 - 315.

Key to genera

- 1a. Flowers in racemes; keel petal with a dentate- or lobed-crest; stamens 8; seeds hairy **1. Polygala**
- b. Flowers in spikes; keel petal without a crest; stamens 4 - 6; seeds glabrous **2. Salomonina**

1. POLYGALA L.

Erect or climbing herbs, shrubs or small trees. Leaves alternate or spiral, exstipulate. Flowers in terminal or lateral racemes; bracts small, persistent or not; bracteoles 2, persistent or not. Sepals 5, unequal, usually wholly or partially persistent; wing sepals (inner) the largest, often petaloid. Petals 3, partially connate below, upper 2 (lateral) adnate basally to staminal tube; lower one (keel) boat-shaped, clawed with basal part above claw sometimes auricled, entire or dorsally crested with 2 lobes each entire or divided into appendages. Stamens 8, monadelphous; filaments connate at base into a staminal tube split on one side; anthers on mouth of tube or on free filaments above tube. Ovary laterally compressed, 2-loculed; locules with 1 anatropous, pendulous ovule; style terminal, variously curved, flat, dilated above; stigma lateral, oblique or spaced into 2 spots. Capsules compressed, mostly margined, sometimes with a double wing, dehiscing loculicidally by marginal split, 2-seeded, often enclosed in persistent sepals or wing sepals; seeds oblong, mostly dark, densely or sparsely hairy with a cap-like entire or lobed caruncle at micropylar part close to attachment with funicle, sometimes with a black shining strophiole at other end.

Subcosmopolitan except New Zealand, ca 500 species, 27 in India and 15 in Kerala.

Literature: Adema, F. 1966. A review of the herbaceous species of *Polygala* in Malasia (*Polygalaceae*). *Blumea* 14: 253 - 356. Chandrabose, M. & Nair, N.C. 1981. The genus *Polygala* L. (*Polygalaceae*) in Andhra Pradesh, Kerala and Tamil Nadu (South India). *Proc. Indian Acad. Sci. (Pl. Sci.)* 90: 107 - 127.

Key to species

- 1a. Sepals caducous **1. *P. arillata***
- b. Sepals or at least wing sepals persistent in fruit 2
- 2a. Wing sepals broader above middle, rounded-obtuse or subacute at apex 3
- b. Wing sepals broader below middle, acute to acuminate at apex 6
- 3a. Wing sepals falcate, acute; petals lavender blue; lateral lobes linear-oblong; midlobe rounded **13. *P. sibirica***
- b. Wing sepals not falcate, or if falcate, obtuse; petals purple or yellow; lateral lobes obovate; midlobe acute 4
- 4a. Stems and racemes dichotomously branched above; wing sepals symmetric, suborbicular, rounded, not mucronate at apex **11. *P. persicariifolia***
- b. Stems and racemes not dichotomously branched; wing sepals asymmetric, elliptic-oblong, obtuse, mucronate at apex 5
- 5a. Leaves revolute at margin; wing sepals with anastomosing nervules forming a hyaline zone at margin; petals pink; crest with 2 bundles of appendages **7. *P. erioptera***
- b. Leaves flat at margin; wing sepals without a hyaline zone at margin; petals blue, purple or purplish white; crest with 1 or 3 bundles of appendages **14. *P. telephioides***
- 6a. Racemes longer than leaves 7
- b. Racemes shorter than leaves 10
- 7a. Ovary neither hairy nor ciliate at apex **9. *P. javana***
- b. Ovary hairy or ciliate at apex 8
- 8a. Midlobe of petals distinctly auricled at base **15. *P. wightiana***
- b. Midlobe of petals not auricled at base 9
- 9a. Racemes 10 - 20 cm long; capsules asymmetric, unequally lobed at apex **6. *P. elongata***
- b. Racemes less than 10 cm long; capsules symmetric, equally lobed at apex **3. *P. bolbothrix***
- 10a. Free portion of filaments on staminal tube differing much in length; filaments in 3 groups

with 2 free filaments in centre and 2 bundles of 2 connate filaments each on either side

4. *P. buxiformis*

- b. Free portion of filaments on staminal tube almost of same length; all filaments free almost to mouth of tube 11
- 11a. Racemes and flowers erect; outer sepals obovate-oblong, mucronulate at apex

12. *P. rosmarinifolia*

- b. Racemes and flowers drooping; outer sepals ovate-falcate, acuminate at apex 12
- 12a. Caruncle with broad membranous winged appendages, covering 2/3 of seed **8. *P. jacobii***
- b. Caruncle with short-toothed or linear to narrowly oblong appendages covering less than 1/2 of seed 13
- 13a. Leaves to 4 cm long; caruncle appendages subequal

2. *P. arvensis*

- b. Leaves usually more than 4 cm long; caruncle appendages unequal, 2 large and 1 very short 14
- 14a. Leaves linear or linear-lanceolate, to 10 mm broad; petals yellowish or dull orange; stigma hooded **10. *P. linarifolia***
- b. Leaves oblong-elliptic, 10 - 25 mm broad; petals white with purple or violet tips; stigma 2-lobed **5. *P. chinensis***

1. *Polygala arillata* D. Don, Prodr. Fl. Nepal.: 199. 1825; A.W. Benn. in Hook.f., Fl. Brit. India 1: 200. 1872; Dunn in Gamble, Fl. Madras: 58(41). 1915.

Small trees or shrubs, erect or subscaudent, to 4 m high; young branches puberulous. Leaves elliptic or lanceolate to oblanceolate, rounded, acute or cuneate at base, revolute at margin or not, cuspidate or acute-mucronate at apex, (4 -) 7 - 11 (- 18) x (2 -) 3 - 4 (- 6) cm, glabrous except on nerves beneath, dull green to dark tan on drying; lateral nerves 5 - 12 pairs, arcuate, forming loops near margin, depressed above, raised beneath with faint reticulations; petioles 5 - 15 mm long. Flowers 12 - 18 mm long, in simple or rarely paniced 5 - 8 cm long axillary or terminal pendulous racemes, bright yellow; pedicels 2 - 10 mm long; bracts linear-subulate, 2 - 2.5 mm long, caducous; bracteoles 3, lanceolate, 1.5 - 2 mm long, ciliate at margin. Sepals 5, caducous; outer 3 ovate-elliptic or obovate, acute, acuminate or rounded at apex, 3 - 8 x 2 - 6 mm, unequal; inner 2 (wings) elliptic-obovate, concave, attenuate at base, obtuse or rounded at apex, 10 - 14 x 6 - 7 mm, glabrous except ciliate margin, distinctly nerved, purplish green. Petals

3-lobed, 1–2 cm long; lateral petals oblong or obovate, obtuse, to 4 mm across, connate with keel petal for almost 1/2, hairy inside; keel petal crested on back of apex with a tuft of 15–20 linear appendages. Stamens 8, shorter than petals; sheath 8–12 mm long, adnate to keel and split into 2 short free bundles each bearing 4 free 2–3 mm long filaments. Ovary suborbicular, obcordate, ca 2 mm long, often sparsely ciliate at margin; style slightly curved at apex, ca 8 mm long, broad in middle, glabrous; stigma flat. Capsules suborbicular or broadly reniform, compressed, deeply notched at apex, narrowly and thinly winged at margin, 10–12 x 12–15 mm, puberulous or glabrous, distinctly nerved, fleshy, pink; seeds subglobose, 4–8 mm across, minutely tubercled, glabrous or sparsely white-silky with appressed hairs, brownish black; caruncle cupular or hood-shaped, with 2 or 3 winged appendages covering 1/3–2/3 of seed.

Key to varieties

- | | | |
|-----|---|----------------------------|
| 1a. | Leaves lanceolate or elliptic-lanceolate, acuminate at apex | 1.1. var. <i>arillata</i> |
| b. | Leaves broadly oblanceolate, cuspidate at apex | 1.2. var. <i>chartacea</i> |

1.1. var. *arillata*

Fl.: March–May *Fr.*: June–Aug.

Habitat: Subtropical evergreen forests, 1000–2000 m.

Distrib.: Idukki and Kollam. Western Ghats, E. Himalayas and NE. India. South and SE. Asia.

1.2. var. *chartacea* (Mukerjee) G.S. Giri in Bull. Bot. Surv. India 26: 5. 1985; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 459. 1993. *P. arillata* D. Don f. *chartacea* Mukerjee in Bull. Bot. Soc. Bengal 12: 32. 1958.

Fl. & Fr.: Almost throughout the year.

Habitat: Subtropical evergreen forests, 1000–2000 m.

Distrib.: Idukki and Kottayam. Tamil Nadu. Endemic.

2. *Polygala arvensis* Willd., Sp. Pl. 3: 876. 1803; B.L. Burtt in Notes Roy. Bot. Gard. Edinburgh 32: 404. 1973; Manilal, Fl. Silent Valley: 14. 1988; Nicolson & al. in Regnum Veg. 119: 210. 1988; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 460. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 47. 1996; Sivar. & P. Mathew, Fl. Nilambur: 62. 1997. *P. chinensis* auct. non L. 1753; A.W.

Benn. in Hook.f., Fl. Brit. India 1: 204. 1872 p.p.; Dunn in Gamble, Fl. Madras: 58(42). 1915. *P. chinensis* var. *linarifolia* sensu Mukerjee in Bull. Bot. Soc. Bengal 12: 40. 1958, non (Willd.) Chodat 1893.

Erect or procumbent herb, 5 - 30 (- 40) cm high; branches arising from base, glabrous or pubescent. Leaves subsessile, orbicular, obovate or oblanceolate to oblong, narrow towards base, subacute, obtuse or emarginate and mucronate at apex, 1 - 4 (- 5) x 0.5 - 2 cm, glabrous to densely pubescent or hirsute, fleshy when fresh, coriaceous when dry; petioles to 3 mm long. Flowers ca 4 mm long, solitary or in 3 - 15-flowered 5 - 20 mm long axillary or lateral racemes, rarely subcapitate, usually yellow, sometimes purplish white and pink-streaked; bracts oblong-ovate, acute, ca 1 mm long, ciliate, persistent; pedicels 2 - 3 mm long. Sepals persistent; outer sepals broadly ovate to ovate-lanceolate, acuminate to acute, 1.5 - 2.5 x 1 - 1.5 mm, hyaline and ciliate at margin, pubescent outside, 1-nerved; wing sepals obliquely ovate, falcate, narrow at base, acute to acuminate, straight at upper margin, rounded at lower, 4 - 7 x 2 - 4 mm, sparsely puberulous, membranous and hairy at margin, persistent. Petals yellow; midlobe keeled, auricled at base, with a crest of shortly multifid or notched to 1 mm long appendages; lateral lobes suborbicular or broadly obovate, ca 3 mm long. Staminal sheath free, 1.5 - 2 mm long; free portion of filaments to 2 mm long, connate at same level. Ovary obovoid, ca 1 mm across, hairy at margin; style curved, dilated and hooked at apex forming a hood with lateral broad capitate stigma at its concavity. Capsules ovoid, orbicular or obliquely obcordate, compressed, emarginate at apex, narrowly winged at margin, 3 - 5 x 2.5 - 4 mm, glabrous on walls, patently hairy at margin; seeds oblong-ellipsoid or obcordate, ca 3 x 2 mm, pilose, black; caruncle hood-shaped, 3-fid almost to base with short appendages.

Fl.: June - Aug. *Fr.*: Aug. - Jan.

Habitat: Wastelands, cultivated fields, roadsides etc., to 2000 m.

Distrib.: Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Almost all states at low levels. South and SE. Asia.

3. *Polygala bolbothrix* Dunn in Gamble, Fl. Madras: 58(42). 1915 & Bull. Misc. Inform. 1916: 13. 1916; Manilal & Sivar., Fl. Calicut: 37. 1982; Manilal, Fl. Silent Valley: 15. 1988; Vajr., Fl. Palghat: 64. 1990; R.N. Banerjee in

B.D. Sharma & N.P. Balakr., Fl. India 2: 462. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 64. 1994. *P. ciliata* sensu Wight & Arn., Prodr. Fl. Ind. Orient.: 38. 1834, non L. 1753. *P. ramaswamiuna* Mukerjee in J. Bombay Nat. Hist. Soc. 53: 55. 1955.

Diffuse, erect or ascending herb; branches to 50 cm long, puberulous or shining-velutinous, mixed with strigose spiny bulbous-based hairs. Leaves elliptic, obovate or oblong, cuneate at base, entire and revolute at margin, obtuse, rounded or emarginate and often mucronate at apex, 8 - 37 x 5 - 15 mm, subcoriaceous. Flowers 4 - 7 mm long, few or many in lax slender leaf-opposed axillary or extra-axillary 2 - 9 cm long patent velutinous racemes, pinkish green; pedicels 2 - 4 mm long, tomentose; bracts 3, deltoid or lanceolate, acuminate, 1 - 3 mm long, unequal. Outer sepals ovate-lanceolate, setaceous, acuminate, 2 - 3 x 0.7 - 1 mm, membranous, ciliate outside; wing sepals obliquely elliptic-ovate, narrow at base, subacute to acuminate at apex, 4.5 - 5 x 2 - 2.5 mm, hyaline at margin, velutinous outside, 5 - 7-nerved. Petals 3-lobed to base, pink or yellow; midlobe ca 3.5 mm long, auricled, keeled, with a crest of filiform forked appendages; lateral lobes oblong or suborbicular, emarginate, clawed and ciliate-margined at base, ca 2.5 mm long. Staminal sheath free, ca 2.5 mm long; free portion of filaments ca 1.7 mm long, connate at different levels. Ovary orbicular, slightly oblique, compressed, hispid at margin; style curved, wide and horseshoe-shaped at apex, ca 2.5 mm long; stigma lateral, hooded. Capsules suborbicular, emarginate and unequally halved, 3 - 4 mm across, longitudinally grooved in middle, stiff-hairy; seeds oblong, obtusely truncate at apex, 2.5 - 3.5 x 1.2 - 2 mm, pilose, black; caruncle hood-shaped with 3 obtusely toothed appendages.

Key to varieties

- | | | |
|-----|--|---------------------------------|
| 1a. | Inflorescences leaf-opposed or extra-axillary, many-flowered | 3.2. var. <i>devicolamensis</i> |
| b. | Inflorescences axillary, 2- or 3-flowered | 2 |
| 2a. | Hairs on stem somewhat spiny | 3.3. var. <i>pulniensis</i> |
| b. | Hairs on stem not spiny, hispid | 3.1. var. <i>bolbothrix</i> |

3.1. var. *bolbothrix*

Fl.: April - May *Fr.*: June - Dec.

Habitat: Grasslands in hills and plains, to 1000 m, rare.

Distrib.: Idukki, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thiruvananthapuram. Andhra Pradesh, Karnataka and Tamil Nadu. Endemic.

3.2. var. devicolamensis (Mukerjee) R.N. Banerjee & N.P. Balakr., stat. & comb. nov.

P. ramaswamiana Mukerjee f. *devicolamensis* Mukerjee in J. Bombay Nat. Hist. Soc. 53: 56. 1955.

Fl. & Fr.: Not known.

Habitat: Moist grassy slopes, 1500 - 2000 m, rare.

Distrib.: Idukki and Palakkad. Tamil Nadu. Endemic.

3.3. var. pulniensis (Mukerjee) R.N. Banerjee & N.P. Balakr., comb. nov.
P. ramaswamiana Mukerjee var. *pulniensis* Mukerjee in J. Bombay Nat. Hist. Soc. 53: 56. 1955.

Fl.: Feb. - July.

Distrib.: Idukki, Kottayam and Pathanamthitta. Tamil Nadu (Pulney hills). Endemic and rare.

4. *Polygala buxiformis* Hassk. in Miq., Ann. Mus. Lugd.-Bat. 1: 161. 1864; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 463. 1993. *P. telephioides* sensu A.W. Benn. in Hook.f., Fl. Brit. India 1: 205. 1872, non Willd. 1802, excl. syn. *P. serpyllifolia* Poir. 1804; Dunn in Gamble, Fl. Madras: 59(42). 1915.

Decumbent-ascending, weak herb. Leaves erect, usually imbricating base of upper ones, narrowly oblong, oblanceolate or elliptic-oblong, obtuse at both ends, recurved at margin, apiculate at apex, 4-14 x 2-5 mm, subcoriaceous, glabrous except thin crisp hairs beneath. Flowers ca 5 mm long, in leaf-opposed or lateral 3-10 cm long spikes, yellow with violet throat and dark blue crest; rachises angled, tomentose with raised semicircular cicatrices of fallen pedicels; bract 1, ovate-oblong, obtuse, ca 2 mm long, ciliate, caducous; bracteoles 2, linear, sharply acute or acuminate, ciliate, caducous; pedicels to 1 mm long. Outer sepals 3, ovate, acuminate, ciliate-hairy, 1-1.5 mm long, accrescent to 1.8 mm in fruit; wing sepals elliptic-falcate, acuminate, ciliate at margin, hispid-hairy, 5-nerved, 2.5-3 mm long, accrescent to 3.5 mm in fruit. Petals violet or blue; midlobe boat-shaped, clawed, auricled at base, 3-5 mm long; crests 20-30,

forked in 3 bundles; lateral lobes obovate, truncate-emarginate at apex, 1.8 - 2 mm long. Stamens 8, monadelphous; sheath basally adnate to midlobe of petals, divided halfway down into 3 bundles with midbundle of 2 anthers and 2 lateral bundles of 2 anthers each. Ovary sessile, orbicular, ciliate-hairy; style ca 2 mm long; stigma hooked. Capsules ca 2 mm across, stiff-silky-hairy; caruncle hood-shaped, unequally 3-partite with longer arm membranous and appressed to seed.

Fl. & Fr.: Aug. - Feb.

Habitat: Dry shaded places in grasslands near forests and wastelands, to 1500 m, rare.

Distrib.: Thiruvananthapuram, Andhra Pradesh, C. India, Nicobar Islands and Tamil Nadu. South and SE. Asia.

5. *Polygala chinensis* L., Sp. Pl.: 704. 1753; Mukerjee in Bull. Bot. Soc. Bengal 12: 38. 1958 p.p.; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 464. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 64. 1994. *P. glomerata* Lour., Fl. Cochinch.: 426. 1790; A.W. Benn. in Hook.f., Fl. Brit. India 1: 206. 1872; Sundararaj in J. Bombay Nat. Hist. Soc. 52: 523. 1956.

Erect or ascending herb, to 75 cm high; stem woody at base; branches terete, hairy. Leaves oblong-elliptic, acute or narrow at base, acute and mucronulate at apex, (2 -) 4 - 9 x 1 - 2.5 cm, glabrous or sparsely puberulous; lateral nerves faint; petioles ca 1 mm long, pubescent. Flowers 6 - 7 mm long, dense in 5 - 20 mm long supra-axillary few-flowered 3 - 14-fascicled racemes, pale blue or greenish white with pink-violet blotches; pedicels 1 - 2 mm long; bracts lanceolate, acute, ca 1 mm long, ciliate, 6 or 7-nerved, caducous. Sepals persistent; outer sepals ovate-lanceolate or elliptic, falcate, acute to acuminate and long-mucronate or aristate at apex, 1.5 - 3 x 0.8 - 1 mm, unequal, ciliate at margin; wing sepals falcate, obliquely ovate, broad at base, acute or acuminate and mucronate at apex, 6 - 7 x 3 - 4 mm, ciliate at margin, green to greenish brown, 5-nerved. Petals 3-lobed; midlobe 4 - 8 mm long, keeled, white with purple or violet apex, crested with 16 - 20 filiform appendages in 2 bundles; lateral lobes obovate, as long as midlobe. Staminal sheath free or basally adnate to petals, 2.5 - 3 mm long, hairy; free portion of filaments arising at different levels on sheath. 1.5 - 2.5 mm long. Ovary orbicular, ca 1 mm, ciliate; style recurved, 4 - 5 mm

long; stigma 2-lobed, horseshoe-shaped. Capsules suborbicular, notched at apex, 5 - 7 mm across, strongly ciliate at narrow wings; seeds obovoid or ellipsoid, white-silky-hairy, black; caruncle hood-shaped with 2 narrowly oblong membranous appendages and a short tooth.

Fl. & Fr.: April - Jan.

Habitat: Among grasses on edges of evergreen forests, to 1500 m.

Distrib.: Kollam, Kozhikode, Palakkad, Pathanamthitta and Thiruvananthapuram. Central and NE. India and Tamil Nadu. South and SE. Asia.

6. *Polygala elongata* Klein ex Willd., Sp. Pl. 3: 879. 1802; A.W. Benn. in Hook.f., Fl. Brit. India 1: 203. 1872, excl. syn. *P. wightiana* Wight & Arn. 1834; Rama Rao, Fl. Pl. Travancore: 25. 1914; Dunn in Gamble, Fl. Madras: 58(42). 1915; Mukerjee in Bull. Bot. Soc. Bengal 12: 36. 1958; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 466. 1993.

Mal.: *Periyanka*

Annual, erect, ascending or prostrate herb; branches 15 - 40 cm long; stems angled near apex. Leaves sessile, oblong, elliptic or oblanceolate to linear-lanceolate, cuneate or attenuate at base, entire and recurved at margin, obtuse, subacute or retuse at apex, 8 - 60 x 2 - 12 mm, chartaceous, glabrous on both surfaces or puberulous; petioles to 1.5 mm long. Flowers 6 - 8 mm long, in supra-axillary or terminal to 20 cm long racemes, yellow; pedicels 6 - 8 mm long, tomentose; bracts ca 1 mm long, persistent. Outer sepals ovate or elliptic, acute, mucronate, 1.5 - 2.5 x 0.6 - 1.5 mm, ciliate at margin, otherwise glabrescent; wing sepals obliquely falcate, ovate or elliptic, acute, mucronate, 4 - 5 x 2 - 3 mm, sparsely ciliate or glabrous, persistent. Petals 5 - 6 mm long, 3-lobed, yellow with brown streaks; midlobe keeled, with a crest of branched shortly forked and notched appendages; lateral lobes obovate or suborbicular, clawed at base, rounded at apex, ca 6 x 4 mm. Staminal sheath free, to 3 mm long; free portion of filaments to 2 mm long, joining at different levels. Styles curved, to 4 mm long, hooked at apex with stigma inside. Capsules rhombate, obliquely emarginate at apex, inequilateral at base, narrowly margined, 4 - 6 x 3 - 4.5 mm, ciliate at margin, glabrous; seeds oblong-obovoid, 2.5 - 3.5 x 1.5 - 2 mm, white-silky-pilose, black; caruncle hood-shaped with 3 toothed or linear appendages, pale brown.

Fl.: July - Sept. *Fr.*: Sept. - Jan.

Habitat: Waste rocky places, open fallow lands, rice fields, roadsides, often on old walls, grasslands and on exposed dry slopes, to 1000 m.

Distrib.: Kannur, Kollam, Kasaragod, Malappuram, Pathanamthitta and Wynad. Southwestern Peninsular, C., E. and W. India.

Use: A decoction of leaf powder is reported to be useful in biliousness and constipation.

7. *Polygala erioptera* DC., Prodr. 1: 326. 1824; A.W. Benn. in Hook.f., Fl. Brit. India 1: 203. 1872; Dunn in Gamble, Fl. Madras: 59(42). 1915; Mukerjee in Bull. Bot. Soc. Bengal 12: 47. 1958; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 467. 1993. *P. vahliana* DC., Prodr. 1: 326. 1824. *P. erioptera* DC. var. *vahliana* (DC.) Chodat in Mem. Soc. Phys. Genève 31: 281. 1893.

Annual or perennial, erect, ascending or prostrate herb, somewhat pubescent; branches to 60 cm long. Leaves subsessile, oblong to linear, elliptic-obovate or oblanceolate, narrow at base, revolute at margin, acute or obtuse and emarginate at apex, 6-45 x 1-8 mm, patently hairy near margin, glabrescent above, tomentose beneath. Flowers ca 4.5 mm long, solitary or in to 3.5 cm long condensed leaf-opposed or extra-axillary racemes, pink or purple; pedicels to 2 mm long; bracts shorter than pedicels, persistent. Sepals persistent; outer sepals ovate-lanceolate to -elliptic, concave, acute-mucronate at apex, 1.5-2.5 x 0.7-1.2 mm, unequal, hyaline at margin, glabrous to densely hairy outside; wing sepals elliptic-obovate or oblong, obtuse to subobtuse, sometimes apiculate, 4-5 x 2-2.7 mm, 3-5-nerved with anastomosing nervules leaving a hyaline zone at margin, sparsely patently hairy outside, membranous in fruit. Petals 3-lobed, pink; midlobe keeled, 2.5-4.5 mm long, with a crest of 2 bundles of filiform pale pink appendages; lateral lobes deltoid or ovate, subacute, ca 3 x 4 mm. Staminal sheath free or slightly adnate to midlobe of petals, ca 1.5 mm long; free portion of filaments ca 1.5 mm long. Ovary ovoid, ca 1 mm long, pilose; style curved, broad in middle, to 3 mm long; stigma capitate. Capsules oblong or ellipsoid, obliquely notched, margined, 3.5-5 x 2-2.5 mm, pubescent; seeds oblong, ca 3 x 1.5 mm, densely pilose, black; caruncle galeate, crustaceous, bristly, lined by 3 membranous appendages. *Fl. & Fr.:* Almost throughout the year.

Habitat: Sandy soil and open dry rocky slopes in waste- cultivated and fallow

lands, roadsides, river banks and scrub forests, to 600 m.

Distrib.: Ernakulam and Wynad. Gangetic Plains, C. and Peninsular India. West Asia to Africa.

8. *Polygala jacobii* Chandrab. in Bull. Bot. Surv. India 9: 288, f.1. 1967; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 472. 1993. *P. chinensis* auct. non L. 1753: C.R. Mudaliar & S. Rao, Handb. S. Indian Weeds: 85, t. 32. 1955. *P. dunnii* Panigrabi in Kew Bull. 29: 655. 1974.

Perennial herb; branches arising from rootstock, sparse, slender, erect or decumbent-ascending, 15–60 cm long, brownish-tomentose, glandular. Leaves oblong-obovate or elliptic to oblanceolate, narrow at base, obtuse, rounded, retuse or emarginate and mucronate at apex, 3–45 x 2–15 mm, glabrous above, glaucous and sparsely pubescent on nerves beneath; petioles 1–1.5 mm long, pubescent. Flowers ca 6 mm long, solitary or in axillary extra-axillary or leaf-opposed 1–3.5 cm long 5–10-flowered racemes; bracts persistent; pedicels 2–3 mm long, accrescent to 3.5 mm, winged. Outer sepals ovate or lanceolate, acute or acuminate, 1–3 x 1–1.8 mm, hyaline at margin, ciliate, 1-nerved; wing sepals falcate, obliquely ovate, acuminate-mucronate at apex, 3–8 x 1.5–4.5 mm, 5–7-nerved, persistent. Petals yellow; midlobe undulate, ca 4 mm long, keeled, crested behind near apex with stalked 2-furcate filiform appendages; lateral lobes suborbicular, clawed at base, ca 4 mm across. Staminal sheath ca 1.5 mm long, free from petals; free portion of filaments ca 2 mm long with 8 anthers at different levels. Styles laterally compressed, curved, wide and hooked at apex. Capsules suborbicular or laterally elliptic, oblique at base, notched at apex, unequally 2-lobed, 3–5 x 4–6.5 mm, ciliate at narrow margin; seeds ovoid or obovoid, ca 4 mm long, appressedly stiff-silky-hairy, black-brown; caruncle hood-shaped, 3-lobed; lobes flat, covering almost 2/3 of seed, membranous, creamy white.

Fl. & Fr.: May–Dec.

Habitat: Among grasses in wetlands and river sides, mainly in plains.

Distrib.: Kerala (exact locality not known). Western Peninsular India. Endemic.

9. *Polygala javana* DC., Prodr. 1: 327. 1824; A.W. Benn. in Hook.f., Fl. Brit. India 1: 201. 1872; Rama Rao, Fl. Pl. Travancore: 25. 1914; Dunn in Gamble, Fl. Madras: 58(42). 1915; Mukerjee in Bull. Bot. Soc. Bengal 12: 44. 1958; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 473. 1993; M. Mohanan &

A.N. Henry, Fl. Thiruvananth.: 45. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 77. 2002. *P. javana* DC. var. *angustifolia* Thwaites, Enum. Pl. Zeyl.: 22. 1864. *P. sibirica* L. var. *heyneana* A.W. Benn. in Hook.f., Fl. Brit. India 1: 205. 1872 p.p. *P. raoi* R.N. Banerjee & L.K. Banerjee in Proc. Indian Acad. Sci. 28B: 218. 1975.

Erect-ascending herb or undershrub, 15 - 100 cm high; stems woody at base; branches divaricate, slender. Leaves subsessile, obovate, oblanceolate or elliptic-oblong to linear-, cuneate or attenuate at base, obtuse or rounded-mucronate at apex, (5 -) 15 - 45 x (2 -) 5 - 20 mm, rusty-strigose on both surfaces; petioles 1 - 2 mm long, puberulous. Flowers 7 - 8 mm long, in axillary terminal or leaf-opposed erect or pendulous 2 - 9 cm long (2 -) 5 - 15 (- many) - flowered racemes, yellow with purple crest or pinkish purple; bracts 3, ovate, 1 - 3 x 0.5 - 1 mm, puberulous, rarely caducous; pedicels to 6 mm long. Sepals 5, unequal, puberulous, yellow; outer sepals broadly ovate or lanceolate to elliptic-oblong, acute or subacute, mucronate, 1.5 - 4 x 1.2 - 2.5 mm; wing sepals broadly ovate, 3-angled, cordate at base, obtuse or subacute and mucronate at apex, 6 - 12 x 4 - 9 mm, distinctly nerved, yellowish turning pale green or reddish violet, persistent. Petals 3, adnate at base for 1/2, yellow; lateral petals ovate or elliptic-oblong, ca 3 mm long; keel petal 4 - 5 mm long, pale yellow or green with violet multifid filiform ca 2 mm long crest on back of apex. Stamens 8, pinkish; sheath 2 - 4 mm long, encircling style; free portion of filaments 0.5 - 0.7 mm long; anthers oblong-ovoid. Ovary stipitate, obcordate, to 1 mm long, velutinous; style curved, broad towards middle, to 5 mm long; stigma subterminal, funnel-shaped, violet. Capsules enclosed in persistent wing sepals, broadly oblong or suborbicular, notched at apex, margined, 4 - 6 x 3 - 5 mm, puberulous; seeds oblong, ca 4 x 2.5 mm, densely stiff-pubescent; caruncle hood-shaped, 3-armed, with 2 arms larger and winged, as long as and covering seed.

Fl. & Fr.: March - Sept.

Habitat: Dry regions, grasslands, roadsides and edges of forests and on exposed slopes, to 1200 m.

Distrib.: Kollam, Kottayam, Kozhikode, Pathanamthitta, Thiruvananthapuram and Wynad. Peninsular India. South and SE. Asia.

Note: The leaf shape and size may vary much depending on the habitat.

10. *Polygala linarifolia* Willd., Sp. Pl. 3: 877. 1803; R.N. Banerjee in

B.D. Sharma & N.P. Balakr., Fl. India 2: 476. 1993. *P. chinensis* L. var. *brachystachya* A.W. Benn. in Hook.f., Fl. Brit. India 1: 204. 1872, non *P. brachystachya* Blume 1825. *P. chinensis* L. var. *linarifolia* (Willd.) Chodat in Mem. Soc. Phys. Genève 31: 381. 1893; Mukerjee in Bull. Bot. Soc. Bengal 12: 40. 1958.

Erect, prostrate or ascending herb, to 35 cm high; branches arising from base, tomentose. Leaves subsessile, linear, rarely narrowly lanceolate, apiculate at apex, 4 - 5 x 0.5 - 1 cm, glabrous and dark green above, pale and scarcely ciliate on nerves beneath, 1-nerved. Flowers 5 - 7 mm long, in leaf-opposed to 2 cm long many-flowered glabrous racemes; pedicels drooping, 2 - 3 mm long, glabrous. Outer sepals oblong-obovate, ca 2 mm long; wing sepals ovate-lanceolate, apiculate, ca 7 mm long, ciliate-hairy outside, glabrous inside. Midlobe of petals ca 5 mm long; lateral lobes ca 3 mm long. Ovary subsessile, obovate, ca 1.5 mm long, ciliate at apex. Capsules obcordate, unequal at apex, winged, glabrous, patently ciliate at margin; caruncle of seeds 3-lobed.

Fl. & Fr.: April - Nov.

Habitat: Slopes of dried up watercourses and moist meadows in forests, to 1000 m.

Distrib.: Kerala (exact locality not known). Gangetic Plains, C., NE. and Peninsular India. South and SE. Asia.

11. *Polygala persicariifolia* DC., Prodr. 1: 326. 1824; A.W. Benn. in Hook.f., Fl. Brit. India 1: 202. 1872 (as *persicariaefolia*); Dunn in Gamble, Fl. Madras: 58(42). 1915; Manilal, Fl. Silent Valley: 15. 1988; Vajr., Fl. Palghat: 65. 1990; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 480. 1993.

Herb, 10 - 60 cm high; stems terete, erect or decumbent, dichotomously branched at top or simple and arising directly from base, finely crisp-hairy, purplish. Leaves alternate, subsessile, ovate-oblong, lanceolate, elliptic or linear-oblong, subacute or cuneate at base, acute or subacute and mucronate at apex, 15 - 65 x 3 - 20 mm, revolute or flat at margin, glabrous, pubescent or sparsely strigose on nerves beneath; basal leaves smaller. Flowers 3 - 5 mm long, in 4 - 14 cm long terminal and extra-axillary or leaf-opposed erect or patent racemes, pink, purple or reddish with pink streaks; pedicels 1 - 3 mm long, directed downward; bracts 3, lanceolate, 1 - 2 mm long, persistent. Sepals persistent; outer sepals elliptic-oblong to lanceolate, obtuse, 2.5 - 3 mm long, subequal,

puberulous at margin; wing sepals rounded, broadly and obliquely obovate to suborbicular, rounded at apex, 5 - 6 x 4 - 5 mm, petaloid, glabrescent or puberulous at margin, 3 - 5-nerved, reddish. Petals pink, purple or yellowish with purple streaks, hairy inside; midlobe ca 6 mm long, keeled with a crest of 2 or 3 bundles of linear membranous forked appendages; lateral lobes obliquely oblong, smaller. Staminal sheath adnate to petals, 1.5 - 2.5 mm long, pink; free portion of filaments ca 1.2 mm long. Ovary obovoid, less than 1 mm long, ciliate at margin; style curved, wide towards middle, broad at apex, ca 3 mm long; stigma oblique, lateral. Capsules elliptic or obcordate, symmetric at base, emarginate at apex, compressed, 5 - 6 x 4 - 4.5 mm, membranous, winged and ciliate at margin above; seeds oblong or ellipsoid, 3 - 3.5 x ca 1.5 mm, hirsute with dense silky light brownish or white hairs, black; caruncle hood-shaped, 3-lobed with short blunt lobes and narrow sinuses.

Fl.: May - July *Fr.*: Aug. - Nov.

Habitat: Humus-covered soil in shaded places in grasslands along edges of forests and roadsides, 1000 - 2000 m.

Distrib.: Idukki, Kottayam, Palakkad and Wynad. Peninsular India, lower regions of Himalayas, Indo-Gangetic Plains to NE. India. Australia, S. & SE. Asia and tropical E. Africa.

12. *Polygala rosmarinifolia* Wight & Arn., Prodr. Fl. Ind. Orient.: 37. 1834; A.W. Benn. in Hook.f., Fl. Brit. India 1: 204. 1872; Rama Rao, Fl. Pl. Travancore: 25. 1914; Dunn in Gamble, Fl. Madras: 58(42). 1915; Mukerjee in Bull. Bot. Soc. Bengal 12: 38. 1958; Manilal & Sivar., Fl. Calicut: 37. 1982; Vajr., Fl. Palghat: 65. 1990; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 480. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 65. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 47. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 78. 2002.

Erect, decumbent or prostrate herb, to 45 cm high; branches densely appressed-pubescent. Leaves sessile or subsessile, linear, elliptic and very rarely oblong or oblanceolate, attenuate at base, thick and recurved at margin, acute or acuminate and apiculate at apex, (5 -) 10 - 40 (- 55) x 2 - 4 (- 6) mm, hairy above, pubescent beneath densely so on midnerve; petioles to 0.5 mm long. Flowers ca 4.5 mm long in lateral extra-axillary or axillary erect to 3 cm long 3 - 8-flowered

racemes, yellow, rarely solitary; bracts caducous; bracteoles 3, ovate, ca 1 mm long, ciliate at margin, tomentose, persistent; pedicels erect, pubescent, ca 1.5 mm long, to 2.5 mm in fruit. Outer sepals pale yellow or chocolate-coloured at tips, ovate to obovate or lanceolate, acute-mucronate at apex, 2 2.5 x 0.4 1.2 mm, ciliate along margin, patently hairy; wing sepals oblong or obliquely elliptic, acute or short-acuminate at apex, ca 4.5 x 2 3 mm, ciliate at margin, glabrous, subparallelly 5-nerved, persistent. Petals yellow with red markings; midlobe to 3 mm long, keeled with a crest of forked filiform appendages on back, 3.5 - 4 mm long; lateral lobes suborbicular, spatulate, truncate, 2.5 3 x ca 2 mm, membranous, wrinkled, prominently nerved. Staminal sheath to 1.5 mm long; lateral pairs of filaments subconnate; terminal filaments free, to 0.6 mm long; anthers oblong, to 0.4 mm long. Ovary obliquely obovate, emarginate, ca 3 mm across, ciliate at margin; style to 3 mm long, curved, broad towards horseshoe-shaped apex; stigma lateral, capitate. Capsules rhomboid or obliquely obovate, inequilateral at base, emarginate at apex, narrowly winged and ciliate at margin, 4 5 x 2.5 3 mm; seeds oblong-subcylindric, truncate at apex, 2.5 3 x 1 1.5 mm, brownish-hirsute, black; caruncle hood-shaped with 2 oblong curved ca 0.8 mm long appendages and a short tooth.

Fl. & Fr.: Almost throughout the year.

Habitat: Open hilly grasslands, roadsides, cleared forests etc., 500 2000 m.

Distrib.: Idukki, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Central and Peninsular India. Sri Lanka.

13. *Polygala sibirica* L., Sp. Pl.: 702. 1753; A.W. Benn. in Hook.f., Fl. Brit. India 1: 205. 1872; Rama Rao, Fl. Pl. Travancore: 25. 1914; Dunn in Gamble, Fl. Madras: 58(42). 1915; Mukerjee in Bull. Bot. Soc. Bengal 12: 43. 1958; Manilal & Sivar., Fl. Calicut: 37. 1982; Manilal, Fl. Silent Valley: 16. 1988; Vajr., Fl. Palghat: 66. 1990; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 481. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 65. 1994; Sivar. & P. Mathew, Fl. Nilambur: 63. 1997. *P. heyneana* Wight & Arn., Prodr. Fl. Ind. Orient.: 38. 1834 p.p.

Perennial, erect or decumbent herb, 10 - 45 cm, pubescent; stems many, slender, ascending, deep-rooted. Leaves linear-oblong to elliptic-lanceolate, rounded or attenuate at base, flat or recurved at margin, acute-mucronate at apex, 6 - 35 x

2 - 10 mm, coriaceous, scabrid above, hairy on nerves beneath; lateral nerves 3 - 9 pairs; nervules prominently reticulate; petioles ca 1 mm long, hairy. Racemes leaf-opposed or terminal, 2 - 10 cm long; bracts linear-lanceolate, 3 - 4 mm long, puberulous; pedicels 3 - 4 mm long, slender, pubescent, elongating and recurved in fruit. Flowers 6 - 7 mm long. Sepals green with purple edges, pubescent, persistent; outer sepals oblong-ovate to linear-lanceolate, concave, 2.5 - 3.5 x 1.5 - 2 mm, subequal; wing sepals falcately ovate-lanceolate or obovate, narrow at base, acute, obtuse or rounded at apex, 5 - 8 x 2 - 4 mm, membranous, ciliate or puberulous at margin, glabrous, 3 - 7-nerved. Petals lavender blue; midlobe rounded, keeled, 5 - 6 mm long, with a much branched linear-appendaged white crest on back near apex; lateral lobes linear-oblong, obtuse, mucronate, 4 - 5 mm long. Stamens 8; filaments connate at different levels in a sheath, to 2.5 mm long; free portion to 1 mm long. Ovary subglobose, glabrous; style ca 6 mm long, enlarged and curved at apex; stigma terminal, 2-dentate, superposed. Capsules suborbicular, obcordate, notched at apex, 4 - 5 x 5 - 6 mm, winged for 1 - 2 mm at margin, glabrous; seeds oblong-ellipsoid, 3 - 4 x 2 - 2.5 mm, sparsely and minutely pilose, dark brown; caruncle 3-fid; long arm ca 2.5 mm long; shorter arms ca 1.5 mm long, covering 1/2 - 2/3 of seed.

Fl. & Fr.: March - Dec.

Habitat: Wet soil in grasslands, cleared forests and roadsides, 1500 - 2500 m.

Distrib.: Idukki, Kottayam, Kozhikode, Malappuram, Palakkad and Thiruvananthapuram. Southern India, W. to E. Himalayas and NE. India. China, Europe and E. Asia.

14. *Polygala telephioides* Willd., Sp. Pl. 3: 876. 1802; A.W. Benn. in Hook.f., Fl. Brit. India 1: 205. 1872; Dunn in Gamble, Fl. Madras: 59(42). 1915; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 485. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 65. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 79. 2002. *P. brachystachya* DC., Prodr. 1: 326. 1824, non Blume 1825; Mukerjee in Bull. Bot. Soc. Bengal 12: 43. 1958.

Herb, 5 - 35 cm high; rootstock woody; stems branched or not, prostrate, ascending or rarely erect, terete below, angled above, velutinous or sericeous. Leaves sessile or subsessile, elliptic, obovate, oblong or linear-oblong, attenuate at base, obtuse or acute and mucronate at apex, 5 - 30 x 2 - 8 mm, glabrous or

sericeous on both surfaces; nerves obscure above, prominent beneath; petioles to 1 mm long, spreading exposing internodes. Flowers ca 3 mm long, crowded in leaf-opposed or lateral to 12 mm long racemes, violet or blue; bracts caducous. Outer sepals linear-lanceolate to ovate-acute, mucronate, concave, ciliate at margin, 1.2 x 0.5 - 1.2 mm, pubescent outside, glabrous inside; wing sepals elliptic or obliquely ovate-lanceolate, acuminate-apiculate at apex, ca 5 x 3 mm, glabrous or sericeous, persistent, 3 - 5-nerved. Petals ca 4 mm long, blue; midlobe keeled, crested with stalked capitate finger-like appendages on back near apex; lateral lobes obovate, subobtuse, ca 1.5 mm long. Staminal sheath basally adnate to petals, ca 1.8 mm long, split for 2/3; filaments 8, arising at different levels from sheath with 2 free filaments in middle and 2 bundles of 3 connate filaments on either side with sessile anthers. Ovary orbicular, flat, pilose at margin; styles bent, broad in middle and apex, ca 3 mm long, glabrous; stigma hooded. Capsules enclosed in wing sepals, broadly ovoid or suborbicular, emarginate at apex, ca 2.5 mm across, glabrous, sericeous at margin; seeds oblong or cylindrical, obtuse, ca 3 mm long, silky-hairy; caruncle hood-shaped with 3 linear short appendages.

Fl. & Fr.: Aug. - Jan.

Habitat: Sandy humus soil in moist situations in open grasslands, to 1000 m.

Distrib.: Pathanamthitta and Thiruvananthapuram. Gangetic Plains, C. and Peninsular India. South and SE. Asia.

15. *Polygala wightiana* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 38. 1834; Dunn in Gamble, Fl. Madras: 59(42). 1915; Mukerjee in Bull. Bot. Soc. Bengal 12: 37. 1958; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 488. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 79. 2002. *P. elongata* sensu A.W. Benn. in Hook.f., Fl. Brit. India 1: 203. 1872 p.p., non Klein ex Willd. 1802.

Erect or ascending herb; branches 10 - 40 cm, often dichotomous at apex, glabrous, glaucous. Leaves subsessile, narrow below, entire, obtuse, subacute and mucronate at apex, flat or recurved at margin, 3 - 3.5 x 1 - 1.3 mm, chartaceous, glabrous. Flowers 3 - 4 mm long, in extra-axillary or leaf-opposed 1 - 8 cm long racemes, yellow; bracts ca 1 mm long. Sepals persistent; outer sepals unequal, lanceolate to ovate-lanceolate, acute-mucronate at apex, 2.5 x 0.5 - 1.2 mm, glabrous; wing sepals obliquely ovate, falcate, subacute-mucronate or apiculate at apex, ca 4.5 x 2.5 mm, glabrous, 5-nerved, petaloid. Petals 2 - 2.5 mm long,

greenish tinged with pink; midlobe keeled, auricled at base, to 3.5 mm long, with a crest of linear forked appendages on back; lateral lobes obovate, clawed, rounded at apex, to 2.5 mm long, hairy at base. Staminal sheath free, ca 1.5 mm long; filaments connate into 3 bundles; lateral ones with 3 sessile anthers each and middle one with 2 anthers with filaments united for halfway. Ovary ovoid, glabrous, ciliate at margin; style slender, curved, hooked at apex with membranous wings, to 3.5 mm long. Capsules overtopped by wing sepals, oblong, emarginate at apex, margined, 2.5 - 4 x 1.5 - 2.5 mm, glabrous; seeds oblong, truncate at apex, 2 - 3 x 0.5 - 1 mm, densely silky-hairy, black; caruncle hood-shaped with 3 curved small toothed-appendages.

Fl. & Fr.: Aug. Dec.

Habitat: Wastelands, cultivated fields, roadsides, to 1800 m.

Distrib.: Thiruvananthapuram. Peninsular India. Indomalesia to N. Australia.

2. SALOMONIA Lour., nom. cons.

Annual, small herbs, erect, ascending, sometimes root-parasites; stems angled. Leaves alternate, petioled or not, entire, 3-nerved, rarely reduced to scales. Flowers sessile, crowded in terminal or axillary spikes, opposite or superposed, each in axil of an acute caducous bract with 2 minute bracteoles at base. Sepals 5, subequal; inner 2 larger, persistent; anterior 2 shorter; segments recurved, acute. Petals 3, connate at base into a tube and adnate to staminal tube, cleft above, violet; lower petal keeled, vaulted, subentire, longer than outer ones, without a crest. Stamens 4 - 6, monadelphous; tube adnate to corolla tube; anthers connate into a rectangular mass, dehiscing by a terminal pore. Ovary 2-loculed; ovule 1 in each locule, pendulous; style thick above, incurved at apex. Capsules obcordate, ovoid or subreniform, thin-walled, dehiscing loculicidally along margin; seeds orbicular, glabrous, black; strophiole very small, gelatinous or absent.

Indomalesia to Australia, 8 species, 2 in India and 1 in Kerala.

Salomonium ciliatum (L.) DC., Prodr. 1: 334. 1824; A.W. Benn. in Hook.f., Fl. Brit. India 1: 206. 1872; Lauener in Notes Roy. Bot. Gard. Edinburgh 26: 344. 1964; Manilal & Sivar., Fl. Calicut: 38. 1982; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 490. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 48. 1996. *Polygala ciliata* L., Sp. Pl.: 705. 1753. *Salomonium oblongifolium* DC., Prodr. 1: 334. 1824; A.W. Benn. in Hook.f., Fl. Brit. India 1: 207. 1872; Dunn in Gamble,

Fl. Madras: 56(41). 1915. *S. obovata* Wight, Ill. Ind. Bot. 1: t. 22B. 1840.

Annual herb, erect or decumbent, 5–25 cm high; stems angled, often glabrous, fluted. Leaves sessile, elliptic to oblong-lanceolate, rounded-obtuse or subcordate at base, entire and ciliate at margin, obtuse-mucronate at apex, 4–14 x 2–8 mm, sparsely ciliate or glabrous. Inflorescences terminal and axillary, 10–17 cm long; rachises winged; bracts linear, ca 1.5 mm long. Flowers opposite, superposed, crowded, 2–3 mm long, pink. Sepals linear-lanceolate, acute at apex, 1.5–2 x ca 0.5 mm, ciliate, persistent; inner 2 somewhat larger. Petals 3, pink or purplish; median petal keeled, ca 3 mm long; lateral ones lanceolate, to 1.8 mm long, adnate to keel petal. Stamens 4, monadelphous; sheath ca 2 mm long; anthers 2-loculed, undifferentiated. Ovary sessile, obovate or orbicular, compressed, spinulose; style ca 2 mm long, curved, flat, hyaline; stigma capitate. Capsules obreniform, deeply notched or 2-lobed at base, winged at margin, ca 1 x 2 mm; central area with subparallel margin; upper prickles 0.5–0.75 mm long, erecto-patent; lower margin inermous; seeds rounded, gelatinously strophioled, ca 0.5 mm across, black.

Fl. & Fr.: Aug.–Dec.

Habitat: Wet places, grasslands and bunds of cultivated fields, to 1000 m.

Distrib.: Kannur, Kollam, Kozhikode, Malappuram, Pathanamthitta, Thrissur and Wynad. Gangetic Plains, C., NE. and Peninsular India. Europe, S. and SE. Asia.

XANTHOPHYLLACEAE

(R.N. BANERJEE & N.P. BALAKRISHNAN)

Trees or shrubs. Leaves alternate, exstipulate, coriaceous or chartaceous, often drying yellowish; petioles thick, channelled above. Racemes axillary, extra-axillary or terminal, simple or paniced, patently branched. Flowers 2- or 3-nate, short-pedicelled. Sepals 5, nearly equal, free; inner 2 larger. Petals 5, rarely 4, free, subequal, declinate, glabrous; lowest one keeled, boat-shaped, not crested, sometimes soft-pubescent; other 4 subequal, narrowly oblong, glabrous; upper 2 recurved in upper half. Stamens mostly 8 (–10), usually all free or 2 partially adnate to keel petal, 4 connate with other petals singly at base and remaining 2 free, inserted on disc; filaments upcurved, strigose-ciliate at base or not; anthers erect, 2-loculed, dehiscing longitudinally by double slits. Disc hypogynous, annular.

Ovary stipitate or not, woolly or glabrous, 1- or imperfectly 2-loculed; stigma terminal, small. Fruits usually 1-seeded indehiscent drupes, globose, exalate, fleshy when fresh, woody and coriaceous on drying; seeds globose or subglobose. estrophiolate; endosperm copious or absent; cotyledons planoconvex, thick, fleshy.

Indomalesia, 1 genus and ca 90 species, 4 in India and 1 in Kerala.

XANTHOPHYLLUM Roxb., nom. cons.

(Characters as for family)

Xanthophyllum flavescens Roxb., Pl. Coromandel 3: 81, t. 284. 1820; Bourd., Forest Trees Travancore: 21. 1908; Rama Rao, Fl. Pl. Travancore: 26. 1914; Dunn in Gamble, Fl. Madras: 59(42). 1915; V.S. Ramach. & V.J. Nair, Fl. Canannore: 51. 1988; Vajr., Fl. Palghat: 66. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 66. 1994, excl. var. *angustifolium* (Wight) A.W. Benn.

var. **flavescens**: A.W. Benn. in Hook.f., Fl. Brit. India 1: 209. 1874; R.N. Banerjee & N.P. Balakr. in B.D. Sharma & N.P. Balakr., Fl. India 2: 497. 1993. *X. arnottianum* Wight, Ill. Ind. Bot. 1: 50, t. 23, f. 9. 1840; Meijden in Leiden Bot. Ser. 7: 79. 1982; Nicolson & al. in Regnum Veg. 119: 210. 1988; Manilal, Fl. Silent Valley: 16. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 48. 1996; Sivar. & P. Mathew, Fl. Nilambur: 64. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 80. 2002.

Mal.: *Karungali, Madakka, Mottal.*

Evergreen tree, 3 - 10 m high; bark grey, warty and corky with fine fissures; branchlets slender, pendulous, puberulous with ca 1 mm long blunt spinose protruberances in vertical series of 2 or 3 above axils of petioles. Leaves elliptic or oblong-lanceolate, acute or subacute at base, entire to subundulate at margin, bluntly acute or long-acuminate at apex, 9 - 20 x 3 - 6 cm, coriaceous, glabrous, shining above, yellowish green when dry; lateral nerves 5 - 9 pairs with stout intermediaries, scattered, often with a few perforated glands in axils of nerves or at angles of nervules; petioles 5 - 10 mm long, rugose, glabrous. Flowers 10 - 13 mm across, white or yellowish, in 9 - 15 cm long axillary or terminal pubescent panicles; pedicels ca 5 mm long, puberulous. Sepals elliptic or suborbicular, subequal, 3 - 5 x ca 2 mm, fleshy, densely pubescent, brownish yellow. Petals (4 or) 5, narrowly oblong, obtuse, subequal, 7 - 10 x 3 - 4 mm, yellowish; upper 2 with recurved upper half. Stamens 8, 7 - 9 mm long, strigose-ciliate at

base, rarely glabrous, 6 adnate to petals, 2 on disc; filaments green; anthers white. Disc hypogynous, annular, deeply lobed. Ovary short-stipitate or sessile, ovoid, densely brownish-strigose; ovules 9 - 12; style brown-hairy, curved with truncate white stigma. Fruits globose, 1.5 - 2.2 cm, olive green when young, yellow when mature, brownish grey and rugose when dry; seeds ovoid to oblong, ca 1.5 cm across.

Fl.: Feb. - May *Fr.*: May - Aug.

Habitat: Evergreen and moist deciduous forests, to 1800 m, common.

Distrib.: Almost throughout Kerala. Andhra Pradesh, Assam, Karnataka, Meghalaya and Tamil Nadu. South and SE. Asia.

Use: Bark is used to purify drinking water by boiling in it which also acts as a cooling agent.

CARYOPHYLLACEAE

(P. DANIEL)

Annual, biennial or perennial herbs, subshrubs or rarely shrubs, dichotomously branched; stems often swollen at nodes. Leaves usually opposite, sometimes alternate, rarely whorled, simple, often connate at base, entire, rarely serrulate; stipules sometimes connate, scarious, rarely absent. Inflorescences usually terminal, paniced, racemiform, capitate dichasial cymes or cincinni, sometimes few-flowered or solitary; bracts often scarious. Flowers actinomorphic, usually bi-, rarely unisexual. Sepals 4 or 5(- 25), imbricate, rarely spiral, free or connate into a tube, often scarious at margin. Receptacle often prolonged into an anthophore carrying petals, stamens and ovary. Petals (4 or)5(- 12), free, entire, emarginate or 2- rarely 4-fid, often basally clawed, sometimes with appendages on inner face, sometimes small or absent. Stamens (1 -)10(- 13), free, usually in 2 series, mostly obdiplostemonous; filaments free, filiform, those opposite sepals sometimes with a glandular thickening at base; anthers 2-loculed, dorsifixed; locules parallel, sometimes separate, dehiscing longitudinally. Ovary superior, 1-, rarely incompletely 2 - 5-loculed at base; ovules 2 - many, rarely 1, campylo- or semianatropous; placentation free-central, axile or basal; styles 1 - 5, free or partially connate. Fruit a capsule, opening by as many or twice as many apical teeth or valves as there are styles, sometimes fleshy dehiscing irregularly or indehis-

cent, an achene or nutlet; seeds usually many, rarely few 1, endospermous; embryo usually curved or straight.

Cosmopolitan, mostly in temperate and alpine regions, some tropical. 87 genera and 2300 species, 25 and 122 in India and, 4 and 5 in Kerala.

Literature: Ghazanfar, S.A. & Nasir, Y.J. 1986. *Caryophyllaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. Pakistan* 175: 1 - 125. Majumdar, N.C. 1975. A note on the family *Caryophyllaceae* with special reference to the Indian species. *Bull. Bot. Surv. India* 14: 71 - 75. Pax, F. & Hoffmann, G.F. 1934. *Caryophyllaceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2, 16C: 275 - 367.

Key to genera

- | | | |
|-----|---|----------------------|
| 1a. | Petals 2-fid for at least 1/3 | 2 |
| b. | Petals not 2-fid | 3 |
| 2a. | Styles 3 - 5, free; capsules cylindric | 1. Cerastium |
| b. | Styles 2 or 3, connate below to middle; capsules ovoid to globose | 2. Drymaria |
| 3a. | Diffuse herbs; sepals keeled or hooded | 4. Polycarpon |
| b. | Erect herbs; sepals neither keeled nor hooded | 3. Polycarpha |

1. CERASTIUM L.

Annual or perennial herbs. Leaves sessile or subsessile, entire. Flowers usually in terminal dichotomous cymes, 5-, rarely 4-merous. Sepals 5, free, scarious, membranous at margin. Petals as many as sepals, 2-fid, white, rarely absent. Stamens usually 10, rarely less, hypogynous; nectaries present. Ovary 1-loculed; styles 3 - 5, filiform. Capsules cylindric, longer than sepals, opening by twice as many short teeth as styles; seeds many, globose, ovoid or reniform, compressed, rough, often tubercled.

Almost cosmopolitan, ca 100 species, 7 in India and 1 in Kerala.

Cerastium glomeratum Thuill., *Fl. Env. Paris* ed. 2, : 226. 1799; Dunn in Gamble, *Fl. Madras*: 61(44). 1915; Majumdar in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 523. 1993. *C. vulgatum* L., *Fl. Suec.* ed. 2, : 158. 1755 p.p.; Wight, *Icon. Pl. Ind. Orient.*: t. 948. 1845. *C. vulgatum* L. var. *glomeratum* (Thuill.) Edgew. & Hook.f. in Hook.f., *Fl. Brit. India* 1: 228. 1874.

Annual herb, 10 - 45 cm high, glandular-pubescent; flowering shoots erect or ascending. Leaves sessile, oblong, lanceolate, ovate, obovate or elliptic, basal ones sometimes spatulate, obtuse at base, entire and ciliate at margin, obtuse and apiculate at apex, 10 - 25 x 6 - 9 mm, white-hairy. Cymes clustered; flowers lax; bracts lanceolate, ca 5 x 3 mm, herbaceous, hairy; pedicels 2 - 5 mm long. Sepals lanceolate, acuminate at apex, 4 - 5 x 1 - 1.5 mm, pubescent. Petals 2-lobed, much longer than sepals, white. Stamens 5(- 10). Capsules cylindrical, curved above, 8 - 11 mm long, scarious, straw-coloured, dehiscent by 10 straight teeth; seeds ovoid, ca 0.5 x 0.3 mm, rugose-tubercled, pale brown.

Fl. & Fr.: Almost throughout the year.

Distrib.: Idukki. Almost throughout hilly regions in India. Bhutan and Nepal.

2. DRYMARIA Willd. ex Schult.

Annual herbs, prostrate to suberect, branching, glabrous or pubescent. Leaves opposite, petioled or not, deltoid-ovate to suborbicular; stipules scarious, persistent or fugacious. Flowers in dichasial cymes, rarely solitary, axillary. Sepals 5, free, scarious at margin. Petals 3 - 5, usually 2-lobed, often auricled, white. Stamens 2 - 5; filaments slightly connate at base; anthers versatile. Carpels usually 3; ovary short-stipitate, 1-loculed; ovules campylotropous; styles 2 or 3, more or less connate below to middle. Capsules ovoid to globose, 3-valved; seeds 1 - many, globose or reniform, cochleate, tubercled.

Tropical and subtropical Asia, Africa and Madagascar, America and the West Indies, ca 50 species, 2 in India and 1 in Kerala.

Literature: Malick, K.C. & Majumdar, N.C. 1977. Observations and critical notes on Indian *Drymaria* Willd. ex Schultes. *Bull. Bot. Surv. India* 16: 151 - 153.

Drymaria diandra Blume, *Bijdr.*: 62. 1825; Majumdar in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 533. 1993. *D. cordata* auct. non Willd. ex Roem. & Schult. 1819: Edgew. & Hook.f. in Hook.f., *Fl. Brit. India* 1: 294. 1874 p.p.; Dunn in Gamble, *Fl. Madras*: 63(46). 1915; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 66. 1994. *D. cordata* (L.) Willd. ex Roem. & Schult. subsp. *diandra* (Blume) J.A. Duke in *Ann. Missouri Bot. Gard.* 48: 253. 1961; Majumdar in *Bull. Bot. Surv. India* 10: 294. 1969; Manilal, *Fl. Silent Valley*: 17. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 51. 1988; Vajr., *Fl. Palghat*: 67. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 49. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 64. 1997.

Annual herb, prostrate or ascending, glabrous to glandular-papillate; branches slender, elongate, arising from base, rooting at nodes. Leaves opposite, ovate-cordate to suborbicular, usually cordate at base, entire at margin, acute or obtuse-mucronate at apex, 5 - 25 x 3 - 20 mm, chartaceous, glabrous, 3 - 7-nerved; petioles 2 - 5 mm long; stipules lacerate into 2 mm long filaments. Cymes terminal or axillary, lax; bracts lanceolate, ca 2.5 mm long; pedicels 1 - 8 mm long, finely glandular-pubescent. Sepals 5, narrowly obovate to elliptic-ovate, 2 - 4.5 mm long, keeled, inflexed, 3-nerved, glandular-papillose on nerves. Petals 3 - 5, 2-fid nearly to middle or more, white; lobes oblong, obtuse, 1.5 - 3 mm long, 1-nerved. Stamens 2 or 3, 1.6 - 2.2 mm long; anthers suborbicular. Ovary globose; styles 2- or 3-fid. Capsules oblong, 2- or 3-valved, 1.5 - 2.5 mm long; seeds 1 - few, cochleate, 1 - 2 mm across, finely tubercled.

Fl. & Fr.: Feb. - Nov.

Habitat: Shady places and in moist situations, ca 800 m, common.

Distrib.: Almost throughout Kerala. Arunachal Pradesh, Assam, Karnataka, Meghalaya, Nagaland, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and W. Bengal. Africa, E., S. and SE. Asia to Australia.

3. POLYCARPAEA Lam., nom. cons.

Annual or perennial herbs, usually erect. Leaves opposite or pseudo-ver-ticillate, linear to obovate; stipules fimbriate or scarious. Flowers many in spreading or condensed cymes. Sepals 5, scarious, sometimes coloured. Petals 5, entire, 2-toothed or with erose margin. Stamens 5, connate together and with petals forming a tube. Ovary 1-loculed; ovules few - many; style slender, 3-fid. Capsules 3-valved; seeds ovoid or flat.

Tropics and subtropics especially Old World, ca 50 species, 5 in India and 2 in Kerala.

Literature: Bakker, K. 1957. Revision of the genus *Polycarpaea* (*Caryophyllaceae*) in Malaysia. *Acta Bot. Neerl.* 6: 48 - 53. Daniel, P. & al. 2000. A taxonomic reassessment of the genus *Polycarpaea* Lam. (*Caryophyllaceae*) in India. *J. Swamy Bot. Club* 17: 3 - 17.

Key to species

- 1a. Leaves pseudover-ticillate; stems hoary-tomentose; sepals colourless or silvery white, with pale orange-red streaks 2. *P. corymbosa*

b. Leaves opposite; stems densely white-tomentose; sepals bright reddish brown 1. *P. aurea*

1. *Polycarpaea aurea* (Wight) Dunn in Gamble, Fl. Madras: 65(46). 1915; Manilal & Sivar., Fl. Calicut: 38. 1982. *P. corymbosa* (L.) Lam. var. *aurea* Wight, Ill. Ind. Bot. 2: 44, t. 110. 1850 (as *ainea* in text); Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 245. 1874; Majumdar in B.D. Sharma & N.P. Balakr., Fl. India 2: 551. 1993.

Annual herb, erect, to 30 cm high, sometimes shorter, much branched and suffruticose; branches terete; internodes long, densely white-pubescent turning grey-pubescent or glabrescent when old. Leaves opposite, rarely pseudovercillate due to presence of a few secondary leaves in axils, sessile, linear, obtuse at base, entire at margin, mucronate at apex, 10–50 x 1–2 mm, glabrous; surface wrinkled and margin recurved on drying; stipules scarious, lanceolate, entire, acuminate, ca 3 mm long, nerveless, colourless or yellowish brown. Inflorescences irregular lax cymes. Flowers highly coloured, ca 3 mm long; bracteoles ovate-lanceolate, entire, acute, 1–1.2 x ca 1 mm, grey with a faint brownish tinge; pedicels ca 1 mm long, pubescent. Sepals 5, free, ovate-lanceolate, entire, acute, ca 2 x 0.8 mm, exceeding petals and capsules, scarious, reddish brown. Petals 5, free, oblong-obovate, obtuse, ca 1.2 x 0.5 mm, partly enclosing capsule, shining, brown. Stamens 5, forming a cup of ca 0.2 mm high at base with petals and encircling ovary. Ovary 1-loculed, free from base, conic, obtuse, ca 0.6 x 0.4 mm; style slender, ca 0.4 mm long, 3-fid. Capsules ovate-elliptic, ca 1.2 x 1 mm, small-stiped, 3-valved; tips faintly incurved when young, recurved after dehiscence; seeds 3–5, reniform, ca 0.5 x 0.3 mm, purplish brown with radiating lines at attachment and a groove.

Fl. & Fr.: Oct.–Dec.

Habitat: More common on hills and rocky areas.

Distrib.: Idukki, Kottayam, Kozhikode and Malappuram. Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu. Endemic.

Note: The distinction between *P. aurea* and *P. corymbosa* becomes obscure for two reasons. (i) Older stems become glabrescent as in *P. corymbosa* though densely tomentose when young (ii) Sepals turn colourless as the flowers grow old in some specimens and resemble that of *P. corymbosa*. However, the ring formed of petals and stamens is cupular in *P. aurea* in contrast to *P. corymbosa* where it is just a ring.

2. Polycarpaea corymbosa (L.) Lam., Tabl. Encycl. 2: 129. 1792; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 245. 1874; Rama Rao, Fl. Pl. Travancore: 26. 1914; Dunn in Gamble, Fl. Madras: 65(46). 1915; Manilal & Sivar., Fl. Calicut: 38. 1982; Nicolson & al. in Regnum Veg. 119: 80. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 52. 1988; Majumdar in B.D. Sharma & N.P. Balakr., Fl. India 2: 549. 1993, excl. var. *aurea* Wight 1850; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 67. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 49. 1996. *Achyranthes corymbosa* L., Sp. Pl.: 205. 1753.

Mal.: *Akkaramkolli*

Annual or perennial herb, decumbent, erect or suberect, densely tomentose to glabrescent with woody rootstock. Leaves pseudovercillate, linear to linear-subulate, -oblong or -lanceolate, obtuse at base, entire at margin, apiculate at apex, sometimes aristate with ca 1 mm long bristles, 5 - 20 x 1 - 3 mm, 1-nerved; stipules linear or lanceolate to subulate, 1 - 5 mm long, fimbriate or not. Cymes terminal, dichasial, crowded, arranged in corymbs; bracts shorter than stipules; pedicels 2 - 5 mm long, puberulous. Sepals 5, lanceolate, acuminate, 1.5 - 5 mm long, scarious at margin, glabrous, silvery white or with a few pale orange-red streaks. Petals 5, linear-oblong or elliptic-obovate, subentire, obtuse, 0.5 - 1.2 mm long, membranous, dull yellow, persistent. Stamens 5; filaments 0.5 - 1 mm long, flat; anthers oblong, ca 0.3 mm long. Ovary ovoid, ca 0.4 mm long, many-ovuled; style ca 0.2 mm long. Capsules subglobose, 1 - 2.5 mm long, entire, shining, brown, 3-valved; seeds 5 or 6, reniform, ca 0.6 x 0.2 mm, striate, reddish brown.

Fl. & Fr.: Aug. - Dec.

Habitat: Plains and lower elevations of hills, common.

Distrib.: Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Thrissur and Thiruvananthapuram. Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and W. Bengal. Almost throughout tropics.

4. POLYCARPON L.

Annual or perennial herbs, small, diffuse, prostrate or suberect, dichotomously much branched. Leaves opposite but appearing verticillate due to presence of axillary fascicles of leaves, obovate to orbicular or spatulate; stipules conspicuous, scarious. Inflorescences terminal dichasial branched condensed cymes; bracts

conspicuous, similar to stipules, scarious. Flowers many, pedicelled or not, bisexual. Sepals 5, keeled and hooded, scarious at margin, green. Petals 5, narrow, entire or subentire, shorter than sepals, hyaline, white. Stamens 1-5; filaments more or less connate at base. Ovary 1-loculed, many-ovuled; style short, 3-fid to middle; stigmas 3. Capsules 3-valved; valves spirally twisting into tubes; seeds many, ovoid.

Cosmopolitan, 16 species, 2 in India and 1 in Kerala.

Polycarpon prostratum (Forssk.) Asch. & Schweinf. in Oesterr. Bot. Z. 39: 128. 1889; Manilal & Sivar., Fl. Calicut: 39. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 52. 1988; Majumdar in B.D. Sharma & N.P. Balakr., Fl. India 2: 553. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 67. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 49. 1996; Sivar. & P. Mathew, Fl. Nilambur: 65. 1997. *Alsine prostrata* Forssk., Fl. Aegypt.-Arab.: 207. 1775. *Hapalosa loeflingiae* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 358. 1834. *Polycarpon loeflingiae* (Wall. ex Wight & Arn.) Benth. ex Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 245. 1874; Dunn in Gamble, Fl. Madras: 64(46). 1915.

Perennial herb, prostrate or suberect, pubescent. Leaves sessile, opposite or verticillate, usually oblanceolate-spatulate, narrow at base, entire at margin, acute or obtuse at apex, 6 - 18 x 2 - 5 mm; stipules lanceolate, 2 - 3 mm long. Flowers in terminal dichasial paniced cymes, ca 3 mm across. Sepals linear-oblong or ovate, subequal, 2 - 3 mm long, obtusely keeled, broadly scarious at margin. Petals linear-lanceolate, truncate, entire or subentire, dentate at apex, ca 1.2 mm long, rarely absent. Stamens 3; filaments ca 0.5 mm long; anthers ovoid. Ovary 1-loculed; style 3-fid. Capsules ovoid, 1.8 - 2 mm long, 3-valved; seeds subcylindric, 0.3 - 0.6 mm long, minutely tubercled, pale brown.

Fl.: March - June *Fr.*: July - Sept.

Habitat: Waste places and banks of rivers, ca 800 m, common.

Distrib.: Almost throughout Kerala. Andhra Pradesh, Assam, Bihar, Karnataka, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and W. Bengal. Tropical Asia and Africa.

Dianthus caryophyllus L., (carnation), may be cultivated in gardens as an ornamental.

PORTULACACEAE

(N.P. BALAKRISHNAN)

Annual or perennial herbs or undershrubs, erect or creeping-decumbent, usually succulent, occasionally rooting at nodes. Leaves spiral or opposite, sometimes rosulate, simple, entire, short-petioled, exstipulate but with a tuft of hairs in axils, otherwise glabrous, pinnately nerved. Inflorescences axillary or terminal clusters, surrounded by bracteoles and hairs, in cymes, panicles or heads, rarely in dichasia; bracts leaf-like or membranous. Flowers bisexual, rarely monoecious, actinomorphic. Sepals 2(5-8), obovate, free or basally connate, keeled above. Petals 4-6 (2-16), obovate, free or basally connate. Stamens 4-5 (1-ca 50), in 1-many distinct whorls; filaments filiform, free, rarely basally connate in bundles, occasionally adnate to petals; anthers small, often pink, dorsifixed, dehiscing longitudinally. Ovary superior, semi-inferior or inferior, septate when young, becoming 1-loculed; ovules 1-many, on free central placenta, 2-tegmic, crassinucellar, ana- or amphitropous, often long-funicled; styles with 2-20 papillose arms. Fruit a capsule, surrounded by persistent calyx bases, dehiscing by apical valves or sometimes circumscissile, or a 3-7-valved schizocarp, rarely a nut; seeds 1-many, globose or reniform, laterally compressed, smooth or ornamented; embryo peripheral, curved; cotyledons almost as wide as radicle; perisperm moderate to copious, rarely scanty, generally hard and semitransparent, sometimes soft and whitish.

Cosmopolitan, except arctic and desert regions, 32 genera and ca 380 species, 2 and 8 in India and, 2 and 4 in Kerala.

Literature: Carolin, R. 1987. A review of the family *Portulacaceae*. *Austral. J. Bot.* 35: 383-412. Geesink, R. 1971. *Portulacaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 7: 121-133. Nyananyo, B. L. 1987. Taxonomic studies in the genus *Portulaca* L. (*Portulacaceae*). *Feddes Repert. Spec. Nov. Regni Veg.* 98: 399-402. Nyananyo, B.L. 1988. The systematic significance of seed morphology and anatomy in *Portulacaceae* (Centrospermae). *Folia Geobot. Phytotax.* 23: 275-279.

Key to genera

- 1a. Flowers sessile, solitary or fascicled, surrounded by a whorl of leaves; ovary semi-inferior; fruits dehiscing circumscissile with an operculum **1. *Portulaca***

- b. Flowers pedicelled, in lax inflorescences, not surrounded by a whorl of leaves; ovary superior; fruits valved or dehiscent irregularly 2. *Talinum*

1. PORTULACA L.

Annual, biennial or perennial, decumbent or prostrate herbs, mostly succulent, usually much branched. Leaves short-petioled or not, opposite or alternate, linear to obovate or orbicular, rarely terete, fleshy, glabrous, exstipulate but mostly with long axillary hairs at node. Flowers sessile, solitary or in 2-25-flowered terminal heads, surrounded by a group of several apical leaves. Receptacle infundibular, mostly with hairs or scales in axil of bract, surrounded by a whorl of 3-30 involucreal leaves, rarely in axillary or terminal dichasia. Sepals 2, unequal, connate into a tube below, sometimes keeled or hooded, persistent or caducous with petals, stamens and styles. Petals 4-6(-8), connate at base, obovate, rarely emarginate or mucronate, marcescent and enfolding ripe carpels. Stamens 4-many in 1 whorl, adnate to petals at base. Ovary semi-inferior, occasionally apparently inferior, 1-loculed; ovules many on a free central placenta, rarely 1; style with 2-18 arms. Capsules surrounded by persistent calyx base, dehiscent circumscissile with an operculum; seeds many or 1-4, reniform, laterally compressed, minutely tubercled or granulate.

Tropics and subtropics, ca 40 species, 6 in India and 3 in Kerala

Note: Flower usually opens only in bright sunshine.

Literature: Geesink, R. 1969. An account of the genus *Portulaca* in Indo-Australia and the Pacific (*Portulacaceae*). *Blumea* 17: 275-301.

Key to species

- 1a. Leaves all opposite; hairs or scales intra- and interpetiolar surrounding node; bracteoles absent; flower solitary or 2-4; petals 4 3. *P. quadrifida*
- b. Leaves at least cauline middle ones spiral; hairs only in axils of leaves; bracteoles present; flowers glomerated, congested; petals 5 or more 2
- 2a. Leaves linear to elliptic; axillary hairs conspicuous; sepals not keeled; stamens usually 10-20 2. *P. pilosa*
- b. Leaves obovate to spatulate; axillary hairs inconspicuous; sepals distinctly keeled; stamens usually 7-12 1. *P. oleracea*

1. **Portulaca oleracea** L., Sp. Pl.: 445. 1753; Dyer in Hook f., Fl. Brit. India 1: 246. 1874; Rama Rao, Fl. Pl. Travancore: 27. 1914; Dunn in Gamble, Fl. Madras: 66 (47). 1915; Manilal & Sivar., Fl. Calicut: 40. 1982; Nicolson & al. in Regnum Veg. 119: 212. 1988; Manilal, Fl. Silent Valley: 17. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 52. 1988; Vajr., Fl. Palghat: 68. 1990; Vasudeva Rao in B.D. Sharma & Sanjappa, Fl. India 3: 4. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 68. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 50. 1996; Sivar. & P. Mathew, Fl. Nilambur: 66. 1997. *P. oleracea* L. var. *linearifolia* Sivar. & Manilal in New Botanist 4: 30. 1977; Sivar. in J. Bombay Nat. Hist. Soc. 78: 258. 1981.

Mal.: *Nilacheera*

Annual herb, glabrous, fleshy with numerous decumbent branches, to 35 cm long. Leaves spiral or subopposite, often crowded at ends of branches, sessile or subsessile, obovate or spatulate to linear-oblong, cuneate or attenuate at base, rounded or truncate at apex, 1 - 3 x 0.2 - 1.5 cm; stipular hairs very few, inconspicuous, ca 1 mm long, caducous. Flowers sessile, ca 3 mm across, terminal, 1 - 15, surrounded by a cluster of crowded leaves; bracts ovate-acuminate, to 3 mm long, membranous. Sepals connate at base into a ca 2 mm long tube; lobes oblong-ovate, keeled or slightly winged on back, 2 - 4 mm long. Petals (4 or)5, connate at base, broadly obovate or oblong-obovate, rarely emarginate at apex, 4 - 8 x 2 - 6 mm, yellow. Stamens 7 - 12(- 15); filaments to 4 mm long. Ovary ovoid; style short, to 5 mm long with 3 - 6 subulate lobes. Capsules obovoid to ovoid, 4 - 5 x ca 3 mm, enveloped by marcescent corolla, dehiscing transversely in middle; seeds many, reniform, 0.5 - 1 mm across, granular, dull black.

Fl. & Fr.: Almost throughout the year.

Habitat: Cultivated in gardens, often runs wild and sometimes a weed of cultivation, to 1000 m.

Distrib.: Almost throughout Kerala. Cosmopolitan.

Uses: Sometimes eaten as a vegetable and used as medicine.

2. **Portulaca pilosa** L., Sp. Pl.: 445. 1753; Manilal & Sivar., Fl. Calicut: 39. 1982; Vajr., Fl. Palghat: 68. 1990; Vasudeva Rao in B.D. Sharma & Sanjappa, Fl. India 3: 6. 1993. *P. tuberosa* Roxb., Fl. Ind. 2: 464. 1832; Dyer in Hook.f., Fl. Brit. India 1: 246. 1874; Rama Rao, Fl. Pl. Travancore: 27. 1914; Dunn in Gamble, Fl. Madras: 66(47). 1915. *P. suffruticosa* Wall. ex Wight & Arn., Prodr. Fl. Ind.

Orient.: 356. 1834; Rama Rao, Fl. Pl. Travancore: 27. 1914; Dunn in Gamble, Fl. Madras: 66(48). 1915. *P. pilosa* L. subsp. *pilosa* var. *tuberosa* (Roxb.) Sivar. in J. Bombay Nat. Hist. Soc. 78: 259. 1981; Sasidh. & Sivar., Fl. Fl. Thrissur: 50. 1996.

Annual herb, prostrate, decumbent-ascending or erect; stems slender, branched, glabrous. Leaves spiral, sessile, linear, linear-lanceolate or elliptic-obovate, acute at apex, 5 - 8 x 1.5 - 3 mm; stipular hairs abundant, 3 - 6 mm long. Flowers ca 10 mm across, pink or yellow, in terminal 2 - 6 (- 12)-flowered glomerules surrounded by 3 - 18 mm long hairs and 8 membranous involucral leaves. Sepals free, ovate-triangular, acute, 2 - 5 x 1 - 3.5 mm, glabrous. Petals 4 - 6, shortly connate at base, obovate, obtuse, 5 - 8 (- 12) x 2 - 10 mm. Stamens (7 -)10 - 20(- 30); filaments ca 1.5 mm long, connate and adnate to petals at base; anthers globose to elliptic. Ovary ovoid; style 4 - 8-fid, 2 - 8 mm long. Capsules subglobose or ovoid, 3 - 6 mm long, enveloped by marcescent corolla and hairs, shining, dull green, dehiscing horizontally in middle; seeds many, reniform, 0.5 - 0.7 mm across, papillate, bluish or brown to black.

Fl. & Fr.: May - Jan.

Habitat: Cultivated and often runs wild, usually in wet places.

Distrib.: Kollam, Kottayam, Kozhikode, Palakkad and Thrissur. Central America; elsewhere introduced.

3. *Portulaca quadrifida* L., Syst. Nat. ed. 12, 2: 328. 1767 & Mant. Pl.: 73. 1767; Dyer in Hook.f., Fl. Brit. India 1: 247. 1874; Rama Rao, Fl. Pl. Travancore: 27. 1914; Dunn in Gamble, Fl. Madras: 66(47). 1915; Nicolson & al. in Regnum Veg. 119: 212. 1988; Vasudeva Rao in B.D. Sharma & Sanjappa, Fl. India 3: 6. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 68. 1994.

Annual herb, prostrate; taproot thick; branches ascending, rooting at nodes, to 25 cm long, often reddish. Leaves opposite, sessile, elliptic-lanceolate to oblong-elliptic, rarely cordate-ovate, acute or obtuse at apex, 8 - 10 x 3 - 4 mm, glabrous, fleshy; petioles ca 1 mm long; stipular hairs numerous, 3 - 5 mm long, encircling nodes, whitish. Flowers ca 5 mm across, orange, rarely pinkish purple or yellow, solitary or 2 - 4 at ends of branches surrounded by 4 leaves often somewhat larger than cauline ones and by numerous ca 4 mm long hairs. Sepals connate at base, somewhat 3-angled, obtuse, 2 - 4 x 1.5 - 3 mm, hyaline. Petals

almost free, elliptic-oblong to ovate, ca 5 x 3 mm. Stamens 8 - 12; filaments hairy at base. Ovary conic-ovoid; style ca 5 mm long, thick at apex; stigmas 4, spreading. Capsules ovoid-conic, ca 4 x 2 mm, shining, greenish pink drying straw-yellow, dehiscent horizontally; seeds many, reniform, verrucose with blunt tubercles.

Fl. & Fr.: Oct. - Feb.

Habitat: Sandy coastal areas.

Distrib.: Kollam (Rama Rao, *l.c.*) and Thiruvananthapuram (Kovalam beach) - an introduction ? Weed in tropics and subtropics.

Portulaca grandiflora Hook. (*P. pilosa* L. subsp. *grandiflora* (Hook.) R. Geesink) may sometimes be cultivated as an ornamental.

2. TALINUM Adans., nom. cons.

Succulent herbs or subshrubs. Leaves spiral, the lowermost sometimes opposite, linear to obovate, flat, exstipulate. Inflorescences terminal, corymbose, cymose or paniced, seldom axillary or, solitary. Sepals 2, mostly caducous. Petals mostly 5, sometimes 4, free or connate at base. Stamens 5 - many. Ovary superior, 1-loculed, many-ovuled; style 3-armed. Capsules globose, chartaceous, mostly 3-valved, many-seeded; seeds reniform or lenticular, often black or greenish; testa smooth or variously tubercled, pitted or ridged with a distinct hilum; embryo annular.

Native to S. & C. America and Africa, some pantropically naturalized, ca 40 species, 2 in India and 1 in Kerala.

Talinum portulacifolium (Forssk.) Asch. & Schweinf. in Bull. Herb. Boissier 2: 172. 1896; Manilal & Sivar., Fl. Calicut: 40. 1982; Vajr., Fl. Palghat: 68. 1990; Vasudeva Rao in B.D. Sharma & Sanjappa, Fl. India 3: 9. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 68. 1994. *Orygia portulacifolia* Forssk., Fl. Aegypt.-Arab.: CXIV, 103. 1775. *Portulaca cuneifolia* Vahl, Symb. Bot. 1: 33. 1790. *Talinum cuneifolium* (Vahl) Willd., Sp. Pl. 2: 864. 1800; Dyer in Hook.f., Fl. Brit. India 1: 247. 1874; Rama Rao, Fl. Pl. Travancore: 27. 1914; Dunn in Gamble, Fl. Madras: 66(48). 1915.

Shrub or perennial large herb, erect, to 1 m high, glabrous; rootstock thick. Leaves sessile, elliptic-obovate or oblanceolate, cuneate-attenuate at base,

rounded or obtuse, emarginate at apex, 3 - 8 x 1 - 3.5 cm, glabrous, fleshy. Inflorescences terminal racemose elongate panicles, to 12 cm long; peduncles ca 1.5 cm long, 1 - 4-flowered; pedicels 1 - 1.5 cm long, recurved in fruit; lower bracts leaf-like, smaller upwards; bracteoles ovate-lanceolate, acuminate, 1 - 4 mm long, membranous. Flowers ca 6 mm long, bright purple-red or pink. Sepals ovate, apiculate, 4 - 6 mm long. Petals obovate, 8 - 12 x 4 - 6 mm. Stamens ca 25; filaments 3 - 4 mm long, yellow. Ovary ovoid; style ca 1.5 mm long. Capsules obovoid, ca 6 x 5 mm, glabrous, shining, yellow-green, dehiscent by valves; seeds 30 - 40, reniform, ca 1 mm across, concentrically striate, shining, black.

Fl. & Fr.: April - Dec.

Habitat: Cultivated, rarely runs wild, to 600 m.

Distrib.: Kollam, Kozhikode, Palakkad and Thiruvananthapuram. Andhra Pradesh, Karnataka and Tamil Nadu. Africa and Arabia.

Talinum triangulare (Jacq.) Willd., used as greens, may sometimes be cultivated.

ELATINACEAE

(V.P. PRASAD)

Annual or perennial herbs of wet places, often creeping and rooting. Leaves opposite or verticillate, simple, stipuled, entire to dentate. Flowers axillary, solitary, glomerated or fascicled, bisexual, actinomorphic, small to minute. Sepals 3 - 5 (2 - 6), free or shortly connate below, pellucid or pellucid-margined, persistent, 1-nerved or not, imbricate in bud. Petals 3 - 5 (2 - 6), free, slightly exceeding sepals or not, membranous, imbricate in bud. Stamens 3 - 10 in 1 or 2 whorls, as many as petals or more, but not more than twice their number, persistent; filaments broad at base; anthers 2-loculed, dorsifixed, introrse, dehiscent longitudinally. Carpels 2 - 5; ovary superior, 5-loculed; ovules many on axile placentae, anatropous, 2-tegmic; styles as many as locules, free, short, persistent; stigma small, capitate. Capsules small, dehiscent septifragally; seeds many, minute, oblong, straight or curved, nonendospermous; embryo straight or curved; cotyledons short.

Tropics and temperate regions, mostly tropics, 2 genera and 34 species, 2 and 8 in India and, 2 and 3 in Kerala.

Literature: Backer, C.A. 1951. *Elatinaceae*. In: Stennis, C.G.G.J. van (ed.), *Fl. Males.* 1, 4: 203 - 206. Ramayya, N. & Prabhakar, M. 1975. Morphology of the appendages 2. *Elatinaceae*. *J. Indian Bot. Soc.* 54: 110 - 115. Sohmer, S.H. 1980. *Elatinaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 1: 424 - 427.

Key to genera

- 1a. Plants not very small or delicate; flowers fascicled; sepals acuminate at apex and keeled by a strong midnerve **1. Bergia**
- b. Plants very small and delicate; flower solitary; sepals obtuse at apex and nerveless **2. Elatine**

1. BERGIA L.

Annual or perennial herbs, erect, ascending or decumbent, often pubescent or glandular-pubescent. Leaves opposite, short-petioled, entire or finely serrate at margin; stipules persistent. Flowers small, pedicelled or not, axillary, fascicled or glomeruled. Sepals 3 - 5(- 6), free, lanceolate, acute or acuminate at apex, keeled by a strong midnerve, broad-margined, pellucid. Petals 3 - 5(- 6), free, ovate-oblong, thin-membranous. Stamens as many as petals or more, but not more than 10; anthers dehiscing by slits. Ovary globose or ovoid, 5-loculed; stigmas capitate. Capsules globose or ovoid; seeds oblong, faintly curved, rounded at ends with a faint or strong scalariform reticulation.

Subtropics, 24 species, 5 in India and 2 in Kerala.

Key to species

- 1a. Stems glandular-pubescent, usually woody at base; leaves with midnerve glandular beneath; lateral nerves 3 or 4 pairs, prominent on both surfaces; stipules ca 1.5 mm long; pedicels pilose **1. B. ammannioides**
- b. Stems glabrous, not woody at base; leaves with midnerve not glandular beneath; lateral nerves 6 - 8 pairs, faint above; stipules ca 3.5 mm long; pedicels glabrous **2. B. capensis**

1. Bergia ammannioides Roxb. ex Roth, Nov. Pl. Sp.: 219. 1821; Wight, Ill. Ind. Bot. 1: t. 25A. 1840; Dyer in Hook.f., Fl. Brit. India 1: 251. 1874; Dunn in Gamble, Fl. Madras: 69(50). 1915; J. Bhattach. in B.D. Sharma & Sanjappa, Fl. India 3: 33. 1993. *Elatine ammannioides* (Roxb. ex Roth) Wight & Arn., Prodr. Fl. Ind. Orient.: 41. 1834.

Erect, ascending or decumbent herb, often deep-rooted; branches usually opposite; stems terete, slightly swollen at nodes, frequently woody at base, glandular-pubescent, often purple-shaded. Leaves subsessile, elliptic, oblong or obovate-oblong, cuneate at base, shortly dentate-serrate at margin, acute at apex, 5-25 x 2-6 mm; midnerve very prominent and glandular beneath, sunken but prominent above; lateral nerves 3 or 4 pairs, alternate; stipules ovate-lanceolate or narrowly 3-angled, acuminate at apex, ca 1.5 x 0.6 mm, glandular-hairy at margin. Flowers ca 1 mm across, in axillary fascicles, white or pinkish; pedicels ca 1.5 mm long, pilose. Sepals 3, ovate-lanceolate, acuminate at apex, ca 1-1.3 x ca 0.5 mm, hyaline and ciliate at margin. Petals 3, elliptic, obtuse at apex and often apiculate, as long as sepals, membranous. Stamens 3, ca 1 mm long. Carpels 5, connate; ovary globose; styles 5, recurved. Capsules globose, ca 1.5 mm, with 5 longitudinal furrows, dehiscing into 5 valves at maturity; seeds numerous, minute, oblong or subcylindric, reticulate, shining, brown.

Fl. & Fr.: Oct.

Habitat: Seasonally inundated and again dried up localities.

Distrib.: Malappuram and Palakkad. Likely to occur in plains in other districts. Throughout India, Africa, Asia and Australia.

2. *Bergia capensis* L., Mant. Pl.: 241. 1771; Dunn in Gamble, Fl. Madras: 69(49). 1915; Subr., Aquat. Ang.: 10. 1962; Manilal & Sivar., Fl. Calicut: 40. 1982; Nicolson & al. in Regnum Veg. 119: 103. 1988; J. Bhattach. in B.D. Sharma & Sanjappa, Fl. India 3: 34. 1993. *B. verticillata* Willd., Sp. Pl. 2: 770. 1799, nom. illeg.; Dyer in Hook.f., Fl. Brit. India 1: 252. 1874. *B. aquatica* Roxb., Pl. Coromandel 2: 22, t. 142. 1800. *Elatine verticillata* (Willd.) Wight & Arn., Prodr. Fl. Ind. Orient.: 40. 1834.

Herb; main stem creeping; branches erect or ascending, to 40 cm high, rooting at lower nodes; stems to 35 cm long, glabrous, reddish or pink, fleshy. Leaves subsessile, elliptic-lanceolate, cuneate at base, minutely serrate at margin, acute at apex, 3-3.6 x 0.6-0.7 cm; midnerve very prominent and purplish beneath, sunken and not prominent above; lateral nerves 6-8 pairs, alternate except basal ones, distinct beneath, faint above; stipules ovate-triangular or -lanceolate, acuminate at apex, dentate to ciliate at margin, ca 3.5 mm long, membranous. Flowers ca 1 mm across, in dense axillary clusters, pinkish; pedicels ca 1.5 mm long, glabrous. Sepals 3, ovate-lanceolate, entire at margin, acuminate at apex

with a blunt swollen tip, ca 1.2 mm long. Petals 3, oblong or subspatulate, obtuse at apex, ca 1.5 mm long. Stamens 5, ca 1.2 mm long. Carpels 5, connate; ovary globose; styles 5. Capsules globose, ca 1.5 mm with 5 longitudinal furrows, breaking into 5 valves; seeds numerous, minute, oblong or obovoid, reticulate, brownish. *Fl. & Fr.*: July - Oct.

Habitat: Aquatic or semiaquatic, in rice fields, floodplains and margins of tanks.

Distrib.: Kollam, Kozhikode and Malappuram. Almost throughout Indian plains. South and SE. Asia.

2. ELATINE L.

Small herbs, glabrous. Leaves opposite, short-petioled; stipules ovate, dentate. Flower solitary, axillary, minute, 2 - 4-merous. Sepals shortly connate at base, obtuse at apex, nerveless. Petals broadly ovate, longer than sepals, white or pink. Stamens as many or twice as many as petals. Ovary globose, 3-loculed. Fruits globose with an impressed apex and a very thin transparent wall; seeds numerous, straight or curved with scalariform reticulation.

Tropical and temperate regions, 10 species, 3 in India and 1 in Kerala.

Literature: Fernald, M.L. 1941. *Elatine americana* and *E. triandra*. *Rhodora* 43: 208 - 211. Ramayya, N. & Rajagopal, T. 1971. Systematics, distribution and anatomy of the two Indian species of the genus *Elatine* L. *Bull. Bot. Surv. India* 13: 328 - 337. Sharma, V.S. 1977. *Elatine triandra* Schkuhr - an interesting distributional new record for Northwestern Himalayas. *New Botanist* 4: 125 - 129.

Elatine triandra Schkuhr, Bot. Handb. ed. 2, 1: 345, t. 109b, f. 2. 1791 1803; Subr., Aquat. Ang.: 10. 1962. *E. americana* Arn. in Edinburgh J. Nat. Geogr. Sci. 1: 431. 1830; Dyer in Hook.f., Fl. Brit. India 1: 250. 1874; Dunn in Gamble, Fl. Madras: 68(49). 1915; J. Bhattach. in B.D. Sharma & Sanjappa, Fl. India 3: 42. 1993.

Small, delicate herb, creeping, much branched, ca 5 cm high, in dense patches; stems rooting at lower nodes. Leaves usually short-petioled, elliptic or ovate, cuneate at base, entire at margin, obtuse or slightly notched at apex, 3 - 15 x 1 - 5 mm; midnerve prominent; lateral nerves indistinct; stipules minute, ovate-triangular, acuminate at apex, caducous. Flowers sessile, ca 0.8 mm across, pinkish. Sepals 3, linear-lanceolate, ca 0.7 mm long, translucent. Petals 3, rarely 2,

broadly ovate, 1–1.4 mm long. Stamens 3, ca 0.6 mm long. Ovary globose, ca 0.5 mm; styles 3, minute, spreading; stigmas 3. Capsules subglobose, 1.5–2 mm across, opening into 3 valves at apex; seeds minute, oblong, slightly curved, reticulate, light brown.

Fl. & Fr.: July.

Habitat: Marshy and shaded areas, to 2400 m.

Distrib.: Kannur, Northwestern Himalayas and S. India. Asia, Australia, Europe, New Zealand and N. America.

HYPERICACEAE

(K. VIVEKANANTHAN)

Trees, shrubs, annual or perennial herbs or, rarely lianas. Leaves opposite or verticillate, rarely lower ones alternate, simple, exstipulate, sessile to short-petioled, entire, often with translucent and sometimes black or red glandular dots or lines, pinnately nerved, sometimes 3-nerved at base. Inflorescences terminal, sometimes axillary, cymose to thyrsoid or rarely racemose or, flower solitary, bracteate at least initially. Flowers bisexual, actinomorphic, yellow, red or white, homostylous or heterodistylous. Sepals 4 or 5, free or connate, imbricate, entire or with margin variously divided, often glandular. Petals 4 or 5, free, imbricate or contorted, antisepalous, clawed or not, entire or margin variously divided, often glandular, sometimes with a nectariferous basal appendage. Stamens numerous, rarely less than 10, hypogynous; filaments free or connate in 3–5 (rarely 6–8) bundles, opposite petals or rarely all connate and monadelphous; anthers 2-loculed, dorsifixed, often with a gland terminating in connective, dehiscing longitudinally. Carpels 3–5; ovary superior, 1- or 3–5-loculed; placenta axile, rarely parietal; ovules numerous, anatropous; styles (2)3–5, distinct or basally connate; stigma punctiform to capitate. Fruits capsular, dehiscing septi- or loculicidally, or an indehiscent berry; seeds minute, 1–numerous, sometimes winged, nonendospermous; embryo cylindrical, straight or curved.

Cosmopolitan except the arctic region, 8 genera and ca 350 species, 3 and 29 in India and, 1 and 3 in Kerala.

Note: Often treated as a subfamily under *Guttiferae* (*Clusiaceae*).

Literature: Khan, H.A. 1969. Pollen morphology of Indian *Hypericaceae*. *J. Palynol.*

(Lucknow) 5: 97 - 99. Robson, N.K.B. 1974. *Hypericaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 8: 1 - 29.

HYPERICUM L.

Perennial or annual herbs, shrubs or small trees; branchlets terete or 2 - 4-angled, glabrous. Leaves simple, opposite, rarely verticillate, entire, sessile or short-petioled, with translucent glands containing essential oil and sometimes black or red glands containing hypericin or pseudohypericin. Inflorescences terminal, cymose, dichasial, monochasial or paniced. Flowers homostylous, yellow. Sepals 5, quincuncial, cori- to chartaceous, glandular as in leaves. Petals 5, usually somewhat oblique at top, glandular as in leaves. Stamens 1 - 60, epipetalous or variously connate; filaments slender, yellow; anthers oblong with an amber or black gland terminating in connective, dorsifixed, yellow or reddish. Ovary 1 - 5-loculed with 3 or 5 parietal placentae; styles free or connate. Capsules septicidal or splitting through placenta when 1-loculed; seeds 1 - numerous on each placenta, cylindric to ellipsoid, curved, sometimes with a membranous wing.

Temperate regions and tropical mountains, ca 370 species, 25 in India and 3 in Kerala.

Literature: Robson, N.K.B. 1972. Notes on Malesian species of *Hypericum* (*Guttiferae*). *Florae Malesianae praecursores* LII. *Blumea* 20: 251 - 274. Robson, N.K.B. 1973. *Guttiferae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 32: 1 - 12. Robson, N.K.B. 1977. Notes on some Nepalese and Indian *Hypericum*. *J. Jap. Bot.* 52: 276 - 288. Robson, N.K.B. 1977. Studies in the genus *Hypericum* L. (*Guttiferae*) 1. Infrageneric classification. *Bull. Brit. Mus. (Nat. Hist.), Bot.* 5: 293 - 355. Robson, N.K.B. & Adams, P. 1968. Chromosome numbers in *Hypericum* and related genera. *Brittonia* 25: 95 - 106.

Key to species

- | | | |
|-----|--|-------------------------|
| 1a. | Shrub, 1 - 3 m high; flowers 4 - 8 cm across | 2. H. mysurense |
| b. | Herbs, less than 1 m high; flowers less than 2 cm across | 2 |
| 2a. | Sepals and bracts fringed with intramarginal dark gland-tipped teeth; seeds dotted | 3. H. wightianum |
| b. | Sepals and bracts devoid of glands but fringed with small dots; seeds ribbed | 1. H. japonicum |

1. **Hypericum japonicum** Thunb. ex Murr., Syst. Veg. ed. 14, : 702. 1784; Dyer in Hook.f., Fl. Brit. India 1: 256. 1874; Dunn in Gamble, Fl. Madras: 70(50). 1915; Manilal, Fl. Silent Valley: 18. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 53. 1988; S.N. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 69. 1993.

Annual herb, erect, decumbent or prostrate, glabrous, rooting at base; stems 4-angled. Leaves sessile, ovate to suborbicular or obovate-spatulate, cordate to attenuate at base, obtuse to rounded at apex, 2 - 18 x 1 - 10 mm, pellucid-punctate, 1 - 3-nerved; laminar glands small, denser above, pale. Inflorescences 1 - many-flowered, cymose and regularly dichasial to monochasial or with branches in uppermost leaf axils. Flowers 4 - 8 mm across, yellow; buds cylindric-ellipsoid. Sepals free, narrowly oblong to elliptic or obovate, acute to mucronate or rounded, 3 - 6 mm long, glandular and pellucid-punctate at apex, 3 - 5-nerved. Petals elliptic to obovate, 2 - 5 mm long. Stamens 5 - 30 in 5 irregular groups, ca 3 mm long, connate at base. Ovary broadly ovoid to subglobose, 1-loculed; styles 3, short. Capsules ovoid, obtuse to rounded, 2 - 6 mm long; seeds ribbed, transversely striate.

Fl. & Fr.: Feb. - June.

Habitat: Wet places near lakes and in rock crevices, 775 - 2100 m.

Distrib.: Idukki, Kannur, Palakkad, Pathanamthitta and Wynad. Himalayas, NE. India and W. Ghats. Australia, China, Hawaii Islands, Japan, Korea, Malesia, Nepal, New Zealand and Sri Lanka.

Note: *Hypericum japonicum* is an extremely variable species and the variations appear to be continuous. Robson (1972) recognized 5 main variants of which 2 variants occur in S. India.

2. **Hypericum mysurense** B. Heyne ex Wight & Arn., Prodr. Fl. Ind. Orient.: 99. 1834; Dyer in Hook.f., Fl. Brit. India 1: 253. 1874; Rama Rao, Fl. Pl. Travancore: 28. 1914; Dunn in Gamble, Fl. Madras: 70(50). 1915 (as *mysorensis*); Manilal, Fl. Silent Valley: 18. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 53. 1988; Vajr., Fl. Palghat: 68. 1993; S.N. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 71. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 51. 1996; Sivar. & P. Mathew, Fl. Nilambur: 66. 1997.

Shrub, 1 - 3 m high, much branched; stem and young branches 4-angled,

glabrous. Leaves closely arranged, opposite or verticillate, elliptic-lanceolate or oblanceolate, attenuate and amplexicaul with small auricles at base, entire at margin, acute at apex, 1.5 - 4.5 x 0.5 - 1.8 cm, glabrous above, slightly glaucous beneath; midnerve prominent. Flowers 4 - 8 cm across, axillary, solitary or in terminal few-flowered cymose panicles, golden yellow. Sepals unequal, ovate-lanceolate, acute with a prominent midnerve. Petals obovate-oblong or obliquely oblanceolate. Stamens numerous in 5 groups, spreading, ca 1.2 cm long; anthers globose. Ovary ovoid; ovules numerous on 5 axile placentae; styles 5, basally connate, longer than stamens. Capsules 5-valved, with a filiform beak, ca 1.5 cm long, dark crimson; seeds cylindric.

Fl. & Fr.: Sept. - June.

Habitat: Grasslands and exposed hill slopes, 850 - 2067 m, very common.

Distrib.: Idukki, Kannur, Malappuram, Palakkad, Thrissur and Wynad.

Western Ghats. Sri Lanka.

Note: An ornamental shrub suitable for introduction into gardens.

3. *Hypericum wightianum* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 99. 1834; Dunn in Gamble, Fl. Madras: 70(50). 1915. *H. nepaulense* sensu Dyer in Hook.f., Fl. Brit. India 1: 256. 1874 p.p., non Choisy 1824. *H. humifusum* sensu Dyer in Hook.f., Fl. Brit. India 1: 255. 1874 p.p., non L. 1753; Rama Rao, Fl. Pl. Travancore: 28. 1914; Dunn in Gamble, Fl. Madras: 70(51). 1915; Vajr. in S.K. Jain & Sastry, Indian Pl. Red Data Book: 87. 1984; S.N. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 68. 1993.

Herb, to 40 cm high; stem slender, diffuse or prostrate, cylindric, often with numerous short axillary and almost regular branches. Leaves ovate, entire at margin, obtuse at apex, 0.5 - 2.2 x 0.3 - 1 cm, glabrous, glaucous beneath with round pellucid gland dots, inconspicuously reticulately nerved, turning black when dry. Flowers in few-flowered cymes, ca 1.2 cm across, yellow with red dots inside. Sepals oblong to elliptic, connate at base, with intramarginal dark gland dots; teeth short. Petals longer than sepals, with apical and usually marginal gland dots. Stamens 3-adelphous at base. Ovary 3-loculed; style 1.5 - 3 mm long, longer than stamens. Capsules subglobose to globose, ca 1.2 cm.

Fl. & Fr.: April - May.

Habitat: Marshy and damp places, 1800 - 2100 m.

Distrib.: Idukki (High Ranges). Himalayas, NE. India and W. Ghats. China,

Myanmar, Sri Lanka and Thailand.

Note: Robson (1977) corrected the identity of the Indian *H. nepaulense* and *H. humifusum* dealt with by Dyer (*l.c.*). The Western Ghats material dealt with by Dunn (*l.c.*) accordingly belongs to *H. wightianum* subsp. *wightianum*.

GUTTIFERAE

(CLUSIACEAE)

(W. ARISDASON & P. DANIEL)

Evergreen trees or shrubs with milky, white, greenish or yellow sap, often resinous; oil glands or passages in leaves and other parts always present. Leaves simple, opposite, rarely verticillate, rarely stipuled, entire, usually coriaceous, sometimes membranous; nervation characteristic on drying. Inflorescences terminal or axillary fascicles, racemes or panicles, often reduced to solitary flower; bracts and bracteoles present. Flowers uni- bisexual or polygamous, regular, hypogynous, white, yellow, pinkish or red. Sepals 2 - 6, imbricate or decussate, persistent or not. Petals 2 - 6, rarely more, or absent, imbricate, contorted or decussate. Stamens mostly numerous, almost free or variously connate, 1 - 6-adelphous, reduced to staminodes in female flowers; staminodes mostly fewer than stamens or absent; anthers various, dehiscent transversely, vertically or circumscissile. Ovary superior, 1 - many-loculed; ovules 1 - 4, erect, in basal, axile or rarely parietal placentation; styles slender, short or absent; stigmas sessile or subsessile, free or connate, sometimes peltate or lobed. Fruit a berry, capsule or drupe, often indehiscent, pulpy or not; seeds large, nonendospermous.

Tropics, 45 genera and ca 1370 species, 5 and 53 in India and, 5 and 20 in Kerala.

Key to genera

- | | | |
|-----|---|---------------------------|
| 1a. | Styles indistinct or absent; stigmas broadly peltate, entire or radiately lobed; fruit a berry | |
| | | 2. <i>Garcinia</i> |
| b. | Styles distinct, long, slender; stigmas not broadly peltate, 2- or 4-lobed or acute; fruit a drupe or capsule | 2 |
| 2a. | Sepals 2 | 3. <i>Mammea</i> |
| b. | Sepals 4 or 5(- 6) | 3 |

- 3a. Leaves with pellucid dots; fruits enclosed by enlarged sepals 4. *Mesua*
- b. Leaves without pellucid dots; fruits not enclosed by sepals 4
- 4a. Stamens numerous (40 - 440); fruit a drupe (berry in *C. austroindicum*) 1. *Calophyllum*
- b. Stamens 16 - 22; fruit a capsule 5. *Poeciloneuron*

1. CALOPHYLLUM L.

Evergreen trees, small to medium-sized, rarely lofty; bark smooth with characteristic diamond- or boat-shaped, or longitudinal fissures, grey or yellowish with yellow or milky white exudate; branchlets generally 4-angled, sometimes flat; buds rusty-puberulous with minute uniseriate hairs. Leaves simple, opposite, petioled, exstipulate, entire, often coriaceous, shining; lateral nerves numerous, slender, close together and parallel. Inflorescences axillary or terminal panicles or racemes, sometimes fascicles. Flowers bisexual or polygamous (male and bisexual), hypogynous, usually homochlamydeous, (1 - 3) numerous, pedicelled; bracts usually caducous. Sepals 2 - 4, decussate. Petals 2 - 4 or 6, or absent, resembling sepals. Stamens numerous; filaments filiform, free or slightly connate at base, often flexuous; anthers ovate or oblong, 2-loculed, basifixed, dehiscing longitudinally. Ovary superior, 1-loculed; ovule 1, basal; styles slender, rather long; stigmas peltate. Fruit a drupe or berry; exocarp thin, membranous; mesocarp dry, subspongy (fibrous); endocarp crustaceous; seed globose or ovoid.

Tropics, mostly Indomalesia, 187 species, 8 in India and 4 in Kerala.

Literature: Stevens, P.F. 1980. A revision of the Old World species of *Calophyllum* (*Guttiferae*). *J. Arnold Arbor.* 61: 117 - 699.

Key to species

- 1a. Petals absent, rarely 2, 4 or 5, caducous; stamens 40 - 85 2. *C. calaba*
- b. Petals 4, rarely to 6; stamens more than 100 2
- 2a. Flowers bisexual; fruit a berry 1. *C. austroindicum*
- b. Flowers polygamous; fruit a drupe 3
- 3a. Sepals reflexed, not ciliolate; stamens in 4 - 6 bundles 3. *C. inophyllum*
- b. Sepals not reflexed, ciliolate; stamens free or scarcely connate at base 4. *C. polyanthum*

1. *Calophyllum austroindicum* Kosterm. ex P.F. Stevens in J. Arnold Arbor. 61: 250, f. 8 g i. 1980; Manilal, Fl. Silent Valley: 18. 1988; Vajr., Fl. Palghat: 69. 1990; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 90. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 69. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 51. 1996. *C. trapezifolium* auct. non Thwaites 1858: Bourd., Forest Trees Travancore: 28. 1908; Rama Rao, Fl. Pl. Travancore: 31. 1914; Dunn in Gamble, Fl. Madras: 76(55). 1915; Maheshw. in Bull. Bot. Surv. India 2: 144. 1960.

Tree, 15 - 30 m tall; bark pale brown to yellowish; branchlets usually 4-angled; young branches minutely rusty-pubescent. Leaves elliptic, subrhomboid to obovate or oblanceolate, cuneate to acute at base, slightly undulate, recurved and margined, rounded, retuse, subacute or shortly and bluntly acuminate at apex, 3 - 8.5 x 1.2 - 4.2 cm, rigid, sometimes olivaceous; midnerve channelled above, raised beneath; lateral nerves 5 - 10 (- 15) pairs, more or less prominent on both surfaces; petioles (3 -)5 - 8 mm long, channelled above, glabrous or minutely rusty-pubescent. Racemes axillary, 3 - 8 cm long, 7 - 17-flowered, glabrous; peduncles 3 - 7.5 cm long, glabrous. Flowers bisexual, ca 2 cm across; pedicels 6 - 15 mm long, glabrous. Sepals 4, subequal; outer pair suborbicular, 3.7 - 5 x 3.5 - 6 mm; the inner broadly elliptic, ca 6 x 4 mm. Petals 4, rarely 6, elliptic or oblong to obovate, obtuse, 4 - 9 x 1.5 - 6 mm. Stamens 100 - 125; filaments ca 4.5 mm long; anthers elliptic to oblong, cordate, truncate or oblique at base, 0.7 - 1.3 x 0.4 - 0.8 mm. Ovary globose, 2 - 3 mm; styles 1.5 - 3.5 mm long; stigmas peltate, 3-radiate, 0.7 - 1 mm across. Berries ovoid, beaked at apex, 3 - 4.3 x 1.6 - 2.7 cm; stone ellipsoid, ca 2.5 x 1.5 cm, smooth; stalks 1.2 - 1.7 cm long.

Fl. & Fr.: Nov. - June.

Habitat: Evergreen forests, 1000 - 2500 m, not common.

Distrib.: Idukki, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. *Calophyllum calaba* L., Sp. Pl.: 514. 1753; Lam., Encycl. 1: 553. 1785; Nicolson & al. in Regnum Veg. 119: 81. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 51. 1996; Sivar. & P. Mathew, Fl. Nilambur: 67. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 81. 2002. *C. apetalum* Willd. in Ges. Naturf. Freunde Berlin Mag. Neusten Entdeck. Gesammten Naturk. 5: 79. 1811 p.p.; Maheshw. in Bull. Bot.

Surv. India 2: 143. 1960; Vajr., Fl. Palghat: 69. 1990; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 88. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 69. 1994. *C. decipiens* Wight, Icon. Pl. Ind. Orient.: t. 106. 1839 & Ill. Ind. Bot. 1: 128. 1840, non Thwaites 1858; Dunn in Gamble, Fl. Madras: 76(54). 1915. *C. wightianum* Wall. ex Planch. & Triana in Ann. Sci. Nat. Bot. 4, 15: 256. 1861; Bedd., Fl. Sylv. S. India: t. 90. 1871; T. Anderson in Hook. f., Fl. Brit. India 1: 274. 1874; Bourd., Forest Trees Travancore: 28. 1908; Rama Rao, Fl. Pl. Travancore: 32. 1914.

Mal.: *Attupunna, Cherupunna, Kattapunna, Manjapunna, Porapunna*

Tree, to 30 m tall; bark thick, deeply fissured, yellowish; exudate a white or yellowish resinous fluid; branchlets 4-angled, glabrous, often pruinose. Leaves ovate, obovate or oblong to elliptic, subtruncate to rounded or rarely acute to cuneate at base, slightly recurved at margin, obtuse-retuse or emarginate at apex, 5 - 11 x 2.5 - 5 cm, coriaceous, glabrous; midnerve obscure above, prominent beneath; lateral nerves 5 - 9 pairs; petioles 3 - 6 mm long, deeply channelled above. Racemes axillary, 5 - 13-flowered, 4 - 7 cm long; peduncles ca 1 cm long, slender; bracts ovate, ca 4 mm long, caducous; pedicels slender, 7 - 15 mm long, glabrous. Flowers bisexual, 1 - 2.5 cm across. Sepals 4, rarely 3, subequal, deflexed, membranous, prominently nerved; outer pair ovate or broadly ovate to orbicular, 3.5 - 6 x 3.3 - 5.5 mm; the inner elliptic to obovate, 6 - 9 x 3.5 - 5 mm, petaloid, white. Petals absent, rarely 2, 4 or 5, small, early caducous. Stamens 40 - 85, many-seriate; filaments ca 5 mm long, almost free; anthers oblong, rounded or mucronate at apex, 1.3 - 2.5 mm long. Ovary ca 2 mm long; styles ca 4.5 mm long, flexuous; stigmas peltate, 3-radiate with crenulate or entire margin, 1 - 1.5 mm across. Drupes ovoid or ellipsoid, apiculate or not, 1 - 2 x ca 1 cm, smooth, red when ripe; stone ovoid to ellipsoid, 7.5 - 10 x 5 - 7 mm, smooth; seed 1, 6 - 7 x 3.5 - 5 mm, brown; stalks 1 - 2.3 cm long.

Fl. & Fr.: Aug. - March (- May).

Habitat: Banks of rivers and streams in evergreen and semievergreen forests and backwaters, to 1100 m, common.

Distrib.: Alappuzha, Idukki, Kollam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats. Endemic.

Uses: Wood is used for construction of bridges, boats, cabinet work, building

purposes etc. Seed oil is used in the treatment of rheumatism and leprosy. Fruit is edible.

3. *Calophyllum inophyllum* L., Sp. Pl.: 513. 1753; Wight, Icon. Pl. Ind. Orient.: t. 77. 1838; T. Anderson in Hook.f., Fl. Brit. India 1: 273. 1874; Bourd., Forest Trees Travancore: 27. 1908; Rama Rao, Fl. Pl. Travancore: 31. 1914; Dunn in Gamble, Fl. Madras: 76(55). 1915; Maheshw. in Bull. Bot. Surv. India 2: 145. 1960; Manilal & Sivar., Fl. Calicut: 41. 1982; Nicolson & al. in Regnum Veg. 119: 82. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 54. 1988; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 92. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 70. 1994. *C. blumei* Wight, Ill. Ind. Bot. 1: 128. 1840.

Mal.: *Pinna*, *Punna*

Tree, to 20 m tall; bark smooth or with boat-shaped fissures, brown to pale grey; exudate milky or yellow; branchlets compressed, slightly flat or 4-angled, glabrous. Leaves broadly elliptic-oblong or obovate, cuneate to rounded at base, slightly recurved and margined, rounded, acute, slightly emarginate, retuse or sub-acute at apex, 6 - 15 x 3 - 10.5 cm, coriaceous, glabrous; midnerve channelled above, raised beneath; lateral nerves 4 - 20 pairs; petioles flat, 1 - 1.7 cm long, glabrous. Racemes axillary, 5 - 12 cm long, (5 -)7 - 12-flowered. Flowers polygamous, 2 - 2.5 cm across, white, fragrant; bracts ovate, 3 - 4 mm long, caducous; pedicels 1 - 3 cm long, glabrous. Sepals 4, reflexed; outer pair ovate to suborbicular, concave, 5.5 - 6.5 x 4.5 - 6.5 mm, nerved; the inner subelliptic, 9 - 15 x 7.5 - 9.5 mm, petaloid, nerved. Petals usually 4, rarely 3 or 5, obovate to elliptic or oblong, reflexed, 9 - 12 x 5 - 9 mm, rarely glabrous, nerved. Stamens (175 -)210 - 360(-440); filaments 3.5 - 5.5 mm long, connate for 1.5 mm into 4 - 6 bundles, cream-coloured; anthers rounded or retuse at apex, 0.7 - 2 mm long. Ovary globose-depressed, 2.5 - 3 x 2.8 - 3 mm, stipitate; style 4.5 - 6.5 mm long; stigmas peltate, 3 - 5-radiate, 0.7 - 2 mm across. Drupes globose to obovoid, short-apiculate, 2.5 - 5 x 2.5 - 4 cm, smooth; stone subglobose, ca 2 cm across.

Fl. & Fr.: Almost throughout the year.

Habitat: Seashores and midlands, to 200 m.

Distrib.: Throughout Kerala, Andaman & Nicobar Islands, Karnataka, Lakshadweep, Maharashtra, Orissa and Tamil Nadu. Old World tropics.

Uses: Cultivated as an ornamental tree. Wood is used for making knees for boats.

railway sleepers, construction etc. Seed oil is used in skin diseases and rheumatism.

4. *Calophyllum polyanthum* Wall. ex Choisy, *Descr. Guttif. Inde*: 43. 1849 & in *Mem. Soc. Phys. Hist. Nat. Genève* 12: 423. 1851; T. Anderson in *Hook.f., Fl. Brit. India* 1: 274. 1874; Maheshw. in *Bull. Bot. Surv. India* 2: 144. 1960; Manilal, *Fl. Silent Valley*: 19. 1988; N.P. Singh in B.D. Sharma & Sanjappa, *Fl. India* 3: 94. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 52. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 68. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 82. 2002. *C. elatum* Bedd., *Fl. Sylv. S. India*: t. 2. 1869; Dunn in Gamble, *Fl. Madras*: 76(54). 1915. *C. tomentosum* auct. non Wight 1840; T. Anderson in *Hook.f., Fl. Brit. India* 1: 274. 1874 p.p.; Bourd., *Forest Trees Travancore*: 27. 1908; Rama Rao, *Fl. Pl. Travancore*: 32. 1914. *C. angustifolium* Dalzell & A. Gibson, *Bombay Fl.*: 32. 1861, non Roxb. 1832.

Mal.: *Katta-pinna, Pinnapai, Viri*

Tree, to 45 m tall; bark deeply fissured, yellow, grey to brown or black; exudate a white, amber or brown latex; branchlets flat, 4-angled, pubescent when young. Leaves ovate-elliptic or oblong- to oblong-lanceolate, acute or cuneate at base, undulate, narrowly recurved and margined, obtuse or acute to acuminate at apex, 10 - 20.5 x 3 - 5.5 cm, coriaceous, glabrous; midnerve sparsely puberulous when young; lateral nerves 9 - 16(- 24) pairs, distinct on both surfaces; petioles 0.8 - 1.7(- 2) cm long, margined, channelled above. Racemes terminal and axillary, simple or paniced, ca 15 cm long, puberulent. Flowers polygamous, 1 - 2 cm across, fragrant; bracts absent or caducous; pedicels 4 - 10(- 18) mm long, puberulent. Sepals 4, unequal, ciliolate; outer pair ovate to suborbicular, 2 - 5.5 x 2 - 4.5 mm, puberulent outside; the inner ovate-obovate to oblong-ovate, 4 - 8 x 3.5 - 6 mm, petaloid. Petals 4, spreading, obovate-oblong, obtuse, 7 - 9.5 x 4.5 - 5 mm, reflexed, concave. Stamens 140 - 320; filaments filiform, 2.5 - 4 mm long, free or scarcely connate at base; anthers elliptic or oblong, 0.4 - 1 mm long. Ovary ovoid, 1.2 - 2.5 mm long, 1-loculed; ovule 1, erect; styles slender, flexuous, 2 - 3 mm long; stigmas peltate, 2- or 3-lobed, 0.7 - 1.2 mm across. Drupes subglobose or ovoid to subovoid, blunt or short-acuminate, 2.5 - 3 x ca 2 cm, smooth; stone obovoid to ellipsoid, 1.9 - 2.6 x 1.5 - 1.8 cm, smooth; seeds ellipsoid or ovoid.

Fl. & Fr.: Jan. - July(- Dec.).

Habitat: Evergreen forests, 800 - 1100 m, common.

Distrib.: Idukki, Kollam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Assam, Karnataka, Meghalaya, Sikkim, Tamil Nadu and W. Bengal. Southwest China and Thailand.

Uses: Fruit is edible. Wood is used for building ships and bridges, general construction, paper pulp etc.

2. GARCINIA L.

Trees, rarely shrubs, with latex; branches usually opposite. Leaves opposite, rarely ternate, simple, stipuled or not, lanceolate or oblong, coriaceous, glabrous. Flowers solitary or in cymes, polygamous, 4- or 5-merous. Sepals 4 or 5 (-6), decussate or imbricate, usually persistent. Petals 4, rarely 5, imbricate or contorted. Male flowers: Stamens numerous, rarely few and definite, free or connate into 1 - 5 bundles or in a central entire or 4- or 5-lobed mass or column, usually surrounding pistillode; anthers erect, sessile or on short thick filaments, 2-, rarely 4 - many-loculed, dehiscing by longitudinal slits, pores, or circumscissile; pistillode various or absent. Female flowers usually solitary and larger than male ones; staminodes minute, free or connate into a ring at base or in short bundles; ovary superior, 2 - 12-loculed; ovule 1 in each locule, erect or lateral; styles very short or absent; stigmas lobed or furrowed with as many lobes as ovary locules or stigmatic mass marginally incised, smooth or papillate. Berries indehiscent, fleshy with a coriaceous rind; seeds 1 - 12, oblong or ovoid, embedded in whitish aril.

Old World tropics especially Asia, ca 200 species, 35 in India and 11 in Kerala.

Key to species

- | | | |
|-----|--|-----------------------------|
| 1a. | Sepals and petals 5, rarely petals 4 or sepals 6 | 2 |
| b. | Sepals and petals always 4 | 4 |
| 2a. | Leaves to 45 x 12 cm; ovary 5-loculed | 11. <i>G. xanthochymus</i> |
| b. | Leaves to 22 x 10 cm; ovary 3- or 4-loculed | 3 |
| 3a. | Stigma 5-lobed | 7. <i>G. spicata</i> |
| b. | Stigma 3-lobed | 8. <i>G. talbotii</i> |
| 4a. | Berries covered with spines or broad sharp tubercles | 6. <i>G. rubro-echinata</i> |
| b. | Berries smooth | 5 |
| 5a. | Lateral nerves in leaves numerous | 6 |

- b. Lateral nerves in leaves 7 - 25 pairs 7
- 6a. Berries not grooved; seeds 1 or 2 9. *G. travancorica*
- b. Berries 4 - 8-grooved; seeds 6 - 8 1. *G. gummi-gutta*
- 7a. Ovary 2-loculed 2. *G. imbertii*
- b. Ovary 3 - many-loculed 8
- 8a. Stamens in male flowers 12 - 15 10. *G. wightii*
- b. Stamens in male flowers more than 20 9
- 9a. Anthers 2-loculed, dehiscence longitudinal 3. *G. indica*
- b. Anthers many-loculed, dehiscence circumscissile 10
- 10a. Staminodes in female flowers 10 - 12, connate in a ring; stigma 4-lobed 4. *G. morella*
- b. Staminodes in female flowers ca 24, in 6 or 7 fascicles; stigma 11 - 13-lobed 5. *G. pictoria*

1. *Garcinia gummi-gutta* (L.) N. Robson in Brittonia 20: 103. 1968; Nicolson & al. in Regnum Veg. 119: 82. 1988; Manilal, Fl. Silent Valley: 19. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 54. 1988; Vajr., Fl. Palghat: 70. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 71. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 52. 1996; Sivar. & P. Mathew, Fl. Nilambur: 68. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 84. 2002. *Cambogia gummi-gutta* L., Gen. Pl. ed. 5, : 522. 1754. *Mangostana cambogia* Gaertn., Fruct. Sem. Pl. 2: 106. 1790. *Garcinia cambogia* (Gaertn.) Desr. in Lam., Encycl. 3: 701. 1792; T. Anderson in Hook.f., Fl. Brit. India 1: 261. 1874, excl. var. *papilla* (Wight) T. Anderson; Bourd., Forest Trees Travancore: 22. 1908; Rama Rao, Fl. Pl. Travancore: 29. 1914; Dunn in Gamble, Fl. Madras: 73(53). 1915.

Tree, to 25 m tall; bark rugose, grey or dark brown; exudate a yellow gum; branchlets glabrous. Leaves oblong, elliptic or lanceolate, cuneate at base, entire at margin, acute to short-acuminate at apex, 7 - 15 x 2 - 7 cm; lateral nerves numerous, slender, prominent; petioles channelled, to 2 cm long. Male flowers 3 - 6 in short axillary fascicles, ca 1.2 cm across, pale white, yellow or yellowish pink; pedicels 7 - 15 mm long; sepals 4, ovate or obovate, unequal; outer pair 5 - 6 mm long; the inner 7 - 8 mm long, coriaceous, fleshy; petals 4, obovate or oblong, 8 - 10 mm long; stamens 12 - 20 or more, inserted on receptacle; filaments ca 0.5 mm long; anthers ca 0.5 mm long, basifixed, dehiscing longitudinally; pistillode absent or minute; stigmatic lobes 3 or 4. Bisexual flowers in fascicles of 1 - 3, terminal and axillary, 1 - 1.5 cm across; pedicels 4 - 6 mm long; sepals and petals

as in male ones; stamens 10–20; filaments unequal, connate at base in a ring around ovary or grouped in unequal bundles; ovary subglobose or ovoid, ca 1 mm long, 8–11-sulcate; berries globose, to 7 cm, (4–)6–8-grooved, mamillate at apex, thick; seeds 6–8, ovoid, compressed, ca 3 cm long, surrounded by a succulent white or red aril.

Key to varieties

- 1a. Stamens 12–20; ovary 8–10-loculed; stigmatic rays 8–10; berries 6–8-grooved to about middle 1.2. var. **gummi-gutta**
- b. Stamens more than 20; ovary 4- or 6–8-loculed; stigmatic rays 4–8; berries 6–8-grooved to tip 2
- 2a. Stamens ca 35; ovary 4-loculed; berries ovoid or conic, 4-grooved 1.1. var. **conicarpa**
- b. Stamens ca 25; ovary 6–8-loculed; berries ovoid-oblong, 4–8-grooved 1.3. var. **papilla**

1.1. var. conicarpa (Wight) N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 110. 1993; Nazarudeen in J. Econ. Tax. Bot. 25: 607. 2001. *G. conicarpa* Wight, Icon. Pl. Ind. Orient.: t. 121. 1839 & Ill. Ind. Bot. 1: 125. 1840. *G. cambogia* (Gaertn.) Desr. var. *conicarpa* (Wight) T. Anderson in Hook.f., Fl. Brit. India 1: 262. 1874; Maheshw. in Bull. Bot. Surv. India 6: 129. 1965.

Fl. & Fr.: March–Jan.

Habitat: Evergreen forests, rare.

Distrib.: Idukki. Western Ghats. Endemic.

1.2. var. gummi-gutta: N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 110. 1993.

Mal.: *Gorakkapuli, Kadumpuli, Kodapuli, Kodokapuli, Pinaru, Pinenga*

Fl. & Fr.: Dec.–Sept.

Habitat: Evergreen and semievergreen forests, to 2000 m.

Distrib.: Kannur, Kasaragod, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Often cultivated. Western Ghats. Endemic.

Use: Dry fruit pulp is used as a substitute for tamarind for making fish curry, mostly in central Kerala.

1.3. var. **papilla** (Wight) N.P. Singh in B.D. Sharma & Sanjappa. Fl. India 3: 111. 1993. *Garcinia papilla* Wight, Icon. Pl. Ind. Orient.: t. 96. 1839. *G. cambogia* (Gaertn.) Desr. var. *papilla* (Wight) T. Anderson in Hook.f., Fl. Brit. India 1: 262. 1874; Maheshw. in Bull. Bot. Surv. India 6: 130. 1965.

Fl. & Fr.: Feb. - Jan.

Habitat: Evergreen forests, to 2000 m.

Distrib.: Kannur, Kottayam, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Also cultivated. Western Ghats of Tamil Nadu. Endemic.

2. **Garcinia imbertii** Bourd. in J. Bombay Nat. Hist. Soc. 12: 349, t. 1. 1899 & Forest Trees Travancore: 24. 1908; Rama Rao, Fl. Pl. Travancore: 31. 1914; Dunn in Gamble, Fl. Madras: 74(53). 1915; Maheshw. in Bull. Bot. Surv. India 6: 117. 1965; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 112. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 85. 2002.

Tree, to 12 m tall; bark smooth, brown or white. Leaves elliptic or lanceolate, cuneate at base, entire at margin, obtuse to acuminate at apex, 4 - 8(- 11) x 1.5 - 3(- 4) cm; lateral nerves 15 - 25 pairs, obscure. Male flowers in fascicles of 3, 6 or 9, terminal, ca 5 mm across, sessile, succulent, ebracteate; sepals 4, suborbicular, concave; outer pair ca 2.5 mm long; the inner ca 3 mm long; petals 4, orbicular, ca 3 mm; stamens ca 16, monadelphous in a central mass around pistillode. Female flowers solitary or paired, sessile, succulent, yellow; staminodes ca 15 in a ring surrounding ovary; ovary 2-loculed; ovule 1 in each locule; stigmas sessile, broad, convex, entire; berries globose, ca 2.5 cm, smooth; seeds 1 or 2, enclosed in a thick leathery rind.

Fl. & Fr.: April - Sept.

Habitat: Evergreen forests, 900 - 1100 m.

Distrib.: Kollam (N. Sasidharan KFRI, pers. comm.) and Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

Note: Ramamurthy (in N.C. Nair & A.N. Henry, *Fl. Tamil Nadu* 1983) excluded this species unexplained.

3. **Garcinia indica** (Thouars) Choisy in DC., Prodr. 1: 561. 1824; T. Anderson in Hook.f., Fl. Brit. India 1: 261. 1874; Maheshw. in Bull. Bot. Surv. India 6: 127. 1965; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 113. 1993.

Brindonia indica Thouars, Dict. Sci. Nat. 5: 340. 1804. *Stalagmitis indica* (Thouars) G. Don, Gen. Hist. 1: 621. 1831.

Mal.: *Penampuli*.

Tree, to 15 m tall; bark smooth, light brown; branchlets subterete, irregularly striate. Leaves obovate-oblong or oblanceolate, contracted into petiole at base, entire at margin, acute or obtuse at apex, 4.5 - 11 x 1.5 - 5 cm; lateral nerves 7 - 18 pairs, slender, prominent; petioles 5 - 12 mm long. Male flowers in fascicles of 4 - 8, axillary and terminal, white; pedicels to 5 mm long; bracts scale-like, caducous; sepals 4, decussate; outer pair 3 - 4.5 mm long; the inner ovate-rotundate, 4.5 - 5 mm long, yellowish to pinkish orange, fleshy; petals 4, 5 - 6 mm long; stamens numerous, inserted on receptacle; filaments short; anthers oblong, 2-loculed, dehisce longitudinally; pistillode present or not. Female flower solitary, terminal; pedicel ca 3 mm long; sepals and petals as in male ones; staminodes 10 - 18, in 4 unequal 2- or 3-seriate phalanges, 1 - 3 mm long; ovary subglobose, 4 - 8-loculed; stigmas convex, coronate, sessile with as many rays as ovary locules; berries globose, smooth, purple or orange-pink, apex with stigmatic lobes; seeds 5 - 8, compressed.

Fl. & Fr.: Nov. - Aug.

Habitat: Evergreen forests, to 1700 m, rare.

Distrib.: Idukki, Western Ghats. Endemic. Elsewhere cultivated.

Uses: Fruit is edible. Seed yields an edible fat known as kokum butter which is used in the manufacture of soap and candle. Medicinally used as a remedy in scrofulous diseases, dysentery, mucous diarrhoea etc. Wood is used for paper pulp.

4. ***Garcinia morella*** (Gaertn.) Desr. in Lam., Encycl. 3: 701, t. 405, f. 2. 1792; T. Anderson in Hook.f., Fl. Brit. India 1: 264. 1874; Bourd., Forest Trees Travancore: 23. 1908; Rama Rao, Fl. Pl. Travancore: 29. 1914; Dunn in Gamble, Fl. Madras: 73(52). 1915, excl. syn. *G. pictoria* Roxb. ex Buch.-Ham. 1826; Maheshw. in Bull. Bot. Surv. India 6: 132. 1965; Manilal, Fl. Silent Valley: 20. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 55. 1988, excl. syn.; Vajr., Fl. Palghat: 71. 1990, excl. syn.; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 119. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 71. 1994, excl. syn.; Sasidh. & Sivar., Fl. Pl. Thrissur: 52. 1996, excl. syn.; Sivar. & P. Mathew, Fl.

Nilambur: 69. 1997, excl. syn.; N. Mohanan & Sivad., Fl. Agasthyamala: 85. 2002. *Mangostana morella* Gaertn., Fruct. Sem. Pl. 2: 106, t. 101. 1790. *Garcinia elliptica* Wight, Icon. Pl. Ind. Orient.: t. 120. 1839. *G. gutta* Wight, Ill. Ind. Bot. 2: t. 144. 1850, excl. syn.

Mal.: *Chigiri, Daramba, Karukkampuli, Pinnarpuli*

Tree, 10–20 m tall; bark smooth, brownish grey to dark brown; latex dark yellow; branchlets 4-angled, glabrous. Leaves elliptic, ovate, obovate or oblanceolate, acute or cuneate at base, entire or subrepand at margin, acute, acuminate or obtuse to short-acuminate at apex, 6.5–14 x 4–7 cm, chartaceous; midnerve slightly distinct and grooved above, prominent beneath; lateral nerves 8–10 pairs, slender, obscure; petioles 7–10(–15) mm long, short-ligulate at base. Male flowers in axillary 3-flowered fascicles or on old wood, 5–10 mm across, white or cream-coloured; pedicels 4–6 mm long; sepals 4, orbicular or elliptic, 4–6 mm long; outer pair smaller than the inner, greenish white; petals 4, orbicular or broadly elliptic, 5–8 mm long; stamens 25–40; filaments short, obconic, free above; anthers peltate, orbicular, flat, red, many-loculed, dehiscence circumscissile or transverse; pistillode absent. Female flower solitary, axillary; staminodes 10–12, connate at base into a ring around ovary; ovary subglobose, 4-loculed; stigma sessile, peltate, 4-lobed, coronate, dentate, yellow turning brown-red, persistent; berries sessile, subglobose or globose, 2–3 cm across, crowned by 4 lobes of round confluent papillate stigmas; seeds 4, ovoid-reniform, laterally compressed, muricate, dark brown.

Fl. & Fr.: Nov. – Aug., fruits persisting till Dec.

Habitat: River banks in evergreen and semievergreen forests, to 1100 m.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Assam, Karnataka, Meghalaya and Tamil Nadu. Bangladesh, Malaysia, Myanmar, Singapore, Sri Lanka and Thailand.

5. *Garcinia pictoria* Roxb. ex Buch.-Ham. in Mem. Wern. Soc. 5: 46. 1826; Roxb., Fl. Ind. 2: 627. 1832; Maheshw. in Bull. Bot. Surv. India 6: 133. 1965; Mabb. in Taxon 26: 529. 1977; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 122. 1993. *G. morella* sensu T. Anderson in Hook.f., Fl. Brit. India 1: 264. 1874 p.p., non (Gaertn.) Desr. 1792.

Tree, to 18 m tall; bark ferruginous with yellow specks; latex yellow; branchlets 4-angled. Leaves oblong or elliptic-lanceolate, acute at base, entire at margin, obtusely acuminate at apex, 10-13 x 3-5.5 cm; lateral nerves ca 20 pairs, prominent; petioles to 5 mm long. Male flowers sessile; sepals 4, orbicular, ca 5 mm; outer pair shorter than the inner, concave, coriaceous; petals 4, larger and thicker than sepals; stamens 24, on a somewhat 4-gonous receptacle; filaments short; anthers depressed, peltate, dehiscence circumscissile; pistillode absent. Female flower solitary, sessile or short-pedicelled, yellow; sepals and petals as in male ones; staminodes 24 in 6 or 7 fascicles; ovary oblong, 4-loculed; ovule 1 in each locule; stigma sessile, 11-13-lobed, 4-furrowed, coronate; berries globose, smooth, with persistent sepals; seeds 4, oblong-reniform.

Fl.: Feb. *Fr.*: May - June.

Habitat: Evergreen forests, to 1100 m.

Distrib.: Wynad. Western Ghats of Karnataka and Tamil Nadu. Malesia.

Uses: The plant yields a yellow pigment. Timber is used for various domestic purposes. Seed oil is used as a substitute for ghee and locally for illuminating purpose.

Note: Maheshwari (*l.c.*) treated *G. pictoria* Roxb. (1832) as a distinct species and stated that it is closely allied to *G. morella* (Gaertn.) Desr. and scarcely distinguishable except by the female flowers and gave the distribution as - Common in forests of W. Ghats from Malabar to Wynad, Nilgiris and Mysore, ascending to 1067 m; Mergui. Singh (*l.c.*) almost literally followed Maheshwari (*l.c.*). Following Dunn (*l.c.*) and beginning with Gandhi (in C.J. Saldanha & Nicolson, *Fl. Hassan*: 126, 1976) almost all later workers synonymised *G. pictoria* Roxb. under *G. morella* except Ramamurthy (in N.C. Nair & A.N. Henry, *Fl. Tamil Nadu* 1983) who chose to ignore the existence of *G. pictoria* Roxb.

Mabberley (*l.c.*) pointed out that Roxburgh's *G. pictoria* was validly published by Buchanan-Hamilton (1826) much before Roxburgh (*Fl. Ind.* 2: 627, 1832) and concluded that it is a synonym of *G. morella* (Gaertn.) Desr. (1792). Buchanan-Hamilton gave the binomial *G. pictoria* for the plant 'Arbor Mundo dicta' in Rumphius' *Herb. Amboin.* with a long description in Latin. However, Roxburgh's (*l.c.*) *G. pictoria* was based on material from Tellicherry (Kerala). Maheshwari (*l.c.*) did not cite any specimen studied. Singh (*l.c.*), the only later worker who could have resolved this problem, just followed Maheshwari (*l.c.*)

and did not even refer to Mabberley (*l.c.*). Our inclusion is based on Roxburgh (*l.c.*) since the type of *G. pictoria* Roxb. is from Kerala and Maheshwari (*l.c.*) who treated it as distinct from *G. morella*. The description by Buchanan-Hamilton (*l.c.*) for *G. pictoria* does not differ much from Roxburgh's *G. pictoria*. However, a comparative study of the Malesian material with that of Kerala is absolutely necessary to conclude with certainty that *G. pictoria* Roxb. (1832) is distinct from *G. pictoria* Roxb. ex Buch.-Ham. (1826).

6. *Garcinia rubro-echinata* Kosterm. in Ceylon J. Sci., Biol. Sci. 12: 128. 1977; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 123. 1993. *G. echinocarpa* auct. non Thwaites 1854: Gamble, Man. Ind. Timb. ed. 2, : 53. 1902; Bourd., Forest Trees Travancore: 23. 1908; Rama Rao, Fl. Pl. Travancore: 29. 1914; Dunn in Gamble, Fl. Madras: 73(52). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 71. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 83. 2002. *G. echinocarpa* var. *monticola* Maheshw. in Bull. Bot. Surv. India 6: 126. 1965.

Mal.: *Para, Pura*

Tree, to 20 m tall; bark lenticelled, dark red; latex white; branchlets apically 4-angled, compressed. Leaves obovate, oblanceolate or oblong to broadly elliptic, cuneate or decurrent at base, revolute at margin, obtuse or retuse at apex, 6 - 17 x 3 - 9.2 cm, coriaceous with sparse minute black eruptions throughout beneath; midnerve flat and channelled above, raised and striate beneath; lateral nerves 30 - 45 pairs, prominent; intramarginal nerve prominent; petioles 1 - 1.8 cm long. Male flowers in axillary or terminal 8-flowered fascicles, subtended by large bracts; sepals 4, orbicular, subcordate or obtuse, to 6 mm long, fleshy; petals 4, suborbicular to oblong, twice as long as sepals, fleshy; stamens 12 - 14, connate into a short 4-angled mass; filaments short; anthers linear-oblong, dehiscing longitudinally; pistillode absent. Female flower solitary, sessile, terminal; staminodes 1-seriate, connate into a ring at base; ovary covered with numerous fleshy scales, 3- or 4-loculed; stigma peltate, irregularly lobed; berries subglobose or ellipsoid, 3 - 4.5 x 2.5 - 3(- 4) cm, covered with spines or broad sharp tubercles, fleshy, dark red; seeds 1 - 3, oblong, to 4 cm long, arillate.

Fl. & Fr.: Feb. - July (- Nov.).

Habitat: Moist evergreen forests, 900 - 1830 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). En-

demic.

Uses: Seed oil is used for illuminating purpose. It is also used in soap and candle manufacture. Leaf and bark are used as vermifuge and in dropsical affections.

7. ***Garcinia spicata*** (Wight & Arn.) Hook.f. in J. Linn. Soc., Bot. 14: 486. 1875; Dunn in Gamble, Fl. Madras: 74(49). 1915 p.p.; Maheshw. in Bull. Bot. Surv. India 6: 112. 1965, incl. vars.; Vajr., Fl. Palghat: 71. 1990; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 125. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 53. 1996. *Xanthochymus spicatus* Wight & Arn., Prodr. Fl. Ind. Orient.: 102. 1834. *Stalagmitis ovalifolius* G. Don, Gen. Hist. 1: 621. 1831. *Xanthochymus ovalifolius* Roxb. [Hort. Bengal.: 42. 1814, nom. nud.], Fl. Ind. 2: 632. 1832. *Garcinia ovalifolius* (Roxb.) Hook.f. ex T. Anderson in Hook.f., Fl. Brit. India 1: 269. 1874, incl. vars. except *macrantha*, non Oliv. 1868; Bourd., Forest Trees Travancore: 26. 1908; Rama Rao, Fl. Pl. Travancore: 30. 1914. *G. spicata* (Wight & Arn.) Hook.f. var. *glomerata* Vesque in A. DC., Monogr. Phan. 8: 311. 1893.

Mal.: *Manjanangu*

Tree, to 30 m tall; bark smooth, olive green to brownish; latex white or yellow. Leaves ovate, elliptic-oblong, lanceolate or suborbicular, obtuse or acute or decurrent into petiole, repand at margin, rounded, obtuse, emarginate, rarely acute to short-acuminate at apex, 6.5 - 22 x 4 - 8 cm, coriaceous; midnerve raised and prominent; lateral nerves 15 - 18 pairs, slender, prominent; intramarginal nerve prominent; petioles to 2.3 cm long, with stem-clasping ligules at base. Flowers in axillary leafy fascicles on 10 - 15 cm long pseudospikes; pedicels 6 - 15 mm long; bracts many, minute, pilose. Sepals 4 or 5, suborbicular, ciliate at margin, pubescent outside; outer 2 coriaceous, 3 - 3.5 x 2 - 2.5 mm; inner 2(or 3), 4.5 - 5 x 3 - 4.5 mm, transparent towards margin. Petals 5, obovate, 6 - 7(- 8.5) x 5 - 6.5 mm. Male flowers: Stamens 8 - 10 in 5 long-clawed spatulate bundles opposite petals, inserted on green flossy convex receptacle; filaments very short, free; anthers few, didymous; pistillode absent. Female flowers: Staminodes 5; ovary globose; styles ca 1 mm long; stigma peltate, thick, 5-lobed; lobes cuneiform; berries broadly oblong or globose, to 4 cm across, smooth, with persistent stigma, yellowish, foetid; seeds 1 - 3, oblong, laterally flat, to 2.5 cm long.

Fl. & Fr.: Feb. - July (- Aug.).

Habitat: Semievergreen forests at low elevations.

Distrib.: Idukki, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Sometimes cultivated. Andhra Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Orissa and Tamil Nadu. Sri Lanka.

8. *Garcinia talbotii* Raizada ex Santapau in Rec. Bot. Surv. India ed. 2, 16: 14. 1960; Maheshw. in Bull. Bot. Surv. India 6: 113. 1965; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 127. 1993. *G. ovalifolius* (Roxb.) Hook.f. ex T. Anderson var. *macrantha* T. Anderson in Hook.f., Fl. Brit. India 1: 269. 1874. *G. spicata* (Wight & Arn.) Hook.f. var. *macrantha* Vesque in A. DC., Monogr. Phan. 8: 311. 1893. *G. malabarica* Talbot in J. Bombay Nat. Hist. Soc. 11: 234. 1897, non Desr. 1792. *Xanthochymus ovalifolius* J. Graham, Cat. Pl. Bombay: 26. 1839, non Roxb. 1832.

Tree, to 15 m tall; branchlets angled, swollen at nodes; latex brownish. Leaves elliptic-oblong or ovate, rounded at base, entire at margin, obtuse or retuse at apex, 7–18 x 4–10 cm, coriaceous; lateral nerves 16–18 pairs or more, distinct; petioles 12–18 mm long, rugose. Inflorescences congested, often on old wood. Flowers 1.8–2.7 cm across, creamy white or white to greenish yellow; pedicels 5–12 mm long; bracteoles many, minute, at base of pedicel. Sepals 5, orbicular, ca 3 mm, green. Petals 5, orbicular or suborbicular, concave, 5–10 mm across, white. Male flowers: Stamens in 5 phalanges, opposite petals; anthers 8–12 in each phalange, didymous, reddish; pistillode absent. Female flowers: Staminodes in 5 thin flat phalanges; anthers 4 or 5 in each phalange, flat, didymous; ovary globose, 3- or 4-loculed; stigmatic lobes 3, thick, spreading; berries broadly oblong, 4–6 cm across, with abundant yellow latex.

Fl. & Fr.: Nov.–May.

Habitat: Evergreen forests.

Distrib.: Palakkad. Western Ghats. Endemic.

Uses: Fruit yields a yellow gum. Dried fruit is used in curries.

9. *Garcinia travancorica* Bedd., Fl. Sylv. S. India: t. 173. 1872; T. Anderson in Hook.f., Fl. Brit. India 1: 268. 1874; Bourd., Forest Trees Travancore: 25. 1908; Rama Rao, Fl. Pl. Travancore: 30. 1914; Dunn in Gamble, Fl. Madras: 74(53). 1915; Maheshw. in Bull. Bot. Surv. India 6: 120. 1965; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 128. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 72. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 87. 2002.

Mal.: *Malampongu*

Tree, to 15 m tall; branchlets obtusely 4-angled; latex yellow. Leaves linear-oblong to subspatulate, acute at base, revolute at margin, obtuse, bluntly acute or with short blunt acumen at apex, 6 - 11 x 1.5 - 3 cm, coriaceous; midnerve channelled above, raised beneath; lateral nerves numerous, slender; petioles 6 - 16 mm long. Male flowers in terminal or subterminal trichotomous few-flowered short cymes, ca 1 cm across, white; pedicels 2 - 3 mm long; sepals 4, orbicular; outer pair ca 2.5 mm; the inner ca 4 mm; petals 4, orbicular, short-clawed, ca 7 mm; stamens numerous in 4 multifid masses; filaments short; anthers linear-oblong, versatile, longitudinally 2-valved; pistillode columnar with a circular peltate stigma. Female flowers solitary or paired, terminal and axillary; staminodes ca 5, free, slender, inserted on a hypogynous ring; filaments flat, in di- or trichotomous branches; anther lobes oblong, divaricate; ovary subglobose or pyriform, ca 6 x 4.5 mm, 4-loculed; stigma entire, convex, ca 3 x 7 mm; berries oblong to subglobose, 2.5 - 3.5 cm across, contracted into a short thick style, with a broad imbricate stigma at top, ca 8 mm across; seeds 1 or 2, 2.5 - 2.8 x 1.5 - 1.8 cm, smooth, shining, brown.

Fl. & Fr.: Sept. - June.

Habitat: Evergreen forests, to 1500 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic.

10. *Garcinia wightii* T. Anderson in Hook. f., *Fl. Brit. India* 1: 265. 1874; Dunn in Gamble, *Fl. Madras*: 74(53). 1915; Maheshw. in *Bull. Bot. Surv. India* 6: 134. 1965; N.P. Singh in B.D. Sharma & Sanjappa, *Fl. India* 3: 129. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 53. 1996; N. Mohanan & Sivad., *Fl. Agasthyamala*: 87. 2002.

Mal.: *Attukaruka, Kolivala, Palimaranga, Pulimaranga*

Tree, to 10 m tall; branchlets 4-angled; bark pustulated, dark brown. Leaves linear to linear-lanceolate or elliptic, slightly falcate, acute and decurrent into petiole, slightly recurved at margin, acuminate or acute at apex, 6.5 - 15.5 x 1 - 2.5 (3.6) cm, coriaceous, with very minute black eruptions beneath; lateral nerves 11 - 20 pairs, very slender, prominent; petioles 5 - 8 mm long. Male flowers sessile, axillary, solitary or, 2 or 3 together, sometimes numerous, ca 1 cm across; sepals 4,

orbicular, 4–5 mm, thin-coriaceous; petals 4, obovate, 4.5–5 x ca 3.5 mm; stamens often 12–15, connate into a 4-gonal column enclosing styloidium; filaments free above; anthers peltate, dehiscing obliquely; pistillode 4-gonal. Female flower sessile, axillary, solitary; ovary almost globose, usually 4-loculed; stigmas sessile, large, 4-lobed; berries subglobose, 11–13 x 9–11 mm, smooth, yellowish, pink tinged, with persistent stigma and sepals; seeds 4, ca 9.5 x 4.5 cm.

Fl. & Fr.: Oct.–March.

Habitat: River banks in evergreen and semievergreen forests, to 700 m.

Distrib.: Idukki, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu. Endemic.

Use: The gamboge yields a good pigment.

11. *Garcinia xanthochymus* Hook.f. ex T. Anderson in Hook.f., *Fl. Brit. India* 1: 269. 1874; Bourd., *Forest Trees Travancore*: 25. 1908; Rama Rao, *Fl. Pl. Travancore*: 30. 1914; Maheshw. in *Bull. Bot. Surv. India* 6: 114. 1965; N.P. Singh in B.D. Sharma & Sanjappa, *Fl. India* 3: 129. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 72. 1994. *Xanthochymus pictorius* Roxb., *Pl. Coromandel* 1: 51, t. 196. 1805 & *Fl. Ind.* 2: 633. 1832. *X. tinctorius* DC., *Prodr.* 1: 562. 1824, nom. illeg. incl. type of *X. pictorius* Roxb. 1805. *Garcinia pictoria* (Roxb.) W. Wight in *U.S.D.A. Bur. Pl. Industr. Bull.* 137: 50. 1909 (as *pictorius*), non Roxb. ex Buch.-Ham. 1826; Manilal, *Fl. Silent Valley*: 20. 1988. *G. tinctoria* (DC.) Dunn in *Gamble, Fl. Madras*: 74(53). 1915; D'Arcy in *Ann. Missouri Bot. Gard.* 6: 998. 1980.

Mal.: *Anavya*

Tree, to 20 m tall; branchlets 6–8-angled; bark blackish or dark grey; latex milky or pale green. Leaves linear-oblong or oblong-lanceolate, cuneate at base, subrepand at margin, acute to acuminate at apex, 12–45 x 4–12 cm, coriaceous; midnerve prominent beneath; lateral nerves 15–20 pairs; petioles angled, 1–2.5 cm long, rugose; stipules fleshy, adnate, intrapetiolar, covering terminal bud. Fascicles 4–10-flowered, in leaf axils or axils of fallen leaves. Flowers 1.5–2 cm across, white or cream-coloured; pedicels 2–2.5 cm long, fleshy; bracts minute, suborbicular, red; bracteoles 2, ca 1 mm long. Sepals 5, rarely 4, unequal, orbicular, fleshy, fifth one often scale-like; outer 2, 4–6 mm long; inner 3 fimbriate, 7–8 mm long, persistent. Petals 5, thin, short-clawed, 7–9 mm long, somewhat ciliate,

nerved, greenish white. Male flowers: Stamens 15 - 20 in 5 broad to 13 mm long bundles of 3 - 5 each alternating with 5 fleshy glands; anthers on short filaments near forked apices of bundles; pistillode absent. Female flowers: Staminodes few in an interrupted ring; ovary ovoid, acuminate, greenish white, usually 5-loculed; styles very short; stigmatic rays 5, oblong, peltate, spreading, entire, persistent; berries subglobose, ca 6.5 cm across; beak 2 - 3 mm long; seeds 1 - 4, oblong, ca 3.5 x 1.8 cm, brown, embedded in aril-like yellow pulp; stalks ca 3 cm long.

Fl. & Fr.: Throughout the year.

Habitat: Moist deciduous to evergreen forests, to 1400 m.

Distrib.: Palakkad and Thiruvananthapuram. Andaman & Nicobar Islands, Andhra Pradesh, Assam, Goa, Karnataka, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu and Tripura. Bangladesh, China, Malay Peninsula, Myanmar and Thailand.

Uses: Fruit is edible. Gamboge is used in dyeing. Seedling is used for grafting and in arching mangosteen. Grown as an ornamental.

Garcinia mangostana L., Sp. Pl.: 443. 1753; T. Anderson in Hook.f., Fl. Brit. India 1: 260. 1874; Rama Rao, Fl. Pl. Travancore: 28. 1914; Dunn in Gamble, Fl. Madras: 73(52). 1915; Maheshw. in Bull. Bot. Surv. India 6: 120. 1965; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 148. 1993.

Mal.: *Mangustan*, *Mangusta*

Evergreen tree, 20 - 25 m tall; latex yellow. Leaves elliptic to elliptic-oblong, acute, obtuse or rounded at base, slightly revolute and thick at margin, acute or short-acuminate at apex, 15 - 25 x 6 - 12 cm, coriaceous. Male flowers rare, ca 4 cm across, pale green or creamy yellow. Bisexual flowers solitary or paired, pseudoterminal, 4 - 5 cm across. Berries to 7 cm across, dark purple-brown, surrounded by enlarged sepals at base and crowned by hard flat stigma; seeds to 8, oblong, laterally compressed, 1 - 2 cm long, with white thick juicy pleasant smelling aril.

Fl. & Fr.: Throughout the year.

Uses: Fruit is edible and is known as 'queen of tropical fruits' Mangostin, a yellow pigment from rind, is used in dyeing and tanning. Rind is astringent and is used as a febrifuge, in chronic diarrhoea, gleet and dysentery. Pericarp paste is used in curing skin infections. Wood suits for cabinet work, building purposes, rice pounders and spear handles.

The plant prefers wet and humid climate. Cultivated in Assam, Goa, Kerala, Maharashtra, Tamil Nadu and W. Bengal and rarely in Andamans and Arunachal Pradesh. Probably native to W. Malesia; cultivated in Indonesia (Java), Malay Peninsula, Myanmar, Panama, Sri Lanka, Sunda Islands, Thailand and Vietnam; semiwild in the Philippines, Singapore and Australia.

3. MAMMEA L.

Evergreen trees, small to medium-sized, mono- or dioecious, resiniferous; bark smooth, yellowish, with white or yellow sap or latex. Leaves simple, exstipulate, opposite or subverticillate, coriaceous, glabrous, shining, with scales at base, pinnately nerved; nervation dense and areolate with a distinct pellucid gland in centre of each areole. Flowers uni- or bisexual, actinomorphic; bracts many, decussate, surrounding flower at base. Calyx connate in bud, splitting into 2 convex halves at anthesis, more or less persistent in fruit. Petals 4, rarely to 7, decussate, white, caducous. Stamens numerous, usually free; filaments free, slender, filiform, white; anthers erect, oblong, dehiscing by longitudinal slits. Ovary in male flowers absent or completely reduced, in bisexual ones sessile, 2-loculed with 2 ovules in each or 4-loculed with 1 ovule in each, sometimes septa incomplete; styles short, stout, crowned by a broad peltate 2 - 4-lobed stigma. Drupes pulpy, indehiscent, usually 1-loculed; pericarp coriaceous; seeds 1 - 4, large, surrounded by transparent pulp.

Pantropic, ca 50 species, 2 in India and 1 in Kerala.

Literature: Maheshwari, J.K. 1972. Morpho-taxonomic studies on Indian *Guttiferae*. The genera *Mammea* Linn. *s.l.* and *Kayea* Wall. In: Murthy, Y.S. & al. (ed.), *Adv. Pl. Morphol.*: 137-152.

Mammea suriga (Buch.-Ham. ex Roxb.) Kosterm. in *Commun. Forest Res. Inst.* 12: 33, f. 19. 1961; N.P. Singh in B.D. Sharma & Sanjappa, *Fl. India* 3: 132. 1993. *Calophyllum suriga* Buch.-Ham. ex Roxb., *Fl. Ind.* 2: 608. 1832. *Calysaccion longifolium* Wight, *Ill. Ind. Bot.* 1: 130. 1840 & *Icon. Pl. Ind. Orient.*: t. 1999. 1853; Bedd., *Fl. Sylv. S. India*: t. 89. 1871. *Mammea longifolia* (Wight) Planch. & Triana in *Ann. Sci. Nat. Bot.* 4, 15: 240. 1861. *Ochrocarpus longifolius* (Wight) T. Anderson in Hook.f., *Fl. Brit. India* 1: 270. 1874; Dunn in Gamble, *Fl. Madras*: 75(54). 1915.

Mal.: *Seraya, Suran-punna*

Evergreen tree, to 18 m tall, monoecious; bark rough, defoliating in irregular pieces; latex milky; branchlets obscurely 4-angled. Leaves opposite or verticillate, at ends of branchlets, oblong, oblong-lanceolate or -elliptic, obtuse, acute or shortly cuneate at base, entire at margin, emarginate, retuse or short-acuminate at apex, 12 - 20 x 4.5 - 7.8 cm, glabrous; midnerve stout, channelled above, raised and striate beneath; lateral nerves 15 - 20 pairs, faint, connected by dense reticulate nervation; petioles stout, 6 - 10 mm long, channelled above. Fascicles in axils of fallen leaves. Flowers uni- and bisexual, ca 1 cm across, white or pinkish; bracteoles ca 8, subulate, 1 - 1.5 mm long; pedicels slender, thick above, 1.5 - 2.5 cm long. Calyx opening into 2 valves; lobes obtuse with a minute cusp at apex, concave, reflexed during anthesis, 5 - 7 mm long, reddish. Petals 4, ovate or oblong-obovate, 4 - 5 x 8.5 - 10 mm, white with red streaks, caducous. Stamens 60 - 100; filaments 4 - 5 mm long; anthers oblong or linear, retuse at apex, 2 - 3 x 0.5 - 0.8 mm. Ovary depressed-subglobose, 2 - 2.5 mm, 2 - 4-loculed; styles subulate, 1.5 - 3 mm long; stigmas large, umbonate, peltate, obscurely sinuate or 2-lobed; berries obliquely ovoid, 2.2 - 3 x 1 - 1.5 cm, with a hard pointed style at apex; seeds 1 - 4, ca 2 x 1 cm; stalks 1.7 - 2.5 cm long.

Fl. & Fr.: March - July.

Habitat: Evergreen and deciduous forests, to 600 m.

Distrib.: Malabar (precise locality not known). Western Ghats; cultivated in Assam, Orissa, Uttar Pradesh and W. Bengal. Bangladesh.

Uses: Cultivated as an avenue tree. Fruit is edible. Flower yields a perfume and dye and medicinally used in dyspepsia and haemorrhoids.

4. MESUA L.

Shrubs or trees. Leaves opposite, petioled, polymorphic, usually lanceolate, entire, coriaceous, pellucid-dotted, shining above, often pruinose or glaucous beneath; midnerve conspicuous; lateral nerves slender, often obsolete, polygonally reticulate; foliar crystals geniculate. Flowers pedicelled or not, axillary or terminal, solitary, paired, subfascicled to fascicled or in panicles, bisexual or polygamous, variable in size; bracts and bracteoles present and persistent or absent. Sepals 4, usually outer pair smaller than the inner, decussate, imbricate, usually accrescent in fruit. Petals 4, imbricate. Stamens numerous, hypogynous; filaments filiform,

free or connate at base; anthers variously shaped, usually linear-oblong to oblong, basifixed, 2-loculed; connectives narrowly margined, dehiscent at top or by lateral vertical clefts. Ovary 1- sometimes incompletely 2-loculed; ovules 2 in each locule, erect, anatropous; style 1, subulate or filiform, slightly flexuous; stigma peltate, irregularly patelliform, obscurely 2-lobed, incised or 4-fid. Fruits fleshy, drupaceous or capsular nuts, enclosed by lignified enlarged sepals, dehiscent or not, sometimes eventually dehiscent into 2-4 valves; seeds 1-4, erect, often mutually pressed in an obtuse angle, exarillate, nonendospermous.

Tropical Asia and Indomalaysia to Australia, ca 40 species, 6 in India and 2 in Kerala.

Literature: Maheshwari, J.K. 1964. Taxonomic studies on Indian *Guttiferae*. II. The genus *Mesua* Linn. *Bull. Bot. Surv. India* 5: 335 - 343. Kostermans, A.J.G.H. 1969. *Kayea* Wall. & *Mesua* L. in *Reinwardtia* 7: 425 - 431. Stevens, P.F. 1986. *Mesua ferrea* became *M. nagassarium* but has to be called *M. ferrea* again (*Clusiaceae*). *Taxon* 35: 352 - 354.

Key to species

- | | | |
|-----|---|-------------------------|
| 1a. | Flowers and fruits distinctly stalked; bracts and bracteoles absent | 1. <i>M. ferrea</i> |
| b. | Flowers and fruits sessile; bracts and bracteoles persistent | 2. <i>M. thwaitesii</i> |

1. ***Mesua ferrea*** L., Sp. Pl.: 515. 1753; T. Anderson in Hook.f., Fl. Brit. India 1: 277. 1874; Dunn in Gamble, Fl. Madras: 77(55). 1915; Nicolson & al. in Regnum Veg. 119: 84. 1988; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 136. 1993, incl. vars.; Sasidh. & Sivar., Fl. Pl. Thrissur: 53. 1996; Sivar. & P. Mathew, Fl. Nilambur: 70. 1997. *Calophyllum nagassarium* Burm.f., Fl. Indica: 121. 1768. *Mesua roxburghii* Wight, Ill. Ind. Bot. 1: 127. 1840. *M. nagana* Gardner in Calcutta J. Nat. Hist. 8: 4. 1847. *M. nagassarium* (Burm.f.) Kosterm. in Ceylon J. Sci., Biol. Sci. 12: 76. 1976; Manilal, Fl. Silent Valley: 21. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 55. 1988; Vajr., Fl. Palghat: 72. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 73. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 88. 2002.

Mal.: *Nanga, Peri, Veluthapala*

Evergreen tree, 20-40 m tall, buttressed; bark smooth, grey to dark brown; branchlets slender, terete. Leaves opposite, linear-lanceolate, oblong-

lanceolate or elliptic-oblong, obtuse, acute or shortly cuneate at abase, entire at margin, acute, acuminate or cuspidate at apex, 5 - 18 x 1 - 5 cm, coriaceous, glabrous, glaucous and pruinose beneath; midnerve channelled above, raised beneath; lateral nerves very fine, almost indistinct beneath; petioles 5 - 13 mm long. Flowers axillary and terminal, usually solitary, rarely paired, bisexual, 4 - 10 cm across, white, fragrant; peduncles short, stout, rusty-tomentose; pedicels 8 - 15 mm long, densely rusty-tomentose. Sepals 4, in 2 pairs, unequal, orbicular, imbricate, glabrous to densely velvety-puberulous outside, persistent. Petals 4, obovate or obcordate, curled and erose at margin, 2 - 4.5 x 2.8 - 3.5 cm, white with brown or purple nerves. Stamens numerous; filaments filiform, 5 - 6.5 mm long, connate at base; anthers linear-oblong, 2 - 2.5 x ca 1 mm, dehiscing longitudinally; connectives prominent, 2.5 - 3 mm thick. Ovary ovoid, 5 - 6 mm long, 2-loculed; ovules 2 in each locule; styles as long as or longer than ovary, often curved; stigma peltate. Fruits ovoid to globose with a conic point, 2.5 - 3.5(- 5) x 3 - 4(- 5) cm, striate; seeds 1 - 4, pyriform, variously faceted, ca 2.5 mm long, smooth, dark brown.

Fl.: Jan. - March *Fr.*: May - Oct.

Habitat: Evergreen forests, to 1100 m.

Distrib.: Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Andaman & Nicobar Islands, NE. and S. India. South and SE. Asia.

2. *Mesua thwaitesii* Planch. & Triana in Ann. Sci. Nat. Bot. 4, 15: 305. 1861; T. Anderson in Hook.f., Fl. Brit. India 1: 278. 1874; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 143. 1993. *M. ferrea* L. var. *thwaitesii* (Planch. & Triana) Vesque in A. DC., Monogr. Phan. 8: 634. 1893; Maheshw. in Bull. Bot. Surv. India 5: 339. 1964; Manilal & Sivar., Fl. Calicut: 41. 1982.

Tree, to 20 m tall; bark smooth, dark brown. Leaves opposite, elliptic, oblong-elliptic or -lanceolate, acute to shortly cuneate or rounded at base, entire and slightly recurved at margin, acute or acuminate to cuspidate at apex, 10 - 23 x 2 - 4 cm, coriaceous, glaucous, white and faintly nerved and papillate beneath. Flowers solitary, paired or rarely in 3s, axillary, ca 11.5 cm across; peduncles short, pubescent; bract and bracteoles broadly obovate or suborbicular-obovate, obtuse, thick, closely adhering sepals. Sepals 4; outer pair smaller than the inner and petals, slightly pubescent, persistent. Petals 4, orbicular, ca 2 cm. Stamens numerous; anthers oblong, cordate, unequal or oblique at base, retuse at apex, 2 -

2.3 x 0.8 - 1 mm; connectives 2 - 3 mm thick. Ovary 2-loculed; stigma peltate. Fruits globose-depressed or obovoid- apiculate or conic, 3 - 5 cm long, woody, surrounded by enlarged sepals and bracts; seeds 2.

Fl. & Fr.: Feb. - Dec.

Habitat: Evergreen and semievergreen forests.

Distrib.: Idukki and Kozhikode. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Excluded species

Mesua pulchella Planch. & Triana was reported to occur in Kerala (Travancore) as well (Singh, *l.c.*: 143). There is no specimen from Kerala at MH nor does any flora therefrom mention it.

5. POECILONEURON Bedd.

Large, evergreen trees; branchlets minutely hairy. Leaves opposite, linear-oblong to lanceolate or elliptic, acute, rounded, attenuate or cuneate at base, entire at margin, acute to acuminate at apex, thick-coriaceous, shining, smooth, with numerous close parallel lateral nerves and minutely reticulate; petioles channelled above, minutely hairy. Inflorescences terminal panicles or solitary flower, sometimes in fascicles, axillary. Flowers yellowish white or yellowish. Sepals 4 or 5, imbricate. Petals 5 or 6, contorted. Stamens 16 - 22 in 2 whorls, free or slightly connate at base; anthers narrowly linear, erect, basifixed. Ovary 2-loculed; ovules 2 in each locule, erect; styles 2, subulate; stigmas punctiform. Capsules ovoid, 1-loculed, 1-seeded, dehiscing septicidally into 2 coriaceous valves; seeds hard, without endosperm; testa loose, membranous, striate.

Southern Western Ghats, 2 species.

Note: Based on the presence of fibre tracheids *Poeciloneuron* is sometimes placed in the *Bonnetiaceae* (Kupiers, B. 1976. *Leiden Bot. Ser.* 3: 76-101). But based on the opposite leaves and basal placentation it can be placed in the tribe *Calophylleae* (Kubitzki & al. 1978. *Biochem. Syst. Ecol.* 6: 105-187).

Key to species

- 1a. Flowers in terminal panicles; sepals and petals 5 each 1. *P. indicum*
- b. Flowers axillary, solitary, sometimes in fascicles of 2 or 4; sepals 4; petals 6

2. *P. pauciflorum*

1. **Poeciloneuron indicum** Bedd. in J. Linn. Soc., Bot. 8: 267, t. 17. 1865 & Fl. Sylv. S. India: t. 3. 1869; Dyer in Hook.f., Fl. Brit. India 1: 278. 1874; Bourd., Forest Trees Travancore: 31. 1908; Rama Rao, Fl. Pl. Travancore: 33. 1914; Dunn in Gamble, Fl. Madras: 77(56). 1915; Manilal, Fl. Silent Valley: 22. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 55. 1988; Vajr., Fl. Palghat: 72. 1990; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 146. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 73. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 54. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 89. 2002.

Mal.: *Vayala, Vayila*

Tree, to 50 m tall, buttressed with stilt roots; bark grey to brown; latex yellow. Leaves elliptic, elliptic-oblong or ovate-lanceolate, rounded, acute or cuneate at base, entire at margin, obtusely or abruptly acuminate at apex, 10 - 25 x 4 - 7.8 cm, coriaceous, shining; petioles to 2 cm long. Panicles terminal, ca 12 cm long, minutely puberulous. Flowers ca 2 cm across, yellowish white, fragrant; pedicels 5 - 8 cm long, slightly puberulous; bracts lanceolate, 3-angled, 3.5 - 4 x 0.5 - 0.7 mm, puberulous outside, longitudinally streaked inside; bracteoles 3-angled, ca 1.3 mm long, puberulous. Sepals 5, deeply cleft, ovate, 1.5 - 3 x 1.8 - 2 mm, ciliate at margin, slightly puberulous outside, imbricate. Petals 5, elliptic to obovate or oblong-elliptic, obtuse at apex, 6 - 8 x 3 - 4 mm, ciliate at margin, red-nerved. Stamens ca 20 in 2 whorls; filaments ca 0.8 mm long, slightly connate at base; anthers linear-oblong, cuneate, truncate or oblique at base, undulate at margin, mucronate at apex, 3 - 4.5 x 0.5 - 0.7 mm, lobuled; 2-loculed with numerous superposed compartments. Disc obsolete. Ovary 1 - 2 mm long, 2-loculed; ovules 2 in each locule; styles 2, 2.5 - 4 mm long, connate for 1 mm from ovary; stigmas 2, punctiform. Capsules ellipsoid or globose, beaked, 2 - 4 cm across, ribbed, glaucous; seed 1, ca 2 x 1.5 cm, fleshy.

Fl. & Fr.: Nov. - May.

Habitat: Evergreen forests and sholas, to 1800 m.

Distrib.: Idukki, Kannur, Kollam, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Timber is used for railway sleepers, bridges, house construction, agricultural implements etc.

2. **Poeciloneuron pauciflorum** Bedd., Fl. Sylv. S. India: t. 93. 1871; Dyer in Hook.f., Fl. Brit. India 1: 278. 1874; Bourd., Forest Trees Travancore: 31. 1908; Rama Rao, Fl. Pl. Travancore: 33. 1914; Dunn in Gamble, Fl. Madras: 77(56). 1915; N.P. Singh in B.D. Sharma & Sanjappa, Fl. India 3: 146. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 89. 2002.

Mal.: *Pudangalli, Puli-vayila*

Tree, to 18 m tall; trunk to 2 m across; branchlets minutely hairy. Leaves elliptic, lanceolate or oblong-elliptic, attenuate at base, entire or slightly recurved at margin, bluntly long-acuminate at apex, 5.5 - 13(- 17) x 1.5 - 4 cm, glabrous; petioles 7 - 10 mm long. Flowers solitary, paired or 4 in fascicles, terminal or in axils of fallen leaves, 1 - 1.2 cm across, white; bracts 3-angled, ca 3 mm long. Sepals 4, unequal; inner pair ca 6 mm long; the outer ca 2 mm long, puberulous outside. Petals 6, imbricate, glabrous. Stamens 16 - 25 in 2 whorls, subsessile, inserted on disc below ovary; filaments to 0.2 mm long; anthers linear-oblong, acute or cuneate at base, 2.5 - 3.5 mm long with a transparent ca 1.5 mm long flap with a distinct nerve and mucronate apex, smooth, 2-loculed. Ovary ca 2 mm long, 2-loculed; ovules 2 in each locule, erect; styles 2, ca 3.5 mm long. Capsules ovoid or globose, ca 2.5 cm, with persistent sepals and 3 stylar bases, dehiscent into 2 coriaceous valves, 1-loculed; seed 1, globose, ca 1 cm.

Fl. & Fr.: March.

Habitat: River banks in evergreen forests, 600 - 1200 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

Uses: Timber is used for building purposes, making walking sticks etc.

THEACEAE

(K. VIVEKANANTHAN)

Trees or shrubs, rarely scandent, usually unarmed, mostly evergreen. Leaves alternate, rarely subopposite, simple, exstipulate, often serrate or entire, coriaceous or membranous, pinnately nerved. Inflorescences racemes, fascicles or of solitary flowers. Flowers usually bi-, rarely unisexual and dioecious, actinomorphic, often showy, pedicelled, bracteate; bracteoles often paired below calyx.

Sepals 4 - 7, mostly 5, free or somewhat connate at base, imbricate, often unequal, persistent. Petals 4 - 9, usually 5, free or slightly connate at base, imbricate. Stamens 5 - many, epipetalous, free or shortly connate, 1- or multiseriate, sometimes adnate to petals at base; anthers 2-loculed, basifixed or versatile, opening lengthwise, very rarely by terminal pores. Ovary superior, rarely half-inferior or inferior, 2 - 5- rarely 1 - 10-loculed; ovules 2 or more in each locule, rarely 1, on axile placenta; styles as many as locules, rarely 1, free or partly connate; stigmas usually small, capitate or entire. Fruit an indehiscent berry or capsule dehiscing septi- or loculicidally bearing a central column; seeds many, smooth or tubercled, sometimes angled or winged; endosperm scanty, rarely copious; embryo straight or curved, variously folded or spirally twisted.

Tropics and warm temperate regions, 22 genera and ca 610 species, 9 and 24 in India and, 3 and 4 including 1 cultivated in Kerala.

Literature: Airy Shaw, H.K. 1936. The classification of the Camellioidaceae. *Bull. Misc. Inform.* 1936: 498 - 499. Keng, H. 1950. The *Theaceae* of Taiwan. *Taiwania* 1: 223 - 268.

Note: Most taxonomists treat the family *Ternstroemiaceae* and *Theaceae* together under the family *Theaceae* in 2 different tribes - Camellieae (anthers versatile; fruit usually a loculi- or septicidal capsule) and Ternstroemieae (anthers basifixed; fruit a berry or achene).

Key to genera

- | | | |
|-----|--|------------------------|
| 1a. | Anthers versatile; fruit a loculicidal capsule; seeds winged | 2. <i>Gordonia</i> |
| b. | Anthers basifixed; fruit a berry; seeds not winged | 2 |
| 2a. | Leaves crenate-serrate; flowers unisexual | 1. <i>Eurya</i> |
| b. | Leaves entire; flowers male and bisexual | 3. <i>Ternstroemia</i> |

1. EURYA Thunb.

Evergreen shrubs or small trees. Leaves alternate, sessile or subsessile, crenate-serrate, glabrous or sparsely pubescent beneath. Flowers unisexual, in small axillary clusters, rarely solitary in leaf axils, with bract and bracteole, pedicelled. Sepals 5, free, elliptic or ovate to orbicular, glabrous or pubescent outside, persistent. Petals 5, connate at base, elliptic, oblong or obovate, white, greenish, pinkish or yellow. Stamens 5 - 20, usually ca 12, unequal, epipetalous,

glabrous; filaments filiform; anthers apiculate, glabrous, basifixed. Ovary ovoid to subglobose, glabrous or pubescent, 2-5-loculed, free or connate; stigmas 2-5, hairy or not. Berries ovoid, globose or subglobose, brown to bluish, crowned by persistent style; seeds small, angled, pitted or tubercled, reticulate with fleshy endosperm.

Tropical Asia and the W. Pacific, ca 70 species, 8 in India and 1 in Kerala.

Literature: Hsu, P.S. 1964. Notes on the genus *Eurya* in China. *Acta Phytotax. Sin.* 9: 85-98.

Eurya nitida Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot. 3: 115, t. 17. 1840; Manilal, Fl. Silent Valley: 22. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 56. 1988; A.S. Chauhan & T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 184. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 74. 1994; Sivar. & P. Mathew, Fl. Nilambur: 72. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 91. 2002. *E. japonica* auct. non Thunb. 1784: Dyer in Hook.f., Fl. Brit. India 1: 284. 1874, incl. vars.; Bourd., Forest Trees Travancore: 3. 1908; Rama Rao, Fl. Pl. Travancore: 1. 1914; Dunn in Gamble, Fl. Madras: 78(57). 1915; Vajr., Fl. Palghat: 73. 1990.

Mal.: *Kattukarana*

Shrub or small tree, 3-15 m tall; young parts glabrous. Leaves obovate or elliptic-lanceolate, cuneate at base, crenate-serrate at margin, acute or acuminate at apex, 2.5-5.5 x 1.2-3.5 cm, glabrous especially beneath; petioles ca 5 mm long. Flowers unisexual, axillary, 1-3 in clusters; pedicels shorter than petiole; bracts 2, ovate, adnate to calyx. Sepals orbicular, 1.5-2 mm, unequal, glabrous, persistent. Petals orbicular, 2-2.5 mm, connate at base. Stamens free, 12-15; filaments ca 1.5 mm long. Ovary ovoid, 3-loculed; ovules numerous in each locule on axile placenta; styles 3. Berries globose to ovoid, apiculate with persistent styles; seeds tubercled.

Fl. & Fr.: Almost throughout the year.

Habitat: Moist deciduous to evergreen forests, 685-2000 m, common.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Wynad. Western Ghats of Tamil Nadu and Karnataka and NE. India. China, Indonesia and the Philippines.

Note: *Eurya nitida* is often erroneously named as *E. japonica*. The former is easily recognized by the smooth lower surface of the leaves with only a few faintly raised narrow nervules.

2. GORDONIA Ellis, nom. cons.

Evergreen trees or shrubs. Leaves alternate, entire or crenate, coriaceous. Flowers solitary, axillary or crowded at ends of branches, often subsessile. Sepals 3 - 5, imbricate, unequal, graduating from bracts to petals, persistent. Petals free or slightly connate, imbricate, inner ones larger. Stamens numerous. 5-adelphous, connate into a ring or adnate to petals at base; anthers versatile. Ovary 3 - 5 (rarely 6)-loculed; ovules 4 - 8 in each locule, pendulous; style simple; stigma 5-lobed. Fruit an oblong woody loculicidal capsule with 4 or 5 flat or grooved valves separating from a persistent axis; seeds flat or compressed, prolonged upwards into an oblong wing, nonendospermous; embryo straight; cotyledons ovate, flat or slightly crumpled; radicle small, superior.

South to SE. Asia and N. America, ca 70 species, 2 in India and 1 in Kerala.

Gordonia obtusa Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 87. 1834; Dyer in Hook.f., Fl. Brit. India 1: 291. 1874; Bourd., Forest Trees Travancore: 33. 1908; Rama Rao, Fl. Pl. Travancore: 33. 1914; Dunn in Gamble, Fl. Madras: 79(57). 1915; Manilal, Fl. Silent Valley: 22. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 73. 1988; A.S. Chauhan & T.K. Pal in B.D. Sharma & Sanjappa, Fl. India 3: 162. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 74. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 54. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 91. 2002.

Mal.: *Atangi, Ola*

Tree, to 25 m tall; bark smooth, grey. Leaves alternate, simple, oblong-lanceolate, acute or attenuate at base, crenate at margin, acute at apex, 7.5 - 14 x 2.5 - 5 cm, glabrous; lateral nerves 8 - 10 pairs, obscure. Flowers bisexual, solitary, axillary, towards ends of branches, 2.5 - 5 cm across, white or golden yellow. Sepals orbicular, silky-pubescent outside. Petals obcordate, somewhat connate at base, membranous. Stamens numerous. Capsules oblong, 5-angled, 2.5 - 3

x 1 1.2 cm, brown; valves deeply sulcate above; seeds many, winged.

Fl.: Sept. - April *Fr.*: March - June.

Habitat: Along streams in sholas and evergreen forests, 800 - 2100 m, common.

Distrib.: Throughout Kerala. Southern India. Sri Lanka.

Use: Wood is used for door frames.

3. TERNSTROEMIA Mutis ex L.f., nom. cons.

Evergreen trees or shrubs, glabrous. Leaves alternate, usually entire, coriaceous; lateral nerves invisible. Flowers uni- or bisexual, solitary or fascicled, axillary or lateral; peduncles often recurved and 2-bracteoid. Sepals 5, imbricate. Petals 5, connate at base, imbricate. Stamens numerous in male and bisexual flowers; anthers glabrous, basifixed; filaments connate at base. Ovary 2 - 4-loculed with 2 - 4 ovules suspended from apex; stigma 2- or 3-lobed. Berries indehiscent, rather dry with a thick rind; seeds few, large, horseshoe-shaped or oblong, rarely nonendospermous.

Tropics, 85 species, 2 in India and 1 in Kerala.

Ternstroemia gymnanthera (Wight & Arn.) Bedd., Fl. Sylv. S. India: t. 91. 1871; A.S. Chauhan & T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 190. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 92. 2002. *Cleyera gymnanthera* Wight & Arn., Prodr. Fl. Ind. Orient.: 87. 1834. *Ternstroemia japonica* auct. non Thunb. 1784: Dyer in Hook.f., Fl. Brit. India 1: 280. 1874; Bourd., Forest Trees Travancore: 32. 1908; Rama Rao, Fl. Pl. Travancore: 33. 1914; Dunn in Gamble, Fl. Madras: 78(56). 1915; Manilal, Fl. Silent Valley: 23. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 74. 1994.

Small or medium-sized tree, 4 - 12 m tall, much branched; bark thick, smooth, brown. Leaves crowded at ends of branches, alternate, simple, oblong-obovate or elliptic, narrow at base, entire at margin, acute or obtuse at apex, 5 - 10 x 1.8 - 2.5 cm, coriaceous, glabrous; lateral nerves 7 - 11 pairs; petioles 4 - 6 mm long, red. Flowers in axils of leaves and fallen leaves or lateral on branches, solitary or fascicled, bisexual, 6 - 8 mm across, greenish yellow or yellowish white, 2-bracteoid; pedicels to 2 cm long, curved. Sepals orbicular with a narrow scarious margin. Petals spreading, twice as long as sepals. Anthers apiculate. Ovary 2-loculed; style subentire; stigma 2-fid. Berries globose, fleshy, brown, tipped with

persistent style and surrounded by persistent bracts and sepals; seeds 3 or 4, oblong or horseshoe-shaped; testa very hard.

Fl.: April - July *Fr.*: April - Nov.

Habitat: Subtropical hill forests and sholas, 1150 - 2000 m, common.

Distrib.: Idukki, Palakkad and Thiruvananthapuram. Assam, Meghalaya, Sikkim and Tamil Nadu. South and SE. Asia.

***Camellia sinensis* (L.) Kuntze**, the tea plant, is cultivated throughout the leeward side of the W. Ghats between 600 and 1200 m.

DIPTEROCARPACEAE

(K.P. JANARDHANAN & W. ARISDASON)

Resinous trees, usually tall with crowns becoming sympodial, all monopodial in beginning and a few remaining so, some or most parts hairy; hairs mostly unicellular, acicular and usually fascicled or stellate, peltate or emarginate and single, frequently with more or less caducous multicellular long-stalked (*Vateria*) or capitate (*Dipterocarpus*) hairs. Leaves alternate, simple, entire, rarely crenate, coriaceous, pinnately nerved, frequently with domatia in axils of nerves; stipules small, caducous. Flowers 5-merous, bisexual, regular, in axillary or terminal panicles, usually fragrant. Sepals free, imbricate, rarely subvalvate, frequently united into a short or long tube, free from or adnate to ovary, accrescent and wing-like in fruit. Petals free, often connate at base, contorted. Stamens 5, 10, 15 or many, variously connate or free; filaments usually short and often dilated below; anthers 2-loculed, basifixed, usually latrorse; connectives elongated above anther lobes. Ovary superior or semi-inferior (*Dipterocarpus*), 2- or 3-loculed with 2 anatropous or pendulous ovules in each; style columnar, entire or 3-fid, frequently on a stylopodium; stigma obscure, 3 - 6-lobed. Fruit an indehiscent nut or a 3-valved capsule with an accrescent calyx more or less enclosing it or reflexed, of which 2 or more lobes generally much enlarged and wing-like; seeds large, usually with a thin testa and no endosperm; embryo with usually fleshy often unequal cotyledons.

Tropics especially Malesia, 16 genera and ca 680 species, 5 and 30 in India and, 5 and 12 in Kerala.

Literature: Anonymous 1985. Dipterocarps of South Asia. *RAPA Monogr.* 4: 1-321.
 Ashton, P.S 1980. *Dipterocarpaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 1: 364 - 423.
 Ashton, P.S 1982. *Dipterocarpaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* I, 9(2): 237 - 552.
 Smitinand & al. 1979. The manual of *Dipterocarpaceae* of mainland Southeast Asia. *Thai For. Bull.* 12: 1-133.

Key to genera

- 1a. Leaves plicately folded in bud; stipules amplexicaul, stipular scars encircling twigs; calyx tubular, shortly lobed 1. **Dipterocarpus**
- h. Leaves, stipules and stipular scars not as above; calyx lobes nearly free 2
- 2a. Sepals in fruit longer than fruit, erect, imbricate, with a thick saccate base; awns of anthers long 3
- b. Sepals in fruit shorter than fruit or developing into short spreading wings, valvate, without thick base; awns of anthers short or none 4
- 3a. Leaf nervation dryobalanoid or subdryobalanoid; petals less than 6 mm long; stamens usually 10, rarely 15; fruiting calyx with 2 aliform and 3 short sepals; enlarged calyx lobes (wings) with 5 or more fine nerves from base 2. **Hopea**
- b. Leaf nervation not as above; petals ca 9 mm long; stamens 15 or more; fruiting calyx with 3 aliform and 2 short sepals, rarely all 5 aliform or all short; enlarged calyx lobes (wings) with 10 or more fine nerves from base 3. **Shorea**
- 4a. Flowers in terminal panicles; sepals linear, obtuse; stamens ca 50; anthers linear; stigma obscure; calyx scarcely enlarged in fruit; lobes reflexed 4. **Vateria**
- b. Flowers in axillary racemes; sepals ovate-lanceolate, acuminate; stamens 15; anthers broadly oblong; stigma prominently conic; calyx enlarged in fruit; lobes erect 5. **Vatica**

1. DIPTEROCARPUS C.F. Gaertn.

Medium-sized to large trees with straight boles, buttressed base and dome-shaped or flat crown; bark pale or dark grey to orange-brown, sometimes pink-brown, shallowly flaking in patches, more or less prominently and densely verrucose-lenticelled. Leaves usually sinuate at margin towards apex, coriaceous, rarely thin; nerves prominent beneath, straight, curved only towards margin; tertiary nerves scalariform; petioles distinctly geniculate, stout; stipules large, hastate to lorate, obtuse, more or less succulent, caducous. Inflorescences short, stout, few-flowered, racemose, zigzag, somewhat irregularly and sparingly branched.

Calyx 5-lobed; lobes valvate, the 2 longer ones oblong to spatulate, more or less distinctly 3-nerved and developing into erect strap-shaped or oblong larger wings in fruit; outer 3 remaining short and forming a crown around apex of nut. Petals narrowly oblong, large, white or cream-coloured with more or less dark crimson or pink stripe down centre. Stamens 15 - many, persisting, in a ring around ovary after fall of petals; filaments of variable length, broad, compressed, connate at base, tapering gradually upwards and filiform below anther; anthers linear, long, tapering apically with 4 pollen sacs; inner 2 somewhat shorter than outer 2; appendages of connective short, stout to filiform, glabrous. Ovary enclosed in calyx tube, ovoid to conic above, narrowing into a glabrous filiform style, densely puberulent. Fruits large, nut-like, enclosed in calyx tube with 2 lobes accrescent.

Indomalaysia, ca 70 species, 10 in India and 2 in Kerala.

Key to species

- 1a. Young shoots densely fulvous-tomentose; lateral nerves in leaves 15 - 20 pairs; stamens less than 30 1. *D. bourdillonii*
- b. Young shoots appressed-tomentose; lateral nerves in leaves 10 - 15 pairs; stamens numerous 2. *D. indicus*

1. *Dipterocarpus bourdillonii* Brandis in Hooker's Icon. Pl. 5: t. 2403. 1895; J. Linn. Soc., Bot. 31: 34. 1895 & Indian Trees: 66. 1906; Bourd., Forest Trees Travancore: 35. 1908; Rama Rao, Fl. Pl. Travancore: 34. 1914; Dunn in Gamble, Fl. Madras: 81(58). 1915; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 210. 1993; Augustine in Indian J. Forest. 25: 339. 2002.

Mal.: *Charatta-anjali*, *Karangali*, *Kalpine*

Evergreen tree, to 50 m tall and ca 1.7 m across with a straight bole; bark smooth, light-coloured; wood reddish brown, hard. Leaves ovate or elliptic, short-acuminate, 20 - 30 x 12 - 17 cm, with long hairs especially on nerves, sometimes also with a few short stellate hairs beneath; lateral nerves 15 - 20 pairs; petioles 4 - 5 cm long. Flowers 3 - 5 in each raceme, ca 5 cm long, white. Calyx tubular, obconic, 5-winged; lobes linear; tube in fruiting calyx ca 3.8 cm long. Stamens 30; anthers hastate; locules subequal; connectives nearly as long as anthers, produced above. Fruits globose or obovoid, ca 3.5 cm long, glabrous, shining; wings purplish brown; 2 longer ones 10 - 12 x ca 1.9 cm.

Fl.: Jan. - March *Fr.*: April - June.

Habitat: Usually on streamsides in evergreen forests, to 600 m.

Distrib.: Idukki, Kollam (Rama Rao, *l.c.*), Malabar (Bourdillon, *l.c.*), Palakkad and Wynad. Endemic.

Uses: Wood is used for house-building and in plywood and match industries.

2. *Dipterocarpus indicus* Bedd., Fl. Sylv. S. India: t. 94. 1871; Rama Rao, Fl. Pl. Travancore: 34. 1914; Dunn in Gamble, Fl. Madras: 81(58). 1915; Vajr., Fl. Palghat: 74. 1990; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 214. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 55. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 93. 2002. *D. turbinatus* sensu Dyer in Hook.f., Fl. Brit. India 1: 295. 1874, non C.F. Gaertn. 1805.

Mal.: *Kalpayin, Vavangu, Velayani*

Evergreen tree, to 40 m tall and 4.5 m across with a straight, cylindric bole often about 20 m high to first branch; wood light brown to dark brown; young shoots shortly appressed-tomentose. Leaves ovate, truncate-cordate at base, entire, acute at apex, 12 - 25 x 6 - 17.5 cm, subglabrous; lateral nerves 10 - 15 pairs. Flowers in axillary 3 - 8-flowered racemes, white tinged with pink, fragrant. Tube in fruiting calyx obconic; 2 enlarged lobes (wings) 7.5 - 14 x ca 3.5 cm, strongly 3 - 5-nerved, reticulately nerved, other 3 lobes deltoid or orbicular, ca 1 cm across. Fruits 1.7 - 2.6 cm across, glaucous, brownish.

Fl.: Dec. - March *Fr.*: April - July.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Kannur, Kollam, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Wood is moderately strong, fine-textured and of good quality and is extensively used for general house-construction especially for interior works, for making masts of boats and in ship-building; also used for making plywoods. Reported to be suitable for railway sleepers after treatment. The oleoresin is applied in rheumatic complaints.

Note: The species closely resembles *D. turbinatus* C.F. Gaertn. and is often considered conspecific with it by some authors. A critical study reveals that the 2 are distinct, *D. indicus* Bedd. differing in having smaller leaves with fewer lateral nerves, smaller flowers in usually branched racemes, more globose fruits, shorter,

more strongly 3-nerved wings and the petioles, main nerves beneath and the inflorescences more or less densely stellately scaly.

2. HOPEA Roxb., nom. cons.

Resinous trees with buttressed trunks; bark smooth in beginning, remaining so or at length cracked and flaked or fissured. Leaves narrowly oblong, oblique at base, coriaceous, often with hairy or pore-like domatia in axils of lateral nerves; stipules linear, fugacious; stipular scars on twigs inconspicuous. Flowers sessile or short-pedicelled, in axillary and/or terminal paniced racemes. Calyx tube during anthesis very short, slightly accrescent or not; lobes densely stellate-tomentose outside; outer 2 longer, ovate, more or less obtuse, thick, growing out almost immediately after anthesis, at last much longer than others; inner 3 suborbicular, frequently mucronate, thin at margin. Petals oblong, fleshy, densely stellate-tomentose outside, imbricate. Stamens 10, 15 or numerous in 1 - 3 verticels or irregularly subconnate at base, falling off with petals; filaments subulate; outermost ones longer; the innermost shorter and sterile; anthers short, medifixed, apiculate portion of connective very thin. Ovary 3-loculed; each locule with many ovules in 2 rows; style short; stigma thick. Fruits nut-like, globose, fibrous, 1-seeded, tightly enveloped by base of calyx lobes.

Indomalesia, 102 species, 11 in India and 7 in Kerala.

Key to species

- | | | |
|-----|--|--------------------------------|
| 1a. | Panicles minutely puberulous or hoary | 2 |
| b. | Panicles glabrous (sometimes minutely puberulous in <i>H. erosa</i>) | 3 |
| 2a. | Branchlets glaucescent; leaves ovate to oblong or ovate-lanceolate, cordate or subcordate at base; lateral nerves often forked at tip; domatia present in axils of lateral nerves beneath; petals lanceolate, dilated and crisped at tip, glabrous; fruits glabrous on belly; larger fruiting calyx lobes to 6 cm long | 4. <i>H. parviflora</i> |
| b. | Branchlets hoary; leaves linear-lanceolate, rounded or attenuate at base; lateral nerves not forked at tip; domatia absent; petals oblong, entire or slightly crenulate at tip, pubescent; fruits covered with a gummy resin on belly; larger fruiting calyx lobes less than 2.5 cm long | 7. <i>H. utilis</i> |
| 3a. | Bark peeling off in long strips upwards becoming recurved and hanging all around trunk; lateral nerves of leaves not exceeding 5 pairs with prominent domatia in axils of leaf nerves; | |

- corolla lobes with a twisted, flat prolongation at apex **6. H. racophloea**
- b. Bark not peeling off as above; lateral nerves of leaves 6 - 14 pairs, without domatia in axils; corolla lobes not as above 4
- 4a. Leaves rounded or subcordate at base, obtuse and emarginate or scarcely acute at apex; lateral nerves 12 - 14 pairs; panicles several together in axils of leaves; petals 2-lobed
- 1. H. erosa**
- b. Leaves acute or obtuse at base, obtuse, acute or obtusely acuminate at apex; lateral nerves less than 10 pairs; panicles 1 - 3 together, either terminal or from axils of leaves; petals not 2-lobed 5
- 5a. Young branches glabrous; petals puberulous outside, ciliate at margin; anthers orbicular 6
- b. Young branches rufous-pubescent; petals glabrous except portion exposed in bud, not ciliate at margin; anthers ovoid **5. H. ponga**
- 6a. Leaves ovate; flowers less than 3 mm long; anther appendages forming a fine straight arista **3. H. jacobi**
- b. Leaves elliptic-oblong to oblong-lanceolate; flowers more than 3 mm long; anther appendages not as above **2. H. glabra**

1. Hopea erosa (Bedd.) Slooten in *Reinwardtia* 3: 318. 1956; V.S. Ramach. & V.J. Nair in *J. Econ. Tax. Bot.* 3: 659. 1982 & *Fl. Cannanore*: 57. 1988; K.P. Janardh. in B.D. Sharma & Sanjappa, *Fl. India* 3: 222. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 55. 1996. *Balanocarpus erosa* Bedd., *For. Man.*: 237. 1873 & *Fl. Sylv. S. India*: t. 329. 1874; Rama Rao, *Fl. Pl. Travancore*: 36. 1914; Dunn in Gamble, *Fl. Madras*: 84(60). 1915.

Mal.: *Karakong*

Evergreen tree, to 25 m tall, ca 1.5 m across; bark thin, smooth; young twigs and petioles glabrous. Leaves oblong to oblong-lanceolate, rounded or subcordate at base, entire, obtuse to emarginate at apex, 10 - 17 x 3 - 6 cm, glabrous on both surfaces. Panicles few-flowered, glabrous or minutely puberulous; bracts and bracteoles small, somewhat persistent. Flowers 5 - 6 mm long. Stamens 15; filaments dilated at base; anthers short, ovoid; connectives terminating in a bristle. Fruits ovoid or oblong, pointed, to 3.5 x 1.3 cm, smooth, brown; fruiting calyx segments truncate, smooth or subtubercled.

Fr.: Oct. - Jan.

Habitat: Dry forests, ca 600 m.

Distrib.: Kannur, Travancore (Rama Rao, *l.c.*), Thrissur and Wynad. Western Ghats of Tamil Nadu. Endemic.

2. *Hopea glabra* Wight & Arn., Prodr. Fl. Ind. Orient.: 85. 1834; Dyer in Hook.f., Fl. Brit. India 1: 309. 1874; Bourd., Forest Trees Travancore: 38. 1908; Rama Rao, Fl. Pl. Travancore: 36. 1914; C.E.C. Fisch. in Gamble, Fl. Madras, Add.: 1867(1292). 1935; Manilal, Fl. Silent Valley: 23. 1988; K.P. Janardh. in B. D. Sharma & Sanjappa, Fl. India 3: 222. 1993. *H. wightiana* Wall. ex Wight & Arn. var. *glabra* (Wight & Arn.) Bedd., Fl. Sylv. S. India: t. 96. 1871.

Mal.: *Ilapongu, Irunbakkam, Karukongu, Kongu*

Tree, ca 7 m high, ca 1.5 m across with a straight cylindric bole, buttressed; branchlets dark coloured. Leaves to 10 x ca 3.7 cm, glabrous and shining on both surfaces. Panicles axillary and terminal, longer than leaves, glabrous. Flowers ca 6 mm long. Calyx lobes glabrous. Stamens 10-15; anthers with appendages about 3 times as long as anthers. Ovary and stylopodium puberulous; styles glabrous. Fruits ovoid or ellipsoid, ca 1.8 cm long, pointed, smooth; larger wings linear-oblong, ca 6.3 x 1.2 cm, 7-nerved with prominent transverse nerves, glabrous, reddish; smaller ones nearly as long as fruit belly.

Fl.: Jan. - March *Fr.*: June - July.

Habitat: Evergreen forests.

Distrib.: Idukki, Kollam, Palakkad and Pathanamthitta. Western Ghats of Karnataka and Tamil Nadu. Endemic.

3. *Hopea jacobi* C.E.C. Fisch. in Bull. Misc. Inform. 1932: 245. 1932 & Gamble, Fl. Madras, Add.: 1867(1292). 1935; Vajr. in S.K. Jain & Sastry, Indian Pl. Red Data Book: 72. 1984; K.P. Janardh. in B.D. Sharma & Sastry, Fl. India 3: 236. 1993.

Tree, glabrous; twigs slender, dark brown, becoming almost black on drying. Leaves entire, rounded or obtuse at apex, 5.5-9 x 2.5-4 cm, chartaceous; petioles 7-10 mm long. Panicles axillary or terminal, solitary or paired, branches to 7-flowered. Calyx lobes suborbicular, ca 1.5 cm long, coriaceous, inner ones thin-margined. Petals oblong, obtuse, 3-3.5 mm long, minutely ciliate, puberulous outside. Stamens 15; anthers orbicular, flat; appendages subulate, about 3 times longer than anthers forming a fine straight arista. Styles short, pointed. Fruits

ovoid, to 1.7 cm long; larger 2 calyx lobes (wings) oblong to oblanceolate, obtuse at apex, ca 4.5 x 1.35 cm, 9-nerved.

Fl. & Fr.: (May)? June.

Distrib.: Palakkad (Silent Valley). Western Ghats of Karnataka (Madikeri). Endemic and rare.

4. *Hopea parviflora* Bedd., Fl. Sylv. S. India: t. 7. 1869; Dyer in Hook.f., Fl. Brit. India 1: 308. 1874; Rama Rao, Fl. Pl. Travancore: 35. 1914; Dunn in Gamble, Fl. Madras: 82(59). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 57. 1988; Vajr., Fl. Palghat: 74. 1990; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 228. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 75. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 56. 1996; Sivar. & P. Mathew, Fl. Nilambur: 73. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 93. 2002.

Mal.: *Irumbagam, Irupu, Kambagam, Thambagam*

Evergreen tree, ca 40 m tall, 5 - 6 m across with a long straight cylindrical bole and a dense rounded crown; bark light brown or greyish, mottled with white markings, smooth in young trees somewhat rough in old ones; branchlets reddish brown. Leaves oblong-lanceolate, obtuse at base, acute to acuminate at apex, to 11.5 x 4.5 cm, glabrous above, paler beneath; petioles ca 1 cm long, grooved above; stipules small, caducous or inconspicuous. Panicles hoary with minute grey tomentum. Flowers short-pedicelled, ca 4 mm long, creamy yellow, fragrant. Sepals lanceolate, obtuse, membranous at margin, pubescent. Petals glabrous. Stamens 15, rarely 10, slightly connate; connectives produced into a subulate point. Ovary glabrous; style subulate, short. Fruit belly ca 7 mm long; larger 2 calyx lobes (wings) linear-oblong, straw-coloured; smaller 3 linear, as long as fruit belly. *Fl.*: Jan. May *Fr.*: April - June.

Habitat: Rich deep moist soil along streams and rivers in wet evergreen forests, to 1000 m.

Distrib.: Almost throughout Kerala. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Wood is extensively used for house-construction and for making planks, piles for bridges, platform boards, agricultural implements etc.; also used for making railway sleepers and electricity transmission poles. Bark is used for tanning heavy quality leather.

5. *Hopea ponga* (Dennst.) Mabb. in *Taxon* 28: 587. 1979; Manilal & Sivar., *Fl. Calicut*: 42. 1982; Nicolson & al. in *Regnum Veg.* 119: 101. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 58. 1988; Vajr., *Fl. Palghat*: 74. 1990; K.P. Janardh. in B.D. Sharma & Sanjappa, *Fl. India* 3: 230. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 75. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 56. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 73. 1997. *Artocarpus ponga* Dennst., *Schlüssel Hortus Malab.*: 30. 1818. *Hopea wightiana* Wall. ex Wight & Arn., *Prodr. Fl. Ind. Orient.*: 85. 1834; Wight, *Ill. Ind. Bot.* 1: t. 37. 1840; Bedd., *Fl. Sylv. S. India*: t. 96. 1871; Dyer in Hook.f., *Fl. Brit. India* 1: 309. 1874; Bourd., *Forest Trees Travancore*: 38. 1908; Rama Rao, *Fl. Pl. Travancore*: 36. 1914; Gamble, *Fl. Madras*: 82(59). 1915, excl. syn. *H. glabra* Wight & Arn. 1834.

Mal.: *Irumbagam, Pongu*

Evergreen tree, ca 40 m tall, ca 2.5 m across with a fluted and somewhat tapering bole; bark white or yellowish inside. Leaves ovate-oblong, rounded at base, subacute at apex, to 18 x 8 cm, glabrous or pubescent on nerves beneath; lateral nerves obliquely curved, prominent beneath; petioles ca 1.5 cm long, swollen, yellow-tomentose. Flowers pale pink, short-pedicelled, 8 - 12 mm across, in copious axillary secured panicles, often 2 or 3 together in a leaf axil. Calyx lobes ovate; outer 2 sepals obtuse and larger than the acute inner ones. Corolla lobes ovate-lanceolate or falcate-oblong, ca 5 mm long. Stamens 10 or 15, alternate filaments carrying 2 anthers; appendages of anthers filiform, 4 times as long as anthers. Ovary puberulous above; stylopodium glabrous; style short with thick stigma. Fruit belly ovoid, apiculate, ca 1.3 mm long, glabrous, green turning red when mature; longer 2 fruiting lobes (wings) oblong-ovate, 5 - 7 x 1.3 - 1.5 cm, crimson; smaller 3 ovate, acute, 8 - 12 mm long, unequal.

Fl.: March - April *Fr.*: May - July.

Habitat: Wet evergreen and semievergreen forests.

Distrib.: Almost throughout Kerala. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Wood is used in building construction and also for making posts and cart wheels.

Note: The tree looks very beautiful when it is covered with the reddish fruits. This species is distinguished by its echinate, axillary and extra-axillary gall-like excrescences.

6. *Hopea racophloea* Dyer in Hook.f., Fl. Brit. India 1: 310. 1874; Brandis in J. Linn. Soc., Bot. 31: 59. 1895 & Indian Trees: 68. 1908; Bourd., Forest Trees Travancore: 36. 1908; Rama Rao, Fl. Pl. Travancore: 36. 1914; Dunn in Gamble, Fl. Madras: 82(59). 1915; Manilal, Fl. Silent Valley: 24. 1988; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 221. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 75. 1994; Sivar. & P. Mathew, Fl. Nilambur: 74. 1997. *H. malabarica* Bedd., Icon. Pl. Ind. Orient.: t. 185. 1868 1874.

Mal.: *Neduvali kongu*

Moderate-sized to large tree with brownish hard wood; bark characteristic; young twigs, petioles, panicles and calyxes glabrous. Leaves broadly ovate, acute at base, shortly caudate-acuminate at apex, to 11.5 x 6.5 cm, glabrous on both surfaces; lateral nerves to 5 pairs, prominent on both surfaces. Panicles 7.5 - 10 cm long, 2 - 4-clustered from old axils or terminal. Flowers short-pedicelled, rather distant, sometimes secund, ca 8 mm long, yellowish white tinged pink. Calyx lobes glabrous; outer 2 ovate-acuminate, inner 3 smaller and pointed. Petals glabrous inside, hairy outside. Stamens 15; filaments flat below, tapering above to a long apiculation below anther; anthers with a long glabrous setaceous appendage more than twice their length. Ovary obconic; style subulate, short; stylopodium cylindrical, slightly narrow at base, nearly as long as ovary. Fruit belly glabrous; 2 fruiting calyx lobes obtuse, 7.5 - 8.2 cm long, with 7 - 11 longitudinal nerves, reddish; third one sometimes somewhat enlarged.

Fl.: Feb. - April *Fr.*: May - Aug.

Habitat: Moist dry forests, to 1000 m.

Distrib.: Kollam, Malappuram, Palakkad, Thiruvananthapuram and Wynad. Western Ghats of Karnataka. Endemic.

Note: This species closely resembles *H. parviflora* Bedd. but is easily distinguished from it by its glabrous panicles, leaves with not more than 5 lateral nerves and larger domatia only in 1 or 2 axils. In *H. parviflora* the leaves are 5 - 7(9)-nerved with much smaller domatia in almost all axils of lateral nerves.

7. *Hopea utilis* (Bedd.) Bole in Kew Bull. 1951: 146. 1951; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 234. 1993. *Balanocarpus utilis* Bedd., For. Man.: 237. 1873 & Fl. Sylv. S. India: t. 330. 1874; Dunn in Gamble, Fl. Madras: 84(60). 1915. *H. longifolia* Dyer in Hook. f., Fl. Brit. India 1: 309. 1874.

Lofty evergreen tree, often to 100 m tall and ca 4.6 m across; bark smooth, dark brown often with greyish patches; wood light olive brown to pale yellowish brown with white tangential lines (resin canals) at irregular intervals. Leaves entire, 12.5–18 x 3–5 cm; lateral nerves 10–12 pairs; tertiary nerves parallel, prominent on both surfaces; petioles ca 1.2 cm long; stipules minute, caducous. Flowers short-pedicelled, secund, ca 3 mm long, yellowish white. Calyx lobes slightly connate at base, hoary outside. Stamens 15; filaments dilated at base. Fruit belly globose, pointed, ca 1.2 cm across, enclosed at base of thick accrescent lobes; fruiting calyx lobes much tubercled below.

Fl.: March - June *Fr.*: July - Nov.

Habitat: Slopes bordering streams and banks of rivers and ravines in evergreen forests, 300 - 1000 m.

Distrib.: Palakkad. Western Ghats of Tamil Nadu. Endemic.

Uses: Wood is used for general construction purposes, also used for making posts, beams, rafters, cart shafts, tool handles etc.

Note: Often associated with *H. parviflora* Bedd. with which it is scarcely distinguishable, especially the long-leaved forms of *H. parviflora*.

3. SHOREA Roxb. ex C.F. Gaertn.

Medium-sized or large, resinous, more or less buttressed trees. Crown of mature trees large, hemispheric or dome-shaped; young branches glabrous or pubescent. Leaves entire or repand, coriaceous; lateral nerves subparallel; stipules large, coriaceous and persistent or small and caducous. Flowers secund, in axillary or terminal lax paniced cymes. Calyx tube very short; lobes imbricate, free to receptacle; outer 3 thicker, somewhat longer and narrower than inner 2, hairy. Petals 5, usually connate at base, sometimes free, hairy outside. Stamens 15 or 20–100; filaments flat, more or less tapering; anthers subglobose or narrowly oblong; connectives produced beyond anther lobes in form of hairs. Ovary glabrous or tomentose, 3-loculed; locules 2-ovuled; style subulate with or without a distinct stylopodium. Fruits indehiscent or nut-like, rarely 2-valved and dehiscent, closely surrounded by persistent calyx lobes of which outer 3 usually longer and broader than inner 2, base of calyx lobes thick, expanded and saccate; nut usually 1-seeded; embryo with large fleshy cotyledons.

Sri Lanka to S. China, Moluccas and Lesser Sunda Islands, 357 species,

4 in India and 1 in Kerala.

Shorea roxburghii G. Don, Gen. Hist. 1: 813. 1831; C.J. Saldanha & M.S.E. Rao in C.J. Saldanha, Fl. Karnataka 1: 195. 1984; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 239. 1993. *S. talura* Roxb., Fl. Ind. 2: 618. 1832; Dyer in Hook.f., Fl. Brit. India 1: 304. 1874; Rama Rao, Fl. Pl. Travancore: 35. 1914; Dunn in Gamble, Fl. Madras: 83(60). 1915. *Vatica laccifera* Wight & Arn., Prodr. Fl. Ind. Orient.: 84. 1834; Wight, Icon. Pl. Ind. Orient.: t. 164. 1839. *Shorea laccifera* (Wight & Arn.) B. Heyne ex Wall. in A.DC., Prodr. 16: 630. 1868; Bedd., Fl. Sylv. S. India: t. 6. 1869.

Mal.: *Taluram*

Deciduous tree, ca 25 m tall, ca 3 m across; bark smooth or narrowly fissured, light grey, fleshy; branchlets glabrous, dark. Leaf buds pale rusty-pubescent. Leaves elliptic or elliptic-oblong, rounded or cordate at base, undulate at margin, acute, obtuse or sometimes emarginate at apex, to 22 x 8.6 cm, glabrous above, tomentose or glabrescent beneath, brownish green when young, dark green when mature; lateral nerves 12 - 16 pairs, slender, prominent beneath, tending to 2-furcate near margin; petioles 1.3 - 4 cm long, somewhat swollen in distal half. Flowers in dense slender drooping panicles. Calyx lobes deltoid, acute, ca 4 mm long, ciliolate at margin, glabrous in flower and fruit, whitish; inner 2 somewhat shorter, subacuminate. Petals free, oblong-lanceolate, ca 1.3 cm long, white or pale pink. Stamens 15 in 3 whorls; filaments short; anthers ovoid with a curved ca 2 mm long seta. Ovary globose or ovoid, hairy; style longer than ovary; stigma 3-fid. Fruit belly ovoid, ca 2.5 x ca 1.2 cm, tapering above into a slender filiform remnant style, glabrous; larger 3 fruiting calyx lobes spatulate, obtuse, saccate at base, 9 - 11 cm long, with 7 - 10 slender parallel nerves; shorter 2 lorate, to 4.5 cm long.

Fl.: Dec. - April *Fr.*: March - May.

Habitat: Usually in dry deciduous forests, to 1000 m.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*), Kottayam, Kozhikode and Palakkad. Andhra Pradesh, Karnataka and Tamil Nadu. Southeast Asia.

Uses: Wood is used for construction purposes such as for beams, bridges, piles etc.; also used for making rough furniture, agricultural implements, tool handles etc. An essential oil is extracted from flower. The tree is an ideal host for the lac

insect (*Laccifer lacca*).

4. VATERIA L.

Large, evergreen, resinous trees; young shoots and inflorescences hoary-stellate-pubescent. Leaves ovate-oblong to elliptic-lanceolate; stipules narrow, caducous, rarely large and persistent. Flowers pedicelled, in terminal or lateral panicles or, 2- or 3-fascicled. Calyx lobes imbricate, very shortly connate at base, subequal, reflexed, persistent, scarcely enlarged in fruit. Petals white. Stamens 15 or ca 50; anthers sessile or on very short filaments, linear or oblong; lobes unequal, the outer much longer, dehiscing longitudinally from apex; connectives usually muticous. Ovary 2- or 3-ovuled; style subulate, entire or shortly lobed; stigma minute. Fruits indehiscent or 3-valved capsules, ovoid or subglobose, coriaceous, fleshy, 1-seeded, supported by reflexed scarcely accrescent calyx. Cotyledons unequal, large, fleshy enclosing superior radicle.

Southern India and Sri Lanka, 3 species, 3 in India and 2 in Kerala.

Key to species

1a. Leaves obtuse or short-pointed; lateral nerves 14 pairs; calyx lobes lanceolate, obtuse, hoary-puberulous on both sides; petals elliptic-oblong, obtuse, hardly twice as long as sepals, slightly pubescent outside; fruits ovoid, ellipsoid or oblong, obtuse at apex

1. *V. indica*

b. Leaves short-acuminate; lateral nerves 16 - 20 pairs; calyx lobes 3-angled, acute, minutely sparsely pubescent outside; petals elliptic, minutely apiculate, ca 4 times as long as sepals, glabrous on both sides; fruits ovoid, narrow and slightly curved towards apex

2. *V. macrocarpa*

1. *Vateria indica* L., Sp. Pl.: 515. 1753; Wight, Ill. Ind. Bot. 1: t. 36. 1840; Dyer in Hook.f., Fl. Brit. India 1: 313. 1874; Bourd., Forest Trees Travancore: 41. 1908; Rama Rao, Fl. Pl. Travancore: 36. 1914; Dunn in Gamble, Fl. Madras: 85(61). 1915; Manilal & Sivar., Fl. Calicut: 42. 1982; Nicolson & al. in Regnum Veg. 119: 102. 1988; Manilal, Fl. Silent Valley: 24. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 58. 1988; Vajr., Fl. Palghat: 75. 1990; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 245. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 75. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 56. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 94. 2002. *V. malabarica* Blume, Mus. Bot. 2: 29.

1856; Bedd., Fl. Sylv. S. India: t. 84. 1871.

Mal.: *Painimaram, Payani, Perumpayani, Perumpiney, Vella payin*
Vella kunturukkam

Evergreen tree, ca 30 m tall with a cylindric bole; bark smooth, whitish to grey, blotched with white and green, peeling off in thick round flakes; young branches and inflorescences stellate-canescens. Leaves ovate-oblong or elliptic-cordate or rounded at base, shortly pointed at apex, to 25 x 10 cm, bright red when young; petioles 2.5 - 3.8 cm long, stout; stipules obliquely lanceolate, acute, ca 1.3 cm long. Flowers ca 2 cm across, drooping, in terminal or lateral ca 20 cm long corymbose panicles, fragrant; bracts ovate, acute, caducous. Calyx lobes hoary-puberulous on both sides. Petals spreading, white. Stamens 40 - 50; filaments short; anthers nearly sessile, glabrous, hairy at base; connective appendage as long as anther. Ovary oblong-ovoid, tomentose; style longer than stamens, filiform, glabrous; stigma small. Fruits ca 11 x 6 cm, pale brown; seeds reddish white or cream-coloured; cotyledons filled with fat.

Fl.: Jan. - April, Aug. - Nov. *Fr.*: May - July.

Habitat: Evergreen forests, to 1300 m.

Distrib.: Almost throughout Kerala. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Wood is much in demand in plywood and veneer industry; also used for making tea chests, trunks, ammunition boxes etc. and for making ceilings, partitions, floorings and other interior fittings. Wood is considered to be fairly suitable for paper pulp. Bark and leaf juice is medicinal. Gum resin, known in trade as piney resin, white damar or dhupa, is used in varnish industry, also used for making incense. The semisolid fat, known as piney tallow, Malabar tallow or dhupa fat, obtained from the dried seed kernel, is used in the manufacture of candle and soap.

2. *Vateria macrocarpa* B.L. Gupta in Indian Forester 55: 231, t. 2. 1929; K.N. Subram. & al. in J. Econ. Tax. Bot. 3: 620. 1982; K.P. Janardh. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 143. 1987; Vajr., Fl. Palghat: 75. 1990; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 246. 1993.

Tree, 8 - 10 m tall, ca 3 m across, with a dense crown; bark smooth, dark grey; young shoots hoary-stellate-pubescent. Leaves elliptic-oblong or oblong-lanceolate, rounded or subcordate at base, entire, to 41 x 19 cm, coria-

ceous, glabrous on both surfaces, rarely with a few stellate hairs on midnerve beneath mainly at its base; lateral nerves prominent beneath; petioles 2.5 - 6 cm long, swollen at tip, minutely pubescent. Flowers ca 3.3 cm across, in axillary hoary-stellate-pubescent panicles, shorter than leaves; pedicels 1.5 - 2.4 cm long, jointed a little below middle. Calyx lobes ca 3 mm long. Petals ca 1.5 cm long, white. Stamens numerous; filaments ca 2 mm long; anthers linear, glabrous, yellow. Ovary densely tomentose, 3-loculed; style subulate, slightly longer than stamens. Fruits to 11 x 6 cm, splitting from top into 3, 1-seeded valves; fruiting sepals not enlarged, reflexed.

Fl.: March *Fr.*: June.

Habitat: Evergreen forests.

Distrib.: So far known to occur only in Muthikulam and Siruvani in Palakkad Forest Division and its environs. Endemic.

Uses: Wood is reported to have been put to more or less the same use as that of *Vateria indica* L. However, due to its restricted distribution it has not found a place in trade.

5. VATICA L.

Small to medium-sized trees, sometimes shrubs with thin smooth bark patched with dark colours and buttressed trunk bases; crown irregular, oblong, sympodial. Leaves very variable in size and shape, coriaceous; nerves curved, usually somewhat oblique to midnerve; tertiary nerves reticulate. Flowers in spikes or racemes, arranged in terminal or axillary panicles, fragrant; flower buds ovoid to lanceolate. Calyx of subequal, more or less valvate lobes. Petals narrowly oblong, erect, not spreading when expanded, usually pale creamy white. Stamens usually 15, in 3 verticils 10 (5 pairs) of which stand opposite sepals; filaments of outer 10 stamens very short, those of inner 5 much longer; anthers short, glabrous; locules very unequal, diverging at base; connective appendages obtuse. Ovary either free or half within obconic receptacle, more or less broadly ovoid or conic, usually hairy, often pitted; style usually shorter than ovary, often ribbed and furrowed, glabrous; stigma capitate or conic, prominent. Fruit capsular, broadly ovoid or globose, variable in size, free or partially within calyx tube, with or without a distinct apical style; fruiting calyx variable.

Indomalesia, 65 species, 2 in India and 1 in Kerala.

Vatica chinensis L., Mant. Pl.: 242. 1771; Dunn in Gamble, Fl. Madras: 84(61). 1915; C.J. Saldanha & M.S.E. Rao in C.J. Saldanha, Fl. Karnataka 1: 196. 1984; Manilal, Fl. Silent Valley: 42. 1988; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 248. 1993. *Vateria roxburghiana* Wight ex Arn. in Ann. Nat. Hist. Ser. 1, 3: 155. 1839. *Vatica roxburghiana* (Wight & Arn.) Blume, Mus. Bot. 2: 31, t. 7. 1852; Bedd., Fl. Sylv. S. India: t. 95. 1871; Dyer in Hook.f., Fl. Brit. India 1: 302. 1874; Bourd., Forest Trees Travancore: 40. 1908; Rama Rao, Fl. Pl. Travancore: 35. 1914.

Mal.: *Adakka payini*, *Eheru piney*, *Vella payini*

Evergreen, resinous tree, 20–30 m tall, ca 2 m across, with a dense irregular spreading crown; bark smooth, pale grey; young shoots, buds, ovary and fruits lepidote-canescens. Leaves ovate to oblong, obtuse to broadly cuneate at base, tapering gradually towards apex into a subulate acumen, 9–25 x 3–11 cm, glabrous; lateral nerves 10–14 pairs; petioles 2–5 cm long. Panicles mostly axillary, ca 30 cm long, spreading; pedicels 5-ribbed; ribs alternating sepals. Calyx lobes ovoid-deltoid to lanceolate, acute, ca 1.9 cm long, pubescent, recurved and more or less appressed to base in fruit. Petals about 5 times as long as calyx lobes, oblong, white. Stamens 15 in 2 rows; filaments short, flat at base; anthers oblong, short-apiculate. Ovary with large shallow pits; style nearly as long as ovary, ribbed; stigma obscurely 3-lobed, densely papillose. Fruits subglobose, ca 2.5 cm across, shortly pointed with 3 obscure loculicidal furrows, puberulous; pericarp coriaceous; testa thin, adhering to endocarp; cotyledons thick, fleshy, planoconvex, 2-fid to base.

Fl.: Feb.–March *Fr.*: June.

Habitat: Alluvial soil along streams and rivers in evergreen forests at low elevations.

Distrib.: Kollam, Kozhikode, Malappuram, Palakkad and Wynad. Western Ghats of Karnataka. Sri Lanka.

Uses: Wood is durable and withstands submersion in water for a long period and hence used for piles etc. The transparent yellow resin obtained from the wood is used in making varnish.

ANCISTROCLADACEAE

(R. CHANDRASEKARAN)

Climbing shrubs; branches sympodial with circinate hooks. Leaves alternate, exstipulate, simple, cuneiform, entire, glabrous, minutely pitted and with wax-like substance on both surfaces, reticulately nerved. Inflorescences few many times dichotomous or spike-like; bracts membranous, fimbriate at margin. Flowers regular. Calyx tube short, adnate to ovary at base; lobes 5, imbricate, unequal, accrescent and wing-like in fruit. Petals 5, imbricate. Stamens usually 10, rarely 5; filaments broad and connate at base; anthers basifixed, introrse. Ovary half-inferior, 1-loculed, 1-ovuled; styles 3, jointed to a round or short cylindrical epigynous disc. Fruit an indehiscent nut; exocarp coriaceous, surrounded by accrescent calyx; seeds subglobose with strongly ruminant endosperm.

Old World tropics, unigeneric, ca 12 species.

Literature: Gilg, E. 1925. *Ancistrocladaceae*. In: Engler, A.G.H. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2, 21: 589 - 592. Steenis, C.G.G.J. van 1948. *Ancistrocladaceae. Fl. Males.* I, 4: 8 - 10.

ANCISTROCLADUS Wall., nom. cons.

(Characters as for family)

Four species in India and 1 in Kerala.

Ancistrocladus heyneanus Wall. ex J. Graham, *Cat. Pl. Bombay*: 28. 1839; Wight, *Icon. Pl. Ind. Orient.*: tt. 1987 & 1988. 1853; Dyer in Hook.f., *Fl. Brit. India* 1: 299. 1874; Rama Rao, *Fl. Pl. Travancore*. 35. 1914; Dunn in Gamble, *Fl. Madras*: 86(62). 1915; Nicolson & al. in *Regnum Veg.* 119: 49. 1988; Manilal, *Fl. Silent Valley*: 24. 1988; Vajr., *Fl. Palghat*: 76. 1990; S. Das in B.D. Sharma & Sanjappa, *Fl. India*: 3: 254. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 76. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 57. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 75. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 95. 2002.

Mal.: *Karatolal*

Woody, climbing shrub with hooked branches. Leaves sessile, elliptic-oblong to oblanceolate, narrow at base, acute at apex, 4 - 20 x 2 - 6 cm, glabrous,

reticulately nerved. Flowers small, in dichotomously branched panicles. Calyx 5-lobed; lobes oblong, rounded at apex, 4 - 8 x 3 - 4 mm, accrescent, spatulate and unequal in fruit. Petals 5, ovate-oblong, 6 - 8 x 3 - 4 mm, pale yellow or white. Stamens 10, 5 - 9 mm long, alternate ones short. Ovary 1-loculed, 1-ovuled; styles 3; stigma discoid. Fruits indehiscent, surrounded by 5 unequal wings; seed globose, corrugated and dorsally somewhat depressed.

Fl. & Fr.: Feb. - April & Oct. - Nov.

Habitat: Evergreen and semievergreen forests, to 950 m.

Distrib.: Idukki, Kollam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats. Endemic.

MALVACEAE

(M. MOHANAN & A.V.N. RAO)

Annual or perennial herbs, rarely prickly shrubs, trees or sometimes woody climbers; stems usually fibrous with mucilaginous sap; bark with dilated rays; indumentum of simple, stellate or glandular hairs. Leaves alternate, stipuled, petioled, simple, entire to variously lobed or dissected, sometimes with extrafloral nectaries on nerves beneath. Flowers bi-, rarely unisexual, 5-merous, actinomorphic, axillary, solitary or in terminal cymes or racemose spikes. Calyx valvately 5 (- 3)-lobed, rarely entire or spathaceous, persistent or not, sometimes accrescent, often subtended by persistent epicalyx of 3 - many free or connate subulate to leafy lobes. Petals 5, contorted, rarely imbricate, adnate to staminal column at base and falling off; limb usually asymmetric. Stamens numerous to 60, rarely 5 or 10, monadelphous, surrounding ovary and style, with a 5-toothed or entire staminal column; anthers 1-loculed, dorsifixed, dehiscing longitudinally; pollen echinate, 3 - 4-colporate, polyrugulate or polyforate. Ovary superior, 5 (- 3) or many-loculed; ovules 1 - many in each locule, axile, 2-tegmic, crassinucellar, ana- or campylotropous; styles as many or twice as many as locules, often connate to various degrees with an equal number of distinct or almost united apical stigmas. Fruit a schizocarp or loculicidal capsule, rarely a berry, 3 - many-loculed; mericarps 1 - many-seeded; testa hairy or glabrous; embryo straight with terete radicle and yellow twisted cotyledons; endosperm scanty or absent, fleshy or hard.

Cosmopolitan especially tropics, 111 genera and 1800 species, 22 and 93 in India and, 17 and 62 in Kerala.

Literature: Abedin, S. 1979. *Malvaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 130: 1 - 170. Borssum Waalkes, J. van 1966. Malesian *Malvaceae* revised. *Blumea* 14: 1 - 123. Hu, S. 1955. *Flora of China*. Family 153. *Malvaceae* 1 - 80. Ngwe, T.M. 1971 - 1972. The Burmese *Malvaceae*. *Union Burma J. Life Sci.* 4: 185 - 262.

Key to tribes

- | | | |
|-----|--|------------------|
| 1a. | Style branches as many as carpels or sometimes undivided | 2 |
| b. | Style branches twice as many as carpels | 5. Ureneae |
| 2a. | Staminal column 5-toothed at apex, antheriferous throughout or for a major portion of it; fruit a capsule | 3 |
| b. | Staminal column without teeth, split at apex into numerous anthers; fruit a schizocarp breaking into mericarps | 4 |
| 3a. | Stipules simple; carpels attached to one another and to central axis at maturity | 3. Hibisceae |
| b. | Stipules lacinate or completely divided into 2 or 3 segments; carpels separate from central axis at maturity | 2. Decaschisteae |
| 4a. | Stigmas decurrent on adaxial side of style | 4. Malveae |
| b. | Stigmas apical or nearly so, capitate, discoid or obliquely truncate | 1. Abutileae |

Tribe 1. ABUTILEAE Endl.

Annual or perennial herbs, rarely small trees. Leaves simple, entire or lobed. Flowers solitary, axillary or in clusters by replacement of upper leaves, pedicelled or not; pedicels slender, jointed or not. Epicalyx absent or 3-lobed. Calyx and corolla 5-lobed. Staminal column short, without teeth, split at apex into numerous anthers. Styler branches as many as carpels; stigmas apical or nearly so, capitate, discoid or obliquely truncate. Fruit a schizocarp, breaking into mericarps.

Key to genera

- | | | |
|-----|---|----------------|
| 1a. | Seeds 2 or more in each mericarp | 2 |
| b. | Seed 1 in each mericarp | 3 |
| 2a. | Stems erect, stout; mericarps more or less pointed, mucronate or aristate at apex, thick-walled | 1. Abutilon |
| b. | Stems ascending, weak; mericarps rounded at apex, thin-walled | 2. Herissantia |
| 3a. | Epicalyx present | 3. Malvastrum |
| b. | Epicalyx absent | 4. Sida |

I. ABUTILON Mill.

Annual herbs, perennial undershrubs or shrubs. Leaves simple, entire, sometimes deeply lobed, cordate at base, palmately nerved. Flowers solitary, axillary, occasionally in panicles due to abortion of upper leaves or in corymbose racemes; pedicels jointed. Epicalyx absent. Calyx campanulate, 5-lobed, persistent. Petals 5, free, rarely connate, rotate. Staminal column shorter than petals, broad at base. Carpels and stylar branches 5 - 40; locules with 2 - 9 ovules each, occasionally 1-ovuled by abortion; styles filiform or clavate; stigmas capitate. Schizocarps globose-depressed, sometimes cylindrical; cocci as many as carpels, dehiscent with 2 - many loosely held seeds.

Tropics and subtropics, ca 100 species, 12 in India and 7 in Kerala.

Literature: Abedin, S. 1980. *Abutilon nuticum* and *Abutilon pannosum* complex. *Pakistan J. Bot.* 12: 43 - 48. Hussain, S.A. & Boquor, S.A. 1974. Biosystematic studies in the genus *Abutilon* from Pakistan. 1. Taxonomy. *Phyton (Horn)* 15: 219 - 234.

Key to species

- | | | |
|-----|--|----------------------------|
| 1a. | Mericarps 2- or 3-seeded | 2 |
| b. | Mericarps 4 - 6-seeded | 3 |
| 2a. | Flowers axillary, solitary or racemose by replacement of upper leaves | 4 |
| b. | Flowers in axillary cymes | 5 |
| 3a. | Flowers red; filaments shorter than staminal column | 7. A. striatum |
| b. | Flowers orange-yellow; filaments longer than staminal column | 5. A. persicum |
| 4a. | Schizocarps longer than calyx | 6 |
| b. | Schizocarps as long as or shorter than calyx | 4. A. pannosum |
| 5a. | Petals obovate, 15 - 20 mm long | 3. A. neilgherrense |
| b. | Petals ovate, 8 - 11 mm long | 6. A. ramosum |
| 6a. | Plant viscid; stipules 6 - 8 mm long; corolla orange-yellow with a purple centre | 1. A. hirtum |
| b. | Plant not viscid; stipules less than 5 mm long; corolla yellow without a purple centre | 2. A. indicum |

1. *Abutilon hirtum* (Lam.) Sweet, Hort. Brit.: 53. 1826; Dunn in Gamble, Fl. Madras: 91(65). 1915; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 264. 1993; Sivar. & Pradeep, Malvac. S. India: 190. 1996. *Sida hirta* Lam., Encycl. 1:

7. 1783. *S. graveolens* Roxb. ex Hornem., Suppl. Hort. Bot. Hafn.: 77. 1819. *Abutilon graveolens* (Roxb. ex Hornem.) Wight & Arn. ex Wight, Cat. Ind. Pl.: 13. 1833; Wight & Arn., Prodr. Fl. Ind. Orient.: 56. 1834; Mast. in Hook.f., Fl. Brit. India 1: 327. 1874, incl. var. *hirtum* (Lam.) Mast.

Annual herb or undershrub, to 2 m high, somewhat viscid, foetid; stems, petioles and pedicels hirsute with simple, stellate and glandular hairs. Leaves broadly ovate or suborbicular, cordate at base, irregularly dentate at margin, acute to subacuminate at apex, 2 - 10 x 3 - 12 cm, soft-tomentose with stellate, simple and glandular hairs on both surfaces, 7-nerved at base; petioles 3 - 15 cm long, hirsute with simple and glandular hairs; stipules linear-lanceolate or falcate, ca 1 x 0.3 cm, reflexed, stellate-velutinous. Flower solitary, axillary; pedicel 1 - 4 cm long, accrescent to 5.5 cm, jointed 1 - 10 mm below flower. Calyx campanulate, 6 - 8 mm long, yellowish green; lobes free to middle, ovate, acute to acuminate, ca 8 x 5 mm, pubescent with stellate hairs outside and sericeous with simple hairs inside, somewhat reflexed in fruit. Corolla orange yellow with a purple centre; petals longer than calyx lobes, obovate with rounded apex, often emarginate, ca 1.5 x 1.3 cm, spreading, finally reflexed, ciliate at base, stellate-pubescent outside, glabrous inside. Staminal column 4 - 6 mm long, stellate-hairy at base, glabrous at apex, yellow or dark purple; filaments ca 4 mm long, yellow. Ovary ovoid, ca 4 mm across, stellate-hairy; stylar arms ca 20, glabrous. Schizocarps globose, 1.5 - 2.5 cm, indented at apex; mericarps 20 - 25, 10 - 15 mm long, broadly ovate-reniform, short-acuminate, sometimes rounded, dorsally stellate-tomentose; seeds 3 - 7, reniform, punctate with minute stellate hairs, brownish black.

Fl. & Fr.: Oct. - April.

Habitat: Open situations in wastelands and roadsides.

Distrib.: Idukki. Almost throughout India. Africa, Australia, Malesia, Pakistan and Sri Lanka.

2. *Abutilon indicum* (L.) Sweet, Hort. Brit.: 54. 1826; Wight, Icon. Pl. Ind. Orient.: t. 12. 1838; Mast. in Hook.f., Fl. Brit. India 1: 326. 1874; emend. Hochr. in Annuaire Conserv. Jard. Bot. Genève 6: 19. 1902; Rama Rao, Fl. Pl. Travancore: 39. 1914; Dunn in Gamble, Fl. Madras: 91(65). 1915; Manilal & Sivar., Fl. Calicut: 45. 1982; Nicolson & al. in Regnum Veg. 119: 170. 1988; Vajr., Fl. Palghat: 78. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 77. 1994.

subsp. **indicum**: Borss. Waalk. in *Blumea* 14: 171. 1966; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 267. 1993; Sivar. & Pradeep, *Malvac. S. India*: 193. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 79. 1997. *Sida indica* L., *Cent. Pl.* 2: 26. 1756.

Mal.: *Uram, Velluram*

Annual or perennial herb or undershrub, ca 3 m high; stems, petioles and pedicels velutinous with minute stellate and simple hairs. Leaves ovate to suborbicular, cordate at base, acute to acuminate at apex, 1 - 8.5 x 1 - 8 cm, sparsely pubescent above densely so beneath; petioles 2 - 18 cm long, hairy; stipules linear. Flower axillary, solitary; pedicel longer than petiole, jointed above, accrescent. Calyx campanulate, 4 - 9 mm across, accrescent, shorter or as long as schizocarp. Corolla ca 1 cm across, yellow to orange; petals broadly obovate, truncate, rounded or emarginate at apex, ciliate at base. Staminal column conic below, tubular above, 5 - 8 mm long, stellate-hairy at base, glabrous above, antheriferous at apex. Schizocarps globose, ca 2 cm, flat at apex or slightly indented; mericarps 15 - 22, reniform, mucronate, acute to obtuse or rounded at apex, dorsally and ventrally stellate-hairy, laterally glabrous, smooth, blackish; seeds 2 or 3 per mericarp, reniform, 2 - 3 mm across, minutely stellate-hairy or glabrescent, brownish black.

Fl. & Fr.: Sept. - April.

Habitat: Open areas, to 1000 m, common.

Distrib.: Kollam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thiruvananthapuram. Throughout India. Tropics and subtropics.

Uses: Stem yields a fibre for ropes. Leaf is used to treat piles and root to treat leprosy; seed is used as a laxative.

3. *Abutilon neilgherrense* Munro ex Wight, *Ill. Ind. Bot.* 1: 66. 1840; Mast. in Hook.f., *Fl. Brit. India* 1: 328. 1874; Rama Rao, *Fl. Pl. Travancore*: 39. 1914; Gamble, *Fl. Madras*: 91(66). 1915; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 267. 1993; Sivar. & Pradeep, *Malvac. S. India*: 198. 1996.

Erect undershrub or shrub, 2 - 3 m high; stems and branches velutinous-stellate-hairy. Leaves broadly ovate, cordate at base, coarsely crenate to nearly dentate at margin, acute to subacuminate at apex, 2.5 - 10 x 3 - 9 cm, 7 - 9-nerved at base, pubescent on both surfaces with simple and stellate hairs; petioles 8 - 12

cm long, stellate-hairy; stipules linear, 5 - 10 mm long, stellate-hairy. Flowers 2 - 5 in axillary long-peduncled cymes, rarely solitary; peduncles ca 10 cm long, pubescent; pedicels ca 5 cm long, jointed near apex, densely stellate-pubescent. Calyx campanulate, 4 - 9 mm across; lobes free to middle or below, ovate to ovate-lanceolate, 6 - 12 x 3 - 7 mm, greyish-stellate-pubescent on both sides. Corolla 1.5 - 3 cm across, yellow; petals broadly obovate, obtuse or truncate at apex, 1.5 - 2 cm long, ciliate at base. Staminal column 5 - 10 mm long, glabrous or pubescent, antheriferous above. Ovary ovoid, stellate-hairy; stylar arms 8 - 10; stigmas globose. Schizocarps subcylindric, ca 2 cm across; mericarps 8 - 12, flat, reniform with a short mucro, to 13 x 9 mm, densely stellate-pubescent; seeds 2 or 3 per mericarp, subreniform, tubercled, glabrous, with a pubescent hilum.

Fl. & Fr.: Feb. - June.

Habitat: Roadsides on hills and forest fringes, 300 - 1500 m.

Distrib.: Idukki and Pathanamthitta. Andhra Pradesh and Tamil Nadu. Endemic.

Note: Paul (*l.c.*) recognized 2 varieties, viz., var. *neilgherrense* with glabrous, 8 - 10 mm long staminal column and var. *fischeri* with densely stellate-hairy, ca 5 mm long staminal column.

4. *Abutilon pannosum* (G. Forst.) Schlegel. in Bot. Zeitung (Berlin) 9: 828. 1851; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 268. 1993; Sivar. & Pradeep, Malvac. S. India: 197. 1996. *Sida pannosa* G. Forst. in Commentat. Soc. Regiae Sci. Gott. 2: 9. 1787. *S. glauca* Cav., Icon. 1: 8, t. 11. 1791. *S. mutica* Delile ex DC., Prodr. 1: 470. 1824. *Abutilon glaucum* (Cav.) Sweet, Hort. Brit.: 54. 1826; Dunn in Gamble, Fl. Madras: 91(66). 1915. *A. muticum* (Delile ex DC.) Sweet, Hort. Brit. ed. 2, : 65. 1830; Mast. in Hook.f., Fl. Brit. India 1: 327. 1874. *Sida tomentosa* Roxb., Fl. Ind. 3: 178. 1832. *Abutilon tomentosa* (Roxb.) Wight & Arn., Prodr. Fl. Ind. Orient.: 56. 1834.

Undershrub or shrub, 1 - 3 m high; stems slender, tomentose with stellate and simple hairs. Leaves orbicular, cordate at base, irregularly toothed at margin, acute at apex, 2 - 8 cm, 5 - 9-nerved at base, stellate-hairy on both surfaces; petioles 1.5 - 6 cm long, stellate-tomentose; stipules linear-falcate, 3 - 6 mm long, stellate-hairy. Flowers solitary, axillary, sometimes racemose by replacing upper leaves; pedicels 1 - 4 cm long, slender, jointed above, pubescent. Calyx campanulate; lobes free to middle, deltoid-ovate, stellate-pubescent outside, simple-hairy inside. Corolla yellow with a dark brown centre; petals 3-angled, glabrous. Stami-

nal column 5 - 6 mm long, longer than petals, stellate-pubescent, antheriferous throughout. Ovary ca 2.5 mm across, pubescent; styles and stigmas ca 25, glabrous. Schizocarps subglobose, depressed at tip, 0.5 - 1 x 1 - 2 cm; mericarps 20 - 25, reniform with an awn, compressed at sides, 6 - 10 x ca 5 cm, hairy at dorsal margin; seeds 2 or 3 per mericarp, minutely hairy or glabrous, brownish.

Fl. & Fr.: Oct. - March.

Habitat: Wastelands, to 300 m, common.

Distrib.: Palakkad, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Tamil Nadu. Afghanistan, Africa, Egypt, Pakistan and Sri Lanka.

Use: Stem yields a fibre of lower quality.

5. *Abutilon persicum* (Burm.f.) Merr. in Philipp. J. Sci. 19: 364. 1921; Manilal, Fl. Silent Valley: 25. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 60. 1988; Vajr., Fl. Palghat: 78. 1990; T.K. Paul in B. D. Sharma & Sanjappa, Fl. India 3: 269. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 58. 1996; Sivar. & Pradeep, Malvac. S. India: 201. 1996; Sivar. & P. Mathew, Fl. Nilambur: 80. 1997. *Sida persica* Burm.f., Fl. Indica: 148, t. 47, f. 1. 1768. *S. polyandra* Roxb., Fl. Ind. 3: 173. 1832. *Abutilon polyandrum* (Roxb.) Wight & Arn. ex Wight, Cat. Ind. Pl.: 12. 1833, non G. Don 1831; Mast. in Hook.f., Fl. Brit. India 1: 325. 1874; Rama Rao, Fl. Pl. Travancore: 38. 1914; Dunn in Gamble, Fl. Madras: 91(65). 1915.

Mal.: *Thurthi*

Undershrub or herb, 1 - 3 m high; stems finely pubescent with stellate, simple or glandular hairs. Leaves 2 - 15 x 1 - 25 cm; lower ones ovate, cordate at base, acute to acuminate at apex; upper ones smaller, ovate to lanceolate, crenate-dentate at margin, gradually long-acuminate at apex, hairy or glabrescent above, velutinous-stellate-hairy beneath; petioles 0.5 - 12 cm long, pubescent; stipules linear-subulate, ca 6 mm long. Flowers solitary, axillary or in terminal panicles or racemes by replacing upper leaves; pedicels 3 - 7 cm long, accrescent to 8 cm, jointed 1 - 2 cm below flower, stellate-pubescent. Calyx cupular, 4 - 6 mm across; lobes ovate to lanceolate, acute to acuminate, 7 - 10 x 3 - 8 mm, densely hairy outside. Corolla orange-yellow; petals obovate, 2 - 3.5 x ca 1.5 cm, hairy at margin outside. Staminal column ca 5.5 mm long, glabrous below, stellate-hairy above; filaments ca 15 mm long. Ovary cylindric, ca 4 mm across, pubescent at apex;

styles 5, glabrous. Schizocarps 12 - 15 mm across; mericarps 5, with 2 stout erecto-patent awns, hairy outside, glabrous inside; seeds 4 - 6 per mericarp, reniform, ca 2 mm across, glabrous or minutely punctate by stellate hairs, blackish brown.

Fl. & Fr.: Almost throughout the year with a peak between Dec. and March.

Habitat: Roadsides in semievergreen forests, more frequent on slopes in ghats, 400 - 1500 m.

Distrib.: Ernakulam, Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thrissur and Wynad. Throughout India. South and SE. Asia.

Use: Stem yields a long silky fibre resembling hemp.

6. *Abutilon ramosum* (Cav.) Guill. & Perr. in Guill. & al., *Fl. Seneg. Tent.* 1: 68. 1830; Mast. in Hook.f., *Fl. Brit. India* 1: 328. 1874; Rama Rao, *Fl. Pl. Travancore*: 39. 1914; Dunn in Gamble, *Fl. Madras*: 91(65). 1915; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 271. 1993; Sivar. & Pradeep, *Malvac. S. India*: 200. 1996. *Sida ramosa* Cav., *Diss.* 1: 28, t. 6, f. 1. 1785.

Perennial herb or undershrub, 1 - 3.5 m high; stems dense with stellate or simple hairs, rarely glabrescent. Leaves ovate, sometimes 3-angled, cordate at base, crenate-serrate at margin, acute to acuminate at apex, 2.5 - 12 x 2.5 - 11 cm, minutely stellate-pubescent or glabrescent above, densely stellate-pubescent beneath, 5 - 7-nerved at base; petioles 2 - 12 cm long, stellate-hairy; stipules linear, 5 - 10 mm long, hairy. Flowers solitary, paired or in axillary or terminal cymes; peduncles 1 - 4.5 cm long, tomentose; pedicels shorter than petioles, jointed above, pubescent. Calyx campanulate, 3 - 5 mm across; lobes free to middle, ovate, acuminate, 4 - 6 x ca 3 mm, accrescent to ca 8 x 5 mm, densely stellate-pubescent outside, minutely stellate or with appressed simple hairs inside. Corolla ca 1 cm across, yellow; petals ovate, 8 - 11 mm long, reflexed, glabrous. Staminal column ca 2.5 mm long, stellate-hairy, antheriferous above. Ovary subglobose, ca 2.5 mm across, pubescent; styles and stigmas 8 - 10, glabrous. Schizocarps ca 1 cm; mericarps 8 - 10, each with 2 long villous spreading or reflexed awns; seeds 2 or 3 per mericarp, reniform, minutely puberulous with stellate hairs, glabrescent, brownish black.

Fl.: Aug. - Oct. *Fr.:* Sept. - March.

Habitat: Lower elevations, occasional.

Distrib.: Ernakulam (Dunn, *l.c.*) and Idukki. Most states in India. Africa and

Pakistan.

7. *Abutilon striatum* Dickson ex Lindl. in Edwards, Bot. Reg., App.: 39. 1839; Borss. Waalk. in Blumea 14: 162. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 273. 1993; Sivar. & Pradeep, Malvac. S. India: 204. 1996. *Sida striata* (Dickson ex Lindl.) Dietr., Syn. Pl. 4: 852. 1874.

Erect shrub, 1 - 3 m high; young branches sparsely stellate-hairy. Leaves broadly ovate, 3 - 5-angled or lobed, cordate at base, serrate to subentire at margin, acuminate at apex, 6 - 12 x 5 - 11 cm, glabrous above, stellate-hairy beneath; petioles ca 10 cm long, glabrous or stellate-pubescent; stipules lanceolate, ca 3 mm long, pubescent at apex and margin at base. Flower solitary, axillary, pendulous; pedicel ca 12 cm long, stellate-pubescent, jointed 1 mm below flower. Calyx ca 12 mm across; lobes ovate, ca 10 x 5 mm, stellate-tomentose, glabrescent inside. Corolla red; petals obovate, ca 3 x 1.5 cm, glabrous. Staminal column ca 2.5 cm long, glabrous, antheriferous above. Ovary cylindrical, ca 2 mm across, densely simple-hairy at apex, stellate-tomentose outside, 9 - 10-loculed; styles 10 - 12, glabrous; stigmas reddish, capitate.

Fl. & Fr.: Jan. - April.

Distrib.: Wynad (Sivarajan & Pradeep, *l.c.*). Karnataka and Tamil Nadu. Native to S. America; cultivated in gardens, sometimes an escape.

2. *HERISSANTIA* Medik.

Perennial herbs or subshrubs, often trailing, pubescent. Leaves ovate, cordate, crenate-dentate, acuminate; stipules linear-subulate, caducous. Flower axillary, solitary; pedicel filiform, geniculate, jointed. Epicalyx absent. Calyx cupular; lobes free to base, lanceolate to ovate. Corolla slightly longer than calyx; petals obovate. Staminal column short, glabrous, included, antheriferous at apex; styles 10 - 15; stigmas capitate. Schizocarps globose, indented at apex; mericarps 10 - 15, inflated, thin walled, rounded at apex, shining; seeds 2 or 3 in each mericarp, reniform, glabrous or sparsely scabrous.

America, Australia and the Hainan Islands of China, 4 species and 1 in India.

Herissantia crispa (L.) Medik., Phil. Bot. 1: 90. 1789; Brizicky in J. Arnold Arbor. 49: 279. 1968; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3:

276. 1993; Sivar. & Pradeep, Malvac. S. India: 209. 1996. *Sida crispera* L., Sp. Pl.: 685. 1753. *Abutilon crispum* (L.) Medik., Malvenfam.: 29. 1787; Mast. in Hook.f., Fl. Brit. India 1: 327. 1874; Rama Rao, Fl. Pl. Travancore: 39. 1914; Dunn in Gamble, Fl. Madras: 91(66). 1915; Borss. Waalk. in Blumea 14: 161. 1966.

Perennial herb, 1 - 1.5 m high; branches slender, ascending or decumbent, pubescent with stellate and simple hairs. Leaves ovate, cordate at base, crenate at margin, acuminate at apex, 2 - 10 x 1 - 8 cm; upper ones smaller, stellate-hairy or tomentose; petioles 0.5 - 6 cm long; stipules filiform, 3 - 6 mm long, reflexed. Flower solitary, axillary; pedicel filiform, 1 - 3 cm long, accrescent to 4.5 cm, jointed above middle, hirsute. Calyx campanulate; lobes free to middle, ovate to lanceolate, pubescent outside, glabrous inside. Corolla as long as or slightly longer than calyx, ca 1.5 cm across; petals broadly obovate, glabrous, white to pale yellow. Staminal column 2 - 2.5 mm long, glabrous, yellow; filaments ca 0.5 mm long, yellow. Ovary 1 - 2 mm across, sparsely pubescent; styles 10 - 12; stigmas discoid, purple. Schizocarps globose, indented at apex; mericarps radially elliptic, inflated, rounded at both ends, with simple and minute stellate hairs and with silvery more or less transparent lateral walls; seeds 2 or 3 per mericarp, reniform, somewhat scabrous, brownish black.

Fl. & Fr.: July - Feb.

Habitat: Roadsides and wastelands.

Distrib.: Idukki (Sivarajan & Pradeep, *l.c.*). Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. Native to America, now a pantropical weed.

3. MALVASTRUM A. Gray, nom. cons.

Annual or perennial herbs or undershrubs with ascending branches. Leaves ovate-lanceolate, usually undivided, rarely shallowly lobed, crenate-serrate, without extrafloral nectaries; stipules lanceolate or falcate. Inflorescences axillary or terminal clusters or spikes. Flower sometimes solitary, sessile or with a short unjointed pedicel. Epicalyx lobes 3, filiform or spatulate, slightly adnate to calyx. Calyx campanulate, 5-parted, sometimes tubular or urceolate. Corolla rotate, yellow or orange-red. Staminal column shorter than corolla, antheriferous at apex. Carpels 10 - 15; ovary 1-ovuled; styler branches as many as carpels; stigmas usually capitate, sometimes clavate or truncate. Schizocarps discoid, setose or pubescent; mericarps separating from axils leaving a short columella, reniform,

indehiscent, reddish brown; seeds reniform, glabrous.

Tropics and subtropics, 14 species, 2 in India and 1 in Kerala.

Literature: Bates, D.M. 1978. Typification of *Malvastrum* A. Gray one last time ? *Taxon* 27: 495. Borssum Waalkes, J. van 1960. The typification of the genus *Malvastrum*. *Taxon* 9: 212 - 213. Brizicky, G. 1966. On the typification of *Malvastrum*. *Taxon* 15: 311 - 315. Fryxell, P.A. & Hill, S.R. 1977. More on the typification of *Malvastrum* DC. *Taxon* 26: 332 - 336. Kearney, T.H. 1955. *Malvastrum* A. Gray - a redefinition of the genus. *Leaflet. W. Bot.* 7: 238 - 241. Rao, S.R.S. & Ramayya, N. 1977. Structure, distribution and taxonomic importance of trichomes in Indian species of *Malvastrum*. *Phytomorphology* 27: 40 - 44.

***Malvastrum coromandelianum* (L.) Garcke** in *Bonplandia* 5: 295. 1857; Dunn in Gamble, *Fl. Madras*: 88(64). 1915; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 62. 1988; Vajr., *Fl. Palghat*: 81. 1990; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 277. 1993; Sivar. & Pradeep, *Malvac. S. India*: 219. 1996. *Malva coromandeliana* L., *Sp. Pl.*: 687. 1753. *Malva tricuspidata* R. Br. in W.T. Aiton, *Hort. Kew.* ed. 2, 4: 210. 1812. *Malvastrum tricuspidatum* (R. Br.) A. Gray, *Pl. Wright.* 1: 16. 1852; Mast. in Hook.f., *Fl. Brit. India* 1: 321. 1874.

Erect, annual herb or undershrub, to 1 m high; stems, petioles and pedicels covered with stiff appressed 4-armed stellate and simple hairs. Leaves ovate-oblong, rarely 3-lobed, obtuse or rounded at base, serrate or dentate at margin, obtuse to acute at apex, 1.5 - 7 x 0.5 - 3.5 cm, covered with simple hairs above and stellate hairs beneath, 5-nerved at base; petioles 0.5 - 3.5 cm long; stipules linear or lanceolate, entire or faintly serrate at margin, acuminate at apex, 4 - 8 mm long, hairy. Flowers axillary, solitary or 2 - 4 in clusters; pedicels 2 - 6 mm long, accrescent to 10 mm. Epicalyx lobes linear-lanceolate, 4 - 7 x 0.7 - 1 mm, hairy. Calyx lobes deltoid to ovate, acuminate, 5 - 10 x 3 - 3.5 cm, stellate-hairy. Corolla ca 1.5 cm across, yellow; petals obliquely obovate, rounded at base, acute at apex. Staminal column conic, without tubular part, glabrous, yellowish. Schizocarps globose, 5 - 8 mm; mericarps 10 - 14, ca 2 mm long, with an awn at apex and 2 awns in middle of dorsal region; seed 1 in each mericarp, reniform, beaked, glabrous, brownish black.

Fl. & Fr.: June - Dec.

Habitat: Roadsides and waste places, common.

Distrib.: Ernakulam (Sivarajan & Pradeep, *l.c.*), Kannur, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram (Sivarajan & Pradeep, *l.c.*) and Wynad (Sivarajan & Pradeep, *l.c.*). Tropics and subtropics.

4. SIDA L.

Annual or perennial herbs or undershrubs, erect or prostrate, pubescent or glabrous. Leaves ovate, rhomboid, obovate or lanceolate, entire, rarely lobed or divided, palmately or pinnately nerved, without nectaries. Flowers axillary, solitary or in clusters by replacing upper leaves; pedicels slender, jointed. Epicalyx absent. Calyx mostly campanulate, 5-lobed, 10-ribbed. Corolla rotate, connate and adnate to staminal column below, yellow or yellowish white, often with a dark centre. Staminal column shorter than petals, included, hairy or glabrous, antheriferous at apex. Carpels 5-14; locules 1-ovuled; styles as many as carpels; stigmas capitate. Schizocarps globose-depressed, glabrous or pubescent; mericarps more or less 3-gonous, mucicous or 2-beaked or 2-aristate, smooth or prominently reticulate outside, indchiscent or dehiscent along mid-dorsal line, rarely along inner margin or by breaking down of lateral or basal walls; seeds ovoid-oblong to reniform, glabrous or hairy.

Tropics and subtropics especially America, ca 200 species, 17 in India and 12 in Kerala.

Literature: Abedin, S. 1979. Revision of *Sida* Linn. (*Malvaceae*) in Pakistan. *Pakistan J. Bot.* 11: 37 - 59. Adhikary, A.K. 1963. Cytotaxonomical studies in some species of *Sida*. *Trans. Bose Res. Inst. Calcutta* 26: 59. Clement, I.D. 1957. Studies on *Sida* 1. A review of the genus and monograph of sections Malacroideae, Physaloides and Pseudo-malvastrum. *Contr. Gray Herb.* 180: 5 - 91. Hazra, R. & Sharma, A. 1971. Chromosome studies in different species and varieties of *Sida* with special reference to accessory chromosomes. *Cytologia* 36: 285 - 297.

Key to species

- | | | |
|-----|--|---------------------------|
| 1a. | Mericarps 5 | 2 |
| b. | Mericarps 6 - 12 | 3 |
| 2a. | Leaves palmately nerved; mericarps mucronate, smooth | 4 |
| b. | Leaves pinnately nerved; mericarps awned, reticulate | 5 |
| 3a. | Leaves glabrescent; stipules dissimilar | 1. <i>S. acuta</i> |
| b. | Leaves densely pubescent; stipules similar | 6 |

4a.	Erect herbs or undershrubs; flowers in racemes or panicles	7
b.	Prostrate herbs; flower usually solitary	8
5a.	Stems spinous	11. <i>S. spinosa</i>
b.	Stems not spinous	2. <i>S. alnifolia</i>
6a.	Mericarps with 2 retrorse-hairy awns	4. <i>S. cordifolia</i>
b.	Mericarps without awns or if present never hairy	9
7a.	Plant glandular-hairy; staminal column glabrous	7. <i>S. mysorensis</i>
b.	Plant not glandular-hairy; staminal column pubescent	5. <i>S. elongata</i> var. <i>balica</i>
8a.	Pedicels jointed near middle; mericarps glabrous	3. <i>S. cordata</i>
b.	Pedicels jointed above middle; mericarps hairy	8. <i>S. repens</i>
9a.	Leaves entire; flowers in corymbs	6. <i>S. linifolia</i>
b.	Leaves serrate; flowers not in corymbs	10
10a.	Staminal column glabrous	9. <i>S. rhombifolia</i>
b.	Staminal column glandular-hairy	11
11a.	Leaves crenate-serrate towards apex, entire at base	10. <i>S. scabrida</i>
b.	Leaves crenate-serrate throughout	12. <i>S. subcordata</i>

1. *Sida acuta* Burm.f., Fl. Indica: 147. 1768; Dunn in Gamble, Fl. Madras: 90(64). 1915; Nicolson & al. in Regnum Veg. 119: 173. 1988; Manilal, Fl. Silent Valley: 28. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 63. 1988; Vajr., Fl. Palghat: 82. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 281. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 81. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 61. 1996; Sivar. & Pradeep, Malvac. S. India: 238. 1996; Sivar. & P. Mathew, Fl. Nilambur: 88. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 99. 2002. *S. carpinifolia* sensu Mast. in Hook.f., Fl. Brit. India 1: 323. 1874, non L.f. 1782; Rama Rao, Fl. Pl. Travancore: 37. 1914. *S. carpinifolia* var. *acuta* (Burm.f.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 45: 119. 1876.

Mal.: *Cheruparuvu, Kattukurunthotti*

Annual, erect herb or undershrub, 0.5 - 1.5 m high; stems pubescent with minute stellate and simple hairs, glabrescent later; branches distichous. Leaves lanceolate to linear or ovate-oblong, mostly acute, rarely obtuse or rounded at base, serrate at margin towards apex, entire towards base, acute at apex, 1.5 - 9 x 0.5 - 2.5 cm, sparsely hairy on both surfaces with stellate and simple hairs, becoming glabrescent later; petioles 2 - 6 mm long, pulvinate at both ends, stellate-

hairy; stipules of each pair different, one linear-lanceolate or falcate, 6 - 7 x 1.5 mm, the other linear-filiform. Flowers solitary, axillary or in clusters of 2 or 3; pedicels 3 - 10 mm long, stellate-pubescent. Calyx campanulate, slightly accrescent, 5 - 6 mm across, 5-lobed, stellate- and simple-hairy outside, glabrous inside. Corolla ca 10 mm across, yellow; petals obovate, as long as calyx lobes or slightly longer, glandular-hairy outside. Staminal column ca 4 mm long with simple and glandular hairs, antheriferous above. Ovary ovoid or globose, ca 1.5 mm, sparsely hairy above; styles 6 - 8; stigmas globose, yellow. Schizocarps ca 5 mm long, glabrous; mericarps 6 - 10, ca 4 mm long, 4-hedral, reticulately striate, glabrous; awns ca 1.5 mm long; seeds ovoid, ca 2 mm long, dark brown; hilum hairy.

Fl. & Fr.: Oct. - Dec.

Habitat: Roadsides and wastelands.

Distrib.: Throughout Kerala. Throughout India. Pantropic.

Use: Juice of leaf boiled in oil is applied to swellings and in elephantiasis.

2. ***Sida alnifolia*** L., Sp. Pl.: 684. 1753; Sivar. & Pradeep in Sida 16: 69. 1994 & Malvac. S. India: 241. 1996. *S. retusa* L., Sp. Pl. ed. 2, : 691. 1763. *S. rhombifolia* L. var. *retusa* (L.) Mast. in Hook.f., Fl. Brit. India 1: 324. 1874. *S. rhombifolia* L. subsp. *retusa* (L.) Borss. Waalk. in Blumea 14: 198. 1966, non Ugbor. 1980; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 64. 1988; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 289. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 62. 1996. *S. rhombifolia* (L.) subsp. *alnifolia* (L.) Ugbor. in Bol. Soc. Brot. 94: 70. 1980.

Mal.: *Anakurumthoti*

Undershrub; branches erect or prostrate. Leaves usually obovate, rarely elliptic-lanceolate, obtuse to rounded at base, crenate-dentate towards apex, entire towards base, retuse, obtuse or acute at apex, 1 - 5 x 0.5 - 3.5 cm, stellate-pubescent on both surfaces; petioles ca 4 mm long, stellate-pubescent; stipules ca 4 mm long, similar, linear-subulate, glabrescent. Flowers solitary, axillary or in clusters by reduction of upper leaves; pedicels ca 3.5 mm long, ca 25 mm in fruit, glabrous, jointed above middle. Calyx ca 6 mm across, stellate-hairy outside, glabrous inside; lobes ovate-triangular. Corolla ca 10 mm across, orange-yellow; petals obliquely obovate, hairy at base. Staminal column ca 3 mm long, glabrous

or sparsely hairy, antheriferous above. Ovary globose-depressed, ca 1.5 mm, glabrous; styles 7 - 10; stigmas capitate, yellow. Schizocarps 3 - 4 mm long; mericarps 7 - 10, enclosed in calyx with a pair of stellate-hairy mucro at apex; seeds glabrous, black.

Fl. & Fr.: Aug. - April.

Habitat: Roadsides in secondary forests, common.

Distrib.: Idukki, Kannur, Kottayam, Kozhikode, Palakkad, Thrissur and Wynad. Pantropical.

Note: After studying ample material and the lectotypes of *Sida rhombifolia* L., *S. alnifolia* L. and *S. retusa* L., Sivarajan and Pradeep (*l.c.*) concluded that *S. retusa* L. and *S. alnifolia* L. are conspecific and that they are distinct from *S. rhombifolia*. Borssum Waalkes (*l.c.*) while agreeing with the conspecificity of these 2 species gave only a subspecific status to this taxon and adopted the epithet *retusa* although the epithet *alnifolia* antedates *retusa* as there is no priority for a name outside its own rank (Art. 11.2). She, however, suggested the use of the epithet '*alnifolia*' if the taxon is considered a distinct species. Sivarajan and Pradeep (*l.c.*) reinstated the species *S. alnifolia* adopting the priorable name.

3. *Sida cordata* (Burm.f.) Borss. Waalk. in *Blumea* 14: 182. 1966; Manilal & Sivar., *Fl. Calicut*: 43. 1982; Nicolson & al. in *Regnum Veg.* 119: 175. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 63. 1988; Vajr., *Fl. Palghat*: 83. 1990; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 283. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 81. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 61. 1996; Sivar. & Pradeep, *Malvac. S. India*: 192. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 90. 1997. *Melochia cordata* Burm.f., *Fl. Indica*: 143. 1768. *Sida veronicaefolia* Lam., *Encycl.* 1: 5. 1783; Dunn in Gamble, *Fl. Madras*: 89(64). 1915. *S. humilis* Cav., *Diss.* 5: 277, t. 134, f. 2. 1788; Mast. in Hook.f., *Fl. Brit. India* 1: 322. 1874; Rama Rao, *Fl. Pl. Travancore*: 37. 1914. *S. humilis* Cav. var. *veronicaefolia* (Lam.) Mast. in Hook.f., *Fl. Brit. India* 1: 322. 1874. *S. beddomei* K.C. Jacob in *J. Bombay Nat. Hist. Soc.* 47: 50. 1950; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 63. 1988; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 61. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 90. 1997.

Mal.: *Vallikurunthoti*

Prostrate or sometimes ascending herb, to ca 1 m, branched mostly towards

base, sometimes rooting at lower nodes; stems, petioles and pedicels stellate- and simple-hairy. Leaves ovate to orbicular, rarely 3-angled, cordate at base, crenate, dentate or serrate at margin, acute to acuminate at apex, 0.5 - 7 x 0.3 - 4 cm, stellate- or simple-hairy on both surfaces; petioles 1.5 - 4 cm long; stipules linear or filiform, 1 - 3 mm long, hairy. Flower solitary, axillary or in few-flowered racemes; pedicels 1 - 3 cm long, slender, slightly accrescent, jointed above middle. Calyx campanulate, ca 3 mm across; lobes connate above middle, deltoid, acuminate, ca 3 x 3 mm, stellate- or simple-hairy outside, glabrous inside except at margin. Corolla ca 10 mm across, yellow; petals obovate, emarginate or rounded at apex, ca 7 x 5 mm, ciliate at base. Staminal column ca 3 mm long, conic at base, short-tubular above, glabrous or simple-hairy, antheriferous at apex. Ovary globose, ca 2 mm, glabrous or sparsely hairy; styles 5; stigmas 5, globose, pink. Schizocarps globose, ca 5 mm, enclosed in persistent calyx, brownish black; mericarps 5, 3-gonous, ca 4 x 2 mm, longitudinally keeled on back, awnless, dehiscing at apex; seeds reniform, ca 2 x 1 mm, glabrous, brownish black.

Fl. & Fr.: Throughout the year.

Habitat: Wastelands and semishaded areas in low level forests, common.

Distrib.: Ernakulam, Idukki, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Throughout India. Tropics.

Uses: Stem, leaf and root bark is medicinal. Stem yields a good fibre.

4. *Sida cordifolia* L., Sp. Pl.: 684. 1753; Mast. in Hook.f., Fl. Brit. India 1: 324. 1874; Rama Rao, Fl. Pl. Travancore: 38. 1914; Dunn in Gamble, Fl. Madras: 89(64). 1915; Manilal & Sivar., Fl. Calicut: 43. 1982; Nicolson & al. in Regnum Veg. 119: 173. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 63. 1988; Vajr., Fl. Palghat: 83. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 285. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 81. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 62. 1996; Sivar. & Pradeep, Malvac. S. India: 256. 1996; Sivar. & P. Mathew, Fl. Nilambur: 41. 1997. *S. rotundifolia* Lam., Encycl. 1: 5. 1783. *S. herbacea* Cav., Diss. 1: 19, t. 132, f. 1. 1785.

Mal.: *Velluppan, Velluram*

Erect undershrub, ca 1 m high, foetid; stems, petioles and pedicels velutinous to densely pubescent with stellate and simple hairs. Leaves ovate to orbicular, shallowly cordate, occasionally rounded or truncate at base, crenate or

serrate at margin, obtuse to acute at apex, 0.5 - 5 x 0.5 - 4 cm, velutinous on both surfaces with stellate hairs; petioles 0.5 - 4 cm long, hairy; stipules filiform, 3 - 10 mm long, densely stellate-hairy. Flowers solitary, axillary or in clusters of 2 - 5; pedicels 2 - 10 mm long, accrescent to ca 2 cm, jointed near apex. Calyx campanulate, 5 - 9 mm across, 10-ribbed; lobes deltoid, acute to acuminate at apex, pubescent outside with stellate and simple hairs, sparsely hairy towards apex inside. Corolla ca 15 mm across, light yellow; petals obliquely obovate, truncate or slightly emarginate at apex, ca 1 x 0.5 cm, ciliate at base. Staminal column ca 2.5 mm long, simple-hairy or glabrous. Ovary conic, stellate-hairy; stigmas capitate, yellow. Schizocarps 6 - 7 mm across, pubescent at tip; mericarps 8 - 10, 3-gonous, ca 3 x 2 mm, prominently reticulate on both surfaces, with a pair of retrorse-hairy awns at apex; seeds reniform, ca 2 mm across, flat; hilum with a few short hairs, dark brown or black.

Fl. & Fr.: Throughout the year with a peak during July - Sept.

Habitat: Wastelands and roadsides, to 1000 m.

Distrib.: Almost throughout Kerala. Throughout India. Tropics and subtropics.

Uses: Stem yields a fibre; root is used in Ayurvedic medicines.

5. *Sida elongata* Blume var. ***balica*** (Miq.) Borss. Waalk. in *Blumea* 14: 182. 1966; P. Mathew & Sivar. in *J. Econ. Tax. Bot.* 4: 618. 1983; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 285. 1993; Sivar. & Pradeep, *Malvac. S. India*: 270. 1996. *Sida balica* Miq., *Fl. Ned. Ind.* 1: 141. 1858. *S. elongata* Blume, *Bijdr.*: 76. 1825; Sivar. & P. Mathew, *Fl. Nilambur*: 92. 1997.

Erect, annual herb or undershrub, to 1.5 m high; stems terete, densely pubescent with stellate and simple hairs. Leaves ovate or obicular, cordate at base, irregularly crenate at margin, acute or acuminate at apex, ca 10 x 8 cm, densely pubescent with stellate and simple hairs on both surfaces; petioles 3 - 6 mm long, pubescent; stipules subulate, 6 - 7 mm long, hairy. Flowers axillary, initially solitary, ultimately in lax racemes or panicles; pedicels ca 6 mm long, jointed in middle. Calyx campanulate, ca 3 mm long, membranous, hairy outside, 5-lobed; lobes lanceolate or 3-angled, as long as tube, ciliate at margin, 3-nerved. Corolla ca 2 cm across, yellow; petals obovate, rounded at apex, ca 1 cm long, glabrous. Staminal column ca 0.5 mm long, conic at base, antheriferous at apex, pubescent. Ovary ovoid, ca 2 mm across, glabrous, 5-loculed; stigmas 5, capitate. Fruits of 5 mericarps,

shorter than calyx, 3-gonous with blind angles and 2 short hairy mucicous processes at apex; seeds 3-gonous, glabrous, dark brown.

Habitat: Undergrowth in disturbed areas bordering teak plantations.

Distrib.: Malappuram, Indonesia and Lesser Sunda Islands.

Note: This taxon is very rare and has been collected only in Nilambur forests so far (Mathew & Sivarajan, *l.c.*).

6. *Sida linifolia* Cav., Diss. 1: 14, t. 2, f. 1. 1785; Pradeep & Sivar. in *Rheedea* 3: 22. 1993; Sivar. & Pradeep, *Malvac. S. India*: 282. 1996.

Erect undershrub, 1–1.5 m high; stems hirsute with simple and glandular hairs. Leaves linear or narrowly lanceolate, obtuse at base, entire at margin, acute at apex, 8–17 x 4–1.5 cm, sparsely hairy; petioles ca 1 cm long; stipules linear-lanceolate, ca 7 mm long, pubescent at margin. Flowers axillary, solitary or in corymbs due to reduction of upper leaves; pedicels jointed above middle, ca 5 mm long, accrescent to 1 cm. Calyx campanulate, ca 1 cm across; lobes free to middle, 3-angled, acuminate, pubescent outside, glabrous inside. Corolla ca 2 cm across, creamy white with a dark red centre; petals obovate, obliquely cuneate at base, slightly emarginate or obtuse at apex, ca 1 x 0.5 cm, glabrous. Staminal column ca 2 mm long, hairy, antheriferous at apex. Ovary globose-depressed, glabrous; styles 8 or 9; stigmas globose, sparsely hairy, red. Schizocarps oblate, ca 5 mm across, glabrous; mericarps 8 or 9, ca 3 x 2 mm, glabrous, brownish black; seeds reniform, glabrous, dark brown.

Fl. & Fr.: July–Nov.

Habitat: Plains, rare.

Distrib.: Thiruvananthapuram (Pradeep & Sivarajan, *l.c.*). Neotropics.

7. *Sida mysorensis* Wight & Arn., *Prodr. Fl. Ind. Orient.*: 59. 1834; Mast. in Hook.f., *Fl. Brit. India* 1: 322. 1874; Rama Rao, *Fl. Pl. Travancore*: 37. 1914; Borss. Waalk. in *Blumea* 14: 180. 1966; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 286. 1993; Sivar. & Pradeep, *Malvac. S. India*: 271. 1996. *S. glutinosa* Roxb., *Fl. Ind.* 3: 172. 1832, non Cav. 1785; Dunn in Gamble, *Fl. Madras*: 89(64). 1915; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 64. 1988; Vajr., *Fl. Palghat*: 83. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 82. 1994; N. Mohanan & Sivad., *Fl. Agasthyamala*: 100. 2002.

Mal.: *Vattakurumthotti*

Annual or perennial, erect herb or undershrub, ca 1 m high, aromatic; stems glandular hairy; petioles and pedicels densely pubescent with stellate, glandular and simple hairs. Leaves ovate, rarely orbicular, occasionally upper ones oblong, cordate, truncate or rounded at base, serrate to crenate at margin, acute to acuminate at apex, 1.5 - 8 x 1 - 7 cm, pubescent with stellate, simple and gland-tipped hairs; petioles 1 - 7 cm long; stipules linear-filiform, 3 - 6 mm long, hairy. Flowers axillary, initially solitary later in condensed racemes or panicles by developing accessory buds; pedicels filiform, 3 - 20 mm long, slightly accrescent, thinner than petioles, jointed near apex. Calyx campanulate, ca 4 mm across, accrescent to 6 mm; lobes deltoid, acute to acuminate, 2.5 - 5 x 2 - 2.5 mm, stellate- and simple-pubescent outside, glabrous inside except at margin. Corolla 5 - 20 mm across, yellow; petals obovate or orbicular, emarginate or retuse at apex, ca 6 x 5 mm, glabrous. Staminal column ca 4 mm long, conic at base, tubular above, glabrous, antheriferous above. Ovary subglobose, ca 1 mm long, brownish black; styles ca 4 mm long, connate to middle. Schizocarps ca 3 mm long; mericarps 5, 4-hedral with rounded angles, 2-cuspidate and hairy at apex, 2.5 - 3 mm long; seeds ovoid, ca 2 mm long, glabrous, brownish black, dispersed by withering of wall.

Fl. & Fr.: Sept. - May.

Habitat: Roadsides and margin of forests, common.

Distrib.: Almost throughout Kerala. Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and W. Bengal. South and SE. Asia.

8. *Sida repens* Dombey ex Cav., Diss. 1: 7. 1785; Fryxell in *Sida* 11: 71. 1985; Sivar. & Pradeep, *Malvac. S. India*: 277. 1996. *S. javensis* Cav. subsp. *expilosa* auct. non Borss. Waalk. 1966; P. Mathew & Sivar. in *J. Econ. Tax. Bot.* 4: 619. 1983; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 286. 1993; Sivar. & P. Mathew, *Fl. Nilambur*: 92. 1997.

Prostrate herb; stems rooting at nodes, stellate-hairy. Leaves orbicular, cordate at base, rounded or obtuse at apex, ca 5 cm, sparsely pubescent with simple hairs above and stellate hairs beneath; petioles 1 - 5 cm long, stellate-hairy; stipules subulate, ca 3 mm long, hairy. Flower axillary, solitary; pedicel 7 - 12 mm long, accrescent to 20 mm, jointed above middle, sparsely hairy. Calyx

campanulate, ca 7 mm long; lobes divided to middle, 3-angled, 3 - 5 x ca 4.5 mm, simple- and stellate-hairy outside, glabrous inside except at margin. Corolla ca 10 cm across, yellow; petals obovate, rounded at apex, ca 7 x 4 mm, glabrous. Ovary subpyramidal, ca 1.5 mm long, glabrous, yellowish green; styles and stigmas 5. Schizocarps ca 3 mm long; mericarps 5, 4-hedral with rounded angles, 2-awned, hairy; seeds ovoid, 2 - 2.5 mm long; hilum hairy, brownish black.

Fl. & Fr.: Nov. Dec.

Habitat: Undergrowth in semievergreen forests bordering teak plantations.

Distrib.: Ernakulam, Kozhikode and Malappuram. Malesia and the W. Indies.

9. *Sida rhombifolia* L., Sp. Pl.: 684. 1753; Mast. in Hook.f., Fl. Brit. India 1: 323. 1874, incl. vars. *obovata* & *rhomboidea*; Rama Rao, Fl. Pl. Travancore: 38. 1914; Dunn in Gamble, Fl. Madras: 90(65). 1915; Manilal, Fl. Silent Valley: 28. 1988; Vajr., Fl. Palghat: 84. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 82. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 62. 1996; Sivar. & Pradeep, Malvac. S. India: 245. 1996; Sivar. & P. Mathew, Fl. Nilambur: 93. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 100. 2002. *S. rhombifolia* L. subsp. *rhombifolia*: Borss. Waalk. in Blumea 14: 193. 1966; Manilal & Sivar., Fl. Calicut: 44. 1982. *S. rhombifolia* L. subsp. *rhombifolia* var. *rhombifolia*: T.K. Paul & M.P. Nayar, Fasc. Fl. India 19: 214. 1988; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 290. 1993. *S. rhomboidea* Roxb. ex Fleming in Asiat. Res. 6: 178. 1810. *S. fryxellii* Sivar. & Pradeep in Kew Bull. 45: 725. 1990.

Mat.: Kurumthotti

Annual or perennial herb or undershrub, ca 1.5 m high; stems, petioles and pedicels stellate- or rigid-hairy, ultimately glabrescent. Leaves ovate to oblong, often more or less rhomboid, obovate or lanceolate, acute, rounded, rarely retuse at base, serrate to crenate towards apex, entire towards base, acute to acuminate at apex, 1 - 8 x 3 - 5 cm, minutely stellate-pubescent or tomentose with more or less stiff simple hairs; petioles 10 - 15 mm long; stipules filiform or linear-lanceolate, ciliate. Flowers axillary, solitary or in clusters of 2 - 5; pedicels ca 4 cm long. Calyx campanulate; lobes free to or above middle, 3-angled to ovate, acuminate, 4 - 6 x ca 3.5 mm, accrescent to 8 mm in fruit. Corolla yellow to pale orange, ca 1.5 cm across; petals oblique, cuneate at base. Staminal column shorter than petals, glabrous. Ovary conic, minutely stellate-hairy; styles 9 - 12. Mericarps (6)

7-12, with 2 short mucro or awns at apex, to 1-2.5 mm long; seeds reniform, flat, ca 2 mm across, brown or black.

Fl. & Fr.: July-Dec.

Habitat: Roadsides and wastelands, common.

Distrib.: Almost throughout Kerala. Throughout India. Pantropic.

Note: Paul (*l.c.*) considered *S. fryxellii* Sivar. & Pradeep only a variant of *S. rhombifolia*.

10. *Sida scabrida* Wight & Arn., Prodr. Fl. Ind. Orient.: 57. 1834; Ugbor. in Bol. Soc. Brot. 54: 100. 1980; Sivar. & Pradeep, Malvac. S. India: 250. 1996; Sivar. & Pradeep in Sida 16: 75. 1997. *S. rhombifolia* L. var. *scabrida* (Wight & Arn.) Mast. in Hook.f., Fl. Brit. India 1: 324. 1874; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 290. 1993 (under subsp. *rhombifolia*).

Erect undershrub, 1-2 m high; stems purplish green, stellate- and simple-hairy. Leaves rhomboid or oblong-lanceolate, acute or truncate at base, crenate-serrate at upper margin, acuminate at apex, 5-7.5 x 2.5-3 cm, pubescent with simple hairs above, with stellate and simple hairs beneath; petioles ca 1 cm long, simple- and stellate-pubescent; stipules filiform-subulate, ca 5 mm long, ciliate. Flowers axillary, solitary or in clusters of 3-5 due to reduction of upper leaves; pedicels not jointed. Calyx campanulate, ca 6 cm across, 10-ribbed; lobes ovate, acuminate, ca 4 x 3 mm. Staminal column ca 3 mm long, stellate-pubescent. Ovary ovoid, ca 2 mm across, sparsely hairy above; styles 7-10; stigmas subglobose. Mericarps 3-gonous, enclosed in calyx, sparsely stellate-hairy on dorsal surface, reticulate with 2 divergent stellate-pubescent awns; seeds reniform, flat, pubescent at hilum, brown.

Fl. & Fr.: Aug. - April.

Habitat: Evergreen, semievergreen and moist deciduous forests, occasional.

Distrib.: Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Peninsular India. Africa.

11. *Sida spinosa* L., Sp. Pl.: 683. 1753; Mast. in Hook.f., Fl. Brit. India 1: 323. 1874; Dunn in Gamble, Fl. Madras: 89(64). 1915; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 292. 1993; Sivar. & Pradeep, Malvac. S. India: 280. 1996.

Annual or perennial, erect or diffuse herb or undershrub, to 65 cm high;

stems with 1 or 2 spines at base of petioles; stems, petioles and pedicels cinereous-stellate- and simple-hairy. Leaves oblong or ovate, acute or subcordate at base, serrate at margin, acute, rounded to truncate at apex, 6 - 30 x 4 - 25 mm, stellate-pubescent, sometimes glabrescent above; petioles 2 - 15 mm long; stipules linear, equal, 1 - 2.5 mm long, hairy. Flowers axillary, solitary or in clusters of 2 - 5 in small axillary shoots; pedicels 2 - 8 mm long, accrescent to 8 mm, jointed above middle. Calyx campanulate, 3 - 5 mm across; lobes free above middle, deltoid, acute to acuminate with a prominent midnerve, 1 - 2 x 1.5 - 2 mm, cinerous-stellate- and simple-hairy outside, glabrous except at margin inside. Corolla ca 1 cm across, yellow or yellowish white; petals obovate, rounded or emarginate at apex, ca 6 x 3 mm, glabrous. Staminal column ca 2 mm long, glabrous, antheriferous at apex. Ovary ovoid; styles 5; stigmas globose, purple. Schizocarps ca 5 mm across, enclosed in calyx; mericarps 5, 3-gonous, 2 - 3 mm long, with 2 divergent awns to 1 - 1.5 mm long, prominently dorsally reticulate, stellate-hairy at apex; seeds ovoid, slightly 3-gonous, 1 - 1.5 mm long, glabrous, brownish black.

Fl. & Fr.: March - Dec.

Habitat: Wastelands

Distrib.: Palakkad. Throughout India. Pantropical.

12. *Sida subcordata* Span. in *Linnaea* 15: 172. 1841; Borss. Waalk. in *Blumea* 14: 119. 1966; Sivar. & Pradeep, *Malvac. S. India*: 253. 1996. *S. corylifolia* Wall. ex Mast. in *Hook.f., Fl. Brit. India* 1: 324. 1874.

Erect undershrub, 0.5 - 1.5 m high; stems purplish green, stellate-hairy. Leaves ovate or elliptic-lanceolate, truncate or subcordate at base, crenate-serrate at margin, acute to acuminate at apex, 2 - 7 x 1 - 4 cm, glabrescent above, sparsely stellate-pubescent beneath; petioles ca 10 mm long, pubescent; stipules linear to filiform, equal, ca 6 mm long. Flower axillary, solitary; pedicel 1 - 3 cm long, jointed near middle, stellate-pubescent. Calyx campanulate, ca 9 cm across, sparsely stellate-hairy outside, glabrous inside; lobes ovate, acute or acuminate at apex, 3 - 5 x 1.5 - 3 mm. Corolla ca 1.5 cm across, yellow; petals obliquely obovate, 10 - 12 x 7 - 9 mm, sparsely simple-hairy outside. Staminal column ca 4 mm long, glandular- and simple-hairy, antheriferous at apex; filaments pubescent. Ovary depressed- globose, ca 1.5 mm long; styles 8 - 10, glabrous, pink; stigmas capitate. Schizocarps ca 7 mm across, enclosed in calyx; mericarps 8 - 10, 3-

angled, ca 3 x 2.5 mm, reticulate with 2 divergent glabrous awns at apex; seeds reniform, flat, ca 2 x 1.5 mm, sparsely hairy at hilum.

Fl. & Fr.: Almost throughout the year.

Habitat: Roadsides and margin of forests, common.

Distrib.: Pathanamthitta and Thrissur (Sivarajan & Pradeep, *l.c.*). Southeast Asia.

Excluded species

Sida schimperiana Hochst. ex A. Rich. (= *S. cuneifolia* Roxb.) was reported to occur in Kerala (Paul, *l.c.*: 292). Rama Rao (*l.c.*) too mentioned without specifying a locality. There are specimens from Kanyakumari, formerly part of S. Travancore, now in Tamil Nadu and not from Kerala (also *vide* Sivarajan & Pradeep, *l.c.*: 261).

Tribe 2. DECASCHISTIEAE Fryxell

Perennial herbs or shrubs; stems glabrous or stellate-tomentose. Leaves entire or lobed, densely pubescent with a nectary on midnerve beneath; stipules lacinate or divided. Epicalyx lobes 10, unequally connate below. Flowers short-pedicelled, axillary or clustered in uppermost axils. Calyx and corolla 5-lobed, not auricled. Staminal column 5-dentate at apex, antheriferous throughout. Ovary 10-loculed; stylar branches 10; stigma capitate. Carpels separate from main axis at maturity. Capsules pubescent, dehiscent loculicidally; seed 1, glabrous or sparsely pubescent.

7. DECASCHISTIA Wight & Arn.

Perennial herbs or shrubs, tomentose. Leaves entire or lobed, coriaceous, densely pubescent on both surfaces; midnerve with a nectary at base beneath. Flowers short-pedicelled, axillary, solitary or clustered in uppermost axils or at tips of branches. Epicalyx lobed, connate in middle or below. Petals 5, not auricled. Staminal column antheriferous throughout. Ovary 10-loculed; stylar branches 10; stigma capitate. Capsules loculicidal, 10-valved; valves attached by base to a short conic 10-angled central column; seeds reniform, ascending.

Southeast Asia to Australia, 18 species, 4 in India and 1 in Kerala.

Literature: Fryxell, P.A. 1975. Generic relationships of *Decaschistia* (Malvaceae) and the description of a new tribe *Decaschistieae*. *Amer. J. Bot.* 62: 172 - 175.

Decaschistia crotonifolia Wight & Arn., Prodr. Fl. Ind. Orient.: 52. 1834; Mast. in Hook. f., Fl. Brit. India 1: 332. 1874; Dunn in Gamble, Fl. Madras: 94(68). 1915; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 296. 1993; Sivar. & Pradeep, Malvac. S. India: 18. 1996.

Erect shrub, 1.5 - 2.5 cm high; stems woody, pale green to grey, whitish-stellate-tomentose, more so on younger parts. Leaves ovate-lanceolate, cordate to rounded at base, serrate or slightly lobed, acute at apex, 3 - 4 x 1.5 - 8 cm, stellate-tomentose on both surfaces more so on nerves beneath; midnerve with a basal nectary; petioles to 5 cm long, terete, brown-stellate-tomentose; stipules linear-subulate, ca 1 cm long, stellate-tomentose. Flowers axillary, solitary or 3 - 6 in racemose clusters due to reduction of upper leaves; pedicels 3 - 15 mm long, densely stellate-pubescent. Epicalyx lobes linear, 5 - 10 x 1 - 1.5 mm, connate at base, pubescent. Calyx campanulate, 5-lobed; lobes ovate, 6 - 8 x 2 - 3 cm, stellate-hairy on both sides. Corolla 5 - 6 cm across, yellow with a dark maroon centre; petals 5, obovate, 3 - 4 x ca 2.5 cm, connate and adherent to staminal tube at base, densely stellate-pubescent outside, glabrous inside. Staminal column antheriferous throughout; tube ca 2 cm long; anthers purple. Ovary ovoid, ca 4 mm across, pubescent, 10-loculed; locules 1-ovuled; styles ca 2 cm long; stigma capitate, glandular-hairy, brown. Capsules globose-depressed, to 2 cm across, enclosed in clayx, densely stellate-pubescent, 10-valved; seeds reniform, ca 5 x 3 mm, glabrous, brownish black.

Fl. & Fr.: Almost throughout the year.

Habitat: Shallow soil in partial shade and open places in dry deciduous forests.

Distrib.: Wynad (Sivarajan & Pradeep, *l.c.*). Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra. Endemic.

Use: Bark yields a fibre comparable well with jute.

Excluded species

Decaschistia trilobata Wight was reported to occur in Kerala as well (Paul, *l.c.*: 300). Rama Rao (*l.c.*) mentioned without specifying a locality. There is no specimen from Kerala (also *vide* Sivarajan & Pradeep, *l.c.*: 23).

Tribe 3. HIBISCEAE Endl.

Perennial herbs, undershrubs, shrubs or trees. Stems stellate-hairy or prickly,

sometimes glabrescent. Leaves simple, palmately lobed, sometimes pinnately lobed, rarely entire, tomentose to hairy; nectaries absent; stipules simple. Flowers solitary, axillary or in terminal racemes due to reduction of leaves. Epicalyx lobes 4 - 16, free or connate at base, winged or not, persistent or not. Calyx and corolla 5-lobed. Staminal column short or long, partly or fully antheriferous. Ovary 5-loculed; style 5-armed or -branched; stigmas capitate or peltate. Fruit a capsule; seeds reniform.

Key to genera

- | | | |
|-----|---|-----------------------|
| 1a. | Epicalyx lobes winged in fruit, ultimately spreading | 2 |
| b. | Epicalyx lobes not winged, rarely spreading | 3 |
| 2a. | Staminal column divided into 5 arms; styles 3-branched | 13. Kydia |
| b. | Staminal column 5-toothed at apex; styles 2 or 3-branched | 12. Julostylis |
| 3a. | Styles distally 5-branched; stigmas capitate or globose | 4 |
| b. | Styles unbranched; stigmas ribbed or lobed | 6 |
| 4a. | Calyx regularly 5-lobed, not spathaceous | 5 |
| b. | Calyx irregularly 2- or 3-lobed, spathaceous | 8. Abelmoschus |
| 5a. | Capsules winged | 9. Fioria |
| b. | Capsules not winged | 11. Hibiscus |
| 6a. | Epicalyx lobes 3, cordate, persistent | 10. Gossypium |
| b. | Epicalyx lobes 3 - 8, linear to oblanceolate, mostly caducous | 14. Thespesia |

8. ABELMOSCHUS Medik.

Erect herbs, undershrubs or trees; stems stellate-hairy or prickly. Leaves palmately lobed or parted, often hastate or sagittate or with pinnately lobed or parted segments without any extrafloral nectaries. Flowers solitary, axillary or in terminal racemes by reduction of upper leaves; pedicels not jointed. Epicalyx lobes 4 - 16, usually free, rarely connate at base, persistent or not. Calyx irregularly 2 or 3-lobed, spathaceous, lobed or toothed, split on one side at base, dropping together with corolla. Corolla large, mostly yellow with a dark purple centre, sometimes creamy white or pink. Staminal column not exerted, antheriferous throughout. Ovary (4- or)5-loculed; ovules many; style 1, distally 5-armed; stigmas cushion-like, discoid. Capsules ovoid to oblong or cylindrical, mucronate, dehiscent loculicidally with longitudinal slits towards base; seeds numerous in each locule, reniform.

Old World tropics, 15 species, 6 in India and 5 in Kerala.

Literature: Arora, R.K. & Singh, H.B. 1973. *Abelmoschus tuberculatus* and its relation to *A. esculentus* (Malvaceae). *Baileya* 19: 90. Bates, D.M. 1968. Notes on the cultivated *Malvaceae* 2. *Abelmoschus*. *Baileya* 16: 99 - 112. Chandra, S. & Bhatnagar, S.P. 1975. Reproductive biology of *Abelmoschus esculentus* 1. Reproductive behaviour, floral morphology, anthesis and pollination mechanism. *Acta Bot. Ind.* 3: 104 - 113.

Key to species

- | | | |
|-----|---|-------------------------|
| 1a. | Epicalyx lobes 6 - 16 | 2 |
| b. | Epicalyx lobes 4 - 6 | 3 |
| 2a. | Epicalyx lobes 10 - 16, 2 - 5 cm long | 2. <i>A. erinitus</i> |
| b. | Epicalyx lobes 6 - 10, 1 - 1.5 cm long | 4 |
| 3a. | Epicalyx lobes 1 - 2.5 x 0.5 - 1 cm, free, shorter than capsule | 4. <i>A. manihot</i> |
| b. | Epicalyx lobes 2 - 3 x 1 - 2 cm, connate at base, as long as or longer than capsule | 1. <i>A. angulosus</i> |
| 4a. | Capsules ovoid to oblong, to 8 cm long | 5. <i>A. moschatus</i> |
| b. | Capsules fusiform, to 25 cm long | 3. <i>A. esculentus</i> |

1. *Abelmoschus angulosus* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 53. 1834; Wight, Icon. Pl. Ind. Orient.: t. 951. 1846; Manilal & Sivar., Fl. Calicut: 49. 1982; Manilal, Fl. Silent Valley: 25. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 59. 1988; Vajr., Fl. Palghat: 77. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 301. 1993; Sivar. & Pradeep, Malvac. S. India: 46. 1996; Sivar. & P. Mathew, Fl. Nilambur: 76. 1997. *Hibiscus angulosus* (Wall. ex Wight & Arn.) Steud., Nomencl. Bot. ed. 2, 1: 758. 1840; Mast. in Hook.f., Fl. Brit. India 1: 341. 1874; Rama Rao, Fl. Pl. Travancore: 42. 1914; Dunn in Gamble, Fl. Madras: 97(70). 1915. *H. setinervis* Dunn in Bull. Misc. Inform. 1914: 324. 1914 & Gamble, Fl. Madras: 97(69). 1915.

Herb or undershrub, ca 3 m high; young branches with simple or stellate and scattered bulbous-based hairs. Leaves elliptic-orbicular, cordate at base, crenate-serrate or subentire at margin, 5 - 15 cm across, 3 - 7-lobed, membranous or coriaceous; petioles longer than lamina; stipules ca 12 x 4 mm. Flower solitary; pedicel ca 8 cm long. Epicalyx 4- or 5-parted; lobes 2 - 3 x 1 - 2 cm. Calyx ca 3 cm long, membranous, hairy. Corolla yellow with a dark violet centre, sometimes

white, pink, mauve or pale red; petals obovate, ca 6 x 8 cm, glabrous. Staminal column ca 2 cm long, glabrous; filaments 0.5 - 1 mm long. Ovary ovoid, hispid, styles 5-armed. Capsules ovoid-oblong, acute to acuminate, 3 - 4.5 x 1.5 - 2 cm, densely hispid; seeds globose, 3 - 4 mm, blackish with concentric rings of minute hairs.

Fl. & Fr.: Almost throughout the year.

Habitat: Exposed slopes, 1500 - 2700 m, common.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thrissur and Wynad. Gujarat, Maharashtra and Tamil Nadu. Indonesia, Sri Lanka and Vietnam.

Note: Sivarajan and Pradeep (*Rheedea* 4: 1 - 12, 1994) reinstated 3 varieties earlier recognized by Thwaites (*Enum. Pl. Zeyl.*: 26, 1858) viz., var. *angulosus*, var. *grandiflorus* and var. *purpureus* with white, yellow and pink flowers respectively.

2. *Abelmoschus crinitus* Wall., Pl. Asiat. Rar. 1: 39, t. 44, 1830; Borss. Waalk. in Blumea 14: 103, 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 302, 1993; Sivar. & Pradeep, Malvac. S. India: 61, 1996. *Hibiscus crinitus* (Wall.) G. Don, Gen. Hist. 1: 380, 1831. *H. cancellatus* Roxb., Fl. Ind. 3: 201, 1832, non L.f. 1782; Mast. in Hook.f., Fl. Brit. India 1: 342, 1874.

Erect, perennial herb, ca 1.5 m high with fusiform tuberous taproot; young branches, petioles and pedicels simple- and stellate- hairy, glabrescent later. Leaves palmately 5 - 7-lobed or -parted, 5 - 8 cm across, cordate at base; lobes triangled-oblong, dentate-serrate at margin, acute or slightly acuminate at apex, hirsute on both surfaces; petioles 1 - 12 cm long; stipules linear-filiform, 1 - 3 cm long, stellate and simple-hairy. Flowers solitary or in terminal racemes by reduction of upper leaves. Epicalyx lobes 10 - 16, linear, 2 - 5 cm long, ciliate at margin, sparsely stellate-hairy; pedicels ca 2.5 cm long, accrescent. Calyx spathaceous, 2 - 5 cm long, densely puberulous outside, sparsely sericeous inside. Corolla ca 6 cm across, yellow with a purple centre; petals broadly obovoid, 4 - 9 x 2 - 4 cm, glabrous. Staminal column ca 2 cm long, glabrous, antheriferous throughout. Ovary ovoid, ca 10 x 5 mm; stylar branches ca 4 mm long; stigmas globose, purple. Capsules ovoid-globose, short-acuminate, 2 - 4 x 2 - 3 cm, hirsute; seeds reniform or globose, ca 4 mm across with concentric rings of hairs, rarely glabrous.

Fl. & Fr.: July - Dec.

Habitat: Drier areas in deciduous forests, rare.

Distrib.: Kannur (Sivarajan & Pradeep, *l.c.*). Throughout India. South and SE. Asia.

3. *Abelmoschus esculentus* (L.) Moench, *Methodus*: 617. 1794; Manilal & Sivar., *Fl. Calicut*: 44. 1982; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 385. 1993. *Hibiscus esculentus* L., *Sp. Pl.*: 696. 1753; Mast. in Hook.f., *Fl. Brit. India* 1: 341. 1874; Rama Rao, *Fl. Pl. Travancore*: 42. 1914; Dunn in Gamble, *Fl. Madras*: 99(71). 1915.

Mal.: *Venda*

Erect herb or undershrub; stems green or purplish, covered with stiff simple hairs. Leaves orbicular, cordate at base, 3 - 20 x 5 - 25 cm, palmately 3 - 7-lobed or -parted; lobes 3-angled, ovate or oblong, serrate-dentate or crenate at margin, acute to acuminate at apex, covered with stiff simple hairs on both surfaces; petioles 5 - 30 mm long, hairy; stipules ovate-lanceolate, 3 - 7 x 1 - 3 mm, hairy. Flower axillary, solitary. Epicalyx lobes 7 - 10, lanceolate, acute at apex, 15 - 20 x 5 - 8 mm, sparsely hairy. Calyx spathaceous, ca 3 cm across, hairy on both sides. Corolla yellow with a red or purple centre, ca 5 cm across; petals obovate, rounded at apex, ca 5 x 6 cm, glabrous or sparsely hairy at margin. Staminal column ca 2 cm long, white. Ovary ovoid, ca 7 x 8 mm, densely sericeous, 5- or 6-loculed; styles 5- or 6-armed; stigmas discoid, purple. Capsules cylindrical, 5-angled, acuminate at apex, 10 - 25 cm long, hairy; seeds globose, glabrous, sometimes pubescent near hilum, dark brown.

Fl. & Fr.: Throughout the year.

Cultivated in kitchen gardens, agricultural farms etc. throughout Kerala. Cultivated in most tropical countries.

4. *Abelmoschus manihot* (L.) Medik., *Malvenfam.*: 46. 1787; Hochr. in *Candollea* 2: 87. 1924; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 59. 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 77. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 58. 1996; Sivar. & Pradeep, *Malvac. S. India*: 67. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 96. 1997. *Hibiscus manihot* L., *Sp. Pl.*: 696. 1753; Mast. in Hook.f., *Fl. Brit. India* 1: 342. 1874; Dunn in Gamble, *Fl. Madras*: 97(69).

1915. *H. tetraphyllus* Roxb. ex Hornem., Hort. Bot. Hafn.: 661. 1815; Mast. in Hook.f., Fl. Brit. India 1: 341. 1874. *H. pungens* Roxb., Fl. Ind. 3: 213. 1832; Mast. in Hook.f., Fl. Brit. India 1: 341. 1874. *Abelmoschus manihot* (L.) Medik. var. *pungens* (Roxb.) Hochr. in Candollea 2: 87. 1924; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 307. 1993. *A. manihot* (L.) Medik. subsp. *manihot*: Borss. Waalk. in Blumea 14: 96. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 304. 1993. *A. manihot* (L.) Medik. subsp. *tetraphyllus* (Roxb. ex Hornem.) Borss. Waalk. in Blumea 14: 47. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 307. 1993.

Undershrub or shrub, ca 3 m high; stems glabrous or hispid with simple, bulbous-based and stellate hairs. Leaves orbicular to ovate, highly variable, 3 - 7-lobed, very rarely entire or 3 - 5-angled, cordate or hastate at base, 5 - 25 cm across; lobes variable, ovate, obovate or oblong, dentate or serrate at margin, glabrous or simple- and stellate-hairy on both surfaces; petioles 3 - 20 cm long, hairy above; stipules linear or lanceolate, acute or acuminate at apex, ca 2.5 x 1 cm, glabrous or stellate-hairy. Flowers axillary, solitary or in terminal racemes by reduction of upper leaves; pedicels 1 - 4 cm long, hispid. Epicalyx lobes 4 - 6, sometimes 8, free, ovate or oblong, ca 2.5 x 1 cm, tomentose with simple and 2-armed stellate hairs. Calyx spathaceous, ca 2.5 x 1.5 cm, velutinous-tomentose outside, sericeous inside. Corolla yellow with a purple centre, ca 5 cm across; petals obovate or orbicular, 4 - 7.5 x 3 - 5 cm, glabrous. Staminal column to 3 cm long, glabrous, yellow, antheriferous throughout. Ovary ovoid, ca 3 x 2 mm; styles yellow or white; stigmas hairy. Capsules oblong-ovoid, 5-gonous, 3 - 7 x ca 2 cm, with 5 prominent costae, stellate-tomentose; seeds globose to reniform, stellate-hairy in concentric rings, brown or black.

Fl. & Fr.: July - March.

Habitat: Cultivated and runs wild in fallow fields and open deciduous forests.

Distrib.: Ernakulam, Idukki, Kannur, Kollam, Kozhikode, Malappuram, Pathanamthitta, Thiruvananthapuram and Thrissur. Most states in India. South-east Asia to Australia.

Note: Borssum Waalkes (*l.c.*) recognized 2 subspecies, viz., *manihot* comprising all cultivated forms and *tetraphyllus* comprising wild ones. Several cultivars are there in subsp. *manihot*. Subspecies *tetraphyllus* is again divided into 2 varieties based on the indumentum on the margin of the epicalyx lobes. Paul (*l.c.*) also

followed this treatment. Sivarajan and Pradeep (*l.c.*), however, considered this separation untenable.

Uses: Juice of fresh plant is used as a febrifuge and expectorant. Stem yields a fibre. Seed is aromatic and serves as a stimulant and antispasmodic. Seed is used in drinks against fever and gonorrhoea; used in stomach disorders and snakebite. Flower being showy, the plant is cultivated.

5. *Abelmoschus moschatus* Medik., Malvenfam.: 46. 1787; Nicolson & al. in *Regnum Veg.* 119: 170. 1988; Vajr., *Fl. Palghat*: 77. 1990; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 305. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 77. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 88. 1996; Sivar. & Pradeep, *Malvac. S. India*: 70. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 77. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 96. 2002. *Hibiscus abelmoschus* L., *Sp. Pl.*: 696. 1753; Mast. in Hook.f., *Fl. Brit. India* 1: 342. 1874; Rama Rao, *Fl. Pl. Travancore*: 42. 1914; Dunn in Gamble, *Fl. Madras*: 97(69). 1915.

Mal.: *Kattukasthuri*

Herb or undershrub, to 3 m high; stems erect, hirsute throughout with simple or stellate hairs. Leaves variable in size and shape, 3 - 5-lobed, hastate or sagittate at base; upper ones with narrow, 3-angled to ovate or even obovate segments with acuminate apex, serrate at margin, simple-hairy above, stellate-hairy beneath; segments of the lowermost orbicular or elliptic; stipules 5 - 10 mm long, hairy. Flower axillary, solitary; pedicel 1.5 - 6 cm long, not jointed, accrescent to 15 cm in fruit, hispid. Epicalyx lobes 7 - 10, free, subulate, 10 - 12 x 1.5 - 2 mm, persistent in fruit, hispid. Calyx 1.5 - 3 cm long, splitting on one side, stellate-tomentose outside, sericeous inside. Corolla ca 10 cm across, bright yellow with a dark purple centre; petals obovate, rounded at apex, fleshy and ciliate at base. Staminal column ca 1.5 cm long, glabrous, antheriferous throughout. Ovary ovoid, 6 - 7 mm long, densely sericeous, hairy at apex; stylar branches 5, glabrous; stigmas hairy, purple. Capsules fusiform, 4 - 8 x 2 - 3 cm, hispid with simple hairs; seeds reniform, 3 - 4 mm, concentrically ribbed, glabrous or minutely stellate-hairy, often musk-scented.

Fl.: July - Oct. *Fr.*: Oct. - Dec.

Habitat: Deciduous forest slopes.

Distrib.: Idukki, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad,

Pathanamthitta, Thiruvananthapuram and Thrissur. Sometimes cultivated. Throughout India. South and SE. Asia and the Pacific Islands.

Uses: Juice of fresh plant is a febrifuge and expectorant. Stem yields a fibre. Seed is stimulant, aromatic, carminative, used in debility, gonorrhoea and in snakebite. 'Ambrette seed oil' is extracted from crushed seed and used in high grade perfumery.

Excluded species

Abelmoschus ficulneus (L.) Wight & Arn. was reported to occur in Kerala (Paul, *l.c.*: 304). Rama Rao (*l.c.*) also mentioned without specifying a locality. But then, there is no specimen from Kerala (also *vide* Sivarajan & Pradeep, *l.c.*: 65 & 67).

9. FIORIA Mattei

Perennial herbs or undershrubs, sparsely to densely pubescent with simple glandular and stellate hairs. Leaves broadly obovate to orbicular, entire or 3-5-lobed. Flowers solitary, axillary or seemingly in racemes by reduction of upper leaves. Epicalyx lobes 7-12, linear, free. Calyx 5-lobed. Corolla yellow with a purple centre. Petals obovate. Staminal column shorter than petals, antheriferous almost throughout. Ovary ovoid, 5-angled, 5-loculed; stigmas clavate. Capsules globose, shorter than calyx with 5 strongly nerved wings; seeds 2-4 in each locule, reniform, verruculose, glabrous.

Tropics and subtropics, 4 species and 1 in India.

Literature: Abedin, S. 1977. Taxonomic notes on *Fioria* Mattei and *Thespesia* Sol. ex Corr. from Pakistan. *Pakistan J. Bot.* 9: 59-66. Kundu, B.C. & Biswas, C. 1977. On *Fioria vitifolia* (L.) Mattei. *Bull. Bot. Surv. India* 16: 125-138.

Fioria vitifolia (L.) Mattei in Boll. Reale Orto. Bot. Giardino Colon. Palermo N.S. 2: 71. 1916; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 310. 1993. *Hibiscus vitifolius* L., Sp. Pl.: 696. 1753; Mast. in Hook.f., Fl. Brit. India 1: 338. 1874; Rama Rao, Fl. Pl. Travancore: 41. 1914; Dunn in Gamble, Fl. Madras: 98(70). 1915; Borss. Waalk. in Blumea 14: 59. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 166. 1972; Nicolson & al. in Regnum Veg. 119: 172. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 79. 1994; Sivar. & Pradeep, Malvac. S. India: 75. 1996; Sivar. & P. Mathew, Fl. Nilambur: 86. 1997.

Mal.: *Kuttuvellurem Velipparuthi, Vella-ooral*

Herb or undershrub, 1 - 2 m high; stems erect, pubescent with simple, glandular and stellate hairs. Leaves broadly ovate to orbicular, subcordate to rounded at base, serrate or dentate at margin, entire or 3 - 5-lobed, acute at apex, 2.5 - 15 x 2 - 12 cm, sparsely stellate-hairy on both surfaces; petioles 2 - 13 cm long; stipules linear, 2 - 4 mm long. Flower solitary, axillary; pedicel 1 - 6 cm long, jointed, accrescent. Epicalyx lobes 7 - 12, linear, 6 - 12 x ca 0.5 mm, erect when young, ultimately spreading or reflexed, hairy. Calyx campanulate, ca 4 mm across, 5-lobed; lobes ovate to deltoid, 5 - 15 x 6 - 10 mm, glandular-hairy outside, glabrous inside. Petals obovate, obtuse or rounded at apex, 2.5 - 5 x 1 - 3 cm, yellow, dark purple at base. Staminal column ca 2 mm long, 5-toothed and glandular-hairy at apex. Ovary ovoid, 5-angled, ca 3 mm long; stylar branches 5, glandular-hairy, purple; stigmas 5, capitate, glandular-hairy, purple. Capsules globose-depressed, shorter than calyx, 5-winged; wings bristly; beaks ca 3 mm long; seeds 2 - 4 in each locule, reniform, 2 - 3 mm across, verruculose, glabrous, brownish black.

Fl. & Fr.: April - Dec.

Habitat: Weed on roadsides and in wastelands, sometimes undergrowth in semievergreen and deciduous forests, to 1500 m.

Distrib.: Almost throughout Kerala. Throughout India. Africa, Pakistan, Sri Lanka, SE. Asia to Australia.

Use: Stem yields a fibre.

Note: This species earlier kept in *Hibiscus* is now placed in *Fioria* on the basis of the fruit having conspicuously scarious and strongly nerved wings.

10. GOSSYPIUM L.

Undershrubs, shrubs or rarely small trees, all parts irregularly dotted with black oil glands. Leaves palmately lobed, sometimes entire, usually with broad nectaries on midnerve beneath; petioles sometimes 4-angled; stipules subulate or falcate. Flower solitary, axillary, large, showy; pedicel not jointed, usually with 3 nectaries below epicalyx. Epicalyx lobes 3, free or connate at base, foliaceous, cordate, entire or deeply parted. Calyx campanulate, shorter than epicalyx, truncate to 5-dentate or lobed, prominently punctate, persistent. Corolla campanulate or funnel-shaped, yellow to white, sometimes red to purple with a deep purple centre, gland-dotted. Staminal column included, antheriferous throughout. Ovary

3 - 5-loculed; ovules many in each locule; style 1, short; stigma clavate, 5-sulcate. Capsules ovoid to subglobose, rarely fusiform, acute or acuminate, 3 - 5- loculed; seeds many, ovoid to obovoid, densely covered with unicellular convoluted hairs springing from seed coat; hairs white to brownish.

Tropics and subtropics, 39 species and 4 in India.

Literature: Banerji, I. 1929. Studies in cotton pollen. *Agric. J. India* 24: 332 - 340. Brizicky, G.G. 1967. Nomenclatural notes on *Gossypium*. *J. Arnold Arbor.* 48: 152 - 158. Fryxell, P.A. 1968. A redefinition of the tribe *Gossypieae*. *Bot. Gaz. (Crawfordsville)* 129: 296 - 308. Fryxell, P.A. 1968. The typification and application of Linnean binomials in *Gossypium*. *Brittonia* 20: 378 - 386. Fryxell, P.A. 1969. A classification of *Gossypium* L. (*Malvaceae*). *Taxon* 18: 585 - 591.

Key to species

- | | | |
|-----|---|-------------------------|
| 1a. | Epicalyx lobes entire to serrate | 2 |
| b. | Epicalyx lobes lacinate | 3 |
| 2a. | Leaves with linear to lanceolate segments and an extra tooth in sinus; epicalyx lobes connate to 1 cm or more at base, entire or 3- or 4-toothed towards apex, closely embracing flower; capsules ovoid | 1. <i>G. arboreum</i> |
| b. | Leaves with ovate to oblong or elliptic lobes, without any extra tooth; epicalyx lobes connate at very base only, 7 - 9-toothed or -lobed at apex, not embracing flower; capsules rounded or oblong | 3. <i>G. herbaceum</i> |
| 3a. | Stipules auricled at base; capsules elongate | 2. <i>G. barbadense</i> |
| b. | Stipules not auricled; capsules globose | 4. <i>G. hirsutum</i> |

1. *Gossypium arboreum* L., Sp. Pl.: 693. 1753; Wight, Icon. Pl. Ind. Orient.: t. 198. 1838; Mast. in Hook.f., Fl. Brit. India 1: 347. 1874; Rama Rao, Fl. Pl. Travancore: 44. 1914; Nicolson & al. in Regnum Veg. 119: 170. 1988; Fryxell in Rheedeia 2: 146. 1992; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 387. 1993; Sivar. & Pradeep, Malvac. S. India: 27. 1996.

Mal.: *Panji, Paruthi*

Annual or perennial shrub, 1 - 3 m high; young branches pubescent with stellate and a few simple hairs, gland-dotted, glabrescent, purple. Leaves ovate to orbicular, cordate at base, palmately 3 - 5 or 7-lobed or -parted with an extratooth in sinus, 5 - 10 x 7 - 12 cm; lobes lanceolate, gland-dotted above, sparsely stellate-

hairy beneath with 1 - 3 nectaries on main nerves; petioles 3 - 8 cm long; stipules linear, often falcate, 0.5 to 1 cm long, sparsely stellate-hairy. Flower axillary, solitary; pedicel ca 2 cm long. Epicalyx lobes ovate, cordate at base, entire or toothed, acute at apex, 1.5 - 2.5 x 1 - 2 cm, accrescent. Calyx cupular, ca 4 mm long, somewhat 5-dentate at apex, glabrous. Corolla ca 7 mm across, yellow, sometimes brown; petals obovate, ca 4 x 3 cm, sparsely pubescent at margin. Staminal column ca 1.5 cm long, glabrous, antheriferous towards apex. Ovary ovoid or 3-gonous, ca 4 mm long; styles ca 2 mm long; stigmas linear. Capsules more or less globose, ca 3 cm, with 3 - 4 mm long beak, 3- or 4-loculed; seeds 5 - 17 per locule, ca 7 mm across, with floss and fuzz; floss white and rusty.

Key to varieties

- | | | |
|-----|--|-------------------------------|
| 1a. | Leaves palmately parted with linear to lanceolate segments | 1.1. var. arboreum |
| b. | Leaves palmately lobed; lobes obovate, ovate or oblong | 1.2. var. obtusifolium |

1.1. var. **arboreum**

Fl. & Fr.: April - June.

Cultivated as an ornamental. Kannur and Kozhikode (Sivarajan & Pradeep, *l.c.*). Most parts of India. Tropics and subtropics.

1.2. var. *obtusifolium* (Roxb.) Roberty in *Condollea* 13: 35. 1950; Borss. Waalk. in *Blumea* 14: 122. 1966. *G. obtusifolium* Roxb., *Fl. Ind.* 3: 183. 1832. *G. herbaceum* L. var. *obtusifolium* (Roxb.) Mast. in Hook.f., *Fl. Brit. India* 1: 437. 1874.

Fl. & Fr.: April - June.

Cultivated in all cotton growing areas in India.

Uses: Fibre is used for guncotton and as filter for atmospheric germs. Seed oil is used in rheumatism. Seed is used as a cattle feed.

2. *Gossypium barbadense* L., *Sp. Pl.*: 693. 1753; Dunn in Gamble, *Fl. Madras*: 102(73). 1915; Borss. Waalk. in *Blumea* 14: 127. 1966; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 388. 1993; Sivar. & Pradeep, *Malav. S. India*: 27. 1996.

Mal.: *Paruthi*

Erect shrub, 3 - 4 m high; stems sparsely stellate-pubescent or glabrate, gland-dotted. Leaves ovate-orbicular, 7 - 18 cm long, cordate at base, 3 - 7-lobed; lobes ovate-lanceolate, entire at margin, glabrous with a single elliptic nectary on midnerve beneath; petioles 10 - 20 cm long, glabrescent, gland-dotted; stipules falcate or lanceolate, 1 - 1.5 cm long, slightly auricled at base, glabrous. Flower axillary, solitary; pedicel ca 2 cm long, with nectaries just below epicalyx. Epicalyx lobes 3, ovate, cordate at base, 4 - 6 cm long, laciniate at margin, gland-dotted, accrescent. Calyx cupular, truncate at apex, gland-dotted. Corolla funnel-shaped, yellow; petals obovate, glabrous. Staminal column ca 2.5 mm long, glabrous, antheriferous above. Ovary ovoid, ca 8 cm long, gland-dotted, glabrous, 3-loculed; styles ca 2.5 cm long, glabrous; stigmas linear, decurrent. Capsules elongate, 3 - 6 cm long, glabrous; seeds subglobose, ca 7 mm across with white cotton.

Fl. & Fr.: April - June.

Kozhikode (Sivarajan & Pradeep, *l.c.*). Native to S. America, now cultivated throughout the world.

3. *Gossypium herbaccum* L., Sp. Pl.: 693. 1753; Mast. in Hook.f., Fl. Brit. India 1: 346. 1874; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 389. 1993.

Shrub or undershrub, 1 - 1.5 m high; young branches sparsely stellate-tomentose, glabrescent later. Leaves ovate-rounded, cordate at base, palmately 3 - 5 or 7-lobed, 5 - 10 cm long; lobes ovate-rounded or oblong-elliptic, acute and apiculate at apex; petioles 1.5 - 3.5 cm long; stipules linear to lanceolate, 0.5 - 1 cm long. Flower axillary, solitary; pedicel 0.6 - 1.5 cm long. Epicalyx lobes ovate, cordate, 1 - 2 cm across, slightly connate at base, laciniate, gland-dotted. Calyx cupular, undulate or truncate, 7 - 10 mm long. Corolla yellow with a purple centre; petals obovate, 2.5 - 3.5 x 2.5 - 4 cm. Staminal column ca 1 cm long, glabrous. Capsules oblong, obtuse, 3 - 4 x ca 2.5 cm; seeds 5 - 7 in each locule, ovoid, 5 - 8 x 3 - 6 mm, with greyish white floss and grey fuzz.

Fl. & Fr.: April - June.

Cultivated in W. India. Tropics and subtropics.

Note: Vide Hutchison (*Emp. Cott. Gr. Rev.* 27: 123. 1950) for cultivars.

4. *Gossypium hirsutum* L., Sp. Pl. ed. 2, : 975. 1763; T.K. Paul in B.D.

Sharma & Sanjappa, Fl. India 3: 389. 1993; Sivar. & Pradeep, Malvac. S. India: 32. 1996. *G. herbaceum* L. var. *hirsutum* (L.) Mast. in Hook.f., Fl. Brit. India 1: 347. 1874.

Mal.: *Paruthi*

Shrub or undershrub, 1 - 3.5 m high; stems much branched, greenish red, densely hairy or glabrous. Leaves more or less orbicular, 3 - 10 x 3 - 15 cm; lobes ovate to broadly 3-angled, acuminate at apex, acute, obtuse or rounded at sinuses, slightly thrown up in a fold or not; upper leaves sometimes ovate and entire; petioles 2 - 10 cm long; stipules lanceolate, often falcate, 6 - 12 x ca 2.5 mm. Flower axillary, solitary; pedicel 1 - 2 cm long. Epicalyx lobes broadly ovate, cordate at base, 2 - 4 x ca 1.3 cm, lacinate; teeth 7 - 12, linear to lanceolate. Calyx cupular, 5 - 6 x 4.5 - 5.5 mm, with 5 rounded acuminate segments; nectaries distinct on nerves. Corolla 5 - 6 cm across, yellow to yellowish white, rarely with a purple centre; petals obovate, 4 - 6 x 3.5 - 4.5 mm. Staminal column 1 - 2 cm long. Capsules ovoid, rarely globose, 3 - 4 x 2 - 3 cm, 3 - 5-loculed; seeds ovoid, 3 - 5 mm long, with a copious coat of floss and fuzz.

Fl. & Fr.: April - June.

Kozhikode (Sivarajan & Pradeep, *l.c.*). Cultivated on a large scale in Madhya Pradesh, Maharashtra, Punjab and Tamil Nadu and also introduced in most tropical countries. Tropical N. & S. America.

11. HIBISCUS L., nom. cons.

Annual or perennial herbs, shrubs or trees; branchlets erect or prostrate, stellate-tomentose, glabrate, scaly or prickly. Leaves simple, palmately lobed or parted, serrate-dentate or subentire, sometimes pinnately lobed, often with an obscure nectary or nectariferous zone on midnerve beneath; stipules subulate to linear, ovate or foliaceous. Flowers solitary, axillary or in terminal racemes or panicles by reduction of upper leaves. Epicalyx lobes 3 - many, free or connate, usually persistent, sometimes absent. Calyx 5-lobed or -parted, sometimes with nectaries, persistent. Corolla mostly large and showy, rotate, campanulate or cylindrical. Staminal column shorter than or as long as corolla, sometimes longer, wholly or partly (upper part) antheriferous, truncate or 5-toothed at apex. Ovary 5- or 10-loculed by 5 false septa with 3 or more ovules in each locule; style 1, distally 5-branched, spreading; stigmas usually discoid, sometimes capitate or indistinct.

Capsules 5- , sometimes 10-loculed by false septa, dehiscent loculicidally; seeds 3 - many in each locule, reniform, subglobose or obovoid, glabrous or hairy.

Tropics and subtropics, ca 300 species. 25 in India and 16 in Kerala.

Literature: Abedin, S. 1980. Critical notes on some *Hibiscus* species. *Pakistan J. Bot.* 12: 49 - 56. Anonymous, 1958. *Hibiscus*. *Bull. Lucknow Natl. Bot. Gard.* 5: 41. Bakhuizen van den Brink, R.C. 1968. Nomenclatural problems around *Hibiscus*. *Taxon* 17: 44 - 47. Bates, D.M. 1965. Notes on cultivated *Malvaceae*. 1. *Hibiscus*. *Baileya* 13: 56 - 130. Rakshit, S.C. & Kundu, B.C. 1972. Revision of the Indian species of *Hibiscus* (*Malvaceae*). *Bull. Bot. Surv. India* 12: 151 - 175.

Key to species

- 1a. Trees or woody climbers; capsules 10-loculed 2
- b. Herbs, undershrubs or erect shrubs; capsules 5-loculed 3
- 2a. Leaves unlobed; stipules foliaceous; epicalyx lobes connate at base 15. *H. tiliaceus*
- b. Leaves palmately 3 - 5-lobed; stipules not foliaceous; epicalyx lobes free 7. *H. platanifolius*
- 3a. Stems bristly or prickly; epicalyx lobes forked at apex 4
- b. Stems neither bristly nor prickly; epicalyx lobes not forked 5
- 4a. Epicalyx lobes with an appendage inside 6
- b. Epicalyx lobes without an appendage 15
- 5a. Staminal column longer than corolla, antheriferous above 7
- b. Staminal column shorter than corolla, antheriferous throughout 8
- 6a. Stipules foliaceous 13. *H. surattensis*
- b. Stipules not foliaceous 9
- 7a. Petals entire 9. *H. rosa-sinensis* (cult.)
- b. Petals lacinate 10. *H. schizopetalus* (cult.)
- 8a. Epicalyx not well developed, ca 1 mm long, caducous 4. *H. lobatus*
- b. Epicalyx lobes well developed, 0.3 - 1.5 cm long, persistent 10
- 9a. Plant a rambler; calyx lobes broadly lanceolate 3. *H. hispidissimus*
- b. Plant an erect undershrub; calyx lobes ovate to deltoid 8. *H. radiatus*
- 10a. Seeds hairy 11
- b. Seeds glabrous 12
- 11a. Shrub; corolla more than 4 cm across 14. *H. syriacus*
- b. Herb or undershrub; corolla less than 3 cm across 2. *H. hirtus*

- | | | |
|------|---|--------------------------------|
| 12a. | Calyx inflated in fruit; lobes distinctly many-nerved | 13 |
| b. | Calyx not inflated in fruit; lobes with indistinct nerves | 5. <i>H. lunariifolius</i> |
| 13a. | Herbs; capsules oblong; seeds glabrate | 14 |
| b. | Shrub; capsules subglobose; seeds hairy | 6. <i>H. mutabilis</i> (cult.) |
| 14a. | Styles branched only at apex | 11. <i>H. sreenarayananus</i> |
| b. | Styles branched nearly in middle | 16. <i>H. trionum</i> |
| 15a. | Stigmas hairy | 1. <i>H. acetocella</i> |
| b. | Stigmas glabrous | 12. <i>H. sabdariffa</i> |

1. *Hibiscus acetocella* Welw. ex Hiern, Cat. Afr. Pl. 1: 73. 1876; Borss. Waalk. in Blumea 14: 59. 1966; Sivar. & Pradeep, Malvac. S. India: 101. 1996.

Mal.: *Pulivenda*

Erect, branched subshrub, 1.5 - 2 m high. Leaves 3 - 5-parted, ovate or orbicular, truncate at base; lobes lanceolate, crenate-serrate at margin, acute or subobtuse at apex, 2 - 7 x 2 - 6 cm, glabrous, with a nectary at base of midnerve; petioles 2 - 8 cm long, reddish; stipules lanceolate, 5 - 10 mm long, glabrous. Flowers solitary, axillary or, 3 or 4 together in clusters; pedicels ca 6 mm long, accrescent to 10 mm, jointed in middle. Epicalyx lobes 8 - 10, spatulate, 2-furcate, 1 - 1.5 cm long, ciliate at margin. Calyx campanulate, 5-lobed, reddish; lobes ovate-lanceolate, 5 - 7 x 1.5 - 3 mm, with hairy marginal costae. Corolla ca 6 cm across, red with a purple centre; petals obliquely obovate, rounded at apex, 3 - 4 cm long, glabrous except glandular-hairy base inside. Staminal column antheriferous throughout. Ovary ovoid, ca 3 x 4 mm, hairy; styles 5-lobed; stigmas discoid, hairy, purple. Capsules ovoid, acuminate at apex, ca 2 x 1.5 cm, hairy; seeds reniform, scabridulous, dark brown.

Fl. & Fr.: Most part of the year.

Cultivated in gardens. Kozhikode (Sivarajan & Pradeep, *l.c.*). Africa, America and Malesia.

2. *Hibiscus hirtus* L., Sp. Pl.: 694. 1753; Mast. in Hook.f., Fl. Brit. India 1: 335. 1874; Rama Rao, Fl. Pl. Travancore: 41. 1914; Dunn in Gamble, Fl. Madras: 97(70). 1915; Nicolson & al. in Regnum Veg. 119: 170. 1988; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 329. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 79. 1994; Sivar. & Pradeep, Malvac. S. India: 94. 1996.

Herb or undershrub, 1 - 1.5 m high; stems erect, pubescent with simple stiff minute stellate hairs. Lower leaves ovate, rounded or cuneate at base, crenate-serrate or irregularly toothed at margin, acute to acuminate at apex, 3 - 6 x 2 - 3 cm, 3 - 5-nerved at base, often with an oblong nectary on midnerve beneath, minutely pubescent with stellate hairs; petioles 0.5 - 1.5 cm long, with long stellate and simple hairs; stipules linear, 2 - 8 mm long, ciliate. Flowers axillary, solitary or seemingly in racemes or panicles by reduction of upper leaves; pedicels longer than petioles, 0.5 - 2 cm, accrescent to 5 cm, jointed below or above middle, pubescent. Epicalyx lobes 6 - 9, free, lanceolate to linear or subulate, acute, 3 - 8 x 0.5 - 1 mm. Calyx ca 1.5 cm across, 5-fid or -parted; lobes divided nearly to base, linear-lanceolate, hairy, persistent. Corolla rotate, pink or white; petals obovate, 1 - 1.5 x 0.5 - 0.8 mm, rounded at apex. Staminal column shorter than or as long as petals. Ovary subglobose, ca 2 mm across; stigmas capitate. Capsules globose, 7 - 10 mm, shorter than calyx; seeds 2 or 3 in each locule, reniform, ca 2 mm across, densely covered with long wooly hairs.

Fl. & Fr.: Nov. - June.

Habitat: Moist deciduous forests, frequent.

Distrib.: Kottayam, Kozhikode, Malappuram and Thiruvananthapuram. Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Orissa, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh and W. Bengal. Malesia.

3. *Hibiscus hispidissimus* Griff., Not. Pl. Asiat. 4: 521. 1854; Pradeep & Sivar, in Taxon 40: 634. 1991; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 78. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 59. 1996; Sivar. & Pradeep, Malvac. S. India: 106. 1996; Sivar. & P. Mathew, Fl. Nilambur: 82. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 96. 2002. *H. furcatus* Roxb. ex DC., Prodr. 1: 449. 1824, non Willd. 1809; Mast. in Hook.f., Fl. Brit. India 1: 335. 1874; Rama Rao, Fl. Pl. Travancore: 40. 1914; Dunn in Gamble, Fl. Madras: 97(70). 1915. *H. aculeatus* Roxb., Fl. Ind. 3: 20. 1832, non Walter 1788; T.K. Paul & M.P. Nayar in Bull. Bot. Surv. India 22: 194. 1980 & Fasc. Fl. India 19: 123. 1988; Maniial, Fl. Silent Valley: 26. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 60. 1988; Vajr., Fl. Palghat: 79. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 323. 1993.

Mal.: Kalapoo, Neiringampuli, Panichakamm, Uppanacham

Rambling undershrub with stiff sharp recurved to 1 mm long prickles with glandular base and simple hairs. Leaves palmately 3 - 5-lobed, rarely entire, cordate at base, 3 - 7 x 2.5 - 7.5 cm; lobes crenate, dentate or crenate-serrate at margin, 5 - 7-nerved at base with stiff prickles on main nerves beneath; petioles 2 - 8 cm long, prickly; stipules ovate-lanceolate, acute, 4 - 13.5 x 2 - 3 mm, hirsute, ciliate at margin. Flower axillary, solitary, 5 - 10 cm across; pedicel 1.5 - 7 cm long, jointed above middle, prickly. Epicalyx ca 2 cm long with 8 - 12 lobes divided at apex into 2 leafy portions, one ovate, the other long-projecting upwards, hairy. Calyx deeply 5-parted; lobes broadly lanceolate, acute or acuminate, 3-nerved, hispid outside with stiff bristles from glandular thick bases, soft-hairy at margin, accrescent, persistent. Corolla yellow with a purple centre; petals 5, obovate, rounded at apex, ca 5 x 4 cm, sparsely hairy at base. Staminal column with 5 conic teeth at tip, glabrous, antheriferous throughout. Ovary ovoid, ca 5 mm across, hairy; stigmas capitate, villous. Capsules ovoid, acute, ca 1.5 cm long, curved, with rigid deciduous hairs, enclosed in enlarged calyx; seeds more or less reniform, 4 - 5 mm across, sparsely covered with whitish scale-like structures, brownish.

Fl.: Sept. - Jan. *Fr.*: Nov. - Feb.

Habitat: Banks of rivers and streams, common.

Distrib.: Throughout Kerala, Andhra Pradesh, Assam, Bihar, Karnataka, Maharashtra, Meghalaya, Orissa, Tamil Nadu and W. Bengal. Africa, Bangladesh, Myanmar and Sri Lanka.

Uses: Stem yields a strong fibre suitable for cordage and rope. Decoction of root is used in kidney disorders, eye diseases and an anthelmintic.

4. *Hibiscus lobatus* (Murr.) Kuntze. *Revis. Gen. Pl.*: 19. 1898; Manilal, *Fl. Silent Valley*: 26. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 61. 1988; Vajr., *Fl. Palghat*: 79. 1990; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 336. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 51. 1996; Sivar. & Pradeep, *Malvac. S. India*: 125. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 83. 1997. *Solandra lobata* Murr. in *Commentat. Soc., Regiae Sci. Gott.* 6: 20, t. 1. 1785. *Hibiscus solandra* L'Her., *Stirp. Nov.* 1: 103, t. 49. 1788, nom. illeg.; Mast. in Hook.f., *Fl. Brit. India* 1: 336. 1874; Rama Rao, *Fl. Pl. Travancore*: 41. 1914; Dunn in Gamble, *Fl. Madras*: 98(70). 1915.

Annual, erect herb, 30 - 100 cm high; stems pubescent with short simple hairs and rarely mixed with stellate hairs. Leaves entire or 3 - 5-lobed; upper ones lanceolate to linear, occasionally lyrate, cordate, rounded or truncate at base, acute to acuminate at apex, 6 - 8 x 5 - 7 cm; lower ones 3-lobed; lobes ovate-lanceolate, sometimes linear, crenate or coarsely serrate at margin, obtuse, acute to acuminate at apex, ca 6 x 3 cm, pubescent with short simple and 3-brachiate stellate hairs, 3 - 5-nerved at base without any nectary; petioles 2 - 8 cm long, appressed with short simple hairs; stipules linear to filiform, 4 - 8 mm long, simple-hairy. Flowers axillary, solitary, rarely in racemes by reduction of upper leaves; pedicels 0.5 - 1 cm long, accrescent to 6 cm, with a joint ca 1 cm below flower. Epicalyx lobes 6 - 8, ca 1 mm long in bud, caducous. Calyx campanulate to rotate, 5 - 8 mm across, 5-fid to -parted; lobes deltoid to lanceolate, acute, 5 - 10 x 1 - 2 mm, accrescent to 1.2 x 0.3 cm, densely hispid with simple and gland-tipped hairs outside, glabrous inside, 3-nerved. Corolla 1 - 2 cm across, white or yellow; petals obovate, 10 - 15 x 6 - 10 mm, glabrous or nearly so. Staminal column 6 - 12 mm long, antheriferous except at base; filaments ca 0.2 mm long. Ovary ovoid, ca 3 mm across, sparsely glandular-hairy; styles glabrous; stigmas capitate, pale pink. Capsules oblong-ovoid, 10 - 15 mm long with 1 - 2 mm long rostrum and simple and 3-brachiate stellate hairs outside; valves smooth inside; seeds 3 or 4 in each locule, 1 - 3 mm across, irregularly prismatic, indistinctly tubercled, glabrous, black. *Fl. & Fr.*: July - Jan.

Habitat: Evergreen and moist deciduous forests, common.

Distrib.: Idukki, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Thrissur and Wynad. Throughout India. Central and SE. Asia, Madagascar and adjacent islands and tropical Africa.

5. *Hibiscus lunariifolius* Willd., Sp. Pl. 3: 811. 1800; Wight, Icon. Pl. Ind. Orient.: t. 6. 1838; Mast. in Hook.f., Fl. Brit. India 1: 338. 1874; Rama Rao, Fl. Pl. Travancore: 41. 1914; Dunn in Gamble, Fl. Madras: 98(70). 1915; Manilal, Fl. Silent Valley: 27. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 61. 1988; Vajr., Fl. Palghat: 79. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 334. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 59. 1996; Sivar. & Pradeep, Malvac. S. India: 138. 1996; Sivar. & P. Mathew, Fl. Nilambur: 53. 1997. *H. pruriens* Roxb. ex Hornem., Hort. Bot. Hafn. 1: 79. 1813.

Mal.: *Malankuruparutthi*

Herb or undershrub, 2 - 4 m high; stems erect, stellate- or simple-hairy, glabrescent later. Leaves orbicular to ovate, rarely lanceolate; lower leaves 3 - 5-lobed, cordate or rounded at base, coarsely serrate to dentate at margin, acute to acuminate at apex, 1 - 15 x 0.5 - 19 cm, sparsely or densely simple- and 3-brachiate-stellate-hairy on both surfaces; petioles 1 - 15 cm long, sparsely hairy; stipules subulate, ca 1.5 cm long, setaceous. Flowers axillary, solitary or in racemes by replacing upper leaves; pedicels 5 - 10 mm long, stout, not jointed, densely pubescent. Epicalyx lobes 5 - 10, usually 5, linear to narrowly lanceolate, alternating with calyx lobes, 10 - 20 x 1 - 2 mm, minutely hairy or glabrescent, persistent. Calyx campanulate, connate below middle with wide round sinuses in between; lobes obovate, rounded at apex, convolute, 6 - 9 x 3 - 6 cm, densely stellate-pubescent outside, glabrous inside. Corolla 6 - 10 mm across, yellow with a dark purple centre; petals obovate, stellate-pubescent outside, glabrous inside. Staminal column 1.5 - 3 cm long, antheriferous nearly throughout. Ovary ovoid-oblong, 5 - 7 mm long, pubescent; stigmas densely pubescent. Capsules obovoid, ca 2.5 x 2 cm with a rostrum of 3 - 5 mm long, densely stellate-hairy outside, glabrous inside, dehiscing into 5 valves; seeds numerous, reniform, ca 2.5 mm across, sparsely covered with minute stellate hairs, black.

Fl. & Fr.: Oct. - Jan.

Habitat: Margins of moist deciduous forests, to 1200 m.

Distrib.: Almost throughout Kerala. Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. Africa, Malesia and Myanmar.

6. *Hibiscus mutabilis* L., Sp. Pl.: 694. 1753; Mast. in Hook.f., Fl. Brit. India 1: 344. 1874; Borss. Waalk. in Blumea 14: 66. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 167. 1972; Nicolson & al. in Regnum Veg. 119: 171. 1988; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 390. 1993; Sivar. & Pradeep, Malvac. S. India: 148. 1996.

Mal.: *Chinapparathi*

Bushy shrub or small tree, 5 - 7 m high; younger parts dense with stellate or simple glandular hairs. Leaves suborbicular, cordate, 10 - 22 cm long, palmately 3 - 7-lobed; lobes 3-angled, coarsely dentate or irregularly crenate at margin, acute or long-acuminate at apex, densely stellate-pubescent above, glabrate or sparsely

stellate-pubescent beneath, 7–11-nerved at base; petioles 5–15 cm long, tomentose; stipules linear-lanceolate, 5–10 mm long, tomentose. Flowers axillary, solitary or in terminal subcorymbose racemes; pedicels 6–12 cm long, jointed 1–2 cm below apex. Epicalyx lobes 8–12, linear-lanceolate, 0.2–2.5 x 0.1–0.2 cm, bent down, eventually spreading. Calyx lobes connate to middle, ovate-lanceolate, acuminate, 3–4 x ca 1 cm, accrescent, densely stellate-pubescent with glandular hairs throughout above, densely stellate-hairy at margin inside and with long simple hairs in middle and base, 5-nerved, yellowish green. Corolla 10–15 cm across, white fading pink; petals 5 or multiples of 5, suborbicular, short-clawed, 6–8 cm long, sparsely stellate-hairy outside, glabrous inside with long stellate hairs at base. Staminal column shorter than corolla, white or yellowish white, antheriferous throughout. Ovary globose, truncate, ca 6 mm, white-silky-hairy, 5-loculed; ovules many in each locule. Capsules subglobose, emarginate, 2–2.5 cm long, densely covered with stellate, simple glandular and long setose hairs; seeds reniform, ca 2 mm long, dorsal and dorsolateral walls with radiating simple to 6-armed to 2 mm long hairs, brownish.

Fl. & Fr.: Sept.–Dec.

Native to China; cultivated throughout tropics.

Uses: Stem yields an inferior quality fibre. Leaf and flower are medicinal.

7. *Hibiscus platanifolius* (Willd.) Sweet, Hort. Brit. 1: 51. 1827; Dunn in Gamble, Fl. Madras: 98(70). 1915; Rakshit & Kundu in Bull. Bot. Surv. India 12: 160. 1972; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 338. 1993; Sivar. & Pradeep, Malvac. S. India: 128. 1996. *Pavonia platanifolia* Willd. in Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 4: 220. 1810. *Hibiscus collinus* Roxb., Fl. Ind. 3: 199. 1832; Mast. in Hook.f., Fl. Brit. India 1: 338. 1874; Rama Rao, Fl. Pl. Travancore: 41. 1914.

Small tree or shrub, 5–10 m high; young twigs pubescent; bark glabrous, greenish. Leaves orbicular, palmately 3–5-lobed with a semicircular furrow in between lobes, 8–15 x 5–12 cm; lobes elliptic, entire or irregularly toothed at margin, acute to acuminate at apex, 5–7-nerved at base, sparsely stellate-pilose above, densely stellate-pubescent particularly on nerves beneath; petioles 2.5–11 cm long, tomentose; stipules linear-lanceolate, 0.5–1 cm long. Flower axillary, solitary; pedicel 2–11 cm long, jointed near apex, hairy. Epicalyx lobes 5, 8 or 10,

foliaceous, lanceolate, acuminate, 12 - 18 mm long, stellate-pubescent. Calyx campanulate, ca 2.5 cm long; lobes connate below middle, ovate, oblong or lanceolate, acute with 1 prominent nerve, 2 - 3.2 x 0.6 - 0.9 cm, pubescent. Corolla pink with a deep purple centre, rarely yellow; petals obovate, 4 - 6 x 3 - 4 cm, hairy outside, glabrous inside. Staminal column 2 - 2.5 cm long, 5-toothed at apex, antheriferous throughout; filaments 2 - 4 mm long. Ovary ovoid, ca 5 mm across, pubescent; stigmas discoid, hairy, purple. Capsules globose-depressed, 2 - 3.5 cm, short-beaked, woolly-tomentose and densely setose, yellow, shining inside; seeds subglobose, glabrous, black.

Fl. & Fr.: Aug. - April.

Habitat: Deciduous and evergreen forests.

Distrib.: Alappuzha and Idukki. Andhra Pradesh, Karnataka, Maharashtra, Orissa, Tamil Nadu and W. Bengal. Nepal and Sri Lanka.

Use: Bark yields a strong fibre.

8. *Hibiscus radiatus* Cav., Diss. 3: 150, t. 54, f. 2. 1787; Mast. in Hook.f., Fl. Brit. India 1: 335. 1874; Borss. Waalk. in Blumea 14: 60. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 162. 1972; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 327. 1993; Sivar. & Pradeep, Malvac. S. India: 113. 1996.

Erect undershrub. 1 - 2 m high; stems occasionally with scattered bulbous-based retrorse prickles and long simple hairs, glabrescent later. Leaves palmately 3 - 5-lobed or -parted, cordate at base, 2 - 10 x 2 - 12 cm; lobes oblong to lanceolate, coarsely serrate-dentate at margin, 4 - 8 x 1 - 2.5 cm, glabrous or sparsely hairy on nerves beneath; petioles 2 - 15 cm long, sparsely aculeate or not, with a strip of short hairs above; stipules lanceolate, ca 1.5 cm long, bristly at margin. Flower axillary, solitary; pedicel 2 - 5 mm long, jointed above middle, aculeate. Epicalyx lobes 8 or 10, free, linear, acute, 10 - 15 x 1 - 2 mm, forked at tip, densely covered with bulbous-based bristles. Calyx ca 1.5 cm across, accrescent to 2.5 cm; lobes ovate to deltoid, acuminate at apex, 7 - 10 x 3 - 4 cm, bristly outside, glabrous inside. Corolla ca 6 cm across, yellow with a dark purple centre; petals obovate, 4 - 6 x 3 - 4.5 cm. Staminal column ca 2 cm long, antheriferous throughout. Ovary ovoid, ca 4 x 5 cm, densely hirsute; styles ca 2 cm long with 5 purple arms; stigmas capitate, purple. Capsules ovoid, beaked, ca 2.5 x 1.5 cm, densely bristly; seeds reniform, ca 4 mm across, scabridulous, brown.

Fl.: Aug. Feb. *Fr.*: Oct. Feb.

Cultivated in gardens; sometimes an escape.

Distrib.: Kozhikode, Malappuram and Thrissur. Native to E. India, Bangladesh and Myanmar.

9. *Hibiscus rosa-sinensis* L., Sp. Pl.: 694. 1753; Mast. in Hook.f., Fl. Brit. India 1: 334. 1874; Borss. Waalk. in Blumea 14: 72. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 105. 1972; Rama Rao, Fl. Pl. Travancore: 42. 1914; Manilal & Sivar., Fl. Calicut: 48. 1982; Nicolson & al. in Regnum Veg. 119: 171. 1988; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 391. 1993; Sivar. & Pradeep, Malvac. S. India: 122. 1996.

Mal.: *Chembarathi*

Shrub, to 4 m high; stems woody, glabrous. Leaves ovate to ovate-lanceolate, truncate or somewhat tapering at base, serrate, crenate or entire, sometimes somewhat dentate towards apex, acute to acuminate at apex, 5 - 11 x 3 - 6 cm, 3 - 5-nerved at base, glabrous to sparsely stellate-hairy on nerves beneath; petioles 1.5 - 4 cm long, simple-hairy; stipules lanceolate or subulate, 3 - 11 mm long, glabrous. Flower axillary, solitary; pedicel 2 - 8 cm long, jointed above middle, glabrous or pubescent. Epicalyx lobes 5 - 8, connate at base, lanceolate, 5 - 15 mm long, sparsely stellate-pubescent. Calyx campanulate, 1 - 3 cm long; lobes connate to middle, lanceolate, 1.5 - 2 cm long, stellate- and glandular-pilose outside. Corolla infundibular, 6 - 12 cm across, red; petals obovate, entire. Staminal column to 5 cm long, exserted beyond corolla, antheriferous in upper half. Capsules oblong-rounded (rarely formed).

Key to varieties

- | | | |
|-----|--|---------------------------------------|
| 1a. | Leaves entire at margin except dentate apex, coriaceous | 9.1. var. <i>liliflorus</i> |
| b. | Leaves serrate to dentate or crenate at margin, not coriaceous | 9.2. var. <i>rosa-sinensis</i> |

9.1. var. *liliflorus* Hochr. in Annuaire Conserv. Jard. Bot. Genève 4: 134. 1900; Borss. Waalk. in Blumea 14: 72. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 166. 1972; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 391. 1993.

Fl. & Fr.: Throughout the year.

Cultivated as an ornamental throughout tropics.

9.2. var. *rosa-sinensis*

Fl. & Fr.: Throughout the year.

Cultivated as an ornamental throughout tropics.

Uses: Leaf, flower and seed are medicinal. Flower is reported to possess contraceptive properties.

10. *Hibiscus schizopetalus* (Dyer) Hook. f. in Curtis, Bot. Mag. 3: 36, t. 6524. 1880; Borss. Waalk. in Blumea 14: 73. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 166. 1972; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 392. 1993. *H. rosa-sinensis* L. var. *schizopetalus* Dyer in Gard. Chron. N.S. 11: 568. 1879; Mast. in Gard. Chron. N.S. 12: 272, f. 45. 1879; Sivar. & Pradeep, Malvac. S. India: 123. 1996.

Mal.: *Kozhichemparuthi, Thoorkuchemurathi*

Shrub, 2 - 3 m high; stems woody; ends of branches pendulous, glabrous. Leaves ovate or elliptic, truncate or cuneate at base, serrate at margin, acute at apex, 2 - 8 x 1 - 4 cm, 3 - 5-nerved at base, glabrous; nectary inconspicuous; petioles ca 2 cm long, glabrous; stipules subulate, minute, caducous. Flower axillary, solitary, pendulous; pedicel 5 - 7 cm long, jointed in middle, minutely ciliate. Epicalyx lobes 6 or 7, subulate, 1 - 2 mm long, glabrous or minutely ciliate. Calyx tubular, spathaceous, 2 - 4-lobed at tip, ca 1.6 mm long, minutely ciliate outside, glabrous inside. Corolla 5 - 6 cm across, red with pink streaks; petals 4 - 7 cm long, deeply laciniate into many linear-oblong reflexed segments. Staminal column twice as long as petals, broader above, antheriferous in upper 1/3 - 1/4. Ovary pyriform, minutely hairy; style 1 - 1.3 cm long; stigmas capitate. Capsules oblong-cylindric, 3 - 4 cm long (rarely formed).

Fl. & Fr.: Throughout the year.

Native to E. tropical Africa; cultivated throughout tropics and subtropics.

11. *Hibiscus sreenarayanianus* Anilkumar & Ravi in Rheedeia 4: 129, f.1. 1994; Sivar. & Pradeep, Malvac. S. India: 144. 1996.

Annual, erect herb, ca 3 m high; stems covered with soft bristles and simple and stellate hairs. Leaves entire or shallowly 5-lobed, ovate to orbicular, deeply

cordate at base, 10 - 12 cm across; lobes 3-angled, dentate-serrate at margin, acute or acuminate at apex, glandular-punctate and stellate-pubescent beneath and nerves above; petioles 10 - 12 cm long, hairy; stipules linear, ca 5 mm long, bristly; upper leaves smaller, entire. Flowers axillary, solitary or in terminal racemes due to reduction of upper leaves; pedicels ca 5 cm long, jointed ca 1 cm below flower, hairy. Epicalyx lobes 8 - 10, linear-subulate, hairy, persistent. Calyx ca 1.5 cm long; lobes 3-angled, acuminate, 8 - 15 x 5 - 7 cm, simple- and stellate-hairy outside. Corolla yellow with a reddish brown centre; petals obovate to oblanceolate, obliquely cuneate at base, obtuse at apex, 3 - 5 x 2 - 3.5 cm. Staminal column ca 2 cm long, 5-toothed at apex, antheriferous throughout. Ovary orbicular or ovoid, pubescent; stigmas discoid, purple. Capsules orbicular-ovoid, enclosed in accrescent calyx, pubescent with a line of hairs on back; seeds reniform, glandular-papillose, brownish black.

Habitat: Coastal plains.

Distrib.: Kollam.

12. *Hibiscus sabdariffa* L., Sp. Pl.: 695. 1753; Mast. in Hook. f., Fl. Brit. India 1: 340. 1874; Rama Rao, Fl. Pl. Travancore: 41. 1914; Borss. Waalk. in Blumea 14: 64. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 162. 1972; Manilal & Sivar., Fl. Calicut: 47. 1982; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 391. 1993; Sivar. & Pradheep, Malvac. S. India: 114. 1996; Sivar. & P. Mathew, Fl. Nilambur: 34. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 97. 2002.

Mal.: *Poichchai, Polechi*

Unarmed, erect shrub, to 3 m high; stems glabrous or sparsely pubescent, green or reddish purple. Leaves 4 - 11 x 0.5 - 1.5 cm, polymorphic, entire or palmately 3 - 5-fid, -partite or -lobed; midlobe lanceolate or oblong, longer than the rest, cuneate at base, serrate at margin, acute at apex, glabrous; midnerve with a nectary at base beneath, reddish purple or green; petioles 2 - 8 cm long, green or reddish purple; stipules linear-subulate, ca 1.5 cm long. Flowers axillary, solitary or in racemose panicles by reduction of upper leaves; pedicels 1.5 - 2 cm long, jointed near base, glabrous. Epicalyx lobes 8 - 12, adnate to base of calyx, lanceolate to oblong-elliptic, green or purple, persistent. Calyx campanulate, 1.5 - 4 cm long, becoming fleshy after anthesis; lobes usually smooth or with a few bristles,

green or purple, 3-nerved with a nectary on midnerve, persistent. Corolla 4 - 5 cm across, yellow with a purple centre; petals orbicular, 4 - 5 cm, glabrous. Staminal column shorter than petals. Ovary ovoid, ca 3 mm across, appressed-hairy; stigmas glabrous. Capsules ovoid, ca 1.5 cm across, densely strigose; seeds reniform, furfuraceous.

Fl.: Jan. May *Fr.*: Aug. Sept.

Distrib.: Alappuzha, Idukki, Kollam, Kottayam, Kozhikode and Malappuram. Throughout India. Native to tropical Africa; cultivated throughout tropics, also an escape.

Uses: Stem yields a good fibre called rosella fibre which is a substitute for jute. Leaf is used as salad. Decoction of seed is administered in dyspepsia and debility.

Note: Two varieties viz., var. *altissima* Wester and var. *sabdariffa* are recognized based on the presence of bristles and hairs on the fleshy calyx (var. *altissima*) and absence of bristles and hairs (var. *sabdariffa*) and intensity of pigmentation. In var. *sabdariffa* 4 races are recognized in cultivation viz., *ruber*, *albus*, *intermedius* and *bhagalpurensis* (Howard & Howard, *Mem. Dept. Agric., India* 1911 & 1924).

13. *Hibiscus surattensis* L., Sp. Pl.: 696. 1753; Mast. in Hook.f., Fl. Brit. India 1: 334. 1874; Rama Rao, Fl. Pl. Travancore: 40. 1914; Dunn in Gamble, Fl. Madras: 97(70). 1915; Borss. Waalk. in Blumea 14: 57. 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 161. 1972; Manilal & Sivar., Fl. Calicut: 47. 1982; Nicolson & al. in Regnum Veg. 119: 172. 1988, sphalm.; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 61. 1988; Vajr., Fl. Palghat: 80. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 327. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 79. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 90. 1996; Sivar. & Pradeep, Malvac. S. India: 119. 1996; Sivar. & P. Mathew, Fl. Nilambur: 85. 1997.

Undershrub or shrub, erect initially, trailing later; stems, petioles, pedicels and main nerves of leaves with simple hairs and bulbous-based recurved prickles. Leaves suborbicular or ovate; lower ones palmately 3 - 5-lobed; upper ones palmately parted; lobes linear to lanceolate, shallowly cordate or truncate, crenate-serrate at margin, acute at apex, 3 - 7 x 4 - 12 cm, simple-hairy, stellate- or glabrous on both surfaces, 5 - 7-nerved at base; petioles 3 - 8 cm long; stipules

foliaceous, ovate, semilunar, auricled at base, serrate to dentate at margin, acute at apex, 5 - 25 x 6 - 15 mm, pubescent or glabrous. Flower axillary, solitary; pedicel 3 - 7 cm long, jointed near apex, densely hairy towards apex. Epicalyx lobes 10, spatulate, 15 - 20 x 2 - 5 mm, spreading with an erect filiform to linear appendage attached near apex, covered with scattered simple hairs. Calyx campanulate, deeply 5-partite; lobes ovate to deltoid, acuminate, 10 - 25 x 5 - 10 mm, hispid with recurved prickles and simple hairs outside, glabrous or nearly so inside, persistent. Corolla yellow with a deep purple centre; petals obovate, rounded at apex, 3 - 5 x 1.5 - 3 cm, sparsely stellate-pubescent at margin outside. Staminal column 0.5 - 1.5 cm long, glandular-hairy, antheriferous throughout; filaments 1.5 - 2 mm long, rarely 2-branched. Ovary conic, 3 - 5 mm long; style arms 2 - 2.5 mm long; stigmas discoid, hairy. Capsules ovoid, acute, ca 1.2 x 1 cm, covered with bristle-like shining white or yellow hairs; seeds 3 - 4 in each locule, angled, ca 3 mm long, with white scale-like emergences, blackish brown.

Fl.: Sept. - Oct. *Fr.*: Dec. - Feb.

Habitat: Coastal plains, to 1000 m.

Distrib.: Alappuzha, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Throughout India, Africa, Asia and Australia.

Uses: Stem yields a strong fibre of good quality. Leaf is used as salad. Decoction of leaf and stem is medicinal.

Note: Sivarajan and Mathew (*l.c.*) opined that Nicolson & al. (*l.c.*) erroneously concluded Rheede's *Narinam-poulli* as *H. surratensis* L. and that the tabula in question belongs to *H. hispidissimus* Griff.

14. *Hibiscus syriacus* L., Sp. Pl.: 695, 1753; Mast. in Hook.f., Fl. Brit. India 1: 344, 1874; Borss. Waalk. in Blumea 14: 75, 1966; Rakshit & Kundu in Bull. Bot. Surv. India 12: 170, 1972; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 393, 1993; Sivar. & Pradeep, Malvac. S. India: 88, 1996.

Erect, bushy shrub, 3 - 6 m high; young branches stellate-pubescent, glabrous later. Leaves deltoid-ovate to rhomboid- often 3-lobed, cuncate at base, coarsely toothed at margin, acute at apex, 4 - 7 x 2 - 5 cm, stellate-pubescent when young, glabrescent later; midnerve with a linear nectary at base beneath; petioles 1.2 - 2 cm long, puberulous; stipules filiform, 5 - 10 mm long, caducous. Flower axillary, solitary; pedicel as long as or shorter than petiole, stellate-hairy.

Epicalyx lobes 6 - 8, linear, ca 1.5 x 1 mm, sparsely stellate-hairy, with 1 prominent nerve. Calyx 12 - 20 mm long; lobes connate to middle, oblong or ovate-lanceolate, acute, ca 7 x 5 mm, sparsely stellate-hairy. Corolla 4 - 7.5 cm across, violet with a red centre; petals obovate, ca 4 x 2.5 cm, ciliate. Staminal column 2 - 4 cm long, 5-toothed at apex, antheriferous below, white or pale purple. Ovary ca 5 mm long, pubescent; styles filiform; stigmas globose, white-hairy. Capsules ovoid, obtuse or abruptly short-beaked, ca 2 x 1 cm, sparsely hispid; seeds reniform, pilose, brownish.

Fl. & Fr.: June - Oct.

Native to China; cultivated throughout India.

Uses: Stem yields a strong fibre. Bark, root and leaf and decoction of flower and seed are variously used in medicine.

15. *Hibiscus tiliaceus* L., Sp. Pl.: 694. 1753; Mast. in Hook.f., Fl. Brit. India 1: 343. 1874; Bourd., Forest Trees Travancore: 43. 1908; Rama Rao, Fl. Pl. Travancore: 43. 1914; Dunn in Gamble, Fl. Madras: 97(70). 1915; Manilal & Sivar., Fl. Calicut: 48. 1982; Nicolson & al. in Regnum Veg. 119: 172. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 79. 1994; Sivar. & Pradeep, Malvac. S. India: 91. 1996. *H. tiliaceus* L. subsp. *tiliaceus*: Borss. Waalk. in Blumea 14: 36. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 322. 1993.

Mal.: *Attuparuthi, Nirparathi, Olaparuthi, Pooparuthi, Veliparuthi*

Tree, 15 - 20 m tall; trunk with tough fibrous bark. Leaves orbicular, deeply cordate, rounded to truncate at base, entire or crenate at margin, acute to acuminate at apex, 3 - 12 cm, coriaceous with 1 - 5 linear nectaries on nerves beneath, glabrous above, stellate-tomentose beneath; petioles 1.5 - 10 cm long; stipules foliaceous, ovate to oblong, ca 2 x 1 cm, stellate-hairy outside, sericeous inside, caducous. Flowers axillary, solitary or in terminal racemes by reduction of upper leaves; pedicels 1 - 3 cm long, not jointed, sparsely stellate-hairy. Epicalyx cupular; lobes 7 - 10, deltoid, usually shorter than calyx, spreading and often splitting, stellate-hairy outside. Calyx campanulate; lobes 3-angled, 2 - 3 x 0.5 - 1 cm, with 3 prominent nerves and a nectary on midnerve and stellate-hairy outside, sericeous inside. Corolla campanulate, 6 - 8 cm across; petals obovate, rounded at apex, fleshy at base, yellow with a dark purple base finally turning red. Staminal column shorter than petals, glabrous, antheriferous throughout. Ovary ovoid, 5-

angled, ca 4 mm long, densely hairy; styles glandular-hairy; stigmas capitate. Capsules globose to ovoid, short-beaked, 1 - 2 cm across, sericeous or tomentose with simple and stellate hairs; pericarp thin; mesocarp fibrous; endocarp pergamentaceous; seeds 5 - 8 in each locule, reniform, papillose, blackish brown. *Fl. & Fr.*: Throughout the year.

Habitat: Along streams, rivers and backwaters.

Distrib.: Alappuzha, Ernakulam, Idukki, Kollam, Kottayam, Kozhikode, Thiruvananthapuram and Thrissur. Also cultivated. Tropical coasts.

Uses: Bark yields a dark strong fibre used for ropes and cordage. The fibre is more resistant to water than jute and sun hemp. Bark, root, leaf and flower have medicinal properties.

16. *Hibiscus trionum* L., Sp. Pl.: 697. 1753; Mast. in Hook.f., Fl. Brit. India 1: 334. 1874; Dunn in Gamble, Fl. Madras: 98(70). 1915; Rakshit & Kundu in Bull. Bot. Surv. India 12: 186. 1972; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 341. 1993; Sivar. & Pradeep, Malvac. S. India: 146. 1996.

Annual, erect or decumbent herb, 30 - 60 cm high; stems simple- and stellate-hairy. Lower leaves ovate or orbicular, entire or lobed, ca 3.5 x 2 - 4 cm; upper leaves palmately 3 - 5-lobed; midlobe longer, 2.5 - 7.5 cm long; lobes oblong, pinnatisect, punctate, sparsely simple- and stellate-hairy on both surfaces, sometimes nearly glabrous above; petioles ca 5 cm long, pubescent with simple and 2- or 3-brachiate stellate hairs; stipules subulate, 3 - 5 mm long, covered with long stiff hairs. Flower axillary, solitary; pedicel ca 4 cm long, jointed above middle, pubescent. Epicalyx lobes 8 - 12, linear, ca 10 x 15 mm, ciliate at margin, spreading upwards in fruit surrounding capsule. Calyx campanulate, inflated, covering capsule; lobes connate for about 1/3 down, broadly ovate, acute, 1 - 1.5 cm long, membranous, hispid with simple hairs on nerves inside, green eventually becoming purple, 4 - 6-nerved. Corolla 1 - 2.5 cm across, yellowish pink with a dark purple centre, hairy outside, glabrous inside; petals obovate, rounded at apex. Staminal column 5 - 8 mm long, glabrous, antheriferous above. Ovary ovoid, ca 4 mm long, densely hairy; styles 5, connate to middle. Capsules oblong, obtuse, 0.5 - 2 x 1 - 1.5 cm, hairy outside, shining inside, dehiscent longitudinally from tip; seeds reniform, ca 2 mm across, minutely tubercled or glabrate.

Fl. & Fr.: July - Jan.

Habitat: Disturbed areas in plains.

Distrib.: Kannur. Tropical and subtropical India. Afghanistan, Africa, Australia, China, Europe, Iran, Myanmar, Pakistan and USSR.

Use: An infusion of flower is used for curing skin diseases.

12. JULOSTYLIS Thwaites

Trees; stems stellate-tomentose. Leaves lanceolate, entire, lobed or angled, with or without abaxial foliar nectaries, puberulous. Panicles terminal. Epicalyx lobes 4-6, connate. Sepals 5, smaller than bracteoles, connate at base. Petals 5, connate below, longer than sepals, yellow with a purple base. Staminal tube 5-toothed at apex, antheriferous below middle. Ovary 2-loculed; styles 2 or 3-branched, connate at base; stigmas globose, large, woolly. Fruits globose, densely stellate-hairy, indehiscent; seeds oblong or reniform.

India and Sri Lanka, 3 species.

Key to species

- | | | |
|-----|---|----------------------------|
| 1a. | Stamens 10; epicalyx longer than calyx | 2 |
| b. | Stamens more than 10; epicalyx as long as calyx | 3. <i>J. polyandra</i> |
| 2a. | Leaves lanceolate, not lobed | 2. <i>J. angustifolia</i> |
| b. | Leaves suborbicular, usually lobed at apex | 1. <i>J. ampumalaensis</i> |

1. *Julostylis ampumalaensis* Pradeep & Sivar. in Bot. Bull. Acad. Sin. 34: 282. 1993; Sivar. & Pradeep, Malvac. S. India: 150. 1996.

Tree, 10 - 15 m tall; young branchlets, peduncles and pedicels stellate-tomentose. Leaves broadly ovate, rounded or truncate at base, obscurely serrulate or subentire, distally 3-lobed, acute or short-acuminate at apex, 5-16 x 4-11 cm, densely rusty-tomentose, 3-nerved at base with an ovate or elliptic nectary at base of midnerve beneath; petioles 2-3 cm long; stipules linear, 3-5 mm long, sparsely stellate-hairy, caducous. Flowers in terminal panicles; pedicels ca 1 cm long. Epicalyx lobes 5, connate at base, elliptic-obtuse, 10-13 x 5-6 mm, sparsely stellate-hairy, accrescent. Calyx 5-lobed; lobes divided to middle, ovate, acute, ca 6 x 2 cm, accrescent. Corolla ca 1 cm across, yellow with a purple centre; petals 5, obovate, cuneate at base, subobtuse at apex, ca 8 x 4 cm, glabrous except at margin and base. Staminal column ca 4 mm long, 5-toothed at apex,

antheriferous towards middle, glabrous; filaments pubescent. Ovary 2- or 3-loculed; ovule 1 in each locule; styles ca 8 mm long, dilated and densely hirsute above, 2- or 3-branched; stigmas peltate. Fruits subglobose, ca 5 mm across, densely stellate-tomentose, enclosed in calyx; seeds reniform, ca 3 x 2 mm, black.
Fl. & Fr.: Nov. Jan.

Habitat: Semievergreen forests, to 500 m.

Distrib.: Malappuram.

2. *Julostylis angustifolia* (Arn.) Thwaites, Enum. Pl. Zeyl.: 30. 1858; Mast. in Hook.f., Fl. Brit. India 1: 332. 1874; Rama Rao, Fl. Pl. Travancore: 40. 1914; Ramam. & Rajan in J. Econ. Tax. Bot. 7: 728. 1985; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 342. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 60. 1996; Sivar. & Pradeep, Malvac. S. India: 150. 1996. *Kydia angustifolia* Arn. in Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. 18: 332. 1836.

Tree, 15–20 m tall; branches slender, stellate-pubescent; bark smooth. Leaves lanceolate, rounded at base, entire at margin, acuminate at apex, 5–16 x 1–7 cm, sparsely stellately-hairy above, densely so beneath; petioles ca 1 cm long, stellate-pubescent; stipules linear, 2–4 mm long, sparsely pubescent, caducous. Flowers pendulous, in axillary and terminal panicles; pedicels 3–5 mm long, stellate-pubescent. Epicalyx lobes 4, forming a bell-shaped tube below, densely stellate-tomentose outside. Sepals 5, shorter than epicalyx, connate below, ovate, acute, stellate-tomentose. Petals 5, connate at base, oblong, stellate-hairy outside, yellow. Staminal column 5-toothed at tip, antheriferous below middle. Ovary stellate-hairy, 2-loculed; ovules 2 in each locule; styles 2, connate below, densely hairy; stigmas globose, large, woolly. Fruits globose, ca 1 cm, densely stellate-hairy, enclosed in accrescent calyx, indehiscent; seeds oblong or reniform, ca 3 x 2.5 mm, concentrically striate, brownish black.

Fl. & Fr.: Nov. Jan.

Habitat: Semievergreen forests, fairly common.

Distrib.: Idukki, Kozhikode, Malappuram and Thrissur. Sri Lanka.

3. *Julostylis polyandra* Ravi & Anilkumar in J. Bombay Nat. Hist. Soc. 87: 260, f. 1. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 342. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 80. 1994; Sivar. & Pradeep, Malvac. S. India: 152. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 98. 2002.

Tree, 8 - 15 m tall; branches stellate-tomentose when young. Leaves reddish when young, suborbicular to ovate, cordate or obtuse at base, entire or 3-angled, 4 - 20 x 2 - 28 cm, progressively smaller upwards, sparsely stellate-tomentose on both surfaces, 5-nerved at base with 1 - 3 nectaries on main nerves beneath; petioles 1 - 8 cm long, terete, stellate-tomentose; stipules linear-oblong, ca 3 mm long, stellate-tomentose outside, caducous. Flowers in congested pyramidal panicles; pedicels ca 1.5 cm long, stellate-tomentose. Epicalyx lobes 4 - 6, ovate to 3-angled, cordate at base, slightly crenate, 7 - 9 x 6 - 8 mm, stellate-pubescent or glabrescent, accrescent. Calyx persistent; lobes connate to middle, ovate, 8 - 10 x 5 - 6 mm, stellate-tomentose outside, sparsely hairy inside. Corolla ca 2 cm across, yellow with a purple centre; petals 5, connate at base, narrowly obovate, 1.5 - 2 x ca 1 cm, stellate-pubescent outside, simple-hairy inside. Staminal column 5 - 7 mm long, 5-toothed at apex, glandular-hairy, antheriferous towards middle; stamens 20, rarely 17 - 19, sparsely glandular; filaments slender, ca 6 mm long, purplish; anthers reniform, yellow. Ovary ca 2 mm long, densely hairy, 2-loculed; ovules 2 in each locule, basal 1 axile; style to 1.5 cm long, 2-branched; stigmas peltate, stellate-hairy above middle. Fruits ovoid or subglobose, ca 5 x 6 mm, short-beaked, densely stellate- and simple-hairy, indehiscent; seeds reniform, ca 4 mm long, closely longitudinally striate, sparsely stellate-hairy, dark brown.

Fl. & Fr.: Aug. - Jan.

Habitat: Evergreen and semideciduous forests, ca 1000 m.

Distrib.: Kollam, Pathanamthitta and Thiruvananthapuram. Endemic.

13. KYDIA Roxb.

Trees; bark mucilaginous; young branches stellate-pubescent. Leaves ovate to suborbicular, palmately lobed or -angled with nectaries on nerves beneath. Flowers polygamous, axillary or in terminal panicles. Epicalyx lobes 4 - 6, foliaceous, connate at base, spatulate, accrescent and spreading in fruit. Calyx 5-fid. Petals 5, obcordate, adnate to staminal tube at base. Staminal column distally branched into 5 arms, each tipped by a cluster of 4 - 6 connate reniform anthers, short with imperfect anthers in female flowers. Ovary 3-loculed; ovules 2 or 3 in each locule; styles 3-branched; stigmas peltate; staminodes absent. Capsules subglobose-depressed, hard, loculicidal, subtended by persistent epicalyx, usually 3-seeded; seeds reniform, rugose, brown.

Himalayas to SE. Asia, 4 species, 2 in India and 1 in Kerala.

Kydia calycina Roxb., Pl. Coromandel 3: 11, t. 215. 1819 & Fl. Ind. 3: 188. 1832; Wight, Icon. Pl. Ind. Orient.: tt. 879 & 880. 1844; Mast. in Hook.f., Fl. Brit. India 1: 346. 1874; Bourd., Forest Trees Travancore: 47. 1908; Rama Rao, Fl. Pl. Travancore: 44. 1914; Dunn in Gamble, Fl. Madras: 93(67). 1915; Manilal, Fl. Silent Valley: 27. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 62. 1988; Vajr., Fl. Palghat: 81. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 344. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 80. 1994; Sivar. & Pradeep, Malvac. S. India: 159. 1996; Sivar. & P. Mathew, Fl. Nilambur: 86. 1997. *K. fraterna* Roxb., Pl. Coromandel 3: 12, t. 216. 1819. *K. roxburghiana* Wight, Icon. Pl. Ind. Orient.: t. 881. 1844.

Mal.: *Kattavanakku, Velukku, Vempu*

Tree, 15 - 20 m high; branches densely pubescent with minute greyish stellate hairs. Leaves suborbicular or ovate, rounded or subcordate at base, entire or irregularly serrate at margin, acute or obtuse at apex, 4 - 12 x 3 - 15 cm, 3- or 5-cuspidate, uniformly stellate-hispid above, greyish-stellate-pubescent beneath, 5 - 9- nerved at base with 1 - 3 raised elliptic-ovate nectaries at base of main nerves beneath; petioles 2 - 6 cm long, densely stellate-pubescent; stipules subulate, ca 2 mm long, caducous. Flowers in dense axillary or terminal panicles; pedicels 0.5 - 1 cm long, densely stellate-pubescent. Epicalyx lobes 4 - 6, connate below, oblong or obovate, ca 1 x 0.7 cm, minutely stellate-pubescent on both sides, eventually spreading, persistent. Calyx cupular, ca 5 mm across; lobes connate below, ovate, acute, ca 2.5 mm long, stellate-pubescent on both sides, accrescent. Corolla ca 15 mm across, white or pink; petals obcordate, ca 1 x 0.5 cm, longer than calyx, shorter than epicalyx, hairy at base, obliquely adnate to staminal column below. Staminal column ca 3 mm long. Pistillode absent in male flowers. Ovary in female flowers ovoid, 3-loculed; ovules 2 or 3 in each locule. Capsules subglobose-depressed, ca 5 mm across, hard; seeds more or less reniform or ellipsoid ca 3 x 2 mm, glabrous, glandular-striate, brown.

Fl.: Sept. - Nov. *Fr.*: Nov. - Feb.

Habitat: Evergreen forests.

Distrib.: Kannur, Malappuram, Palakkad, Thiruvananthapuram and Wynad. Bhutan, China, Myanmar, Nepal and Pakistan.

Uses: Bark yields a fibre. Wood is used for ploughs.

14. *THESPESIA* Sol. ex Corrêa, nom. cons.

Trees or shrubs; branchlets stellate-hairy or scaly. Leaves simple, ovate-cordate, entire or palmately lobed, often with extrafloral nectaries; stipules early caducous. Flowers axillary, solitary or in racemes by replacing upper leaves; pedicels jointed, swollen above into a hypanthium. Epicalyx lobes 3 or 8, free, caducous. Calyx cyathiform, nearly truncate, remotely denticulate, persistent. Corolla large, showy, yellow. Staminal column cylindrical, shorter than petals, distally 5-dentate, antheriferous throughout. Ovary 5- or 10-loculed by 5 false dissepiments; styles unbranched; stigmas clavate, 5-sulcate, rarely 5-lobed. Capsules globose or pyriform, indehiscent or partly dehiscent or loculicidal; pericarp woody; seeds 3 - many in each locule, obovoid, pubescent, tomentose or glabrous.

Tropics, 17 species, 4 in India and 2 in Kerala.

Literature: Fosberg, F.R. & Sacht, M.H. 1972. *Thespesia populnea* (L.) Solander ex Correa and *Thespesia populnoides* (Roxb.) Kostelecky. *Smithsonian Contr. Bot.* 7: 1 - 13.

Key to species

- 1a. Leaves 3 - 5-lobed, densely stellate-hairy with a linear nectary on midnerve beneath; seeds 8
15 in each locule **1. *T. lampas***
- b. Leaves not lobed, lepidote, without a nectary; seeds 2 - 4 in each locule **2. *T. populnea***

1. *Thespesia lampas* (Cav.) Dalzell & A. Gibson, *Bombay Fl.*: 19. 1861; *Mast. in Hook. f., Fl. Brit. India* 1: 345. 1874; Rama Rao, *Fl. Pl. Travancore*: 43. 1914; Borss. Waalk. in *Blumea* 14: 116. 1966; Manilal, *Fl. Silent Valley*: 29. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 64. 1988; Vajr., *Fl. Palghat*: 54. 1990; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 350. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 82. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 63. 1996; Sivar. & Pradeep, *Malvac. S. India*: 40. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 94. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 101. 2002. *Hibiscus lampas* Cav., *Diss.* 3: 154, t. 56, f. 2. 1787; Dunn in Gamble, *Fl. Madras*: 98(71). 1915.

Mal.: *Katpuvarasu, Kartuparathi*

Shrub, ca 3 m high; branches densely stellate-tomentose when young, glabrous later. Lower leaves orbicular, cordate at base, 6–12 cm across, 3–5-lobed; lobes deltoid, acute, acuminate or rarely obtuse at apex; upper leaves ovate to oblong, unlobed, shallowly cordate to rounded at base, acuminate, acute or rarely obtuse at apex, 5–20 x 2–22 cm, with a linear to 5 mm long nectary at base of midnerve beneath, sparsely covered with stellate and short simple hairs above, densely stellate-tomentose beneath; petioles 1–12 cm long, densely stellate-hairy; stipules lanceolate 5–8 mm long, stellate-hairy. Flowers axillary, solitary or 1–5 in long-stalked racemes by replacing upper leaves; pedicels 3–7 mm long, jointed above middle, slightly accrescent. Hypanthium obconic. Epicalyx lobes 5, free, usually subulate, minutely stellate-hairy, caducous. Calyx cyathiform, ca 5 mm long, with 5 small subulate to deltoid segments, densely stellate-hairy at base outside, glabrous inside. Corolla campanulate, ca 7 cm across, yellow with a dark purple centre; petals obovate, rounded at apex, ca 6 x 4 cm, stellate- and glandular-hairy outside, glabrous inside. Staminal column 1–2 cm long, glabrous, 5-toothed at apex. Ovary conic, ca 8 mm across, densely hairy. Capsules ovoid-globose, 2–3 x 1.5–2 cm, minutely stellate-hairy, glabrescent, dehiscing into 5 valves; seeds 8–15 in each locule, obovoid, angled, ca 5 mm long, densely appressed-hairy, glabrescent, black.

Fl. & Fr.: Aug. – Dec.

Habitat: Evergreen and moist deciduous forests.

Distrib.: Almost throughout Kerala. Throughout India. Africa, S. and SE. Asia.

2. *Thespesia populnea* (L.) Sol. ex Corrêa in Ann. Mus. Natl. Hist. Nat. 9: 290, t. 8, f. 1. 1807; Mastr. in Hook.f., Fl. Brit. India 1: 345. 1874; Rama Rao, Fl. Pl. Travancore: 43. 1914; Dunn in Gamble, Fl. Madras: 98(71). 1915; Borss. Waalk. in Blumea 14: 106. 1966; Manilal & Sivar., Fl. Calicut: 49. 1982; Nicolson & al. in Regnum Veg. 119: 174. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 65. 1988; Vajr., Fl. Palghat: 84. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 352. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 88. 1994; Sivar. & Pradeep, Malvac. S. India: 37. 1996; Sivar. & P. Mathew, Fl. Nilambur: 95. 1997. *Hibiscus populneus* L., Sp. Pl.: 694. 1753.

Mal.: *Pooparuthi*, *Poovarasu*

Tree, 5–10 m high; young branches covered with minute peltate scales,

glabrescent; bark fissured. Leaves broadly ovate, deeply cordate at base, entire at margin, acute to acuminate at apex, 5 - 10 x 5.5 - 15 cm, glabrescent, 5 - 7-nerved at base; petioles 5 - 10 cm long, scaly; stipules linear, acute, 4 - 10 mm long, caducous. Flower axillary, solitary; pedicel 2 - 5 cm long, erect, jointed near base, glabrescent, slightly accrescent. Epicalyx lobes 3, oblong-lanceolate, acute, 5 - 15 x 2 - 3 mm, subcoriaceous, densely scaly, caducous. Calyx campanulate, 8 - 12 x ca 18 mm, obscurely 5-dentate or subtruncate at apex, densely scaly outside, densely hirsute inside, accrescent in fruit. Corolla broadly campanulate, light yellow with a dark purple centre, eventually reddish; petals obliquely obovate, rounded at apex, 5 - 7.5 x 4 - 6 cm, fleshy, ciliate at base, densely scaly outside, glabrous inside. Staminal column 1.5 - 2.5 cm long, glabrous. Ovary globose to ovoid, 6 - 8 mm across, scaly; ovules 4 in each locule; styles ca 2 cm long; stigmas connate, grooved. Capsules globose, obtuse or slightly depressed at apex, 2 - 3.5 cm, indehiscent, 4- or 5-loculed; seeds obovoid, angled, acute to short-acuminate at base, rounded at apex, 6 - 10 x 5 - 8 mm, covered with yellowish brown long simple hairs densely so at angles.

Fl. & Fr.: Aug. - Jan.

Habitat: Seacoasts, often cultivated in interior plains.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Africa, Asia and the Pacific Islands.

Uses: Wood is used for furniture. Bark yields a fibre. Pigment from capsule is used to treat scabies.

4. Tribe MALVEAE A. Gray

Annual, biennial or perennial herbs or undershrubs, erect, pubescent or glabrous. Leaves entire or parted, reniform or suborbicular, cordate. Flowers axillary, solitary or fascicled in terminal racemes by replacing upper leaves. Epicalyx lobes 3 - 9. Calyx cupular to rotate, 5-lobed. Corolla ca 3 cm across. Fruit a schizocarp; mericarps indehiscent; seeds reniform.

15. ALCEA L.

Alcea rosea L., Sp. Pl.: 687. 1753; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 386. 1993; Sivar. & Pradeep, Malvac. S. India: 207. 1996. *Althea rosea* (L.) Cav., Diss. 2: 91, t. 28, f. 1. 1786; Mast. in Hook.f., Fl. Brit. India 1: 319. 1874; Borss. Waalk. in Blumea 14: 157. 1966.

Annual, erect herb, 1.5 - 2 m high, stellate-hairy when young, glabrescent. Leaves orbicular-cordate, deeply 3 - 7-lobed; upper ones 3-lobed; lobes subrotundate or 3-angled, crenate to dentate at margin, acute at apex; petioles 2 - 8 cm long, stellate-hairy; stipules ovate, split at apex into 3 - 5 linear-lanceolate segments, caducous. Flowers axillary, solitary or in terminal racemes by replacing upper leaves; pedicels 5 - 10 mm long, accrescent to 15 mm in fruit. Epicalyx lobes 6 or 7, connate below middle, ovate-lanceolate or 3-angled, 1 - 1.5 x 0.3 - 0.5 cm, densely stellate-tomentose. Calyx lobes ovate to ovate-lanceolate, acute at apex, accrescent. Petals 4 - 7 cm long, variously coloured, usually red. Staminal column 10 - 15 mm long; styles and stigmas 20 - 40. Schizocarps globose-depressed, ca 2 cm, pubescent, enclosed in calyx; mericarps 20 - 40, horseshoe-shaped, ca 4 mm across, pubescent, 2-winged; seeds ca 5 mm across, stellate-hairy.

Fl. & Fr.: March - Sept.

Native to the Aegean Islands and the adjacent Balkan Peninsula; cultivated throughout the world.

Uses: Flower and seed are medicinal. Flower yields a red dye which is used as an indicator.

5. Tribe URENEAE Benth. & Hook.f.

Annual or perennial herbs, undershrubs or shrubs; stems hairy. Leaves undivided, angled, palmately lobed or parted. Flowers axillary, solitary or in terminal condensed spikes. Epicalyx absent, when present free or connate. Calyx and corolla 5-lobed, yellow to purplish red. Staminal column shorter or as long as corolla. Schizocarps discoid, subglobose, globose or pyriform; mericarps indehiscent.

Key to genera

- | | | |
|-----|--|--------------------------------|
| 1a. | Flowers in condensed racemes intermixed with foliaceous bracts; epicalyx rarely present | 16. Malachra |
| b. | Flowers axillary, solitary or in clusters without foliaceous bracts; epicalyx always present | 2 |
| 2a. | Petals auricled; fruits berry-like, fleshy | 17. Malvaviscus (cult.) |
| b. | Petals not auricled; fruits neither berry-like nor fleshy | 3 |

3a. Leaves with nectary on midnerve beneath; mericarps usually glochidiate, rarely smooth

19. *Urena*

b. Leaves without nectary; mericarps mucronate or with 1 - 3 retrorsely barbed awns at apex, never glochidiate

18. *Pavonia*

16. MALACHRA L.

Annual or perennial herbs or undershrubs; stems hirsute or prickly. Leaves suborbicular-ovate, undivided to angled, palmately or digitately divided; stipules filiform. Flowers in large axillary or terminal condensed racemes surrounded by large deeply cordate leafy bracts. Epicalyx rarely present. Calyx cupular, 5-dentate. Petals 5, red, yellow or white. Staminal column as long as or shorter than petals, 5-toothed at apex, antheriferous throughout. Carpels 5; styles 10-branched; stigmas capitate, papillose. Schizocarps globose; mericarps 5, reticulately nerved, indehiscent; seed 1 in each mericarp, glabrous.

Tropical America, 8 species, 2 or 3 species introduced into the Old World and naturalized and 1 in India.

Malachra capitata (L.) L., Syst. Nat. ed. 12, 2: 458. 1767; Mast. in Hook.f., Fl. Brit. India 1: 329. 1874; Dunn in Gamble, Fl. Madras: 102(73). 1915; Borss. Waalk. in Blumea 14: 147. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 367. 1993; Sivar. & Pradeep, Malvac. S. India: 163. 1996. *Sida capitata* L., Sp. Pl.: 685. 1753.

Annual or perennial, erect herb or undershrub, to 1.5 m high; stems, petioles and peduncles densely pubescent with prickly-stellate and simple hairs. Leaves orbicular or ovate, 3 - 5-angled or -lobed, cordate at base, crenate to serrate at margin, obtuse or rounded at apex, 3 - 14 x 4 - 20 cm, velutinous with stellate and simple hairs on both surfaces, glabrescent, 5-nerved at base; petioles 2 - 8 cm long; stipules 1 - 2 cm long, filiform, rarely forked, hispid. Inflorescences 0.5 - 1.5 cm long, stout, bearing 3 - 7 heads; each head with 2 - 5 flowers encircled by 3 or 4 leafy bracts; bracts ovate to orbicular, cordate to rounded at base, entire or crenate-serrate at margin, acute at apex with a slightly recurved tip, 0.5 - 2 cm across, folded along midnerve, stellate-pubescent and also with stiff bristles at margin and on nerves beneath. Calyx cupular, accrescent; lobes oblong to deltoid, acuminate, ca 6 x 1.5 mm, 3-nerved, with a few stiff simple hairs at apex. Corolla

ca 1.5 - 2.5 cm across, bright yellow; petals obovate, ca 1.5 x 1 cm, ciliate at base, densely stellate-hairy outside, glabrous inside. Staminal column ca 1 cm long, pubescent with both stellate and simple hairs and a few glandular hairs, antheriferous throughout. Ovary glabrous; styles ca 1.3 cm long, glabrous, 10-branched; stigmas capitate, hairy. Schizocarps obpyriform, 5 - 6 mm across; mericarps 5, 3-gonous, acute at base, rounded at apex, ca 3 x 2 mm, glabrous, reticulate with brownish nerves, whitish; seeds 3-gonous, ca 2.5 mm long, covered with minute stellate hairs, brownish black.

Fl. & Fr.: April - Dec.

Habitat: Roadsides; naturalized.

Distrib.: Kozhikode and Palakkad (Sivarajan & Pradeep, *l.c.*). Naturalized in tropical India.

17. MALVAVISCUS Fabr.

Perennial shrubs, often climbing or suberect. Leaves entire, palmately lobed or angled; lobes without nectary on nerves. Flower axillary, solitary; pedicel not jointed. Epicalyx lobes 8 or 9, shortly connate at base, lanceolate to spatulate. Calyx campanulate, 5-fid. Corolla erect-connivent. Staminal column usually longer than corolla, antheriferous above. Carpels 5; ovule 1 in each locule; style 10-branched; stigmas capitate. Schizocarps subglobose, berry-like, eventually drying and separating into indehiscent mericarps.

Tropical America, 3 species and 1 in India.

Malvaviscus penduliflorus DC., Prodr. 1: 445. 1824; Fryxell, Syst. Bot. Monogr. 45: 247. 1988; Sivar. & Pradeep, Malvac. S. India: 167. 1996. *M. arboreus* Cav. var. *penduliflorus* (DC.) Schery in Ann. Missouri Bot. Gard. 29: 223. 1942; Borss. Waalk. in Blumea 14: 133. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 394. 1993.

Mal.: *Mulakuchemparathi*

Shrub, 3 - 5 m high; stems erect, branched, glabrous or pubescent with a row of simple hairs when young. Leaves elliptic or ovate, 3-angled, truncate or shallowly cordate at base, serrate-dentate at margin, acuminate at apex, 5 - 10 x 2 - 5 cm, glabrous; petioles 4 - 6 cm long, hirsute; stipules linear, 3 - 4 mm long, sparsely strigose. Flower axillary, solitary; pedicel ca 5 cm long, pubescent. Epi-

calyx lobes 5 - 8, connate at base, lanceolate or spatulate, 4 - 5 mm long, glabrous. Calyx tubular, 5-lobed; lobes ovate, acute, sparsely hairy at margin. Corolla crimson-red; petals obovate, ca 6 cm long, erect, not spreading, auricled at base, angled at apex. Staminal column ca 8 cm long, 5-toothed at apex, antheriferous at tip; filaments retrorse. Ovary globose-depressed, hairy; stylar arms 10; stigmas hairy, purple. Fruit usually not formed.

Fl.: Most part of the year.

Cultivated throughout India.

18. PAVONIA Cav., nom. cons.

Annual or perennial herbs, undershrubs or shrubs. Leaves ovate, elliptic or lanceolate, entire or lobed to parted, dentate-crenate at margin, rarely with nectaries on midnerve beneath, palmately nerved. Flowers usually axillary, solitary or fascicled by reduction of upper leaves; pedicels jointed above middle. Epicalyx lobes 5 - 16, free or connate. Calyx campanulate or tubular, 5-lobed or -toothed. Corolla rotate, yellow, pink or pinkish white. Staminal column as long as or shorter than corolla, antheriferous throughout or above. Carpels 5, each 1-ovuled; styles 10; stigmas capitate, papillose. Schizocarps discoid to globose; mericarps 5, echinate or not, winged or not, glabrous or pubescent, reticulately nerved, indehiscent; seed 1 per mericarp, reniform, pubescent or glabrous.

Tropics and subtropics, ca 150 species, 7 in India and 3 in Kerala.

Literature: Abedin, S. 1979. Revision of *Pavonia* Cav. (*Malvaceae*) from Pakistan. *Pakistan J. Bot.* 11: 61 - 72.

Key to species

- | | | |
|-----|---|-------------------------|
| 1a. | Epicalyx lobes 5, shortly connate at base | 1. <i>P. burchellii</i> |
| b. | Epicalyx lobes 8 - 14, free | 2 |
| 2a. | Mericarps winged at angles | 3. <i>P. zeylanica</i> |
| b. | Mericarps wingless | 2. <i>P. odorata</i> |

1. ***Pavonia burchellii*** (DC.) Dyer in Bull. Misc. Inform. 1932: 152. 1932; Fryxell in Nuytsia 6: 305. 1988; Sivar. & Pradeep, Malvac. S. India: 176. 1996. *Althea burchellii* DC., Prodr. 1: 438. 1824. *Lebretonia procumbens* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 47. 1834; Wight, Icon. Pl. Ind. Orient.: t. 4. 1838.

Pavonia procumbens (Wall. ex Wight & Arn.) Walp., Repert. Bot. Syst. 1: 301. 1842, non Casar. 1842; Dunn in Gamble, Fl. Madras: 93(67). 1915; Borss. Waalk. in Blumea 14: 135. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 374. 1993. *Lebretonia glechomifolia* A. Rich., Tent. Fl. Abyss. 1: 54. 1847. *Pavonia glechomifolia* (A. Rich.) Garcke ex Schweinf., Beitr. Fl. Aethiop. 1: 54. 1867; Mast. in Hook.f., Fl. Brit. India 1: 330. 1874 p.p.; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 372. 1993.

Procumbent or spreading herb; stems, petioles and pedicels sparsely covered with stellate, simple and gland-tipped hairs. Leaves orbicular to ovate, often 3-lobed or -angled, cordate at base, crenate to serrate at margin, acuminate at apex, 2 - 10 x 1 - 9 cm, sparsely stellate- and simple-hairy above densely so beneath, glabrescent; petioles 1 - 5 cm long; stipules linear to filiform, 3 - 5 mm long, hairy. Flower axillary, solitary; pedicel 1.5 - 6 cm long, jointed above middle, geniculate at joint, densely hairy above joint. Epicalyx lobes 5, rotate, ovate, acute at apex, 5 - 10 x 3 - 6 mm, shortly connate at base, stellate-hairy on both sides. Calyx campanulate, 9 - 12 mm across; lobes connate to middle, ovate to lanceolate, acute to acuminate, 5 - 8 x 3 - 4 mm, densely hairy outside, glabrous inside. Corolla 1.5 - 2 cm across, yellow; petals obovate, rounded at apex, ca 14 x 10 mm, ciliate at base, with scattered stellate hairs outside, glabrous inside. Staminal column ca 5 mm long, 5-toothed at apex, sparsely stellate-hairy, antheriferous above. Ovary 5-gonous; styles and stigmas 10. Schizocarps ca 5 mm across, slightly compressed; mericarps 5, obliquely 3-quetrous, obovoid, obtuse, ca 5 x 3 mm, with a median dorsal serrulate crest and 3 or 4 lateral stout ridges on either side, sparsely stellate-hairy or glabrous, indehiscent; seeds reniform, ca 2 mm across, angled, glabrous, brownish black.

Fl. & Fr.: Aug. - Dec.

Habitat: Drier areas in deciduous forests.

Distrib.: Kollam, Gujarat, Maharashtra, Punjab, Rajasthan and Tamil Nadu. Africa, Arabia, Malesia, Pakistan and Sri Lanka.

2. *Pavonia odorata* Willd., Sp. Pl. 3: 837. 1800; Mast. in Hook.f., Fl. Brit. India 1: 331. 1874; Rama Rao, Fl. Pl. Travancore: 40. 1914; Dunn in Gamble, Fl. Madras: 93(67). 1915; Vajr., Fl. Palghat: 81. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 373. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 1993.

80. 1994; Sivar. & Pradeep, Malvac. S. India: 171. 1996. *Hibiscus odoratus* (Willd.) Roxb. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 47. 1834.

Erect herb, to 40 cm high, odorous; stems, petioles and pedicels simple-glandular-hairy. Leaves orbicular-ovate, occasionally upper ones lanceolate, obscurely 3 - 5-lobed, cordate or more or less truncate at base, irregularly dentate at margin, acute or slightly acuminate at apex, 2 - 10 x 2 - 4 cm, with scattered simple and stellate hairs on both surfaces, denser beneath; petioles 1 - 5 cm long; stipules linear, ca 2 mm long, hairy, caducous. Flower axillary, solitary; pedicel 1.5 - 4 cm long, accrescent to 6 cm, jointed above middle. Epicalyx lobes 10 - 12, free, linear, 0.5 - 1.5 cm long, ciliate, persistent. Calyx campanulate, ca 3 mm across; lobes connate at base, ovate-lanceolate, ca 4 x 1.5 mm, simple-hairy on both sides. Corolla 1 - 3 cm across, pink; petals obovate, 1 - 2 cm long, glabrous. Staminal column shorter than petals, glabrous. Ovary globose, ca 1.5 mm, glabrous; styles 10, ca 3 mm long, glabrous; stigmas capitate, minutely pubescent. Schizocarps ca 6 mm across; mericarps 5, more or less reniform, ca 4 x 2 mm, wingless, unarmed, glabrous; seeds reniform, ca 2 mm long, minutely papillose, brownish black.

Fl. & Fr.: Aug. - Sept.

Habitat: Drier areas in deciduous forests and coastal plains.

Distrib.: Palakkad and Thiruvananthapuram. Andhra Pradesh, Bihar, Karnataka, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and W. Bengal. Africa, Myanmar, Pakistan and Sri Lanka.

Uses: The herb has a musk-like odour. Decoction is used as a drink in fever. Stem yields a good fibre. Root is used to prepare perfumes.

3. *Pavonia zeylanica* (L.) Cav., Diss. 3: 134, t. 48, f. 2. 1787; Mast. in Hook.f., Fl. Brit. India 1: 331. 1874; Dunn in Gamble, Fl. Madras: 93(67). 1915; Vajr., Fl. Palghat: 82. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 377. 1993; Sivar. & Pradeep, Malvac. S. India: 173. 1996. *Hibiscus zeylanicus* L., Sp. Pl.: 699. 1753.

Perennial herb, to 1 m high; stems profusely branched, woody at base; stems, petioles and pedicels pubescent with stellate and glandular simple hairs. Leaves orbicular or obovoid-rounded, deeply 3 - 5-lobed, cordate at base, 1 - 4 x 0.5 - 3.5 cm; lobes obovate-oblong, dentate at margin, acute or rounded at apex,

simple-hairy above, stellate-hairy beneath; petioles 1 - 4 cm long; stipules linear, ca 2 mm long, hairy, caducous. Flower axillary, solitary; pedicel 1 - 4 cm long, jointed towards apex. Epicalyx lobes 10, free, linear, 5 - 10 mm long, ciliate, persistent. Calyx campanulate, ca 5 mm across; lobes free to middle, ovate-lanceolate or deltoid, acute at apex, ca 2 x 1 mm, hairy outside, glabrous inside. Corolla ca 1.5 cm across, rotate, light pinkish; petals obovate, ca 10 x 15 mm, glabrous. Staminal column ca 8 mm long, 5-toothed at apex, antheriferous throughout. Ovary more or less ovoid, ca 1.5 mm across, glabrous; styles 10-branched; stigmas capitate. Schizocarps globose, pubescent; mericarps 5, oblong, obtuse, ca 4 x 3 mm, winged at angles, awnless, glabrous, dehiscing from top; seeds reniform, ca 3 x 1.5 mm, minutely pubescent, brown.

Fl. & Fr.: July - Dec.

Habitat: Dry deciduous forests.

Distrib.: Palakkad. Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu and Uttar Pradesh. Africa, Arabia, Mauritius, Pakistan and Sri Lanka.

Uses: Plant yields a good fibre. Decoction of root is administered in fever.

19. URENA L.

Annual or perennial undershrubs or shrubs; young parts densely covered with minute stellate hairs. Leaves variable in shape and size, palmately lobed to parted or undivided, angled, palmately nerved with 1 - 3 nectaries on nerves beneath; petioles shorter than lamina. Flowers axillary, solitary or in clusters; pedicels not jointed. Epicalyx campanulate; lobes 5, connate at base, alternating with sepals. Calyx campanulate, 5-parted; lobes ovate to ovate-lanceolate, 1-nerved. Corolla rotate, purplish red, stellate-pilose outside; petals 5. Staminal column as long as corolla, truncate or denticulate at apex, antheriferous towards upper half; anthers subsessile. Ovary globose-depressed, 5-loculed; ovule 1 in each locule; styles divided into 10 arms above middle, reflexed; stigmas discoid, papillose. Schizocarps subglobose; mericarps 5, separating at maturity, 3-angled, obovoid, dorsally convex, covered with glochidiate spines.

Tropics and subtropics, 6 species and 2 in India.

Key to species

- 1a. Leaves shallowly lobed; epicalyx cupular in fruit, appressed to mericarps; lobes 3-angled 1. *U. lobata*
- b. Leaves palmately lobed; epicalyx spreading or reflexed in fruit; lobes linear-lanceolate 2. *U. sinuata*

1. *Urena lobata* L., Sp. Pl.: 692, 1753; Mast. in Hook.f., Fl. Brit. India 1: 329, 1874; Dunn in Gamble, Fl. Madras: 92(66), 1915; Manilal, Fl. Silent Valley: 29, 1988. *U. viminea* Cav., Diss. 6: 335, t. 184, f. 1, 1788. *U. lobata* L. subsp. *lobata* var. *lobata*: Borss. Waalk. in Blumea 14: 140, 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 380, 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 83, 1994; Sivar. & Pradeep, Malvac. S. India: 180, 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 102, 2002. *U. lobata* L. subsp. *lobata* var. *viminea* (Cav.) Gürke in Bot. Jahrb. Syst. 16: 375, 1892; Borss. Waalk. in Blumea 14: 141, 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 382, 1993.

Mal.: *Oorpum, Udiram, Uram, Vatti*

Annual or perennial, erect undershrub, 0.5–3 m high; stems stellate-pubescent. Leaves ovate to orbicular, unlobed, shallowly lobed or angled, shallowly cordate, rounded, obtuse to acute at base, serrate to crenate or entire at margin, obtuse to acute or rounded at apex, 1–10 cm, densely stellate-hairy on both surfaces, glabrescent, 4-nerved from base with nectaries on main nerves; petioles 1–8 cm long, stellate-pubescent; stipules linear to lanceolate, 2–4 mm long, pubescent. Flowers axillary, solitary or in clusters of 2 or 3; pedicels 1–4 mm long, pubescent. Epicalyx lobes 5, linear to lanceolate or spatulate, 3–10 × 1–3 mm, sparsely pubescent outside, glabrous inside, adnate to calyx at base. Calyx tubular to campanulate; lobes ovate to deltoid, acute to acuminate, 4–6 × 1.5–2 mm, pubescent at margin. Corolla 2–3 cm across, pink with a dark purple centre; petals obovate, 1–1.5 × ca 0.5 cm, stellate-hairy outside, glabrous inside. Staminal column ca 1 cm long, declinate, glabrous, pink; anthers sessile. Ovary subglobose, ca 4 mm across, densely hairy; stylar arms ca 1 mm long; stigmas capitate, pubescent. Schizocarps globose, 5–8 mm, glochidiate, stellate-hairy, dorsally and laterally reticulately nerved; seeds reniform, 2–3 mm across, minutely hairy or glabrescent.

Fl. & Fr.: Aug. Feb.

Habitat: Roadsides and wastelands, common.

Distrib.: Emakulam, Idukki, Kannur, Malappuram, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Throughout India. Pantropical.

2. *Urena sinuata* L., Sp. Pl.: 692. 1753; Mast. in Hook.f., Fl. Brit. India 1: 329. 1874; Rama Rao, Fl. Pl. Travancore: 39. 1914; Dunn in Gamble, Fl. Madras: 92(66). 1915. *U. lobata* L. subsp. *sinuata* (L.) Borss. Waalk. in Blumea 14: 142. 1966; Manilal & Sivar., Fl. Calicut: 46. 1982; Nicolson & al. in Regnum Veg. 119: 174. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 66. 1988; Vajr., Fl. Palghat: 85. 1990; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 382. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 103. 2002.

Mal.: *Oorpan, Udiram, Uram, Uren*

Erect shrub or undershrub, 1 - 3 m high; stems branched, densely stellate-pubescent. Leaves palmately 5-parted, rarely 5-angled, shallowly cordate to truncate at base, crenate-serrate at margin, sometimes entire, acute or subacute at apex, 3 - 12 x 4 - 9 cm, densely stellate-hairy on both surfaces with a linear to elliptic nectary on midnerve beneath; petioles 5 - 10 cm long, stellate-pubescent; stipules subulate, ca 2 mm long, simple-hairy. Flowers axillary, solitary or paired; pedicels ca 4 mm long, pubescent. Epicalyx lobes 5, spatulate, ca 5 x 1.5 mm, divided to middle, adnate to calyx, simple-hairy outside, stellate-hairy inside. Calyx campanulate, ca 4 mm across, 5-parted; lobes ovate-elliptic, acute, ca 5 x 2.5 mm, densely stellate-hairy outside, glabrescent inside except at apex. Corolla ca 15 mm across, pink with a dark purple centre; petals obovate, obtuse at apex, ca 10 x 7 mm, sparsely stellate-hairy outside, glabrous inside. Staminal column slightly curved, ca 7 mm long, pink. Ovary globose, ca 2.5 mm, densely pubescent; styles 10; stigmas capitate, pubescent. Schizocarps oblate, ca 10 mm across; mericarps 5, 3-gonous, ca 6 x 4 mm, densely stellate-pubescent and glochidiate; seeds minutely pubescent, black.

Fl. & Fr.: Aug. Feb.

Habitat: Roadsides and wastelands.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Throughout India. Pantropical.

BOMBACACEAE

(S.K. SRIVASTAVA & K. VIVEKANANTHAN)

Trees, rarely shrubs; trunk and branches prickly or not. Leaves alternate, simple or palmately compound, entire or minutely serrate at apex, often lepidote; stipules caducous. Inflorescences cymose, racemose, fascicled or flower solitary, sometimes ramiflorous. Flowers bracteoid, bisexual, large, showy, actino-, rarely zygomorphic, usually 5-merous. Sepals 5, sometimes basally connate, rarely deeply 5-lobed, truncate, valvate, persistent or not, often subtended by an epicalyx. Petals usually 5, contorted, usually adnate to staminal tube at base, rarely absent. Stamens 5 - numerous, free or monadelphous; anthers reniform to linear, free or coherent, sometimes stipitate, 1-loculed, dehiscing longitudinally; staminodes often present. Ovary superior, rarely inferior, 2 - 5-loculed; ovules 2 or more in each locule, erect, anatropous in axile placenta; style simple; stigma capitate or lobed. Capsules loculicidal, dehiscing into 3 - 5 valves, rarely indehiscent and falling away; pericarp smooth or spinose; seeds 1 - many, glabrous, smooth, embedded in hairs from wall of fruit, arillate or alate; endosperm scanty or absent; cotyledons flat, contorted or plicate.

Tropics especially America, 26 genera and ca 250 species, 4 and 6 in India and, 4 and 5 in Kerala.

Literature: Baker, H.G. & Baker, I. 1968. Chromosome numbers in the *Bombacaceae*. *Bot. Gaz. (Crawfordsville)* 129: 294 - 296. Qasier, M. 1978. *Bombacaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 119: 1 - 6. Robyns, A. 1971. On pollen morphology of *Bombacaceae*. *Bull. Jard. Bot. État* 41: 451 - 456. Robyns, A. 1980. *Bombacaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 1: 59 - 71. Sharma, B.D. 1970. Contribution to the pollen morphology and taxonomy of the family *Bombacaceae*. *Proc. Indian Natl. Sci. Acad.* 36B.: 175 - 191. Tsukada, M. 1965. Taxonomic significance of *Bombacaceae* pollen morphology. *Amer. J. Bot.* 52: 652 - 653.

Key to genera

- | | | |
|-----|---|--------------------|
| 1a. | Flowers with epicalyx; corolla absent; capsules covered with spines | 3. Cullenia |
| b. | Flowers without epicalyx; corolla present; capsules not covered with spines | |
| 2a. | Leaves simple, angled or lobed; flower solitary, terminal | 4. Ochroma |
| b. | Leaves palmately compound; flowers clustered in leaf axils or on branches | |
| 3a. | Flowers red; stamens numerous; capsules thick, woody, dehiscent | 1. Bombax |
| b. | Flowers pale yellow; stamens 5; capsules thin, leathery, indehiscent | 2. Ceiba |

1. BOMBAX L., nom. cons.

Trees, buttressed, deciduous; stem prickly. Leaves digitately foliolate; leaflets 5 - 9, entire, glabrous or sparingly lepidote; stipules small. Flowers fascicled or solitary, pediceled, bracteoid. Calyx cupular to campanulate, truncate to deeply 5 - 7-lobed, leathery. Petals 5, oblong to obovate, adnate to staminal tube at base, tomentose outside, twisted in bud. Stamens numerous, connate at base in a whorl of 5 bundles opposite petals; anthers reniform or horseshoe-shaped, medifixed, 1-loculed. Ovary 5-loculed; style filiform; ovules numerous; stigma 1 - 5-lobed. Capsules more or less woody, loculicidal, dehiscing by 5 leathery or woody valves; seeds numerous, globose, black, embedded in a dense wool-like flock; cotyledons crumpled.

Old World tropics, 20 species, 3 in India and 2 in Kerala.

Literature: Chatterjee, D. & Raizada, M.B. 1954. Notes on the typification of the generic name *Bombax* L. *Taxon* 3: 102. Nicolson, D.H. 1979. Nomenclature of *Bombax*, *Ceiba* (*Bombacaceae*) and *Cochlospermum* (*Cochlospermaceae*) and their type species. *Taxon* 28: 367 - 373. Santapau, H. 1959. *Salmalia malabarica* and *S. insigne* in Bombay. *J. Bombay Nat. Hist. Soc.* 56: 364 - 365.

Key to species

- 1a. Leaflets petioluled; flowers 6 - 8.5 cm across, dark red; stamens 80 - 100; style 5-fid **1. B. ceiba**
- b. Leaflets nearly sessile or petiolules to 2 mm long; flowers 10 - 14 cm across, creamy yellow to light red; stamens 400 - 500; style simple **2. B. insigne**

1. *Bombax ceiba* L., Sp. Pl.: 511. 1753; A. Robyns in Bull. Jard. Bot. État 33: 88. 1963; Manilal & Sivar., Fl. Calicut: 50. 1982; Nicolson & al. in Regnum Veg. 119: 74. 1988; Manilal, Fl. Silent Valley: 30. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 66. 1988; Vajr., Fl. Palghat: 86. 1990; M.P. Nayar & M.C. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 398. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 83. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 64. 1996; Sivar. & P. Mathew, Fl. Nilambur: 96. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 104. 2002. *B. malabaricum* DC., Prodr. 1: 479. 1824; Mast. in Hook.f., Fl. Brit. India 1: 349. 1874; Bourd., Forest Trees Travancore: 44. 1908; Rama Rao, Fl. Pl. Travancore: 45. 1914; Dunn in Gamble, Fl. Madras: 99(71).

1915.

Mal.: *Elavu*, *Mullila pula*, *Mullilavu*, *Pula-maram*

Tree, to 45 m tall; bark 20 - 30 mm thick, grey; branches sharply prickled, warty. Leaves digitately (5 -)7-foliolate; rachises 10 - 18 cm long; leaflets elliptic, ovate or oblong-lanceolate, terminal one larger, attenuate, obtuse or acute at base, entire at margin, cuspidate at apex with to 3.5 cm long acumen, 7 - 17.5 x 3 - 5.5 cm, thin-coriaceous, glabrous; lateral nerves 10 - 12 pairs, distinct; petiolules 1 - 2 cm long, grooved. Flowers solitary or 1 - 3 together, 6 - 8.5 cm long, fleshy, pubescent, bright red; pedicels to 1.5 cm long, jointed at base. Calyx campanulate, 3 - 5-lobed; lobes broadly ovate, acute at apex, ca 1.5 cm across, silky-hairy inside. Petals 5, ovate, oblong or obovate, acute at apex, involute at margin, 7 - 8.5 x 2.5 - 3.5 cm, fleshy, sparsely puberulous inside, velvety outside, adnate to staminal tube at base. Stamens in whorls, 80 - 100, 3.5 - 4.5 cm long; filaments 3.4 - 4.3 cm long, broad at base, connate with other filaments, ciliate at margin at base; anthers ca 2 mm long, extrorse, dehiscent longitudinally. Ovary ovoid, ca 1 x 0.5 cm, 5-loculed; ovules many in each locule; style 3.5 - 4.5 cm long, glabrescent; stigma 5-lobed; lobes linear, puberulous inside. Capsules oblong to ellipsoid, 8 - 10 cm long, loculicidal; seeds ovoid, ca 6 mm across, embedded in cottony wool.

Fl. & Fr.: Dec. - April.

Habitat: Moist deciduous and semievergreen forests, often in wastelands, to 1200 m, common. Also grown in plantations. It thrives best on alluvial soil under heavy rainfall.

Distrib.: Throughout Kerala. Andaman & Nicobar Islands, Himalayas, Gangetic Plains, C. and S. India. Indonesia, Myanmar and Sri Lanka.

Uses: Wood is widely used in match industry, also used in making canoes, toys and brush handles. The cotton is used for stuffing pillows. Gum from bark is used medicinally.

2. *Bombax insigne* Wall., Pl. Asiat. Rar. 1: 71. 1830; Mast. in Hook.f., Fl. Brit. India 1: 349. 1874; Bourd., Forest Trees Travancore: 45. 1908; Rama Rao, Fl. Pl. Travancore: 45. 1914; Dunn in Gamble, Fl. Madras: 100(71). 1915; A. Robyns in Bull. Jard. Bot. État 33: 188. 1963; Vajr., Fl. Palghat: 87. 1990; M.P. Nayar & M.C. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 398. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 64. 1996; N. Mohanan & Sivad.,

Fl. Agasthyamala: 104. 2002. *B. scopulorum* Dunn in Gamble, Fl. Madras: 100(72). 1915 & Bull. Misc. Inform. 1916: 65. 1916; M.P. Nayar & M.C. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 399. 1993.

Mal.: *Kalilavu*

Tree, to 25 m tall; bark grey, 20–25 mm thick, armed with conic prickles; branches whorled. Leaves digitately 7–9-foliolate, crowded at end of branchlets; rachises 15–25 cm long; leaflets ovate-elliptic to obovate, narrow, cuneate at base, entire at margin, acuminate to cuspidate at apex, 12–18 x 2.5–4.5 cm, chartaceous, glabrous; lateral nerves 15–18 pairs, distinct on both surfaces; petiolules to 2 mm long or nearly sessile. Flower axillary, solitary, 10–14 cm long, pubescent, creamy yellow to light red; pedicel 1.2–1.8 cm long, rough, warty, jointed at base. Calyx tubular, 3–5-lobed; lobes ovate, 1.5–2 cm long, hard, leathery, glabrous outside, wooly inside, dark brown or black when dry. Petals 5, ovate-lanceolate or spatulate, rounded at apex, 9–11 x 1.3–2.5 cm, thick, fleshy, pubescent on both sides, densely wooly inside at base. Stamens 400–500, in whorls, 4.5–6.5 cm long, opposite petals; filaments 4.2–6.3 cm long, basally connate, fleshy; anthers reniform, ca 2 mm long. Ovary ovoid; style cylindrical, 5–6.5 cm long, glabrous; stigma unequally subulate, exerted beyond stamens. Capsules elongate, 10–20 x 4–4.5 cm, hard, woody, glabrous, loculicidal, distinctly valved; seeds many, subovoid, 4–5 mm across, covered with silky white cotton, brownish black.

Fl. & Fr.: Nov.–March.

Habitat: Rocky soil and exposed situations in evergreen, semievergreen and moist deciduous forests, to 800 m.

Distrib.: Idukki, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Andaman & Nicobar Islands, Assam and Peninsular India. Myanmar.

Uses: Timber is used for making match splints, boxes, toys and furniture. Flower and fruit are relished by parrots.

Note: Dunn (1916) described *Bombax scopulorum* as a new species from Koni Valley, now in Pathanamthitta District, based on a plant earlier described as *Bombax insigne* Wall. by Bourdillon. Robyns (1963) reduced it to a synonym under *B. insigne* Wall.

2. CEIBA Mill.

Deciduous trees; trunk prickled or not; branches whorled. Leaves digitately 5 - 7-foliolate, entire or dentate; stipules small. Flowers axillary or terminal, solitary or fascicled, white to pale yellow. Calyx cupular, truncate or irregularly 3-5-lobed. Petals 5, oblong to oblanceolate, pubescent or wooly, twisted in bud. Staminal tube short, divided into 5 filiform branches each bearing 2 or 3 anthers simulating a single stamen. Ovary ovoid, 5-loculed; ovules many in each locule; style cylindrical, dilated, clavate at apex; stigma obscurely 5-lobed. Capsules oblong, woody or coriaceous, densely wooly inside, 5-valved; seeds globose or obovoid, black, covered with a wool of endocarp; testa crustaceous, smooth, enveloped by silky hairs; endosperm very thin or absent; cotyledons much contorted, plicate, wrapped around incurved radicle.

Tropics especially America, 11 species and 1 in India.

Literature: Davis, T.A. & Kundu, A. 1965. Floral structure and stamens in *Ceiba pentandra* (L.) Gaertn. *J. Bombay Nat. Hist. Soc.* 62: 399 - 411. Meher-Homji, V.M. 1975. Buttress-like structures on the upper part of the trunk of *Ceiba pentandra* (L.) Gaertn. *J. Bombay Nat. Hist. Soc.* 71: 336 - 338.

***Ceiba pentandra* (L.) Gaertn.**, *Fruct. Sem. Pl.* 2: 244, t. 333, f. 1. 1791; Bakh. in *Bull. Jard. Bot. Buitenzorg* 3, 6: 194. 1924; Manilal & Sivar., *Fl. Calicut*: 50. 1982; Nicolson & al. in *Regnum Veg.* 119: 74. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 67. 1988; Vajr., *Fl. Palghat*: 87. 1990; M.P. Nayar & M.C. Biswas in B.D. Sharma & Sanjappa, *Fl. India* 3: 400. 1993; Sivar. & P. Mathew, *Fl. Nilambur*: 97. 1997. *Bombax pentandrum* L., *Sp. Pl.*: 511. 1753. *Eriodendron anfractuosum* DC., *Prodr.* 1: 479. 1824; Wight, *Icon. Pl. Ind. Orient.*: t. 400. 1840; Mast. in *Hook.f., Fl. Brit. India* 1: 350. 1874; Bourd., *Forest Trees Travancore*: 45. 1908; Rama Rao, *Fl. Pl. Travancore*: 45. 1914. *E. pentandrum* (L.) Kurz in *J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist.* 43: 113. 1874; Dunn in *Gamble, Fl. Madras*: 100(72). 1918.

Mal.: *Ilavu, Mullilavu, Panjimaram, Pooia*

Tree, to 30 m tall, buttressed; trunk straight, ca 50 cm across; branches in whorls of 3. Leaves 5 - 9-foliolate, 6 - 20 cm long; rachises 6 - 16 cm long; leaflets ovate to ovate-lanceolate, narrow at base, entire and minutely dentate towards

apex at margin, acute to acuminate or apiculate at apex, 5 - 12 x 1.5 - 4.5 cm, chartaceous or thin-coriaceous, glabrous; lateral nerves 10 - 14 pairs, distinct on both surfaces; petiolules 2 - 5 mm long. Flowers few - many, clustered in leaf axils, ca 3.5 cm long, pale yellow. Calyx campanulate, ca 1.3 cm long, 4- or 5-lobed, persistent; lobes ovate, 3-angled, glabrous outside, silky inside. Petals 5, obovate-spatulate, rounded at apex, 2 - 3 x 1 - 1.2 cm, villous outside except at base, glabrous inside, adnate to staminal tube at base. Staminal tube conic, short, glabrous. Stamens 5, ca 4 cm long; filaments 2 - 2.2 cm long. Ovary globose, 5-loculed; ovules many in each locule; style filiform, 2.5 - 2.7 cm long; stigma capitate or lobed. Capsules ellipsoid to fusiform, 10 - 12 x 3 - 4 cm, wrinkled when dry, indehiscent, valves with silky fibres; seeds numerous, subglobose, 5 - 8 x 2 - 4 mm; testa dark brown to black, covered with silky hairs.

Fl.: Nov. - Jan. *Fr.*: Feb. - April.

Habitat: Almost naturalized in evergreen and moist deciduous forests.

Distrib.: Idukki, Kannur, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Naturalized in Andaman & Nicobar Islands, S. India and W. Bengal. Tropical America; elsewhere introduced.

Uses: Root bark yields a fibre. Tree yields a dark gum used in bowel complaints as an astringent. The cotton is used for stuffing pillows and cushions.

3. CULLENIA Wight

Trees; young branches covered with peltate scales. Leaves simple, elliptic, oblong or oblong-lanceolate, entire, lepidote. Flowers fascicled on older leafless branches, densely lepidote. Calyx tubular, 5-toothed, surrounded by a tubular somewhat 3-lobed involucre, both very densely lepidote with overlapping scales. Corolla absent. Staminal tube 5-lobed, exserted; anthers small, subglobose, crowded on outside of lobes. Ovary 5-loculed; ovules 2 or more in each locule, superposed; style elongate, hairy; stigma capitate. Capsules globose, densely covered with long spines, 5-valved; seeds 1 - few, nonendospermous, enclosed by a fleshy aril; cotyledons unequal, thick, fleshy.

India and Sri Lanka, 3 species and 1 in India.

Literature: Kadambi, K. 1954. *Cullenia excelsa* Wight (*C. zeylanica* Gardner. *Durio zeylanica* Gardner). *Indian Forester* 80: 442 - 445. Kostermans, A.J.G.H. 1956. The genus *Cullenia* Wight (*Bombacaceae*). *Reinwardtia* 4: 69 - 71. Raizada, M.B. 1957. The genus *Cullenia* Wight.

Indian Forester 83: 497 - 499.

Cullenia exarillata A. Robyns in Bull. Jard. Bot. État 40: 249. 1970; Manilal, Fl. Silent Valley: 30. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 67. 1988; Vajr., Fl. Palghat: 87. 1990; M.P. Nayar & M.C. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 402. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 84. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 64. 1996; Sivar. & P. Mathew, Fl. Nilambur: 98. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 105. 2002. *C. excelsa* Wight, Icon. Pl. Ind. Orient.: tt. 1761 & 1762. 1851 p.p.; Mast. in Hook.f., Fl. Brit. India 1: 350. 1874 p.p.; Bourd., Forest Trees Travancore: 46. 1908; Rama Rao, Fl. Pl. Travancore: 46. 1914; Dunn in Gamble, Fl. Madras: 101(73). 1918.

Mal.: *Karanai, Karanini, Korongu*

Evergreen tree, to 40 m tall, buttressed; bark 1 - 1.5 cm thick, smooth, grey; branches horizontal, slender, lepidote when young. Leaves elliptic-lanceolate to oblong-, rounded or obtuse at base, entire at margin, short- to long-acuminate at apex with to 1 cm long acumen, 11 - 23 x 3.5 - 7 cm, coriaceous, glabrous; lateral nerves 12 - 18 pairs or more, obscure; petioles 1.5 - 2.5 cm long, channelled, granular. Flowers in fascicles, 20 - 25 in each, arising from bulging growth on older branches, 3 - 4.5 cm long, brownish white; pedicels 1.5 - 2 cm long, jointed, wrinkled. Calyx tubular, 2 - 3 cm long, subtended by caducous 3-toothed involucre. Staminal tube 5-lobed, 2 - 2.5 cm long, exerted; anthers clustered on staminal tube, glabrous or wooly; stigma capitate, to 1 mm long. Capsules globose, 6 - 10 cm, covered with numerous spines, yellowish brown; spines linear, broad at base, curved at apex, 1.5 - 2 cm long; seeds 8 - 10, ellipsoid, flat, 3.5 - 5 x 2 - 2.5 cm, glabrous, deep brown to black when dry.

Fl. & Fr.: Nov. - Feb.

Habitat: Wet evergreen forests, 700 - 1000 m.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Tamil Nadu. Endemic.

Uses: Fruit is relished by monkeys including the endangered lion-tailed macaque and the giant Malabar squirrel. Wood is used for sheds and huts.

3. OCHROMA Sw.

Ochroma lagopus Sw., Prodr.: 98. 1788. *Bombax pyramidale* Cav., Diss. 5: 294, t. 153. 1788. *Ochroma pyramidale* (Cav.) Urban in Feddes Repert. 5: 123. 1920; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 67. 1988.

Tree, 15 - 18 m tall. Leaves angled or 5 - 7-lobed, cordate, broad at base, nearly entire or dentate at margin, mucronate or obtuse at apex, 10 - 20 x 8 - 20 cm, glabrous above, puberulous beneath; lateral nerves 6 or 7 pairs, prominent; petioles 4 - 10 cm long, puberulous. Flowers large, terminal, pale yellow. Calyx 5-lobed with ovate or rounded lobes, 5 - 7 cm long, silky-pubescent on both sides, subtended by a caducous involucre. Petals obovate, wavy, 8 - 11 cm long, extending beyond column of stamens, yellowish white or brown. Staminal column 5-lobed with anthers above. Stigma 5, exserted. Capsules elongate, 6 - 8 cm long, 5-valved with reddish brown wool inside.

Fl. & Fr.: Nov. - Feb.

The tropical American balsa or cork tree, world's lightest commercial timber, is sometimes cultivated. Kannur and Thrissur. It is cultivated on small scale in a few other states, viz., Andaman Islands, Andhra Pradesh, Assam, Karnataka and W. Bengal.

STERCULIACEAE

(V. CHITHRA)

Trees, shrubs, rarely herbs or lianas; branchlets stellate-tomentose. Leaves alternate, stipuled, simple or digitately compound, entire, toothed or lobed. Inflorescences axillary or terminal, sometimes cauliflorous panicles, racemes or cymes, rarely flower solitary. Flowers bi- or unisexual, monoecious, actino- . rarely zygomorphic, 5-merous. Sepals 3 - 5, basally connate, valvate, persistent. Petals 5, free or connate, contorted, imbricate or valvate, usually clawed, adnate to staminal tube at base, sometimes absent. Stamens 5 - 10 in 2 whorls or many, connate into a tube, rarely free; anthers 2-loculed, parallel or diverging, rarely confluent, dorsifixed, dehiscing longitudinally, rarely poricidal, sometimes in bundles. Staminodes 5 or 10, showy, alternating with stamens or absent. Ovary superior, stipitate or not. Pistil of (1 -)5(- 60) carpels with as many locules, rarely 1-loculed; ovules (1) 2 or more in each locule on axile placenta, 2-tegmic,

crassinucellar, anatropous; styles as many as locules, free or connate, rarely eccentric; stigma capitate or lobed. Fruit a loculi- or septicidal capsule, woody or membranous, sometimes a follicle; seeds reniform or obovoid, sometimes arillate, rarely winged; endosperm copious, moderate or fleshy; embryo straight or curved; cotyledons foliaceous, flat, folded and corrugated or spirally twisted.

Tropics and subtropics, a few temperate, 67 genera and ca 1500 species, 19 and 68 in India and, 15 and 25 in Kerala.

Literature: Abedin, S. & Ghafoor, A. 1976. *Sterculiaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 99: 1 - 25. Malick, K.C. & Safui, B. 1982. A review of the androecium in *Sterculiaceae* with a key to the genera. *Bull. Bot. Surv. India* 22: 213 - 216. Sharma, B.D. 1969. Studies of Indian pollen grains in relation to plant taxonomy - *Sterculiaceae*. *Proc. Natl. Inst. Sci., Pt. B, Biol. Sci.* 35: 320 - 359. Venkata Rao, C. 1950. Pollen grains of *Sterculiaceae*. *J. Indian Bot. Soc.* 29: 130 - 131.

Key to genera

- | | |
|---|-------------------------|
| 1a. Flowers uni- and bisexual; petals absent | 2 |
| b. Flowers bisexual; petals present | 3 |
| 2a. Leaves with peltate scales beneath; fruits indehiscent | 6. Heritiera |
| b. Leaves without peltate scales; fruits with dehiscent follicles | 4 |
| 3a. Petals equal | 6 |
| b. Petals unequal, the upper with longer claws | 7. Kleinhovia |
| 4a. Follicles membranous, dehiscing before maturity | 3. Firmiana |
| b. Follicles woody or coriaceous, not dehiscing before maturity | 5 |
| 5a. Follicles subglobose or obovoid, woody; seeds winged | 12. Pterygota |
| b. Follicles oblong, coriaceous; seeds not winged | 13. Sterculia |
| 6a. Staminal tube adnate to gynophore forming a long stalk | 7 |
| b. Staminal tube distinct from carpels and enclosing them, sessile | 8 |
| 7a. Fruit a follicle, spirally twisted; seeds not winged, tubercled | 5. Helicteres |
| b. Fruit a loculicidal capsule, not twisted; seeds winged, not tubercled | 11. Pterospermum |
| 8a. Staminodes absent | 9 |
| b. Staminodes 5 or 10 | 11 |
| 9a. Petals caducous; staminal tube not toothed, with stamens on its outer surface | |
| | 2. Eriolaena |
| b. Petals marcescent; staminal tube with 5 teeth bearing anthers | 10 |

- | | | |
|------|---|-----------------------|
| 10a. | Ovary 5-loculed; style median; capsules 5-valved | 10. <i>Melochia</i> |
| b. | Ovary 1-loculed; style eccentric; capsules 2-valved | 15. <i>Waltheria</i> |
| 11a. | Petals caducous | 12 |
| b. | Petals persistent | 13 |
| 12a. | Petals appendaged; fruits many-seeded | 14 |
| b. | Petals unappendaged; fruits few-seeded | 8. <i>Leptonychia</i> |
| 13a. | Fertile stamens 5 | 9. <i>Melhania</i> |
| b. | Fertile stamens 10 - 25 | 1. <i>Dombeya</i> |
| 14a. | Staminal tube with 5 lanceolate staminodes and 5 groups of 3 fertile anthers | 4. <i>Goazuma</i> |
| b. | Staminal tube with 5 linear or lanceolate staminodes and 2 or 3 fertile anthers | 14. <i>Theobroma</i> |

1. DOMBEYA Cav., nom. cons.

Shrubs or small trees. Leaves often cordate, angled or lobed, palmately nerved. Flowers rather showy, in axillary or terminal loose cymes or crowded into dense heads, with a small unilateral sometimes united bracteoles. Calyx lobes at length reflexed, persistent. Petals 5, flat. Stamens united into a short or elongate tube bearing at apex 5 staminodes alternating with 10 - 25 anther-bearing stamens in 2 - 5 bundles. Ovary sessile, 2 - 5-loculed with 2 - many ovules in each; styles distinct or connate at base. Fruit a capsule, dehiscing loculicidally by 5 valves.

Africa and Mascarenes, ca 200 species, cultivated in tropics, ca 10 species in India and 1 in Kerala.

Dombeya calantha K. Schum. in Engl., Monogr. Afrik. Pflanzen-Fam. 5: 28. 1900; L.H. Bailey, Man. Cult. Pl.: 669. 1958; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 475. 1993.

Shrub. Leaves 3 - 5-lobed, cordate at base, coarsely dentate at margin, acuminate at apex, 9.2 - 30.2 x 7.5 - 17 cm, pubescent on both surfaces, 7-nerved at base. Corymbs axillary; peduncles, bracts and bracteoles pubescent. Flowers mildly fragrant. Sepals linear-lanceolate, acute, ca 9 x 3 mm, pubescent, persistent. Petals obliquely obovate, ca 1.3 x 1.2 cm, pinkish white, persistent. Stamens 15, alternating with 5 staminodes; staminal tube ca 2 mm long. Ovary sessile, pubescent, 5-loculed; ovules many in each locule; stigma 5-fid, reflexed. Capsules

dehiscing loculicidally.

Fl. & Fr.: Throughout the year

Cultivated in gardens for the showy flower.

2. ERIOLAENA DC.

Trees or large shrubs, stellate-pubescent. Leaves simple or lobed, cordate, crenate or serrate, stellate-pubescent, 5 - 9-nerved at base. Flowers rather large, solitary or many on axillary peduncles, bisexual; bracteoles 3 - 5, laciniate, entire or lobed, persistent or small and caducous. Calyx spathaceous, 5-fid or -partite, stellate-pubescent. Petals 5, flat with dilated tomentose claws, caducous. Stamens many, connate in a short column; anthers many-seriate; staminodes absent. Ovary sessile, 5 - 10-loculed; ovules many in each locule; style simple; stigmas 5 - 10, spreading. Capsules woody, loculicidal; seeds ascending, winged above; endosperm scanty; cotyledons conduplicate or contortuplicate.

South and SE. Asia, 17 species, 7 in India and 2 in Kerala.

Key to species

- 1a. Leaves membranous, greyish-white-pubescent beneath; buds oblong, constricted in middle; petals yellow 1. *E. lushingtonii*
- b. Leaves chartaceous or coriaceous, creamy-white-pubescent beneath; buds ovoid; petals white 2. *E. quinquelocularis*

1. *Eriolaena lushingtonii* Dunn in Bull. Misc. Inform. 1915: 88. 1915 & Gamble, Fl. Madras: 109(78). 1915; Ahmedul. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 251. 1990; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 251. 1993; Pandur. & V.J. Nair in J. Econ. Tax. Bot. 17: 176. 1993.

Tree, 4 - 5 m high. Leaves orbicular to ovate, rounded or cordate at base, irregularly dentate at margin, acuminate at apex, 5 - 9 x 4 - 7 cm, stellate-pubescent above, greyish-white-pubescent beneath. Flowers 1 - 3 in axillary cymes, fragrant; bracteoles laciniate, 5 - 6 mm long; pedicels and bracteoles pubescent. Sepals linear, acuminate, 1.8 - 2.2 x 0.2 - 0.3 cm, stellate-tomentose outside, pubescent inside. Petals obovate, 1.8 - 2 x 0.9 - 1.1 cm, yellow with tomentose claws. Stamens 12 - 15; staminal tube 1.2 - 1.4 cm long, pubescent; anthers linear, basifixed. Ovary ovoid, 5 - 6 x 4 - 5 mm, pubescent, 5-loculed; style pubescent; stigma minutely 5-lobed. Capsules ovoid, short-acuminate, 1.2 - 1.5 x 0.5 -

0.7 cm, woody, pubescent; seeds winged above.

Fl. & Fr.: June - Aug.

Habitat: Open slopes in moist deciduous forests, 350 - 900 m.

Distrib.: Idukki. Andhra Pradesh (Nallamalais), Karnataka and Tamil Nadu. Endemic and endangered.

2. *Eriolaena quinquelocularis* (Wight & Arn.) Wight, Icon. Pl. Ind. Orient.: t. 882. 1847; Mast. in Hook.f., Fl. Brit. India 1: 371. 1874; Bourd., Forest Trees Travancore: 52. 1908; Rama Rao, Fl. Pl. Travancore: 50. 1914; Dunn in Gamble, Fl. Madras: 110(78). 1915; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 418. 1993. *Microchlaena quinquelocularis* Wight & Arn., Prodr. Fl. Ind. Orient.: 71. 1834.

Mal.: *Vetinar*

Small tree. Leaves orbicular, cordate at base, crenate-serrate at margin, acute or acuminate at apex, 7 - 19 x 5 - 13 cm, stellate-pubescent or glabrescent above, creamy-white-pubescent beneath. Cymes 1 - 3-flowered; peduncles longer than leaves, pubescent; pedicels jointed above middle. Flowers mildly fragrant. Sepals linear-oblong or lanceolate, acute, 2 - 2.5 x 0.3 - 0.5 cm, stellate-pubescent, glandular at base inside. Petals obovate-oblong with a broad claw, ca 2 x 0.8 cm, pubescent, white. Staminal column 1.6 - 1.9 cm long. Ovary and lower portion of style pubescent. Capsules oblong-ovoid, beaked, ca 3 x 2.5 cm, woody, 5-loculed, 5 - 10-valved; valves villous at inner angle; seeds numerous; wings papery, falcate.

Fl. & Fr.: May - Oct.

Distrib.: Idukki, Kottayam and Wynad. Bihar, Karnataka, Maharashtra, Rajasthan and Tamil Nadu. Endemic.

Uses: Wood is strong and useful. A poultice made from root is applied for healing wounds.

3. FIRMIANA Marsili

Medium-sized or large trees, deciduous. Leaves long-petioled, often cordate, ovate-elliptic to elliptic, palmately 3 - 5-lobed, glabrous or stellate-pubescent; stipules lanceolate, caducous. Inflorescences terminal coralliform panicles, stellate-pubescent. Flowers uni- or bisexual, stellate-pubescent, brightly coloured. Calyx tubular, 5-lobed to middle or less, usually with nectariferous disc at base

inside, often orange or rusty red in bud. Petals absent. Stamens 10(-30); staminal tube slender; anthers sessile or on short filaments, 2-loculed. Carpels 5, free; ovules 2-4 or rarely 6; styles free, short; stigma recurved. Fruit of 5 stalked follicles, membranous, dehiscing before maturity; seeds 2-4, ovoid, smooth, wrinkled when dry.

Old World tropics, E. Africa eastwards, 12 species, 2 in India and 1 in Kerala.

Literature: Kostermans, A.J.G.H. 1957. The genus *Firmiana* Marsili (Sterculiaceae). *Reinwardtia* 4: 281-310.

Firmiana colorata (Roxb.) R. Br. in Benn., *Pl. Jav. Rar.*: 235. 1844; Dunn in Gamble, *Fl. Madras*: 107(76). 1915; Manilal, *Fl. Silent Valley*: 31. 1988; Vajr., *Fl. Palghat*: 88. 1990; Malick in B.D. Sharma & Sanjappa, *Fl. India* 3: 420. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 65. 1996; N. Mohanan & Sivad., *Fl. Agasthyamala*: 106. 2002. *Sterculia colorata* Roxb., *Pl. Coromandel* 1: 26, t. 25. 1795 quoad t., excl. descr.; Mast. in Hook.f., *Fl. Brit. India* 1: 359. 1874. *S. rubicunda* Wall. ex Mast. in Hook.f., *Fl. Brit. India* 1: 360. 1874.

Mal.: *Mala-paruthi*

Tree, to 25 m tall, buttressed; bark fissured. Leaves variable in shape and size, palmately 3-5-lobed, cordate at base; lobes 3-angled, entire, obtuse or acute to acuminate at apex, 14-22 x 17-24 cm, wooly beneath; petioles 15-28 cm long; stipules lanceolate. Panicles short, terminal or from axils of fallen leaves, rusty-brown-stellate-tomentose. Calyx tube infundibuliform, slightly curved, densely covered with minute hairs and scales, wooly at base inside, orange; lobes 5, 3-angled, acute, 4-6 mm long. Staminal column red, with 10-30 sessile yellow anthers. Male flowers with 5 free pistillodes. Ovary oblong or flask-shaped, 5-loculed; ovules 2 in each locule; style short, recurved; stigmas 5, peltate, recurved. Follicles 5, stalked, oblong, 4.5-7 cm long, membranous, straw-coloured; seeds 2, ovoid, compressed, wrinkled or smooth, yellow.

Fl. & Fr.: Jan. - May.

Habitat: Deciduous forests, to 600 m.

Distrib.: Ernakulam, Kasaragod, Kottayam, Palakkad, Thiruvananthapuram and Thrissur. Throughout India including Andaman Islands. South and SE. Asia.

Uses: Bark yields a fibre used for ropes. Leaf makes a good fodder. Wood is suitable for paper pulp.

4. GUAZUMA Mill.

Trees, stellate-tomentose or glabrous. Leaves simple, often oblique at base, tomentose. Flowers bisexual, in axillary cymes. Calyx 2 - 5-partite. Petals 5, clawed, hooded-concave at base; hood with apex inflexed and produced into 2 slender ligulate appendages. Staminal tube with 5 lanceolate staminodes alternating with 5 groups of 3 fertile anthers each; anthers divaricate. Ovary 5-lobed, 5-loculed; ovules numerous; styles more or less connate. Capsules globose, woody, muricate or armed with very long softly plumose bristles, septically 5-valved; seeds many, endospermous; cotyledons foliaceous, inflexed-plicate.

Tropical America, elsewhere cultivated and/or naturalized, 4 species and 1 in India.

Guazuma ulmifolia Lam., *Encycl.* 3: 52. 1789; Malick in B.D. Sharma & Sanjappa, *Fl. India* 3: 424. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 85. 1994. *G. tomentosa* Kunth in Humb. & al., *Nov. Gen. Sp.* 5: 320. 1823; Bedd., *Fl. Sylv. S. India*: t. 107. 1871; Mast. in Hook.f., *Fl. Brit. India* 1: 375. 1874; Bourd., *Forest Trees Travancore*: 54. 1908; Rama Rao, *Fl. Pl. Travancore*: 51. 1914; Dunn in Gamble, *Fl. Madras*: 111(79). 1915.

Mal.: *Rudraksham, Utharasham*

Small or medium-sized tree. Leaves lanceolate, oblong-lanceolate or ovate, obliquely cordate at base, serrulate at margin, acuminate at apex, 4 - 17 x 2 - 10 cm, stellate-pubescent on both surfaces. Cymes axillary and terminal; bracts and bracteoles subulate, caducous. Sepals 3 - 5, connate, elliptic-lanceolate or ovate, 2 - 3 x 1 - 2 mm, subequal, tomentose outside. Petals obovate, ca 3 x 2 mm, concave with 2 apical 3 - 4 mm long appendages. Staminal tube ca 3 mm long; staminodes petaloid. Ovary globose, stellate-tomentose. Capsules subglobose, 1 - 2 x 1 - 1.5 cm, woody, tubercled.

Fl. & Fr.: April - Dec.

Habitat: Plains and coastal regions.

Distrib.: Idukki, Kollam, Kottayam, Kozhikode and Thiruvananthapuram. Cultivated and naturalized in the Indian subcontinent.

Uses: Wood called the bastard cedar is used for furniture, panels of coaches, packing cases and casks; used as fuel and for making charcoal. Young branch yields a fibre used for ropes. Fruit contains a sweet edible mucilage. Infusion of old bark is useful in cutaneous and chest diseases. Leaf makes a good fodder.

5. HELICTERES L.

Trees or shrubs, more or less stellate-pubescent. Leaves simple, entire or serrate; stipules caducous. Inflorescences axillary few-flowered fascicles or flower solitary. Flowers bisexual, actino- or zygomorphic. Calyx tubular, 5-fid; lobes often unequal. Petals 5, equal or somewhat 2-lipped; claws often with auricled appendages. Staminal column adnate to gynophore, truncate or 5-toothed or -lobed at apex or bearing 5 antherless segments and 1 or 2 anthers in sinuses; anther lobes divaricate or confluent. Ovary at top of column, 5-lobed, 5-loculed; ovules many in each locule; styles 5, subulate, more or less connate, slightly swollen and stigmatose at apex. Follicles spirally twisted or straight, dehiscing by ventral sutures; seeds tubercled; endosperm scanty; cotyledons foliaceous, spirally twisted.

Tropical Asia and America. ca 40 species, 5 in India and 1 in Kerala.

Helicteres isora L., Sp. Pl.: 963. 1753; Wight, Icon. Pl. Ind. Orient.: t. 180. 1839; Mast. in Hook.f., Fl. Brit. India 1: 365. 1874; Rama Rao, Fl. Pl. Travancore: 48. 1914; Dunn in Gamble, Fl. Madras: 107(77). 1915; Manilal & Sivar., Fl. Calicut: 51. 1982; Nicolson & al. in Regnum Veg. 119: 253. 1988; Manilal, Fl. Silent Valley: 31. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 67. 1988; Vajr., Fl. Palghat: 89. 1990; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 426. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 85. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 66. 1996; Sivar. & P. Mathew, Fl. Nilambur: 99. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 107. 2002.

Mal.: *Isvarmuri, Kaivum, Valumburi*

Large shrub or small tree. Leaves oblong, obovate or orbicular, sometimes slightly lobed, oblique, rounded or cordate at base, irregularly crenate-serrate at margin, abruptly acuminate or rounded at apex, 6 - 14 x 3 - 10 cm, tomentose on both surfaces; stipules subulate, caducous. Flowers 5 - 8 in axillary fascicles; bracts and bracteoles subulate, hairy. Calyx tubular, ca 2 cm long, 2-lipped, ob-

lique, laterally compressed; lobes 3-angled, unequal, stellate-tomentose outside, persistent. Petals free, 4 - 5 cm long, unequal, closely reflexed on calyx; lower pair shortly clawed; upper ones obovate, red fading to lead colour. Staminal tube cupular, 3 - 4 cm long; anthers 10 in a ring; staminodes 5. Ovary conic, on a gynophore; style deflexed. Follicles of 5 spirally twisted carpels, cylindric, ca 6.5 x 0.7 cm, beaked, woody, stellate-tomentose; seeds angled.

Fl. & Fr.: Aug. - May.

Habitat: Undergrowth in semievergreen forests.

Distrib.: Throughout Kerala. Throughout India. South and SE. Asia to Australia.

Uses: Root and bark are useful in colic, scabies, empyema, gastropathy, diabetes, diarrhoea and dysentery. Fruit is useful in conditions of pitta, ophthalmitis, colic, flatulence, diarrhoea, dysentery, verminosis, wounds, ulcers, haemorrhages, epistaxis and diabetes. Fibre from stem is used for rough sacks or canvas and as cordage for sewing gunny bags and cattle harness. Stalk and twig are used to manufacture writing and printing paper. Charcoal from wood is useful for gun powder. Tender branch makes a good fodder.

6. HERITIERA Aiton

Trees, usually buttressed. Leaves simple, digitate or 1-foliolate, peltate, usually finely-silvery-lepidote beneath, pinnately nerved. Panicles axillary. Flowers unisexual; pedicels jointed. Calyx campanulate or urceolate, 4 - 6-lobed. Petals absent. Staminal column with a ring of 4 or 5 anthers or irregular clusters overtopped by minute rudimentary carpels or the latter reduced. Female flowers similar to male ones. Carpels 4 - 6, loosely connivent, alternating at base with pairs of staminodes, 1- or 2-ovuled; style short; stigma minute. Fruiting carpels free, samaroid, indehiscent; seeds nonendospermous; cotyledons thick.

Tropical Africa, Indomalaysia to Australia, ca 30 species, 5 in India and 2 in Kerala.

Literature: Kostermans, A.J.G.H. 1959. A monograph of the genus *Heritiera* Aiton. *Reinwardtia* 4: 465 - 583.

Key to species

- | | | |
|-----|---|-------------------------|
| 1a. | Leaves elliptic-oblong; nut of samaras much longer than wing | 1. <i>H. littoralis</i> |
| b. | Leaves lanceolate or ovate-lanceolate; nut of samaras shorter than wing | 2. <i>H. papilio</i> |

1. **Heritiera littoralis** Dryand. in Aiton, Hort. Kew. 3: 546. 1789; Mast. in Hook. f., Fl. Brit. India 1: 363. 1874; Bourd., Forest Trees Travancore: 51. 1908; Rama Rao, Fl. Pl. Travancore: 48. 1914; Dunn in Gamble, Fl. Madras: 104(74). 1915; Nicolson & al. in Regnum Veg. 119: 253. 1988; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 429. 1993.

Mal.: *Mukuram, Nakam*

Tree, 10–25 m tall; bark furrowed, grey-brown; young parts scaly. Leaves elliptic-oblong, rounded to cordate and often oblique at base, entire at margin, acute, obtuse or rounded at apex, 9–28 x 3–8.5 cm, coriaceous, silvery beneath; stipules lanceolate, caducous. Panicles axillary, drooping, much branched, tomentose. Male flowers smaller than female ones. Calyx campanulate, ca 4 x 2 mm, orange yellow; lobes 4, rarely 5 or 6, ovate, acute. Male flowers: Staminal tube shorter than calyx; anthers 4, rarely 5, sessile, surmounted by minute sterile ovaries. Female flowers: Ovaries 4 or 5, broadly ovoid, smooth or tubercled, winged on outer margin; style as long as ovary; stigma curved outwards. Staminodes in 4 groups of 2 at base of ovaries. Samaras ellipsoid, ca 4 x 3 cm, tubercled or smooth, light brown; seeds subglobose, light brown.

Fl. & Fr.: Feb.–May.

Habitat: Along backwaters, rare.

Distrib.: Ernakulam (Kochi, Dunn, *l.c.*) and Kollam. Andaman & Nicobar Islands, E. & W. Coasts of S. India, Meghalaya and W. Bengal. Africa, Australia, Hawaii, Malesia, New Caledonia, Pacific Islands and Taiwan.

Uses: Timber is used for building boats, canoes, ships, wharfs, bridges, piling posts, rafters, beams, poles, furniture, levers, tool handles, mallets etc. It is a good fuel wood. Seed is edible. Decoction of seed is used in diarrhoea and dysentery. Tannin from bark is used for toughening fishing nets.

2. **Heritiera papilio** Bedd., Fl. Sylv. S. India: t. 218. 1872; Mast. in Hook. f., Fl. Brit. India 1: 363. 1874; Bourd., Forest Trees Travancore: 52. 1908; Rama Rao, Fl. Pl. Travancore: 48. 1914; Dunn in Gamble, Fl. Madras: 104(74). 1915; Manilal, Fl. Silent Valley: 32. 1988; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 430. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 85. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 66. 1996.

Tree, 10 - 15 m tall; branchlets golden-tomentose; bark fissured. Leaves lanceolate or ovate-lanceolate, obtuse or rounded at base, entire at margin, acute at apex, 5 - 12.5 x 2 - 5 cm, coriaceous, smooth, shining above, with an appressed layer of tiny scales beneath; stipules ovate, caducous. Panicles axillary, lax, rusty-pubescent. Calyx campanulate, 4 - 5 mm long; lobes 5, broadly ovate, acute, cream or pale yellow. Male flowers: Anthers 5 in a regular ring on an androgynophore topped by a sterile ovary. Female flowers: Similar to male ones; ovaries 5 or 6, sessile, pubescent when young, with a pair of staminodes between each; styles and stigmas recurved; fruit of 1 - 6 samaroid carpels, 5 - 7 cm long, red, 1-seeded.

Fl.: Jan. May, Aug. Sept. *Fr.*: Feb. March.

Habitat: Subtropical forests, to 900 m.

Distrib.: Palakkad, Thiruvananthapuram and Thrissur. Assam, Karnataka, Meghalaya, Mizoram and Tamil Nadu. Bangladesh.

Use: Wood is used for building purposes, cart poles and agricultural implements.

7. KLEINHOVIA L.

Trees. Leaves simple, ovate, acuminate, palmately nerved. Flowers in large terminal cymose panicles, bisexual, zygomorphic; bracteoles ensiform, remote from calyx. Sepals 5, free or basally connate, longer than petals, caducous. Petals 5, unequal, clawed, involute at margin. Staminal column broadly campanulate, adnate to gynophore, with 3 anther-bearing segments alternating with antherless teeth; anther lobes divaricate. Ovary inserted within dilated apex of staminal column, 5-lobed, 5-loculed; ovules 3 or 4 in each locule; style slender, divided. Capsules pyriform, 5-lobed, inflated, membranous, loculicidally 5-valved; seeds 1, rarely 2 in each locule, globose, tubercled; endosperm scanty or absent; cotyledons convolute.

Tropical Asia to Australia, unispecific. Commonly cultivated.

Kleinhovia hospita L., Sp. Pl. ed. 2, : 1365. 1763; Bedd., Fl. Sylv. S. India, For. Man.: t. 4, f. 4. 1871; Mast. in Hook.f., Fl. Brit. India 1: 364. 1874; Rama Rao, Fl. Pl. Travancore: 49. 1914; Dunn in Gamble, Fl. Madras: 113(81). 1915; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 434. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 89. 1994.

Medium-sized tree; branchlets tomentose. Leaves broadly ovate or sub-orbicular, cordate at base, entire at margin, acuminate at apex. 10 - 15 x 8 - 12 cm, glabrous; stipules ensiform. Panicles large, terminal; bracteoles linear to ensiform. Sepals 5, linear-lanceolate, 6 - 7 mm long, basally connate, pubescent outside. Petals 5, unequal, shorter than sepals, rosy. Staminal tube adnate to gynophore with a 5-fid cup at top, each segment with 3 anthers; staminodes 5, acute. Ovary 5-loculed; style slender, divided. Capsules pyriform, inflated, membranous, loculicidal, 5-valved; seeds tubercled.

Fl. & Fr.: Sept. - Dec.

Cultivated in gardens and avenues for the showy flower in hotter parts of India.

Uses: Young leaf and flower are eaten as a vegetable. Decoction of leaf is used in skin eruptions and scabies; leaf juice is used as an eye wash. Bark and leaf are used as hair wash to destroy lice. Bark yields a strong fibre used for ropes.

8. LEPTONYCHIA Turcz.

Shrubs or small trees. Leaves oblong to elliptic, acuminate. Flowers subsessile, in axillary cymose clusters, bisexual. Sepals 5, free, valvate. Petals 5, orbicular, concave, free or connate into a ring, valvate. Staminal tube short; filaments 3-seriate; outer series with 10 - 15 ligulate staminodes; middle one with 10 fertile stamens and the innermost with 5 short fleshy staminodes. Ovary 5 - 3-loculed; ovules many in each locule; style simple; stigma 5 - 3-fid. Capsules coriaceous, dehiscent loculicidally or irregularly; seeds membranous, with an orange aril; cotyledons flat, foliaceous.

Old World tropics, ca 45 species and 1 in India.

Literature: Veldkamp, J.E. & Flippi, R.C.H. 1987. A revision of *Leptonychia* (*Sterculiaceae*) in Southeast Asia. *Blumea* 32: 443 - 457.

Leptonychia caudata (Wall. ex G. Don) Burret in Notizbl. Bot. Gart. Berlin-Dahlem 9: 729. 1926; R. Dutta in B.D. Sharma & Sanjappa, *Fl. India* 3: 435. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 66. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 100. 1997. *Grewia caudata* Wall. ex G. Don, *Gen. Hist.* 1: 547. 1831. *Leptonychia moacurroides* Bedd., *Fl. Sylv. S. India*: t. 114. 1871; Mast. in Hook.f., *Fl. Brit. India* 1: 379. 1874; Bourd., *Forest Trees Travancore*: 55. 1908; Rama Rao, *Fl. Pl. Travancore*: 51. 1914; Dunn in Gamble, *Fl. Madras*: 112(80). 1915;

R.S. Rao in J. Bombay Nat. Hist. Soc. 55: 377. 1958; Manilal, Fl. Silent Valley: 32. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 68. 1988; Vajr., Fl. Palghat: 89. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 85. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 108. 2002. *Paragrewia poilanei* Gagnep. ex R.S. Rao in J. Bombay Nat. Hist. Soc. 51: 671. 1953.

Small tree. Leaves lanceolate-elliptic or oblanceolate, rounded or acute at base, entire at margin, acuminate at apex, 6.8 - 17 x 1.7 - 5.7 cm, glabrous; stipules lanceolate, caducous. Flowers axillary, solitary or to 7 in short cymes. Sepals 5, linear-lanceolate, 6 - 7 x 1 - 1.5 mm, pubescent. Petals 5, orbicular, ca 3 mm, densely villous, yellow or greenish white. Staminal tube short. Ovary obovoid, 4-lobed; ovary and style pubescent; stigma indistinctly 2- or 3-lobed. Capsules globose to obovoid, 1.5 - 2 x 1.2 - 1.5 cm, tubercled, irregularly 2-valved, 1-3-seeded; seeds black with an orange aril.

Fl. & Fr.: July - March.

Habitat: Evergreen forests, 500 - 1000 m.

Distrib.: Idukki, Kannur, Malappuram, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Andaman Islands, Karnataka and Tamil Nadu. South and SE. Asia.

9. MELHANIA Forssk.

Herbs, shrubs or undershrubs, soft-tomentose. Leaves simple, linear-oblong, ovate or cordate, crenate or serrate, tomentose; stipules filiform. Flowers bisexual, axillary, solitary or in few-flowered cymes; bracteoles 3, cordate, sometimes reniform, often longer than calyx, persistent. Calyx 5-partite. Petals 5, marcescent around ovary. Stamens 5, alternating with 5 ligulate staminodes, all connate into a short cup. Ovary sessile, 5-loculed; ovules 1 - many in each locule; style short, 5-lobed, subulate; lobes stigmatose on inner side. Capsules loculicidal; seeds endospermous; cotyledons plicate, 2-partite.

Old World tropics, ca 60 species, 7 in India and 1 in Kerala.

Melhania incana B. Heyne ex Wight & Arn., Prodr. Fl. Ind. Orient.: 68. 1834; Mast. in Hook.f., Fl. Brit. India 1: 372. 1874; Dunn in Gamble, Fl. Madras: 113(81). 1915; Vajr., Fl. Palghat: 89. 1990; R. Dutta in B.D. Sharma & Sanjappa. Fl. India 3: 439. 1993.

Undershrub; branchlets stellate-tomentose. Leaves oblong, lanceolate or

elliptic, obtuse, rounded or subcordate at base, crenate-serrate at margin, obtuse-apiculate at apex, 1.5 - 3.5 x 0.5 - 1.5 cm, chartaceous, tomentose beneath; stipules filiform. Cymes 1 - few-flowered; bracteoles 3, linear-oblong, ca 4 mm long. Calyx tube ca 2 mm long; lobes lanceolate, acute, tomentose, accrescent. Petals obovate or orbicular, ca 9 mm, yellow. Staminal tube ca 2 mm long; staminodes linear. Ovary ovoid, 5-lobed; ovules 2 in each locule; style ca 3 mm long, 5-fid. Capsules globose or ovoid, ca 8 mm across; seeds ovoid, angled, tubercled.

Fl. & Fr.: Dec. - March.

Habitat: Open dry places in plains and scrub forests in foothills.

Distrib.: Palakkad. Southern India. Australia.

10. MELOCHIA L.

Herbs, shrubs or rarely trees, with stellate and simple indumentum. Leaves simple, serrate. Flowers in axillary or terminal fascicles, panicles, corymbs or spike-like thyrses, bisexual. Calyx campanulate, sometimes inflated, 5-toothed or -fid. Petals 5, spatulate or oblong, marcescent. Stamens 5, connate, opposite petals; staminodes minute or absent. Ovary sessile or subsessile, 5-loculed; ovules 2 in each locule; styles 5, free or connate at base. Capsules globose or subglobose, loculicidally 5-valved; each locule 1-seeded; seeds endospermous; cotyledons flat.

Tropics especially America, 54 species, 3 in India and 2 in Kerala.

Key to species

- | | | |
|-----|--|----------------------------|
| 1a. | Herb; filaments united half way or more; capsules globose | 1. <i>M. corchorifolia</i> |
| b. | Shrub; filaments united almost to tip; capsules subglobose | 2. <i>M. nodiflora</i> |

1. *Melochia corchorifolia* L., Sp. Pl.: 675. 1753; Mast. in Hook.f., Fl. Brit. India 1: 374. 1874; Rama Rao, Fl. Pl. Travancore: 50. 1914; Dunn in Gamble, Fl. Madras: 110(79). 1915; Manilal & Sivar., Fl. Calicut: 51. 1982; Nicolson & al. in Regnum Veg. 119: 254. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 68. 1988; R. Dutta in B.D. Sharma & Sanjappa, Fl. India 3: 441. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 86. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 67. 1996; Sivar. & P. Mathew, Fl. Nilambur: 100. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 108. 2002.

Mal.: *Cheruran*

Herb or undershrub. Leaves ovate-lanceolate, sometimes 3-lobed, rounded or truncate at base, serrate-dentate at margin, acute at apex, 0.7 - 5 x 0.5 - 2.5 cm, glabrous or with scattered stellate hairs; stipules lanceolate, ciliate. Cymes terminal or axillary, dense; bracts and bracteoles lanceolate-subulate, pubescent. Calyx cupular, ca 2 mm long; lobes lanceolate, ciliate-hairy outside. Petals oblong-obovate, ca 4 mm long, hispid, white, yellow or pink. Staminal tube ca 1.5 mm long. Ovary ovoid-oblong, ca 1 mm long, pubescent; styles long. Capsules globose, 3 - 5 mm across, loculicidal; seeds ovoid, 3-gonous, mottled black and grey.

Fl. & Fr.: July - March.

Habitat: Weed on roadsides, wastelands, bunds of rice fields and fallow lands.

Distrib.: Throughout Kerala. Throughout India. Pantropical.

Uses: Leaf is eaten as a vegetable or used in soups; applied as a poultice on sores and swellings of abdomen. Decoction of leaf and root is used in dysentery. Stem bark yields a strong silvery white fibre used for fishing-lines.

2. **Melochia nodiflora** Sw., Prodr.: 97. 1768; Sreek. & N.C. Nair in J. Bombay Nat. Hist. Soc. 78: 424. 1981; Maiti & al. in J. Econ. Tax. Bot. 3: 178. 1982; R. Dutta in B.D. Sharma & Sanjappa, Fl. India 3: 442. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 86. 1994.

Shrub or undershrub. Leaves broadly ovate or ovate-lanceolate, cordate at base, serrate at margin, acuminate at apex, 3 - 16.5 x 0.75 - 7 cm, sparsely pubescent on both surfaces; stipules lanceolate, pubescent. Flowers in a cluster of 3 - 15, axillary; bracts ovate-lanceolate, foliaceous. Calyx lobes connate for about 1/2, ovate-lanceolate, acuminate, 2 - 3 x 1 - 1.5 mm, sparsely pubescent. Petals spatulate, 3 - 4 x 1.5 - 2 mm, white with purple nerves. Staminal tube ca 2.5 mm long; anthers extrorse. Ovary 3.5 - 4 mm long, hispid; styles 5, free or slightly connate at base. Capsules subglobose, longitudinally 5-grooved, hispid, reddish when young; seeds 3-gonous, brown with a white spot at tip.

Fl.: Oct. - Feb. *Fr.*: Nov. - April.

Habitat: Stream sides and other wet places.

Distrib.: Thiruvananthapuram. Bihar and W. Bengal. Native to tropical America, naturalized.

Excluded species

Rama Rao (*l.c.*) who included *M. umbellata* (Houtt.) Stapf did not specify a locality. Kerala was included in distribution in *Wealth of India* (6: 344. 1962). But then, there is no specimen.

11. PTEROSPERMUM Schreb., nom. cons.

Trees or shrubs, lepidote or stellate-tomentose. Leaves oblong, oblong-lanceolate or obovate, cordate, sometimes peltate, often oblique, entire or serrate, coriaceous, pinnately nerved, 3-7-nerved at base. Flowers bisexual, axillary and terminal, solitary or, 2 or 3 together; bracteoles 3, entire or laciniate, persistent or not. Calyx tubular, 5-fid or -partite, caducous. Petals 5, obovate, oblong or linear, caducous. Staminal column adnate to gynophore, divided at apex into 5 ligulate staminodes alternating with 5 groups of 3 fertile stamens each; anthers linear, apiculate. Ovary within top of staminal column, 5-loculed; ovules many in each locule; style simple; stigma cupular, 5-grooved. Capsules ovoid or oblong, terete or angled, woody, loculicidal, 5-valved; seeds winged above; endosperm thin or absent; cotyledons corrugated or plicate.

Tropical Asia, ca 25 species, 11 in India and 6 in Kerala.

Key to species

- | | | |
|-----|--|-----------------------------------|
| 1a. | Leaves less than 8 cm long, inconspicuously reticulate | 5. <i>P. rubiginosum</i> |
| b. | Leaves more than 8 cm long, conspicuously reticulate | 2 |
| 2a. | Sepals less than 4 cm long | 3 |
| b. | Sepals more than 4 cm long | 4 |
| 3a. | Leaves acuminate at apex; capsules acute at angles, not tubercled | 4. <i>P. reticulatum</i> |
| b. | Leaves obtuse or bilobed at apex; capsules obtuse at angles, tubercled | 3. <i>P. obtusifolium</i> |
| 4a. | Bracteoles linear, entire, ligulate | 2. <i>P. diversifolium</i> |
| b. | Bracteoles palmatifid or laciniate | 5 |
| 5a. | Leaves 8 - 18 x 4 - 13 cm; capsules pyriform, horned; locules 8 - 10-seeded | 6. <i>P. xylocarpum</i> |
| b. | Leaves 18 - 32 x 10 - 28 cm; capsules oblong, tubercled; locules more than 10-seeded | 1. <i>P. acerifolium</i> |

1. *Pterospermum acerifolium* (L.) Willd., Sp. Pl. 3: 729. 1800; Wight, Icon. Pl. Ind. Orient.: t. 631. 1843; Mast. in Hook.f., Fl. Brit. India 1: 368. 1874; Vajr., Fl. Palghat: 90. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 448. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 86. 1994. *Pentapetes acerifolia* L., Sp. Pl.: 698. 1753.

Tree, 12 - 15 m tall; bark smooth, ash-coloured; branchlets ferruginous-tomentose. Leaves polymorphous, obovate to orbicular or oblong, cordate, sometimes peltate at base, coarsely serrate at margin, entire or sinuately lobed at apex, 18 - 32 x 10 - 28 cm, grey-tomentose beneath; stipules multifid, caducous. Flowers axillary, solitary or, in 2- or 3-flowered cymes, fragrant; bracts semilunar; bracteoles laciniate, caducous. Sepals linear-oblong, obtuse, 11 - 12.5 x 0.7 - 1.4 cm, fleshy, densely tomentose outside, villous inside. Petals linear-oblong, 8 - 10 x 0.7 - 1.2 cm, slightly shorter than sepals, stellate-pubescent outside, white. Staminodes ca 6 cm long, clavate. Ovary oblong, 5-loculed; ovules many in 2 rows; stigma clavate. Capsules stalked, oblong, 7.5 - 14 cm long, 5-angled, woody, brown-tubercled; seeds obliquely ovoid, compressed, with a large membranous wing.

Fl. & Fr.: March - May.

Habitat: Moist deciduous and semievergreen forests, occasional.

Distrib.: Palakkad and Thiruvananthapuram. Tropical India. Asia.

Uses: Commonly planted in gardens and avenues. Timber is used for planks, packing cases, turnery articles, veneers, constructional works, panelling, bridges, furniture, boats etc. Flower is edible; used to cure inflammation, ulcers, tumours and leprosy; employed as an insect-repellant and as a disinfectant; smoked with tobacco. Leaf is used as a platter and for thatching huts and packing material for tobacco.

2. *Pterospermum diversifolium* Blume, Bijdr.: 88. 1825; Mast. in Hook.f., Fl. Brit. India 1: 369. 1874; Dunn in Gamble, Fl. Madras: 108(78). 1915; Nicolson & al. in Regnum Veg. 119: 254. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 68. 1988; Vajr., Fl. Palghat: 90. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 449. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 87. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 67. 1996; Sivar. & P. Mathew, Fl. Nilambur: 101. 1997. *P. glabrescens* Wight & Arn., Prodr. Fl. Ind. Orient.: 69. 1834; Mast. in Hook.f., Fl. Brit. India 1: 369. 1874; Bourd., Forest Trees

Travancore: 54. 1908; Rama Rao, Fl. Pl. Travancore: 50, 1914.

Mal.: *Malavurum*, *Pambaram*

Medium-sized tree; bark brown, mottled with green and white. Leaves obovate-oblong or broadly elliptic, rarely panduriform, cordate at base, entire or sinuate at margin, abruptly acuminate at apex, 15 - 30 x 7 - 20 cm, coriaceous, silvery beneath; young leaves peltate and lobed; stipules lanceolate, caducous. Flowers axillary, solitary or in pairs, fragrant. Sepals linear-oblong, 10 - 12 x 0.4 - 0.5 cm, fleshy, rusty-tomentose outside, silky yellow inside. Petals spatulate, 10 - 12 cm long. Stamens ca 8 cm long; staminodes ca 10 cm long. Ovary ca 1.5 cm long, downy. Capsules subclavate-oblong, acutely 5-angled, 10 - 12.5 x 2 - 2.5 cm, woody, brown; seeds winged at one end.

Fl. & Fr.: Aug. - Nov.

Habitat: Evergreen forests, 300 - 900 m.

Distrib.: Ernakulam, Idukki, Kannur, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Peninsular India. Malasia.

Uses: Timber is used for building construction, furniture, vehicle shafts, household and agricultural implements, turnery and combs; also for bullock carts, bridges, boats, oars etc.; yields a pulp which produces paper of silky appearance. Bark is chewed with betel leaf as a masticatory; used for dyeing fishing nets and cloth. Root bark is a fish poison.

3. *Pterospermum obtusifolium* Wight ex Mast. in Hook.f., Fl. Brit. India 1: 369. 1874; Dunn in Gamble, Fl. Madras: 108(77). 1915; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 450. 1993.

Tree. Leaves obovate-oblong, slightly oblique, cuneate at base, entire, coarsely dentate at margin near apex, obtuse or 2-lobed at apex, 7.5 - 17 x 3.5 - 6.5 cm, coriaceous, glabrescent above, ashy-tomentose beneath. Cymes axillary; bracteoles laciniate. Sepals linear-lanceolate, ca 2.5 x 0.5 cm, stellate-tomentose. Petals oblanceolate, ca 2.2 x 0.8 cm, clawed. Stamens 15; staminal tube ca 2 mm long; staminodes 5, filiform, stellate-pubescent. Ovary globose, ca 2.3 cm, pubescent. Capsules oblong, obtusely angled, 6.5 - 8.5 cm long, tubercled.

Fl. & Fr.: March - Aug.

Habitat: Low elevations.

Distrib.: Malabar (Masters, *l.c.*) and Travancore (Dunn, *l.c.*). Andhra Pradesh and Tamil Nadu. Endemic and rare.

4. *Pterospermum reticulatum* Wight & Arn., Prodr. Fl. Ind. Orient.: 69. 1834; Mast. in Hook.f., Fl. Brit. India 1: 369. 1874; Bourd., Forest Trees Travancore: 53. 1908; Rama Rao, Fl. Pl. Travancore: 49. 1914; Dunn in Gamble, Fl. Madras: 108(77). 1915; Ahmedul. & M.P. Nayar in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 254. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 451. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 67. 1996; Sivar. & P. Mathew, Fl. Nilambur: 102. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 109. 2002.

Mal.: *Mala-uram*, *Mala-viriam*.

Tree, 18 - 25 m tall; bark brown mottled with green. Leaves stipuled, oblong-obovate, oblique, cuneate, obtuse or subcordate at base, entire or dentate at margin towards apex, acuminate at apex, 8.8 - 16 x 5.5 - 7 cm, coriaceous, whitish, rusty-stellate-pubescent beneath. Cymes axillary, 2- or 3-flowered; bracteoles numerous, imbricate, deeply laciniate, almost mossy, caducous. Sepals linear-lanceolate, 2.6 - 4 x 0.5 - 0.9 cm, stellate-tomentose outside, silvery-hairy inside. Petals obovate-oblong, recurved, 2.5 - 4.3 x 1.3 - 2 cm, clawed, stellate-tomentose outside, yellow or white. Stamens 15 in 5 rows, each with 3 alternating staminodes; staminodes filiform, stellate-pubescent. Ovary globose, 7 - 8 mm, pubescent; style pubescent. Capsules oblong, acutely angled-furrowed, 5 - 7.5 cm long; seeds 4 in each locule, winged at one end.

Fl. & Fr.: Dec. - March.

Habitat: Evergreen and moist deciduous forests.

Distrib.: Idukki, Kollam, Malappuram, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Planted in gardens and on roadsides. Wood is used for boats, house-building, match boxes and match splints.

5. *Pterospermum rubiginosum* B. Heyne ex Wight & Arn., Prodr. Fl. Ind. Orient.: 68. 1834; Bedd., Fl. Sylv. S. India: t. 106. 1871; Mast. in Hook.f., Fl. Brit. India 1: 368. 1874; Bourd., Forest Trees Travancore: 53. 1908; Rama Rao, Fl. Pl. Travancore: 49. 1914; Dunn in Gamble, Fl. Madras: 109(78). 1915; Vajr., Fl. Palghat: 90. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 451.

1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 69. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 110. 2002.

Mal.: *Malam-thodali*

Tree, to 20 m tall. Leaves ovate-lanceolate, obliquely cordate at base, entire at margin, acuminate at apex, 4 - 8 x 1.2 - 2.5 cm, coriaceous, rusty-pubescent beneath; stipules oblique, laciniate, caducous. Flower axillary, solitary, fragrant; bracteoles laciniate, caducous. Sepals linear, ca 5.2 x 0.2 cm, rusty-tomentose outside. Petals obovate-oblong, ca 3.5 x 0.25 cm. Stamens ca 1.5 cm long; staminodes ca 2 cm long. Capsules cylindrical, 5-gonous, beaked, 4 - 7 x 0.6 - 0.9 cm, brown; seeds winged at one end.

Fl. & Fr.: Feb. - July.

Habitat: Evergreen forests, to 700 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Palakkad, Thiruvananthapuram, Thrissur and Wynad (Dunn, *l.c.*). Assam, Karnataka and Tamil Nadu.

Uses: Wood is used for house-construction, making boats, match boxes, match splints and paper pulp.

6. *Pterospermum xylocarpum* (Gaertn.) Santapau & Wagh in Bull. Bot. Surv. India 5: 108. 1963; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 454. 1993. *Velago xylocarpa* Gaertn., Fruct. Sem. Pl. 2: 245, t. 133, f. 2. 1791. *Pterospermum heyneanum* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 69. 1834; Wight, Icon. Pl. Ind. Orient.: t. 489. 1841; Mast. in Hook.f., Fl. Brit. India 1: 369. 1874; Rama Rao, Fl. Pl. Travancore: 49. 1914; Dunn in Gamble, Fl. Madras: 108(77). 1915.

Mal.: *Palaka-unam*.

Medium-sized tree; branchlets rusty-stellate-pubescent. Leaves oblong-obovate, obliquely subcordate or obtuse at base, entire, dentate or lobed towards apex, acuminate at apex, 8 - 18 x 4 - 13 cm, greyish-pubescent beneath; stipules ensiform. Flowers solitary or, in 2- or 3-flowered fascicles, fragrant; bracteoles broadly ovate, palmatifid, persistent. Sepals 5, oblong or spatulate, ca 7 x 0.8 cm, tomentose outside, silky-villous inside. Petals 5, obovate-oblong, ca 6 x 1.3 cm, stellate-pubescent outside, white turning yellow on fading. Gynandrophore ca 5 mm long. Stamens 15, 1 - 1.3 cm long; staminodes 5, linear,

2 - 3 cm long. Ovary oblong, ca 8 mm long; style ca 3.5 cm long, grooved. Capsules pyriform, obtusely 5-angled, horned, ca 7 x 3.5 cm, rusty-stellate-tomentose; seeds orbicular, compressed, with a papery wing.

Fl. & Fr.: Oct. - May.

Distrib.: Travancore (Kulathurpuzha, Rama Rao, *l.c.*). Andhra Pradesh, Karnataka, Maharashtra, Orissa and Tamil Nadu. Endemic.

Uses: Wood is used for agricultural implements. Leaf is used in leucorrhoea; also smoked like tobacco.

12. PTERYGOTA Schott & Endl.

Trees, sometimes buttressed. Leaves cordate, mostly entire (variously lobed in seedlings), digitately nerved at base. Inflorescences axillary or subterminal racemes or panicles. Flowers uni- or bisexual. Calyx campanulate, 5-partite to base, reflexed at apex, fleshy. Petals absent. Stamens in male flowers connate into an elongated column with a globose head at top with sessile anthers in 5 clusters with 5 anthers each. Female flowers with 5 bundles of staminodes. Carpels 5, nearly free; ovules many in each locule; style short, recurved; stigmas dilated, radiating. Follicles 5, subglobose or obovoid, woody, opening by a valve; seeds numerous, winged at apex.

Tropics especially Old World, 15 species and 1 in India.

Pterygota alata (Roxb.) R.Br. in Benn., *Pl. Jav. Rar.*: 234. 1844; Dunn in Gamble, *Fl. Madras*: 104(75). 1915; Vajr., *Fl. Palghat*: 91. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, *Fl. India* 3: 455. 1993; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 69. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 102. 1997. *Sterculia alata* Roxb., *Pl. Coromandel* 3: 84, t. 287. 1820; Mast. in Hook.f., *Fl. Brit. India* 1: 360. 1874; Bourd., *Forest Trees Travancore*: 50. 1908; Rama Rao, *Fl. Pl. Travancore*: 48. 1914. *S. heynei* Bedd., *Fl. Sylv. S. India*: t. 230. 1874.

Mal.: *Anathondi, Kodathani, Pothondi*

Tree, to 35 m tall, often buttressed; branchlets densely golden-stellate-pubescent. Leaves clustered at ends of branches, broadly ovate-cordate, truncate or subcordate at base, entire or undulate at margin, caudate-acuminate at apex; stipules subulate, minute. Panicles axillary, 9- or 10-flowered; bracts ensiform. Calyx lobes 5 or 6, linear-lanceolate or elliptic, 12 - 15 x 3 - 4 mm, ferruginous-

stellate-pubescent outside, sparsely pubescent inside. Male flowers: Staminal tube slender, 4 - 6 mm long with 5 or 6 minute pistillodes at apex around which stamens are placed regularly in 4 or 5 groups bearing 4 anthers each. Female and bisexual flowers: Staminalodes or stamens around base of ovary; carpels 5, sessile, 2 - 3 mm long; style pilose; stigma 2-lobed; follicles 3 - 5, obovoid or globose, 10 - 12.5 cm long with mealy pubescence; seeds 25 - 30, in 2 rows, oblong, compressed, winged. *Fl. & Fr.*: Sept. - March.

Habitat: Evergreen forests.

Distrib.: Kollam, Malappuram, Palakkad, Pathanamthitta and Thrissur. Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Karnataka, Maharashtra, Tamil Nadu and W. Bengal. Bangladesh, Bhutan and Myanmar.

Uses: Wood is used for tea boxes and light packing cases; suitable for planking, plywood, for making light furniture, match boxes and match splints. Bark yields a fibre used for rough cordage. Roasted seed is eaten. Seed yields a fatty oil.

13. STERCULIA L.

Trees or shrubs. Leaves simple, palmately lobed or digitately foliolate; stipules caducous. Inflorescences axillary or terminal, paniced or racemose. Flowers uni- or bisexual, terminal ones mostly female. Calyx tubular or campanulate, rarely 4-partite, often petaloid. Petals absent. Staminal column with a ring of 10 - 30 anthers at apex. Carpels 5, partly free; ovules 2 - many in each locule; styles connate at base; stigmas as many as carpels. Ripe carpels free, stalked or not, follicled, stellately spreading, woody or membranous; seeds 1 - many, sometimes winged or arillate; endosperm 2-partite, resembling thick cotyledons; cotyledons flat and thin.

Tropics, ca 200 species, 15 in India and 5 in Kerala.

Literature: Datta, K. 1960. Some phytogeographical and economic aspects of the genus *Sterculia* (Sterculiaceae). *Indian Forester* 92: 510 - 516. Tantra, I.G.M. 1976. A revision of the genus *Sterculia* in Malesia. *Penerbitan Majd. Pengetahuan Indonesia* 12: 1 - 194.

Key to species

- | | | |
|-----|---|----------------------|
| 1a. | Leaves digitate or palmately lobed | 2 |
| b. | Leaves neither digitate nor lobed | 3 |
| 2a. | Leaves digitate; calyx lobes densely stellate-hairy; follicles glabrous | 2. <i>S. foetida</i> |

- b. Leaves palmately lobed; calyx lobes glabrous or glandular-hairy; follicles villous or with stinging hairs 4
- 3a. Lower nerves arising acutely from base of petiole; petioles and nerves rusty-tomentose; calyx lobes broadly ovate; follicles obovoid 3. *S. guttata*
- b. Lower nerves arising divaricately from base of petiole; petioles and nerves glabrescent; calyx lobes linear; follicles oblong-ovoid 1. *S. balanghas*
- 4a. Calyx glandular-hairy inside; follicles radiating with sharp stinging hairs 4. *S. urens*
- b. Calyx glabrous inside; follicles spreading, rusty-villous, without stinging hairs 5. *S. villosa*

1. *Sterculia balanghas* L., Sp. Pl.: 1007. 1753; Wight, Ill. Ind. Bot. 1: t. 30. 1840; Mast. in Hook.f., Fl. Brit. India 1: 358. 1874; Rama Rao, Fl. Pl. Travancore: 47. 1914; Dunn in Gamble, Fl. Madras: 106(76). 1915; Nicolson & al. in Regnum Veg. 119: 254. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 87. 1994. *S. balanghas* L. var. *glabrescens* Mast. in Hook.f., Fl. Brit. India 1: 358. 1874; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 458. 1993.

Mal.: Kavalam, Narthondi, Thondi

Small or medium-sized tree; branchlets rusty-tomentose. Leaves clustered at ends of branchlets, oblong-ovate or elliptic, rounded at base, entire at margin, acuminate at apex, 10–33 x 4.5–12.3 cm, glabrescent above, stellate-hairy beneath, pinnately nerved; stipules subulate. Panicles axillary or terminal, ca 15 cm long, much branched, erect or nodding, stellate-pubescent. Flowers fragrant. Calyx campanulate; lobes 5, linear, ca 7 x 1.5 mm, densely hairy at margin. Male flowers: Staminal tube ca 2 mm long, with a group of 2-loculed anthers at tip. Female flowers: Stigmas recurved, as long as styles; follicles 4 or 5, horizontally spreading, oblong-ovoid, 5–8 cm long, coriaceous, rusty-tomentose, orange-scarlet; seeds ovoid, shining, black.

Fl. & Fr.: Sept.–Dec.; April–June.

Habitat: Deciduous forests, occasional.

Distrib.: Ernakulam, Kollam, Kottayam, Pathanamthitta and Thiruvananthapuram. Hotter parts of India. Myanmar and Sri Lanka.

Uses: Often grown in gardens as a fence. Roasted seed is edible. Fruit is a laxative. Bark yields a fibre used for cordage and for making hats.

2. ***Sterculia foetida*** L., Sp. Pl.: 1008. 1753; Wight, Icon. Pl. Ind. Orient.: t. 181. 1839; Mast. in Hook.f., Fl. Brit. India 1: 354. 1874; Bourd., Forest Trees Travancore: 48. 1908; Rama Rao, Fl. Pl. Travancore: 46. 1914; Dunn in Gamble, Fl. Madras: 105(75). 1915; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 459. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 87. 1994.

Mal.: *Pottakavalom*

Large, deciduous tree; bark whitish; branches whorled. Leaves digitately 5-7-foliolate; leaflets subsessile, elliptic or oblong-lanceolate, cuneate at base, entire at margin, acute or acuminate at apex, 9.5 - 13 x 2 - 4 cm, glabrous; stipules ensiform, caducous. Panicles axillary, ca 20 cm long; pedicels jointed in middle. Flowers foetid. Calyx campanulate; lobes 5, lanceolate to linear-oblong, subacute, ca 1.7 x 0.4 cm, spreading, stellate-hairy densely so inside, dull orange or yellow. Male flowers: Staminal tube curved, ca 1 cm long, pubescent at base; anthers 10-15. Female flowers: Gynandrophore ca 1 cm long; staminodes subsessile; ovary globose, villous, 5-loculed; ovules many; style deflexed, pubescent; follicles 3-5-lobed, boat-shaped, 10-12 cm long, beaked, woody, bright red; seeds ovoid-ellipsoid, black with a small yellow caruncle on one side at base.

Fl. & Fr.: April - June.

Habitat: Deciduous forests, frequent.

Distrib.: Kottayam, Thiruvananthapuram and Malabar (Masters, *l.c.*). Andhra Pradesh, Bihar, Maharashtra, Orissa, Tamil Nadu and W. Bengal. Africa, South and SE. Asia to Australia.

Uses: The heartwood is mildly thermogenic, depurative, febrifuge and vulnerary. It is useful in convulsions, neuropathy, helminthiasis, leprosy, rheumatism, erysipelas, skin diseases, fever, ulcers and cephalalgia. Gum from the tree is used for bookbinding; bark yields a weak cordage fibre. Wood is used for inferior construction. Seed is roasted and eaten, used to adulterate cocoa; seed oil is used for culinary purposes; to cure itches and other skin diseases, in surface-coating industry and soap making, also as an illuminant.

3. ***Sterculia guttata*** Roxb. ex DC., Prodr. 1: 482. 1824; Wight, Icon. Pl. Ind. Orient.: t. 487. 1844; Mast. in Hook.f., Fl. Brit. India 1: 355. 1874; Bourd., Forest Trees Travancore: 49. 1908; Rama Rao, Fl. Pl. Travancore: 47. 1914; Dunn in Gamble, Fl. Madras: 106(76). 1915; Manilal & Sivar., Fl. Calicut: 51. 1982;

Nicolson & al. in *Regnum Veg.* 119: 255. 1988; Manilal, *Fl. Silent Valley*: 33. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 69. 1988; Vajr., *Fl. Palghat*: 91. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, *Fl. India* 3: 462. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 88. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 70. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 103. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 111. 2002.

Mal.: *Kavalam, Kithondi, Pottakavalam, Thondi*

Large to medium-sized tree; bark brown, exfoliating in scales; branchlets stellate-pubescent. Leaves ovate-oblong or elliptic, rounded or cordate at base, entire at margin, acute or acuminate at apex, 13 - 44 x 5 - 21 cm, glabrous above, stellate-pubescent beneath; stipules linear, caducous. Panicles terminal, to 15 cm long, densely stellate-tomentose. Flowers foetid; bracts subulate. Calyx campanulate, densely rusty-tomentose outside, glandular inside; lobes 5, broadly ovate, 8 - 12 x 3 - 5 mm, pinkish brown. Male flowers: Stamens 10; staminal tube slender, 6 - 8 mm long. Bisexual flowers: Stamens 10; ovary globose, strigose, 5-loculed; ovules many; style deflexed; stigma 5-lobed; gynandrophore ca 6 mm long, stout, curved; follicles 1 - 5, obovoid, 2- or 3-lobed; lobes ovoid, beaked, 5 - 9 cm long, villous outside, glabrous and pink inside, deep orange-red; seeds oblong-ellipsoid, shining, black.

Fl. & Fr.: Sept. - May.

Habitat: Moist deciduous and semievergreen forests, to 1100 m.

Distrib.: Throughout Kerala. Andaman Islands, Assam, Karnataka, Maharashtra and Tamil Nadu. South and SE. Asia.

Uses: Bark yields a fibre used for cordage and rough fabrics. Seed is roasted and eaten.

4. *Sterculia urens* Roxb., *Pl. Coromandel* 1: 25, t. 24. 1795; Mast. in Hook.f., *Fl. Brit. India* 1: 355. 1874; Bourd., *Forest Trees Travancore*: 49. 1908; Rama Rao, *Fl. Pl. Travancore*: 46. 1914; Dunn in Gamble, *Fl. Madras*: 106(75). 1915; Manilal & Sivar., *Fl. Calicut*: 51. 1982; Vajr., *Fl. Palghat*: 91. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, *Fl. India* 3: 470. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 88. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 70. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 103. 1997.

Mal.: *Thondi*

Small or medium-sized tree, deciduous; bark white or greenish grey, peeling off in thin papery flakes. Leaves clustered at ends of branchlets, palmately 3 - 5-lobed, cordate at base, entire at margin, caudate-acuminate at apex, 14 - 29 x 19 - 31 cm, scabrid above, velvety beneath. Panicles terminal, pyramidal, glandular-pubescent. Flowers fragrant. Calyx campanulate, 5 - 6 mm long; lobes oblong, acute, glandular-hairy inside at base, greenish yellow. Male flowers: Staminal tube ca 3 mm long; anthers 10 - 15 at apex of tube. Bisexual flowers: Stamens inserted on apex of short thick gynandrophore; ovary globose, 5-loculed; ovules many; style short, pubescent; stigmas 5, radiating; follicles 4 - 6, ovoid-oblong, 3 - 7 cm long, woody, densely pubescent mixed with stinging hairs, red; seeds 3 - 6 in each follicle, oblong, dark brown.

Fl. & Fr.: Oct. - April.

Habitat: Rocky hills in dry and moist deciduous forests.

Distrib.: Ernakulam, Idukki, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Almost throughout India except the Himalayas. South and SE. Asia.

Uses: Pulverized bark is given to women to facilitate delivery. Mucilage obtained from leaf and tender shoot steeped in water is used against pleuropneumonia in cattle. Gum from the tree, called gum karaya or kadaya, is used in preparing printing pastes for textile industry; used in pharmaceutical and medicinal preparations such as lozenges, emulsions, lotions, sprays and pastes, denture fixative powders, cosmetics and as a pulp-binder. In baking and dairy industries the powdered gum is used in dressings, spreads, preparation of ground meat etc. Timber is used for toys, guitars, furniture, packing cases etc.; suitable for barrels, moulded picture frames, slate frames, match boxes and splints. Seed is edible; seed oil is used for edible purposes and in soap-making. Bark yields a fibre used for cordage. A glue made from the seed protein is used as an adhesive in making plywood.

5. *Sterculia villosa* Roxb. ex Sm. in Rees, Cycl. 36: No. 16. 1816; Mast. in Hook.f., Fl. Brit. India 1: 355. 1874; Bourd., Forest Trees Travancore: 49. 1908; Rama Rao, Fl. Pl. Travancore: 47. 1914; Dunn in Gamble, Fl. Madras: 106(76). 1915; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 472. 1993; M. Mohanan

& A.N. Henry, Fl. Thiruvananth.: 88. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 70. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 112. 2002.

Mal.: *Vakka*

Medium-sized, deciduous tree; bark grey-white with red blaze. Leaves clustered at ends of branchlets, palmately 5-7-lobed, cordate at base, acuminate at apex, 21 - 26 x 24 - 29 cm, stellate-pubescent above, tomentose beneath; stipules lanceolate, caducous. Panicles terminal, 5-8 at end of thick leafless branches, drooping, rusty-pubescent. Calyx campanulate, ca 8 mm long, pubescent outside, glabrous inside, pinkish or pale yellow; lobes oblong-lanceolate, acute. Male flowers: Stamens 10; staminal tube recurved, 2-3 mm long. Female flowers: Gynandrophore stout, cylindrical, surrounded by a membranous ring at base; ovary globose, strigose, stellate-pubescent; style deflexed, hairy; stigma 5-lobed; staminodes on a ring below ovary; follicles 2-7, oblong, 3.7-7.5 cm long, stellate-pubescent inside and outside, bright red; seeds many, oblong, shining, black.

Fl. & Fr.: Nov. - May.

Habitat: Moist deciduous forests.

Distrib.: Idukki, Kannur, Palakkad, Thiruvananthapuram and Thrissur. Throughout hotter parts of India including the Andaman Islands. Bangladesh, Bhutan, Myanmar and Nepal.

Uses: Wood is used for tea boxes, packing cases, ship-building, match boxes, splints etc. Fibre from bark is used for cordage, making rough bags, breast bands of elephants for dragging timber and tying cattle. Seed is edible. Pericarp yields a dye. White gum from the bark is used in veterinary medicine.

14. THEOBROMA L.

Trees. Leaves undivided. Peduncles mostly on main stem and branches, 1-flowered and fascicled or branched and many-flowered. Calyx 5-fid or -partite. Petals 5, contracted at base into a hooded-concave claw, produced above into a spatulate limb. Staminal cup 5-lobed. Ovary 5-loculed; ovules many in each locule. Fruits drupaceous, often large, woody; seeds in shining pulp, nonendospermous.

Tropical America, ca 20 species, widely cultivated in tropics.

Theobroma cacao L., Sp. Pl.: 752. 1753; Dunn in Gamble, Fl. Madras: 113(81). 1915; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 476. 1993.

Mal.: *Cocoa*

Small, evergreen tree. Leaves large, short-petioled with a well marked pulvinus at each end, elliptic-oblong or obovate-, entire, abruptly acuminate, 15 - 30 cm long, leathery. Flowers cauliflorous, small. Petals hooded at base. Staminal tube short with 5 petaloid elongate staminodes and 2 or 3 sessile anthers. Ovary sessile, 5-loculed; ovules many in each locule; stigma 5-lobed. Fruit a large woody drupe, ellipsoid-ovoid, ca 30 cm long, smooth or ribbed, reddish yellow, 5-loculed each with a double row of almond-like seeds embedded in white-pinkish or brownish mucilaginous aromatic pulp.

Fl.: Nov. Jan. Fr.: March May.

Cultivated at low elevations. Widely cultivated in tropics.

Uses: Seed is a source of a beverage. Cocoa extracted from roasted and fermented beans is used in the manufacture of cocoa, cocoa butter and chocolate. Cocoa products are a good source of energy. They provide essential fatty acids and serve as a source of phospholipids and fat-soluble vitamins.

15. WALTHERIA L.

Herbs or undershrubs, stellate-pubescent. Leaves oblong to ovate, serrate; stipules filiform, caducous. Flowers glomeruled or cymose in leaf axils or terminal racemes or panicles. Calyx campanulate, turbinate, 5-fid; lobes lanceolate-subulate, persistent. Petals 5, spatulate, adnate to staminal tube at base, marcescent. Stamens 5, connate into a tube; staminodes absent. Ovary sessile, 1-loculed; ovules 2; style eccentric; stigmas clavate or fimbriate. Capsules obovoid, hairy at apex, 2-valved, 1-seeded; seeds obovoid, laterally slightly compressed, endospermous; cotyledons flat.

Africa, Tropical America, Malay Peninsula and Taiwan, ca 67 species and 1 in India.

Literature: St. John, H. 1976. Evaluation of *Waltheria indica* L. and *W. americana* L. (*Sterculiaceae*) - Pacific Plant Studies 28. *Phytologia* 33: 89 - 92.

Waltheria indica L., Sp. Pl.: 673. 1753; Mast. in Hook.f., Fl. Brit. India

1: 374. 1874; Rama Rao, Fl. Pl. Travancore: 51. 1914; Dunn in Gamble, Fl. Madras: 111(79). 1915; Manilal & Sivar., Fl. Calicut: 52. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 69. 1988; Vajr., Fl. Palghat: 92. 1990; S.K. Chandra in B.D. Sharma & Sanjappa, Fl. India 3: 473. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 89. 1994; Sivar. & P. Mathew, Fl. Nilambur: 104. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 112. 2002.

Erect shrub or undershrub; branchlets densely pubescent. Leaves ovate or oblong, rounded or subcordate at base, crenate-serrate at margin, acute to obtuse at apex, 1–11 x 0.9–5 cm, coriaceous, soft-pubescent on both surfaces. Flowers in globose axillary clusters; bracts and bracteoles lanceolate. Calyx campanulate, 3–4 mm long, strigose; lobes 3-angled, ca 1 mm long. Petals oblanceolate, 4–4.5 mm long, yellow or white. Staminal tube ca 3 mm long. Ovary globose; style eccentric; stigma fimbriate. Capsules obconic, ca 2 mm long, 2-valved, enclosed in calyx; seeds obovate.

Fl. & Fr.: Jan.–Dec.

Habitat: Weed on roadsides and wastelands.

Distrib.: Almost throughout Kerala. Throughout hotter parts of India. Pantropical.

Uses: Plant as a resinous powder is used for drying and healing wounds, and against cough. Root is chewed to control internal haemorrhage; its decoction is used to induce fertility in women. Flower and root bark are used against thrush.

Pterocymbium tinctorium (Blanco) Merr. is occasionally planted by the Forest Department (*vide* Sasidharan & Sivarajan, *l.c.*).

Excluded species

Pentapetes phoenicea L., Sp. Pl.: 698. 1753; Nicolson & al. in Regnum Veg. 119: 254. 1988. Naga-pou of Rheede has not yet been re-collected (*vide* Nicolson & al., *l.c.*).

TILIACEAE

(P. DANIEL)

Trees, shrubs or herbs, with stellate, simple or lepidote hairs. Leaves alternate, rarely opposite, petioled, stipuled, rarely not, simple, entire or dentate, rarely lobed, usually palmately and occasionally pinnately nerved. Inflorescences

axillary, terminal or leaf-opposed cymes or panicles, rarely flower solitary. Flowers bracteate, bi- very rarely unisexual, mostly 4- or 5-merous, hypogynous, actinomorphic, sometimes with epicalyx. Sepals 4 or 5, free or partly connate, valvate, rarely imbricate, occasionally persistent and accrescent. Petals 4 or 5, free, contorted, imbricate or valvate, sometimes sepaloid, rarely absent. Stamens 5 - many, free or slightly connate at base or, in 5 or 10 bundles, inserted at base of petals or on an androphore; anthers 2-loculed, opening by a slit or apical and rarely a basal pore; staminodes present or not. Carpels 2 - 5(- 10), rarely more, syncarpous, rarely free; ovary superior, rarely inferior, sessile, 2- or 1-loculed; ovules 1 many in each locule, erect or pendulous; placentation usually axile, rarely parietal; style usually simple and divided at apex; stigma rarely sessile. Fruit a drupe, nut or capsule and variously dehiscent; seeds rarely arillate, occasionally pilose, mostly endospermous; embryo usually straight; cotyledons foliaceous.

Subcosmopolitan, 46 genera and 680 species, 8 and 53 in India and, 4 and 24 in Kerala.

Literature: Ghafoor, A. 1974. *Tiliaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 75: 1 - 33. Robyns, A. & Meijer, W. 1991. *Tiliaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 7: 402 - 437.

Key to genera

- | | | |
|-----|--|----------------------|
| 1a. | Inflorescence a panicle; fruits 6-winged; seeds covered with bristles | 1. Berrya |
| b. | Inflorescence a cyme or raceme; fruits not winged; seeds not covered with bristles | 2 |
| 2a. | Fruit a drupe | 3. Grewia |
| b. | Fruit a capsule | 3 |
| 3a. | Petals eglandular at base; capsules not echinate | 2. Corchorus |
| b. | Petals glandular at base; capsules echinate | 4. Triumfetta |

1. BERRYA Roxb., nom. & orth. cons.

Trees. Leaves alternate, cordate, 5 - 7-nerved. Panicles terminal and axillary, leafy at base. Calyx campanulate. Petals 5. Stamens numerous. Ovary 3- or 4-lobed; styles subulate; stigma lobed. Fruit a capsule; seeds 1 or 2 in each locule; endosperm fleshy.

Indomalesia, 3 - 5 species and 1 in India.

Berrya cordifolia (Willd.) Burret in Notizbl. Bot. Gart. Berlin-Dahlem 9: 606. 1926; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 478. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 92. 1994; Sivar. & P. Mathew, Fl. Nilambur: 105. 1997. *Espera cordifolia* Willd. in Ges. Naturf. Freunde Berlin Neue Schriften 3: 450. 1801. *Berrya ammonilla* Roxb., Pl. Coromandel 3: 60, t. 264. 1819; Bedd., Fl. Sylv. S. India: t. 58. 1870; Mast. in Hook.f., Fl. Brit. India 1: 383. 1874; Bourd., Forest Trees Travancore: 56. 1908; Rama Rao, Fl. Pl. Travancore: 53. 1914; Dunn in Gamble, Fl. Madras: 122(87). 1915.

Tree, to 35 m tall. Leaves simple, ovate-oblong, cordate at base, undulate at margin, acuminate at apex, 12 - 25 x 4 - 14 cm, glabrous on both surfaces, stellate-pubescent when young; petioles 3.5 - 5 cm long, glabrous below, stellate-pubescent above; stipules 1 - 1.5 cm long, linear, sericeous, caducous. Flowers numerous, lax; buds globose; pedicels 1 - 1.5 cm long, pubescent. Petals oblong, obtuse, 6 - 8 mm long, ultimately reflexed. Stamens inserted on a short receptacle; filaments 4 - 5 mm long; anther lobes divergent, dehiscing longitudinally. Ovary 3- (or 4)-loculed with 4 ovules in each; style ca 3 mm long, slightly papillose at base; stigma peltate, 3-lobed. Capsules globose, 1 - 1.25 cm, pubescent with 6 horizontally spreading blunt thin wings; wings 2.5 - 3 x 0.7 - 1 cm, stellate-pubescent; seeds ca 6 x 3 mm, clothed with brown to yellow caducous bristles.

Fl.: March - April *Fr.*: Sept. - Nov.

Habitat: Dry forests, rare (Rama Rao, *l.c.*); also cultivated.

Distrib.: Malappuram and Thiruvananthapuram. Andaman Islands (at sea level in inland forests), Andhra Pradesh and Tamil Nadu (cultivated). South and SE. Asia.

Use: The tough and flexible wood is used for agricultural implements.

2. CORCHORUS L.

Shrubs, undershrubs or herbs, simple- and stellate-hairy. Leaves alternate, petioled, stipuled, serrate; stipules filiform. Inflorescences peduncled, axillary or leaf-opposed, few- to 2-flowered cymes. Flowers small, bracteate, short-pedicelled. Sepals 5 or 4, free, valvate. Petals 5 or 4, free, imbricate, yellow. Stamens many or rarely twice as many as sepals, free; anthers dehiscing longitudinally. Carpels 2 - 5, syncarpous; ovary superior, 2 - 5-loculed; ovules many; style short; stigma simple, undulate or crenate, papillate. Capsules elongate, globose to subglobose, loculicidally 2 - 5-valved, transversely septate between seeds or not;

seeds pendulous or horizontal, endospermous, often with an incurved embryo; cotyledons foliaceous.

Tropics, ca 100 species, 8 in India and 5 in Kerala.

Literature: Chakravarti, H.L. 1951. Indian *Corchorus* Linn. *Bull. Bot. Soc. Bengal* 5: 75

86.

Key to species

- | | |
|---|---------------------------|
| 1a. Capsules globose to subglobose | 2. <i>C. capsularis</i> |
| b. Capsules elongate | 2 |
| 2a. Capsules terminating in 3, 2-fid spreading tips | 1. <i>C. aestuans</i> |
| b. Capsules terminating in a point | 3 |
| 3a. Capsules 10-ribbed, 5-loculed | 3. <i>C. olitorius</i> |
| b. Capsules 3-ribbed, 3-loculed | 4 |
| 4a. Capsules falcate; seeds wrinkled | 5. <i>C. urticifolius</i> |
| b. Capsules straight; seeds smooth | 4. <i>C. trilocularis</i> |

1. ***Corchorus aestuans*** L., *Syst. Nat.* ed. 10, 2: 1079. 1759; Fawc. & Rendle in *J. Bot.* 59: 221. 1921; Manilal & Sivar., *Fl. Calicut*: 53. 1982; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 69. 1988; Vajr., *Fl. Palghat*: 92. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, *Fl. India* 3: 485. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 89. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 71. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 105. 1997. *C. acutangulus* auct. non Forssk. 1775; Lam., *Encycl.* 2: 104. 1786; Wight, *Icon. Pl. Ind. Orient.*: t. 739. 1844; Mast. in Hook.f., *Fl. Brit. India* 1: 398. 1874; Dunn in Gamble, *Fl. Madras*: 121(86). 1915.

Annual, suberect or spreading herb, 10 - 60 cm high; branches and branchlets pilose, often purple. Leaves ovate-lanceolate, more or less rounded at base, serrate at margin with basal most serrations extending into filiform processes or not, acute at apex, 2 - 10 x 1 - 5 cm, glabrous above, pilose with conspicuously raised nerves beneath, 3 - 5-nerved; petioles 0.5 - 4 cm long, grooved, pilose, purple; stipules setaceous, 5 - 10 mm long, sparsely hairy, purplish green. Flowers in leaf-opposed 2- or 3-flowered short-peduncled cymes; pedicels ca 2 mm long, jointed near apex; bracts filiform, 4 - 6 mm long, purple. Sepals linear-oblong,

hooded, apiculate, 3 - 4 mm long, glabrous, purple-dotted inside, green outside. Petals obovate, obtuse with a glandular claw, 3 - 5 mm long, hairy at base, yellow. Stamens 12 - 30. Carpels 3; ovary oblong-cylindric, ca 2 mm long, pubescent, 3-loculed; styles 3-fid, ca 1.5 mm long; stigma 2-lobed. Capsules solitary or paired, 10 - 30 x 4 - 6 mm, glabrous, 6-angled with 3 of them winged, truncate with 3, 2-fid 3 - 7 mm long beaks at top, 3-loculed; locules transversely septate or not; seeds numerous, truncate at both ends, dark brown.

Fl. & Fr.: Aug. - Feb.

Habitat: Moist areas, common.

Distrib.: Almost throughout Kerala. Throughout India. Pantropical.

2. *Corchorus capsularis* L., Sp. Pl.: 529. 1753; Wight, Icon. Pl. Ind. Orient.: t. 311. 1840; Mast. in Hook.f., Fl. Brit. India 1: 397. 1874; Dunn in Gamble, Fl. Madras: 122(87). 1915; Manilal & Sivar., Fl. Calicut: 54. 1982; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 485. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 89. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 71. 1996.

Annual, erect, much branched herb, 1 - 2.5 m high, glabrous. Leaves linear-lanceolate to ovate-, rounded at base, serrate at margin with basal most serrations extending into filiform processes, acute or acuminate at apex; petioles to 4 cm long, pubescent; stipules linear, 6 - 10 mm long. Flowers in 1- or 2-flowered axillary or leaf-opposed cymes, 8 - 10 mm across, sessile or subsessile; bracts linear-ovate, 2 - 3 mm long. Sepals linear-oblong, 4 - 5 mm long. Petals obovate, notched at apex, 3 - 5 mm long, yellow. Stamens 20 - 30. Ovary subglobose, glabrous, 5-loculed. Capsules ca 1 cm across, truncate and depressed at apex, longitudinally grooved, scabrous, wrinkled, muricate or tubercled, 5-loculed; locules aseptate; seeds cuneiform, ca 3 x 1 mm, glabrous, brown.

Fl. & Fr.: July - Nov.

Habitat: Moist areas, common.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Thiruvananthapuram and Thrissur. Throughout India. Cultivated in most tropical countries for the fibre, the jute of commerce.

3. *Corchorus olitorius* L., Sp. Pl.: 529. 1753; Mast. in Hook.f., Fl. Brit. India 1: 397. 1874; Dunn in Gamble, Fl. Madras: 122(87). 1915; P. Daniel &

Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 487. 1993.

Annual or biennial herb, erect, stout, branched, to 1.5 m high; rootstock woody. Leaves lanceolate to ovate-lanceolate, subobtusate at base, serrate at margin with basal most serrations extending into filiform processes, acute at apex, glabrous except sparsely hairy nerves, 3-5-nerved; petioles 2-3 cm long, pubescent; stipules subulate, 8-12 mm long, glabrous. Flowers in 1- or 2-flowered leaf-opposed cymes, 12-15 mm across, subsessile; bracts subulate, 4-5 mm long. Sepals linear-oblong, apiculate, 5-7 mm long. Petals oblong-spatulate, obtuse, 5-7 mm long. Stamens numerous, somewhat connate at base. Ovary cylindrical, sparsely hairy, 5-loculed; style short; stigma 5-lobed, minutely papillate. Capsules solitary or paired, subcylindrical, 2-7 cm long, 10-ribbed, glabrous, 5-loculed; locules septate between seeds; beak entire, 4-8 mm long; seeds 3-gonous, ca 2 x 1.5 mm, inconspicuously verrucose, black.

Fl. & Fr.: July - Jan.

Habitat: Moist areas, common.

Distrib.: Ernakulam, Kollam, Kottayam, Pathanamthitta and Thiruvananthapuram. Throughout India. Pantropical.

4. *Corchorus trilocularis* L., Mant. Pl.: 77. 1767; Mast. in Hook.f., Fl. Brit. India 1: 397. 1874; Dunn in Gamble, Fl. Madras: 122(87). 1915; Vajr., Fl. Palghat: 93. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 488. 1993.

Annual, erect or suberect herb, much branched, 30-150 cm high. Leaves narrowly oblong-lanceolate to broadly oblong-elliptic, crenate-serrate at margin with basal most serrations extending into filiform processes or not, obtuse at apex, 1.3-10 x 0.4-3.5 cm, sparsely hairy on both surfaces especially nerves, 3-5-nerved; petioles 4-12 mm long, pilose; stipules setose, 4-5 mm long. Flowers in 1-3-flowered leaf-opposed cymes, ca 1.2 cm across; pedicels ca 2.5 mm long, glabrous; bracts linear-lanceolate, caudate, ca 3 mm long. Sepals linear-oblong, acuminate, 4-5 mm long. Petals subpandurate, obtuse, 5-6.5 mm long, yellow. Stamens 15-20. Ovary cylindrical, hairy, 3-loculed; style short; stigmas 3, capitate. Capsules 3-angled, 2-7 x ca 2.5 mm, scabrous-tubercled, 3-loculed; locules septate between seeds; beak undivided, ca 2.5 mm long; seeds subtrigonal, truncate at both ends, 1-1.2 mm long, black.

Fl. & Fr.: Almost throughout the year.

Habitat: Weed in plains.

Distrib.: Kottayam, Palakkad and Thrissur. Throughout India. Paletropics.

5. **Corchorus urticifolius** Wight & Arn., Prodr. Fl. Ind. Orient.: 73. 1834 (as *urticaefolius*); Mast. in Hook.f., Fl. Brit. India 1: 397. 1874; Dunn in Gamble, Fl. Madras: 122(87). 1915; Vajr., Fl. Palghat: 93. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 489. 1993.

Annual herb, erect, to 1 m high, pubescent. Leaves ovate-lanceolate, obtuse or truncate at base, serrate at margin with basal most serrations not extending into filiform processes, acute at apex, 4.5 - 8 x 1.7 - 4.5 cm, thinly pilose; petioles 0.8 - 2 cm long, hairy; stipules linear, ca 5 mm long, hairy. Flowers in 2 - 4-flowered leaf-opposed cymes; bracts subulate, ca 2 mm long. Sepals oblong, acuminate, ca 4 mm long, hairy outside. Petals ovate-spatulate, obtuse, ca 3 mm long, yellow. Stamens ca 15. Ovary 3-loculed. Capsules falcate, 3-angled, 2 - 3.5 cm long, strigose, 3-loculed; locules septate between seeds; beak entire, short; seeds 3-gonous, ca 1.5 mm long.

Fl. & Fr.: Oct. - Dec.

Habitat: Weed in lower elevations.

Distrib.: Palakkad and Wynad. Gujarat, Karnataka, Maharashtra and Tamil Nadu. Africa, Malay Peninsula, Myanmar and Sri Lanka.

3. GREWIA L.

Small trees, shrubs or climbers, stellate-pubescent. Leaves alternate, petioled, stipuled, serrate or entire, sometimes lobed, somewhat coriaceous, 7 - 3-nerved at base. Inflorescences axillary, leaf-opposed or terminal, solitary or clustered peduncled umbelled cymes or panicles. Flowers bracteate, 5-merous, bisexual. Sepals 5, free, valvate, coriaceous, mostly glabrous and coloured inside. Petals 5, free, much shorter, clawed with a gland at base inside and a tuft of hairs around, rarely absent. Receptacle raised or not, usually densely pubescent, often glandular at base. Stamens numerous, free, inserted on more or less elevated receptacle or androphore; anthers dorsally curved, dorsifixed, dehiscing longitudinally. Ovary superior, 2 - 4-loculed with 2 or more superposed ovules in each; style subulate; stigma 2 - 4-lobed or laciniate. Drupes entire or 2 - 4-lobed, fleshy

or fibrous with 1-4 pyrenes, each stone 1- or 2-seeded; seeds suberect or horizontal, endospermous; embryo straight.

Old World tropics and subtropics, rarely in temperate regions, ca 150 species, 31 in India and 15 in Kerala.

Key to species

- | | | |
|------|---|-----------------------------------|
| 1a. | Flowers in panicles; drupes not lobed | 8. <i>G. nervosa</i> |
| b. | Flowers in cymes; drupes 2-4-lobed | 2 |
| 2a. | Peduncles shorter than or as long as petioles | 3 |
| b. | Peduncles longer than petioles | 6 |
| 3a. | Flower buds more than 1 cm long | 3. <i>G. flavescens</i> |
| b. | Flower buds less than 1 cm long | 4 |
| 4a. | Stipule auricled | 13. <i>G. tiliifolia</i> |
| b. | Stipules not auricled | 5 |
| 5a. | Leaves villous beneath; flower buds ellipsoid; corolla dull yellow | 15. <i>G. villosa</i> |
| b. | Leaves stellate-tomentose beneath; flower buds ovoid; corolla usually white | 1. <i>G. abutilifolia</i> |
| 6a. | Plant with bi- and unisexual flowers | 6. <i>G. hirsuta</i> |
| b. | Plants with bisexual flowers only | 7 |
| 7a. | Inflorescences axillary, leaf-opposed and/or terminal | 8 |
| b. | Inflorescences axillary only | 12 |
| 8a. | Trees or erect shrubs; peduncles to 4.5 cm long; drupes tomentose or pilose, yellow or black | 9 |
| b. | Scandent shrubs; peduncles to 11 cm long; drupes subglabrous, purple | 10 |
| 9a. | Leaves rhomboid-ovate or lanceolate, glabrous on both surfaces; flowers in umbelled cymes; stigma 4-lobed; drupes brown-tomentose, yellow | 11. <i>G. rhamnifolia</i> |
| b. | Leaves ovate or elliptic-ovate, stellate-pubescent above, woolly beneath; flowers in simple cymes; stigma laciniate; drupes pilose, black | 9. <i>G. oppositifolia</i> |
| 10a. | Leaves glandular-serrate at margin, glabrous or subglabrous; buds grooved; petals ovate-oblong | 14. <i>G. umbellifera</i> |
| b. | Leaves eglandular crenate-serrate at margin, pubescent; buds not grooved; petals linear-oblong or oblong-lanceolate | 11 |

- 11a. Peduncles to 2.5 cm long; sepals oblong-lanceolate, 1 - 1.4 cm long **4. *G. gamblei***
 b. Peduncles to 11 cm long; sepals linear-oblong, 1.5 - 1.8 cm long **5. *G. heterotricha***
- 12a. Drupes 2-lobed, glabrous when mature **12. *G. serrulata***
 b. Drupes 4-lobed, pilose or bristly when mature 13
- 13a. Flower buds ovoid or ovoid-oblong; petals reflexed; drupes rusty-pubescent
2. *G. bracteata*
 b. Flower buds conic or cylindric; petals not reflexed; drupes bristly or pilose 14
- 14a. Leaves obliquely cordate at base; sepals oblong; drupes bristly
10. *G. orientalis*
 b. Leaves narrow at base; sepals linear-lanceolate; drupes pilose
7. *G. lanceaefolia*

1. *Grewia abutilifolia* Vent. ex Juss. in Ann. Mus. Natl. Hist. Nat. 4: 92. 1804; Mast. in Hook.f., Fl. Brit. India 1: 390. 1874; Rama Rao, Fl. Pl. Travancore: 53. 1914; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; Vajr., Fl. Palghat: 93. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 493. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur: 71. 1996; Sivar. & P. Mathew, Fl. Nilambur: 106. 1997. *G. aspera* Roxb., Fl. Ind. 2: 591. 1832; Dunn in Gamble, Fl. Madras: 119(85). 1915.

Mal.: *Pampukontu*

Shrub or small tree. Leaves ovate-rotund, elliptic-ovate or broadly oblong, subcordate at base, irregularly serrate, sometimes obscurely lobed, acute or acuminate at apex, 3.5 - 20 x 1 - 16 cm, scabrous above, stellate-tomentose beneath, 5-nerved; petioles 0.5 - 4.5 cm long. Flowers in axillary umbelled cymes; buds ovoid or oblong, ca 8 x 4 mm; peduncles to 1 cm long, 1 - 3 together; pedicels ca 2 mm long. Sepals narrowly oblong or lanceolate, acute, 8 - 12 mm long, wooly outside. Petals oblong, obtuse, 2 - 4 x 1 - 1.5 mm, ciliate at base, white; glands subglobose, ca 2 mm across, densely ciliate. Receptacle 5-angled, ca 1 mm long, glabrous. Stamens many; filaments ca 5 mm long. Ovary subglobose, ca 1.5 x 1 mm, villous; stigma lacinate. Drupes subglobose, obscurely 4-lobed, 0.8 - 1.6 cm across, tomentose, fleshy.

Fl. & Fr.: Almost throughout the year.

Habitat: Moist deciduous forests, common.

Distrib.: Idukki, Kasaragod, Kozhikode, Malappuram, Palakkad, Pathanamthitta,

Thrissur and Wynad. Almost throughout India. South and SE. Asia.

2. *Grewia bracteata* B. Heyne ex Roth, Nov. Pl. Sp.: 243. 1821; Mast. in Hook.f., Fl. Brit. India 1: 389. 1874; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 495. 1993. *G. obtusa* Wall. ex Dunn in Gamble, Fl. Madras: 115(83). 1915. *G. wightiana* J.R. Drumm. ex Dunn in Gamble, Fl. Madras: 115(83). 1915.

Shrub. Leaves broadly ovate, ovate-lanceolate or orbicular, subcordate at base, irregularly crenate-serrate at margin, subacute, acuminate or rounded at apex, 2 - 12 x 1.5 - 7 cm, glabrous except nerves beneath, 3-nerved; petioles to 0.7 cm long; stipules ovate, sparsely pubescent. Cymes axillary, few-flowered; buds 1 - 1.5 x ca 0.5 cm, tomentose; pedicels 4 - 10 mm long. Sepals ovate-lanceolate or lanceolate, 1.5 - 2.3 x ca 0.3 cm, pilose outside. Petals ovate or oblong, obtuse at apex, 4 - 6 x 2 - 2.5 mm, ciliate at base, white or yellow; glands ca 2.5 mm long. Receptacle angled, ca 1.5 mm long, glabrous. Androgynophore ca 1 mm long, wooly. Stamens ca 1.2 cm long. Ovary globose, ca 2 mm, strigose; stigma clavate, laciniate. Drupes ovoid or globose-depressed, obscurely or distinctly 4-lobed, 1.5 - 2 cm across.

Fl. & Fr.: Almost throughout the year.

Habitat: Dry deciduous forests, occasional.

Distrib.: Kollam, Malappuram, Palakkad and Pathanamthitta. Andhra Pradesh, Karnataka and Tamil Nadu. Sri Lanka.

3. *Grewia flavescens* Juss. in Ann. Mus. Natl. Hist. Nat. 4: 91. 1804; Dunn in Gamble, Fl. Madras: 119(85). 1915; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 498. 1993; Sivar. & P. Mathew, Fl. Nilambur: 107. 1997. *G. carpinifolia* sensu Mast. in Hook.f., Fl. Brit. India 1: 387. 1874, non Juss. 1804. *G. pilosa* sensu Mast. in Hook.f., Fl. Brit. India 1: 388. 1874, non Lam. 1789.

Tree, to 6 m high. Leaves ovate-elliptic, oblong or ovate-oblong, subcordate or rounded at base, serrate at margin, usually acute rarely obtuse at apex, 1.5 - 13 x 1 - 7 cm, scabrous above, tomentose beneath, 3-nerved; petioles to 7 cm long. Flowers in short axillary cymes; buds oblong, obtuse, slightly dilated, 1.2 - 1.7 cm long, tomentose; peduncles 1 - 3 together; pedicels 2 - 5 mm long. Sepals

linear-lanceolate, acute, 1.2 - 1.7 cm long, tomentose outside. Petals spatulate or linear-oblong, usually 2-fid, 5 - 10 mm long; glands oblong, ca 3 mm long. Receptacle obconic, obscurely angled, crenulate at apex, 1.5 - 2 mm long, glabrous. Androgynophore absent. Stamens ca 1 cm long. Ovary subglobose or ovoid, ca 2 x 0.5 mm, pilose; stigma 2-fid. Drupes 2 - 4-lobed, globose if not lobed, 0.7 - 1 x 0.7 - 1.5 cm, stellate-tomentose, yellowish brown.

Fl. & Fr.: Almost throughout the year.

Habitat: Scrub and dry deciduous forests.

Distrib.: Kollam, Malappuram and Palakkad. Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and W. Bengal. Tropical Africa.

4. *Grewia gamblei* J.R. Drumm. ex Dunn in Gamble, Fl. Madras: 117(84). 1915; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 498. 1993; K.K.N. Nair in J. Econ. Tax. Bot. 17: 268. 1993.

Scandent shrub. Leaves ovate-elliptic to -oblong, rounded or subacute at base, crenate-serrulate at margin, acute or short-acuminate at apex, 4 - 9 x 2 - 4 cm, scabrid above, tomentose beneath, 3-nerved; petioles to 9 mm long. Flowers in axillary or extra-axillary umbelled cymes; buds oblong to ovoid-oblong, 1 - 1.4 cm long, tomentose; peduncles to 2.5 cm long; pedicels to 1.3 cm long. Sepals oblong-lanceolate, 1 - 1.4 cm long, tomentose outside. Petals oblong-lanceolate, ca 8 mm long; glands ovoid, ca 3 x 2 mm. Androgynophore well developed. Ovary subglobose, ca 2 mm across, hirsute; stigma 4-lobed. Drupes deeply 4-lobed, ca 2 cm across, subglabrous.

Fl.: April - Aug. *Fr.*: July - Nov.

Habitat: Evergreen and moist deciduous forests.

Distrib.: Idukki and Wynad (Dunn, *l.c.*). Western Ghats of Tamil Nadu. Endemic.

5. *Grewia heterotricha* Mast. in Hook.f., Fl. Brit. India 1: 385. 1874; Rama Rao, Fl. Pl. Travancore: 510. 1914; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 500. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 114. 2002. *G. ritchiei* Mast. in Hook.f., Fl. Brit. India 1: 389. 1874; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950. *G. lawsoniana* J.R. Drumm. ex Dunn in Gamble, Fl.

Madras: 117(84). 1915; V. Naray. & R.S. Rao in *J. Indian Bot. Soc.* 29: 179 1950; Manilal & Sivar., *Fl. Calicut*: 53. 1982; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 71. 1988; Vajr., *Fl. Palghat*: 94. 1990. *G. umbellata* auct. non Roxb. 1832: Mast. in Hook.f., *Fl. Brit. India* 1: 385. 1874; Rama Rao, *Fl. Pl. Travancore*: 51. 1914; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 72. 1988.

Scandent shrub. Leaves elliptic-ovate, ovate-lanceolate to oblong, subcordate, obtuse or rounded at base, crenate-serrate at margin, acute or acuminate at apex, 5 - 13 x 2.5 - 7.5 cm, scabrid on both surfaces, sometimes harshly tomentose beneath, 3-nerved; petioles to 1.3 cm long. Flowers in axillary or leaf-opposed umbelled cymes; buds oblong, acute, 1.5 - 1.8 cm long, brown-tomentose; peduncles 2.5 - 11 cm long; pedicels 1 - 2.5 cm long. Sepals linear-oblong, 1.5 - 1.8 cm long, densely pubescent outside. Petals oblong-lanceolate, acute, 7 - 9 mm long, white; glands ca 3 mm long. Receptacle ca 9 mm long, villous. Androgynophore to 1.2 cm long. Ovary subglobose, ca 1.5 mm across, pilose; stigma obscurely 4- or 5-lobed. Drupes 4-lobed, 1 - 2 cm across, glabrescent, black-purple, fleshy.

Fl.: April - Jan. *Fr.*: Dec. - March.

Habitat: Deciduous and semievergreen forests, common.

Distrib.: Kannur, Kollam, Kozhikode, Palakkad, Pathanamthitta, Thiruvananthapuram and Wynad. Karnataka, Maharashtra and Tamil Nadu. Endemic.

6. ***Grewia hirsuta*** Vahl, *Symb. Bot.* 1: 34. 1790; Wight, *Icon. Pl. Ind. Orient.*: t. 76. 1838; Mast. in Hook.f., *Fl. Brit. India* 1: 391. 1874; Rama Rao, *Fl. Pl. Travancore*: 53. 1914; Dunn in Gamble, *Fl. Madras*: 119(85). 1915; V. Naray. & R.S. Rao in *J. Indian Bot. Soc.* 29: 179. 1950; Vajr., *Fl. Palghat*: 94. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, *Fl. India* 3: 501. 1993. *G. tomentosa* sensu V. Naray. & R.S. Rao in *J. Indian Bot. Soc.* 29: 179. 1950, non Juss. 1804.

Shrub or small tree. Leaves ovate, lanceolate or ovate-lanceolate to elliptic, oblique, subcordate or subobtuse at base, serrate at margin, usually acute or acuminate sometimes subobtuse or rounded at apex, 1 - 12 x 0.7 - 4.5 cm, pubescent above, densely tomentose beneath, 3 - 5-nerved; petioles to 7 mm long. Flowers polygamous, in axillary umbelled cymes; buds globose; peduncles to 1 cm long, 1- 3 together; pedicels 2 - 5 mm long. Sepals elliptic-lanceolate, ca 8 mm long, hirsute outside. Petals oblong, rounded at apex, ca 3 mm long, white;

glands about half as long as petals. Receptacle subterete, dilated at apex. short, glabrous. Stamens more than 40. Ovary globose, ca 2 mm, densely villous; stigma 5-lobed; lobes fringed. Drupes subglobose, obscurely 4-lobed, ca 1.2 cm across, wrinkled, hirsute or hispid, fleshy.

Fl. & Fr.: Almost throughout the year.

Habitat: Deciduous forests, fairly common.

Distrib.: Kollam, Kozhikode, Palakkad and Wynad. Almost throughout India. Bangladesh, Myanmar and Sri Lanka.

7. ***Grewia lanceaefolia*** Roxb., Fl. Ind. 2: 586. 1824; Dunn in Gamble, Fl. Madras: 118(84). 1915; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 502. 1993. *G. diplocarpa* Thwaites, Enum. Pl. Zeyl.: 31. 1858; Mast. in Hook.f., Fl. Brit. India 1: 390. 1874; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950.

Shrub or small tree. Leaves ovate-lanceolate to elliptic-, narrow at base, crenate-serrate at margin, acuminate at apex, 4 - 12.5 x 1.5 - 6 cm, glabrescent, 3-nerved; petioles 0.2 - 2 cm long. Flowers in axillary cymes; buds cylindric. 1 - 1.3 cm long; peduncles 1 - 3 cm long; pedicels 1 - 2 cm long. Sepals linear-lanceolate, 1.3 - 1.5 cm long, hirsute outside. Petals ovate, obtuse, ca 3.5 x 2 mm, pilose at margin, white. Ovary subglobose, ca 2 mm across, hirsute; stigma 4-lobed. Drupes distinctly 4-lobed, ca 1.4 cm across, sparsely pilose.

Fl.: May - Sept. *Fr.*: July - Feb.

Habitat: Moist deciduous and evergreen forests.

Distrib.: Travancore (Dunn, l.c.). Western Ghats of Tamil Nadu. Bangladesh, Pakistan and Sri Lanka.

8. ***Grewia nervosa*** (Lour.) Panigrahi in Taxon 34: 702. 1985; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 71. 1988; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 502. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 90. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 72. 1996. *Fallopia nervosa* Lour., Fl. Cochinch.: 336. 1790. *Microcos paniculata* L., Sp. Pl.: 514. 1753, non *Grewia paniculata* Roxb. ex DC. 1824; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 181. 1950; Nicolson & al. in Regnum Veg. 119: 257. 1988; N. Mohanan & Sivad., Fl. Agasthyamala: 116. 2002. *Grewia microcos* L., Syst. Nat. ed. 12, : 602. 1767, nom. illeg. incl. *Microcos paniculata* L. 1753; Mast. in Hook.f.,

Fl. Brit. India 1: 392. 1874; Rama Rao, Fl. Pl. Travancore: 53. 1914; Dunn in Gamble, Fl. Madras: 116(83). 1915; Manilal & Sivar., Fl. Calicut: 53. 1982.

Mal.: *Kotta, Kottakka*

Shrub or small tree. Leaves elliptic-oblong, ovate-lanceolate or lanceolate, more or less oblique, rounded or cordate at base, subentire to serrulate at margin, acute or acuminate at apex, 9–23 x 4–10.5 cm, glabrous or pubescent beneath, 3–5-nerved; petioles to 1 cm long. Flowers in terminal and axillary panicles; buds obovoid or subglobose, 5–7 mm long, tomentose. Sepals oblong-obovate, 5–7 mm long, tomentose. Petals ovate, acute, ca 2 mm long, pubescent at base, white or yellow; glands about half as long as petals, sparsely ciliate. Receptacle ca 1 mm long, ciliate at apex. Stamens many; filaments 3–4 mm long, hairy at base. Ovary globose, ca 1 mm, glabrous; stigma 2-fid, minute. Drupes globose or subglobose, 8–10 mm across, wrinkled, glabrous, purple.

Fl.: March–Dec. *Fr.*: June–March.

Habitat: Semievergreen and evergreen forests, common.

Distrib.: Almost throughout Kerala. Andaman Islands, Assam, Goa, Gujarat, Karnataka, Maharashtra, Meghalaya, Tamil Nadu, Tripura and W. Bengal. South and SE. Asia.

9. *Grewia oppositifolia* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.: 227. 1825; Roxb., Fl. Ind. 2: 583. 1832; Mast. in Hook.f., Fl. Brit. India 1: 384. 1874; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 503. 1993. *G. emarginata* Wight & Arn., Prodr. Fl. Ind. Orient.: 79. 1834; Mast. in Hook.f., Fl. Brit. India 1: 384. 1874; Dunn in Gamble, Fl. Madras: 117(84). 1915.

Small tree or shrub. Leaves ovate or elliptic-ovate, obtuse or subcordate at base, serrulate or crenate at margin, abruptly acute or obtuse at apex, 3.5–9 x 2–5.5 cm, stellate-pubescent above, woolly beneath, 3-nerved; petioles 0.5–1 cm long. Flowers in leaf-opposed, terminal or axillary cymes; buds ovoid-oblong, 1–1.4 cm long, tomentose; peduncles to 4.5 cm long; pedicels 1–3 cm long. Sepals lanceolate, 1.2–1.6 cm long, pubescent. Petals ovate-lanceolate, emarginate, ca 6 x 2.5 mm, white; glands rotund, ca 3 mm. Receptacle 5-angled, ca 7 mm long, glabrous. Androgynophore ca 1.5 mm long, tomentose. Stamens ca 1 cm

long. Ovary elongate, strigose; stigma laciniate. Drupes deeply 4-lobed, 1–1.5 cm across, sparsely pilose, black.

Fl. & Fr.: Almost throughout the year.

Habitat: Hilly areas.

Distrib.: Kottayam. Himachal Pradesh, Jammu & Kashmir, Karnataka, Punjab and Tamil Nadu. Nepal.

10. *Grewia orientalis* L., Sp. Pl.: 964. 1753; Mast. in Hook.f., Fl. Brit. India 1: 384. 1874 p.p.; Rama Rao, Fl. Pl. Travancore: 51. 1914; Dunn in Gamble, Fl. Madras: 117(84). 1915; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 506. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 90. 1994. *G. columnaris* Sm. in Rees, Cycl. 17: No. 5. 1811; Mast. in Hook.f., Fl. Brit. India 1: 383. 1874; Rama Rao, Fl. Pl. Travancore: 51. 1914.

Mal.: *Kayyonnar, Payippala*

Shrub or small tree. Leaves ovate-elliptic or elliptic-oblong to lanceolate, obliquely cordate at base, crenate-serrate at margin, acute or acuminate at apex, 3.5–13 x 1.8–6 cm, scaberulous, 3-nerved; petioles ca 5 cm long. Flowers in 1–3-flowered axillary cymes; buds brown-tomentose; peduncles more than 0.5 cm long; pedicels to 1 cm long. Sepals oblong, acute, 1.5–2.5 cm long, tomentose outside. Petals ovate-lanceolate, 0.5–0.8 cm long, white; glands half as long as petal. Receptacle angled, ca 6 mm long, softly villous. Ovary globose, pilose; stigma 5-lobed. Drupes subglobose, 4-lobed, 1–1.5 cm across, bristly with stiff hairs, yellow.

Fl. & Fr.: May–Jan.

Habitat: Deciduous and semievergreen forests, common.

Distrib.: Kannur, Kollam, Pathanamthitta and Thiruvananthapuram. Andhra Pradesh, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu and W. Bengal. Africa to Malesia and Sri Lanka.

11. *Grewia rhamnifolia* B. Heyne ex Roth, Nov. Pl. Sp.: 244. 1821; Dunn in Gamble, Fl. Madras: 117(83). 1915; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 507. 1993. *G. orientalis* sensu Mast. in Hook.f., Fl. Brit. India 1: 384. 1874 p.p., non L. 1753.

Shrub, to 3 m high. Leaves rhomboid-ovate or lanceolate, subcordate or rounded at base, crenate-serrate at margin, acute or acuminate at apex. 2 - 14 x 1.5 - 7 cm, glabrous, 3-nerved; petioles 3 - 10 mm long. Flowers in axillary or terminal umbelled cymes; buds ovoid-oblong or conic, 1 - 1.5 cm long, ribbed, tomentose; peduncles to 1.5 cm long; pedicels 1 - 2.2 cm long. Sepals lanceolate, 1.2 - 2 cm long, wooly-tomentose outside. Petals ovate-lanceolate, 5 - 7 mm long; glands ca 3 mm long. Receptacle angled, ca 1 mm long, glabrous. Androgynophore ca 2 mm long, grooved, wooly. Stamens many; filaments 6 - 8 mm long. Ovary globose, 1 - 1.5 mm, pilose; stigma 4-lobed. Drupes subglobose, obscurely 2 - 4-lobed, 1.2 - 1.5 cm across, brown-tomentose, yellow.

Fl.: May - Sept. *Fr.*: Aug. - Feb.

Habitat: Dry deciduous forests.

Distrib.: Kollam and Thiruvananthapuram. Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu. Sri Lanka.

12. *Grewia serrulata* DC., Prodr. 1: 510. 1824; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 509. 1993. *G. glabra* Blume, Bijdr.: 115. 1825; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; Manilal, Fl. Silent Valley: 33. 1988; Vajr., Fl. Palghat: 94. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 72. 1996; Sivar. & P. Mathew, Fl. Nilambur: 107. 1997. *G. laevigata* auct. non Vahl 1790: Mast. in Hook.f., Fl. Brit. India 1: 389. 1874; Bourd., Forest Trees Travancore: 58. 1908; Rama Rao, Fl. Pl. Travancore: 53. 1914; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; Sasidh. & Sivar., Fl. Pl. Thrissur: 72. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 114. 2002. *G. multiflora* auct. non Juss. 1804: Mast. in Hook.f., Fl. Brit. India 1: 388. 1874; Rama Rao, Fl. Pl. Travancore: 53. 1914. *G. disperma* auct. non Rottler ex Spreng. 1825: Dunn in Gamble, Fl. Madras: 118(84). 1915. *G. barberi* J.R. Drumm. ex Dunn in Gamble, Fl. Madras: 118(84). 1915; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 70. 1988; N. Mohanan & Sivad., Fl. Agasthyamala: 114. 2002.

Mal.: *Kayonenar*

Small tree or shrub. Leaves ovate-lanceolate, elliptic-ovate or obovate, rounded or narrow at base, sharply serrate at margin, usually acute or acuminate

sometimes obtuse at apex, glabrescent or pubescent, 3-nerved; petioles to 1.5 cm long. Flowers in axillary umbelled cymes; buds ovoid-oblong or subglobose, 0.8 - 1.5 x 0.5 - 0.8 cm, tomentose; peduncles 1.5 - 2.5 cm long, 1 or 2 together; pedicels to 2.5 cm long. Sepals oblong or lanceolate, 0.9 - 1.6 x 0.3 - 0.5 cm, tomentose outside. Petals obovate or ovate, usually notched, sometimes acuminate at apex, ca 3.5 x 1.5 mm, greenish white; glands slightly shorter than petals. Receptacle 2 - 3 mm long, grooved, pubescent in upper half. Stamens numerous; filaments 4 - 5 mm long, glabrous. Ovary ovoid, ca 2.5 x 1.5 mm, pilose; stigma 5-lobed; lobes laciniate. Drupes 2-lobed, 0.5 - 1.5 cm across, glabrous when mature, black.

Fl.: April - Dec. *Fr.*: June - March.

Habitat: Moist deciduous and evergreen forests, common.

Distrib.: Almost throughout Kerala. Throughout India. Africa, S. and SE. Asia to Australia.

13. *Grewia tiliifolia* Vahl, *Symb. Bot.* 1: 35. 1790 (as *tiliaefolia*); Mast. in Hook.f., *Fl. Brit. India* 1: 386. 1874 p.p; Bourd., *Forest Trees Travancore*: 57. 1908; Rama Rao, *Fl. Pl. Travancore*: 52. 1914; Dunn in Gamble, *Fl. Madras*: 118(84). 1915; V. Naray. & R.S. Rao in *J. Indian Bot. Soc.* 29: 179. 1950; Manilal, *Fl. Silent Valley*: 34. 1988; Nicolson & al. in *Regnum Veg.* 119: 256. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 71. 1988; Vajr., *Fl. Palghat*: 94. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, *Fl. India* 3: 511. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 90. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 72. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 108. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 115. 2002. *G. tiliifolia* Vahl var. *leptopetala* Brandis ex T. Cooke, *Fl. Bombay*: 142. 1901. *G. leptopetala* (Brandis ex T. Cooke) Brandis, *Indian Trees*: 100. 1906. *G. tiliifolia* Vahl var. *argentea* Burret in *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 659. 1926; V. Naray. & R.S. Rao in *J. Indian Bot. Soc.* 29: 179. 1950.

Mal.: *Cataacci, Chudicha*

Tree, 6 - 15 m tall; bark peeling off. Leaves elliptic-ovate or ovate-rotund, obliquely cordate at base, serrate to crenate-serrate at margin, acuminate or rounded at apex, 1.7 - 36 x 1.5 - 24 cm, sparsely pubescent or tomentose, glabrescent, 5-nerved; petioles to 4 cm long. Flowers 3 - 6, in axillary cymes; buds subglobose or obovoid-oblong, 3 - 6 mm long, tomentose; peduncles 1 - 2 cm

long; pedicels 4 - 13 mm long. Sepals elliptic or lanceolate, subacute, ca 6 x 3 mm, tomentose outside. Petals elliptic-oblong or spatulate, obtuse, notched at apex, ca 4 x 1.5 mm, sparsely ciliate at base, yellow; glands ca 0.5 mm long. Receptacle minute, glabrous except at apex. Stamens many; filaments ca 4 mm long, yellow turn, brown. Ovary globose, ca 1.2 mm, sparsely hirsute; stigma 4-lobed. Drupes distinctly 2-lobed, 2.5 - 5 x 0.7 - 1 cm, sparsely hirsute, black; lobes globose.

Fl.: Jan. Sept. *Fr.*: May Oct.

Habitat: Semievergreen and moist deciduous forests, common.

Distrib.: Almost throughout Kerala. Throughout India. Africa, Myanmar and Sri Lanka.

14. *Grewia umbellifera* Bedd., *Fl. Sylv. S. India, For. Man.*: 37. 1871; Mast. in Hook.f., *Fl. Brit. India* 1: 393. 1874; Rama Rao, *Fl. Pl. Travancore*: 53. 1914; Dunn in Gamble, *Fl. Madras*: 117(84). 1915; V. Naray. & R.S. Rao in *J. Indian Bot. Soc.* 29: 179. 1950; Manilal & Sivar., *Fl. Calicut*: 53. 1982; Manilal, *Fl. Silent Valley*: 34. 1988; Vajr., *Fl. Palghat*: 95. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, *Fl. India* 3: 513. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 91. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 72. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 110. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 116. 2002.

Mal.: *Bhasmavalli*

Scandent shrub. Leaves elliptic or elliptic-ovate, rounded or subacute at base, glandular-serrate at margin, acute or acuminate at apex, 9 - 15 x 6 - 8.5 cm, subglabrous when young, glabrous when old, 3-nerved; petioles to 1 cm long. Flowers few, in axillary or terminal umbelled cymes; buds narrowly conic, 8 - 15 x 2.5 - 3 mm, grooved, pubescent; peduncles to 3 cm long; pedicels 1 - 2 cm long. Sepals narrowly lanceolate, acute, 1.3 - 1.8 cm long, pubescent outside. Petals ovate-oblong, subacute, 7 - 10 mm long, white; glands oblong, ca 4 mm long. Receptacle ca 4 mm long, pubescent. Androgynophore cylindrical, tomentose. Stamens many. Ovary subglobose, ca 1.5 cm across, hirsute; stigma 5-lobed. Drupes distinctly 4-lobed, 1 - 2 cm across, subglabrous, purple, fleshy.

Fl.: April - Nov. *Fr.*: June - Feb.

Habitat: Moist deciduous and semievergreen forests, common.

Distrib.: Almost throughout Kerala. Western Ghats of Karnataka, Maharashtra

and Tamil Nadu. Endemic.

15. *Grewia villosa* Willd. in Ges Naturf. Freunde Berlin Neue Schriften 4: 205. 1803, in anmerkungen; Mast. in Hook.f., Fl. Brit. India 1: 388. 1874; Dunn in Gamble, Fl. Madras: 117(85). 1915; V. Naray. & R.S. Rao in J. Indian Bot. Soc. 29: 179. 1950; Vajr., Fl. Palghat: 95. 1990; P. Daniel in Taxon 40: 610. 1991; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 515. 1993.

Small tree or shrub, 3 - 5 m high. Leaves ovate-orbicular or cordate, cordate at base, crenate or serrulate at margin, rounded or short-acuminate at apex, 3 - 15 x 3 - 12 cm, scabrous above, villous beneath, 5-nerved; petioles to 4 cm long. Flowers in axillary or leaf-opposed cymes; buds ellipsoid, ca 5 x 3 mm, pilose; peduncles 1 - 5 mm long; pedicels 2 - 5 mm long. Sepals lanceolate, ca 1 cm long, pilose. Petals spatulate, emarginate, ca 5 mm long, dull yellow; glands obovoid, ca 1.5 mm long. Receptacle angled, ca 1 mm long, glabrous, ciliate on toothed rim. Stamens many; filaments ca 5 mm long. Ovary subglobose, ca 2 mm across, densely villous; stigma lacinate. Drupes subglobose, obscurely 4-lobed, 1.2 - 1.5 cm across, villous, yellowish red.

Fl. & Fr.: Almost throughout the year.

Habitat: Scrub and dry deciduous forests.

Distrib.: Palakkad. Throughout India. Tropical Africa and W. Asia.

4. TRIUMFETTA L.

Shrubs, undershrubs or herbs, stellate-hairy. Leaves simple, alternate, petioled, entire or 3 - 5-lobed, serrate, basal serrations mostly glandular; stipules persistent, rarely caducous. Inflorescences axillary or leaf-opposed dense fascicles or 3-flowered dichasia. Flowers pedicelled, bisexual or female, 5-merous. Sepals 5, free, valvate, often hooded at apex. Petals 5, mostly ciliate and pitted-glandular at base, rarely petals absent. Stamens many, rarely twice as many as sepals, free, inserted above 5-glandular receptacle; anthers dehiscing longitudinally. Carpels 2 - 5, syncarpous; ovary usually with uncinata hairs, 2 - 5-loculed; locules 2-ovuled; style filiform; stigma 2 - 5-lobed. Capsules indehiscent or separating into cocci, subglobose, echinate, rarely tubercled all over, bristles often hooked at apex, 2 - 5-loculed; locules 1- or 2-seeded; seeds ovoid-obovoid, endospermous; embryo straight; cotyledons flat, foliaceous.

Tropics, ca 70 species, 8 in India and 3 in Kerala.

Key to species

- | | | |
|-----|---|-------------------------|
| 1a. | Undershrub; capsule bristles patent hairy | 2. <i>T. pilosa</i> |
| b. | Herbs; capsule bristles glabrous | 2 |
| 2a. | Leaves 3 - 5-lobed; cymes axillary; petals yellow | 3. <i>T. rhomboidea</i> |
| b. | Leaves not lobed; cymes leaf-opposed; petals orange | 1. <i>T. annua</i> |

1. *Triumfetta annua* L., Mant. Pl.: 73. 1767; Mast. in Hook.f., Fl. Brit. India 1: 396. 1874; Dunn in Gamble, Fl. Madras: 120(86). 1915; Manilal & Sivar., Fl. Calicut: 52. 1982; Manilal, Fl. Silent Valley: 34. 1988; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 318. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 91. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 73. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 117. 2002.

Erect herb, to 1 m high, nearly glabrous; stem glabrous except for a single line of hairs on one side alternating at each node. Leaves ovate-lanceolate, rounded at base, serrate at margin, acuminate to acute at apex, 5.5 - 12 x 2 - 5.5 cm, sparsely hairy on both surfaces, 3 - 5-nerved; petioles to 4 cm long, hairy above; stipules subulate, ca 5 mm long, hairy. Cymes leaf-opposed, 3-flowered, peduncled. Flowers ca 8 mm across; pedicels ca 2 mm long. Sepals lorate, cucullate, awned at apex, ca 4 mm long. Petals spatulate, obtuse, ca 4 mm long, orange. Stamens 10. Carpels 4; ovary globose, hairy, 4-loculed; style as long as stamens; stigma 4-lobed. Capsules globose, 5 - 8 mm, glabrous, covered with 4 - 5 mm long glabrous conic uncinate bristles.

Fl. & Fr.: Aug. - March.

Habitat: Moist deciduous forests, occasional.

Distrib.: Almost throughout Kerala. Throughout India. Africa to Malesia.

2. *Triumfetta pilosa* Roth, Nov. Pl. Sp.: 223. 1821; Mast. in Hook.f., Fl. Brit. India 1: 394. 1874; Rama Rao, Fl. Pl. Travancore: 54. 1914; Dunn in Gamble, Fl. Madras: 120(86). 1915; Manilal, Fl. Silent Valley: 35. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 72. 1988; Vajr., Fl. Palghat: 95. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 519. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 91. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 73. 1996; Sivar. & P. Mathew, Fl. Nilambur: 110. 1997.

Erect herb, to 1.5 m high, woody at base, hispid with bulbous-based stellate or simple hairs. Leaves ovate-oblong to elliptic-lanceolate, cordate or rounded at base, coarsely serrate at margin, acute or acuminate at apex, 5 - 13.5 x 1.5 - 7.5 cm, stellate-hairy, 3 - 5-nerved; petioles 1 - 3(- 5) cm long, pilose; stipules linear-lanceolate, ca 8 mm long, pilose. Flowers in many-flowered leaf-opposed or axillary short-peduncled cymes, ca 1 cm across; pedicels 2 - 3 mm long, hairy. Sepals lorate, apiculate, 9 - 10 mm long, hairy outside. Petals narrowly oblanceolate, obtuse, dentate at apex, 7 - 8 mm long, ciliate at base, yellow. Stamens 10. Carpels 4; ovary globose, hairy, 4-loculed; style subulate; stigma 4-lobed. Capsules subglobose, 6 - 10 mm across excluding bristles, tomentose; bristles 6 - 8 mm long, unciniate with patent hairs around except extreme tip; seeds planoconvex, ca 2.5 mm long, shiny, dark brown to black.

Fl. & Fr.: Almost throughout the year.

Habitat: Moist deciduous forests, occasional.

Distrib.: Almost throughout Kerala. Throughout India. Africa, S. and SE. Asia.

3. *Triumfetta rhomboidea* Jacq., Enum. Pl. Carib.: 22. 1760; Mast. in Hook.f., Fl. Brit. India 1: 395. 1874; Rama Rao, Fl. Pl. Travancore: 54. 1914; Dunn in Gamble, Fl. Madras: 120(86). 1915; Manilal & Sivar., Fl. Calicut: 52. 1982; Manilal, Fl. Silent Valley: 35. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 72. 1988; Vajr., Fl. Palghat: 95. 1990; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 520. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 92. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 73. 1996; Sivar. & P. Mathew, Fl. Nilambur: 111. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 118. 2002. *Bartramia indica* L., Sp. Pl.: 389. 1753, non *Triumfetta indica* Lam. 1792. *Triumfetta bartramia* L., Syst. Nat. ed. 10, 2: 1044. 1759 & Sp. Pl. ed. 2, : 638. 1763, nom. illeg. *T. angulata* Lam., Encycl. 3: 421. 1792; Wight & Arn., Prodr. Fl. Ind. Orient.: 74. 1834; Wight, Icon. Pl. Ind. Orient.: t. 320. 1840. *T. tungarensis* Billore in J. Econ. Tax. Bot. 3: 621. 1982; Ramam. & Rajan in J. Econ. Tax. Bot. 7: 728. 1985.

Erect herb, to 1 m high, much branched. Leaves rhomboid-ovate, rounded to cuneate at base, palmately 3 - 5-lobed or entire at margin, acute or acuminate at apex, 3 - 9.5 x 2.5 - 8 cm, stellate-pubescent to glabrescent, 3 - 7-nerved; petioles to 5 cm long, pubescent; stipules subulate, 3 - 4 mm long, pubescent. Flowers in terminal or leaf-opposed cymes, short-pedicelled, 5 - 6 mm across; buds clavate.

Sepals oblong, apiculate, ca 5 mm long, hairy outside. Petals oblong-obovate, almost as long as sepals, hairy at base, yellow. Stamens 8 - 15. Carpels 2 or 3; ovary subglobose, hairy, 2- or 3-loculed; style subulate; stigma 2- or 3-lobed. Capsules globose or subglobose, 3.5 - 4 mm across, albido-tomentose; bristles uncinata, 1.5 - 2 mm long, glabrous.

Fl. & Fr.: Aug. - Jan.

Habitat: Wastelands in plains, common.

Distrib.: Throughout Kerala. Throughout India. Pantropical.

ELAEOCARPACEAE

(M. REEMA KUMARI, W. ARISDASON & P. DANIEL)

Large to small trees, sometimes buttressed. Leaves simple, alternate, rarely opposite, often crowded at ends of branchlets; stipules caducous. Inflorescences axillary racemes, cymes or flowers solitary, paired or fascicled. Flowers regular, bisexual, rarely polygamous, often fragrant. Sepals free, rarely shortly connate, hairy or not. Petals free, usually valvate, entire or ciliate at margin, laciniate at apex, pubescent, hairy or not, sometimes sepaloid or absent. Stamens many, arising from inside of disc; filaments free, hairy or not; anthers 2-loculed, awned or bearded, opening by terminal pores or slits. Disc lobed, cushion-shaped or glanduliform, nectariferous. Ovary superior, rarely semi-inferior, hairy or not, 2 - 7-loculed; ovules 2 - many in each locule; styles glabrous at base or not; stigmas simple. Fruit a drupe, capsule or berry, smooth or wrinkled, setose or spinose, dehiscent or not; seeds smooth, rugose or tubercled, arillate or not, pendulous from axile placentae; testa crustaceous or bony; endosperm fleshy; cotyledons flat.

Tropics and subtropics, 10 genera and 520 species, 2 and 33 in India and, 2 (1 cultivated) and 8 in Kerala.

1. ELAEOCARPUS L.

Large to medium-sized trees. Leaves alternate, often crowded at ends of branchlets, entire or crenate-serrate, occasionally gland-dotted, pinnately nerved. Flowers in few - many-flowered racemes, often fragrant. Sepals usually 5, rarely 4 or 6, valvate, inserted on annular disc, caducous. Petals 5, rarely 4 or 6, valvate,

fimbriate or toothed with 10 - 60 more or less linear divisions. Stamens many, sometimes subaggregated into groups opposite petals and alternating with disc lobes; filaments long or short; anthers innate, linear or oblong, awned or not, comose. Disc flat, cushion-shaped, swollen, often pitted, glabrous or villous, often 5-lobed, rarely glanduliform. Ovary superior, 2 - 5- rarely 1-loculed; ovules pendulous; styles long or short, subulate, sometimes twisted; stigmas entire. Drupes with woody rugose or tubercled pyrenes; pyrenes 1 - 5 or rarely more-loculed; locules usually 1-seeded.

Old World tropics and subtropics excluding Africa, ca 360 species, 29 in India and 7 in Kerala.

Key to species

- | | | |
|-----|--|---------------------------|
| 1a. | Leaves longitudinally recurved | 3. <i>E. recurvatus</i> |
| b. | Leaves not recurved | 2 |
| 2a. | Anthers with awns or bristles | 3 |
| b. | Anthers with neither awns nor bristles | 1. <i>E. glandulosus</i> |
| 3a. | Axils of primary nerve with glands; ovary glabrous | 6. <i>E. venustus</i> |
| b. | Axils of primary nerve without glands; ovary pubescent | 4 |
| 4a. | Anthers with awns; filaments pubescent | 5 |
| b. | Anthers with bristles; filaments glabrous | 4. <i>E. serratus</i> |
| 5a. | Petals with 25 - 35 apical frills; filaments swollen at base | 5. <i>E. tuberculatus</i> |
| b. | Petals with 10 - 13 apical frills; filaments not swollen at base | 2. <i>E. munroii</i> |

1. *Elaeocarpus glandulosus* Wall. ex Merr. in J. Arnold Arbor. 32: 194. 1951; Manilal, Fl. Silent Valley: 36. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 73. 1988; Murti in B.D. Sharma & Sanjappa, Fl. India 3: 539. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 92. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 74. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 119. 2002. *E. oblongus* auct. non Gaertn. 1788, nec. Sm. 1809; Wight & Arn., Prodr. Fl. Ind. Orient.: 82. 1834; Mast. in Hook.f., Fl. Brit. India 1: 403. 1874; Bourd., Forest Trees Travancore: 59. 1908; Rama Rao, Fl. Pl. Travancore: 54. 1914; Dunn in Gamble, Fl. Madras: 124(88). 1915. *E. tectorius* sensu Ramamoorthy in C.J. Saldanha & Nicolson, Fl. Hassan: 131. 1974, excl. syn., non (Lour.) Poir. 1812.

Mal.: *Kattu kara*

Tree, to 30 m tall. Leaves broadly oblong-elliptic, obovate, ovate-elliptic or elliptic, acute to cuneate at base, crenate-serrate at margin often crenations with linear glands, acute to acuminate or obtuse at apex, 7 - 16.5 x 4 - 6.8 cm, coriaceous, glabrous above, glandular beneath. Racemes axillary, 4 - 10(- 16) cm long, puberulous when young. Flower buds ovoid-conic; flowers white, 10 - 12(- 15) mm across; pedicels 7 - 12(- 15) mm long, pubescent, reddish. Sepals ovate, acute at apex, 5 - 6 x 1.5 - 2 mm long, villous at margin, glandular-pubescent, brown. Petals 5, cuneate, broad above, laciniate to about halfway down, 6 - 9 mm long, ciliate at margin, faintly hairy outside, hairy inside; apical frills 33 - 36, unequal and twisted, pointed at apex, hairy to 3/4 from base. Stamens 40 - 45 in groups; filaments to 1.5 mm long, curved, puberulous; anthers oblong, ca 2 mm long, puberulous. Ovary subglobose-ovoid, 1 - 1.3 x ca 1 mm, pilose, 2-loculed; style conic, tapering, ca 2 mm long, hairy at base. Drupes oblong to elliptic or obovate, 2.5 - 3.5 cm long, rugose, fleshy; pyrenes oblong, 2-loculed, 2-seeded.

Fl. & Fr.: Jan. - Nov.

Habitat: Evergreen forests especially sholas, to 2000 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats. South Asia.

Uses: Fruit is used as an emetic, useful in rheumatism, pneumonia, ulcers, piles and leprosy. Wood is suitable for matchboxes.

2. *Elaeocarpus munroii* (Wight) Mast. in Hook.f., Fl. Brit. India 1: 407. 1874; Bourd., Forest Trees Travancore: 60. 1908; Rama Rao, Fl. Pl. Travancore: 55. 1914; Dunn in Gamble, Fl. Madras: 124(88). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 73. 1988; Vajr., Fl. Palghat: 96. 1990; Murti in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 113. 1990 & B.D. Sharma & Sanjappa, Fl. India 3: 546. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 93. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 120. 2002. *Monocera munroii* Wight, Ill. Ind. Bot. 1: 83. 1840 & Icon. Pl. Ind. Orient.: t. 952. 1845.

Mal.: *Pungari*

Tree, to 50 m tall. Leaves crowded at ends of branchlets, ovate-lanceolate, rounded, truncate or acute at base, crenate-serrate at margin often crenations with a gland, acuminate or acute at apex, 5 - 13 x 2.5 - 5 cm, chartaceous, glabrous; nerves prominent beneath; petioles 2.5 - 4.5 cm long, slender, glabrous. Racemes

axillary, to 9 cm long. Flower buds ovoid or ovate-lanceolate, hairy; flowers 1 - 1.5 cm across; pedicels 5 - 15 mm long, glabrous, curved in fruit. Sepals 5, linear to ovate-lanceolate, acute at apex, 7 - 9 x 1.5 - 2 mm, ciliate at margin, glabrescent. Petals 5, elliptic-oblong to obovate, 8 - 10 x 1.5 - 2 mm, laciniate at apex, silky-hairy on both sides, white; apical frills 10 - 13, unequal, blunt at apex, glabrous. Stamens 20 - 40; filaments ca 1.5 mm long, pubescent; anthers oblong, ca 2.5 mm long; awns ca 1 mm long, reflexed. Ovary ovoid, ca 3 x 1 mm, silky-pubescent, 2-loculed; ovules 2 in each locule; style ca 5 mm long, tapering, hairy at base. Drupes ellipsoid, 1.5 - 2 cm long, smooth, shining, yellowish green turning bluish when ripe; pyrenes 1-loculed, 1-seeded.

Fl.: June - March *Fr.*: Dec. - June.

Habitat: Along streams in evergreen forests and sholas, to 1800 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Palakkad, Pathanamthitta, Thiruvananthapuram and Wynad. Western Ghats. Endemic and rare.

Use: Fruit is edible.

3. *Elaeocarpus recurvatus* Corner in Gard. Bull. Straits Settlements. 10: 319. 1939; Manilal, Fl. Silent Valley: 36. 1988; Murti in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 115. 1990 & B.D. Sharma & Sanjappa, Fl. India 3: 549. 1993. *Monocera ferruginea* Wight, Icon. Pl. Ind. Orient.: t. 205. 1839, non Jack 1830. *Elaeocarpus ferrugineus* (Wight) Bedd., Fl. Sylv. S. India: t. 112. 1871, non (Jack) Steud. 1840; Mast. in Hook.f., Fl. Brit. India 1: 406. 1874; Bourd., Forest Trees Travancore: 60. 1908; Rama Rao, Fl. Pl. Travancore: 55. 1914; Dunn in Gamble, Fl. Madras: 124(88). 1915.

Tree, to 10 m tall; young parts densely rusty-stellate-hairy. Leaves oblong-ovate, oblanceolate or elliptic, cucullate, narrow at base, shallowly serrate at margin with serrations tipped with short hairs, short-acuminate or acute at apex, 7.5 - 11 x 4 - 7 cm, longitudinally recurved, coriaceous, cinnamon-tomentose beneath; petioles 1.5 - 2.5 cm long, swollen above, tomentose. Racemes axillary, 5 - 10 cm long, densely rusty-tomentose. Flower buds ellipsoid, tomentose; flowers 1.5 - 2 cm across; pedicels 0.8 - 1.5 cm long, hispid-tomentose. Sepals 5, lanceolate or linear-ovate, acute and hirsute at apex, 1.1 - 1.2 x 0.2 - 0.3 cm, densely tomentose outside, hairy inside. Petals 5, oblong, narrow below, broad above, laciniate at apex, 1.2 - 1.4 x 0.3 - 0.4 cm, tomentose on both sides, white; apical frills

10 - 14, acute at apex, equal. Stamens 20 - 40, unequal; filaments to 3 mm long, puberulous outside; anthers oblong, 2.5 - 4 mm long, pilose; awns ca 1 mm long, erect, slender. Ovary ovoid or oblong-ovoid, 2 - 3 x ca 1.8 mm, tomentose, 3-loculed; style slender, to 5 mm long, pilose at base; stigma simple. Drupes ovoid or oblong, 1.5 - 1.8 cm long, shining, green, fleshy; pyrenes 3-loculed.

Fl.: March - Oct. *Fr.*: June - Feb.

Habitat: Sholas, 1800 - 2500 m.

Distrib.: Idukki, Kottayam, Palakkad and Travancore (Rama Rao, *l.c.*; Dunn, *l.c.*). Western Ghats of Tamil Nadu. Endemic and rare.

4. *Elaeocarpus serratus* L., Sp. Pl.: 515. 1753 (as *serrata*); Mast. in Hook.f., Fl. Brit. India 1: 401. 1874 p.p.; Bourd., Forest Trees Travancore: 58. 1908; Rama Rao, Fl. Pl. Travancore: 54. 1914; Dunn in Gamble, Fl. Madras: 123(87). 1915; Nicolson & al. in Regnum Veg. 119: 103. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 74. 1988; Vajr., Fl. Palghat: 96. 1990; Murti in B.D. Sharma & Sanjappa, Fl. India 3: 553. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 93. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 74. 1996; Sivar. & P. Mathew, Fl. Nilambur: 112. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 121. 2002. *E. oblongus* Gaertn., Fruct. Sem. Pl. 1: 202, t. 43, f. 3. 1788; Mast. in Hook.f., Fl. Brit. India 1: 403. 1874, non Sm. 1809, nec. Wight 1838. *Ganitrus sphaericus* Gaertn., Fruct. Sem. Pl. 2: 271. 1791 p.p. *Elaeocarpus perim-kara* DC., Prodr. 1: 519. 1824. *E. cuneatus* Wight, Ill. Ind. Bot. 1: 83. 1840; Mast. in Hook.f., Fl. Brit. India 1: 402. 1874.

Mal.: *Kara, Perim kara, Valiya kara*

Tree, to 25 m tall; branchlets with persistent leaf scars. Leaves oblong, obovate, oblanceolate or elliptic, cuneate or acute at base, repand-serrate or crenate at margin, acute, obtuse or short-acuminate at apex, 5 - 14.5 x 2.5 - 7 cm, coriaceous, glabrous with prominent nerves beneath, pustulate when dry; petioles 2 - 4 cm long, glandular-pubescent, rarely glabrous. Racemes axillary, drooping, 4 - 10 cm long, pustulate. Flower buds ovoid-lanceolate or conic; flowers 8 - 10 (- 15) mm across, creamy white; pedicels 8 - 10 mm long, pubescent, becoming puberulous and pustulate later. Sepals 5, narrowly ovate-lanceolate, acute at apex, 5 - 6 x 1 - 1.5 mm, ciliate at margin, pubescent inside and outside, pustulate, red. Petals obovate, narrow below, 7 - 8 mm long, laciniate, glabrous, ciliate at margin ca 1.5

mm above base for 2 mm, occasionally pustulate; apical frills to 35, in 3 or 4 bundles, equal, tapering. Stamens 30 - 35; filaments ca 1 mm long, glabrous; anthers oblong, ca 2 mm long, puberulous, with 4 - 6 bristles; bristles to 1.5 mm long. Disc swollen, glandular-wooly. Ovary subglobose-ovoid, villous, 2- or 3-loculed; style subulate, 3 - 4 mm long, hairy at base. Drupes oblong-obovoid or ellipsoid, obtuse at apex, 2.5 - 3.5 cm long, greenish yellow; pyrenes oblong, acute at apex, 2 - 2.5 cm long, rugose or tubercled, 1 - 2 (- 3)-loculed, 1- or 2-seeded.

Fl.: Throughout the year *Fr.*: Feb. May, Sept. Oct.

Habitat: Moist deciduous to semievergreen and evergreen forests, to 1200 m.

Distrib.: Emakulam, Idukki, Kannur, Kollam, Kottayam, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats and Sikkim. South and SE. Asia.

5. *Elaeocarpus tuberculatus* Roxb., *Fl. Ind.* 2: 594. 1832; Mast. in Hook.f., *Fl. Brit. India* 1: 404. 1874; Bourd., *Forest Trees Travancore*: 59. 1908; Rama Rao, *Fl. Pl. Travancore*: 55. 1914; Dunn in Gamble, *Fl. Madras*: 124(88). 1915; Manilal, *Fl. Silent Valley*: 37. 1988; V.S. Ramach. & V.I. Nair, *Fl. Cannanore*: 74. 1988; Vajr., *Fl. Palghat*: 97. 1990; Murti in B.D. Sharma & Sanjappa, *Fl. India* 3: 559. 1993; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 93. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 74. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 112. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 121. 2002. *Monocera tuberculata* (Roxb.) Wight & Arn., *Prodr. Fl. Ind. Orient.*: 83. 1834.

Mal.: *Naggara, Pilahi*

Tree, to 50 m tall, sometimes buttressed; bark brown-grey and white-mottled. Leaves crowded at ends of branchlets, obovate, elliptic or oblanceolate, rounded, acute or truncate at base, obscurely crenate-dentate or subentire at margin, rounded to obtuse, sometimes retuse, acute to short-acuminate at apex, 6 - 20(- 25) x 4 - 12.5(- 14.5) cm, subcoriaceous; nerves prominent beneath; midnerve rufous-hairy beneath; petioles 0.7 - 3 cm long, swollen above, rufous-hairy. Racemes axillary, 3 - 12 cm long, rufous-hairy. Flower buds lanceolate, ribbed; flowers 2 - 2.5 cm across, drooping; pedicels 1.5 - 2.5 cm long, recurved, softly rufous-tomentose. Sepals 5, subulate, acute at apex, 10 - 12 x 2.5 - 3 mm, ciliate at margin, hairy outside. Petals 5, narrow at base, broad above, deeply cleft in middle, lacinate at apex; apical frills ca 35, acute at apex, 1.5 - 2 cm long, more or less

equal, hairy outside, entirely silky-pubescent outside, densely pubescent at base inside. Stamens 40 - 80, unequal; filaments 2 - 4 mm long, dilated below, pubescent; anthers oblong, 5 - 6 mm long; awns to 3 mm long, with bristle-like hairs, puberulous. Ovary oblong-ovoid, 3 - 4 x 2 - 2.5 mm, silky-tomentose, 2-loculed; style to 1.2 cm long, tapering, hairy at base. Drupes ovoid or oblong, 2 - 4 cm long, glabrescent; pyrenes terete, tubercled, 1- or 2-loculed.

Fl.: Sept. - April *Fr.*: Feb. - Sept.

Habitat: River banks in evergreen forests, to 1800 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Andaman Islands and Western Ghats. South and SE. Asia.

Uses: Nut is used as a substitute for rudraksha (*Elaeocarpus sphaericus* (Gaertn.) K.Schum.) used as beads in rosaries, necklaces and bracelets. Wood is used for planking, packing cases and splints.

6. *Elaeocarpus venustus* Bedd., Fl. Sylv. S. India: t. 174. 1872; Bourd., Forest Trees Travancore: 60. 1908; Rama Rao, Fl. Pl. Travancore: 55. 1914; Dunn in Gamble, Fl. Madras: 124(88). 1915; M.P. Nayar & Ahmedul. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 2: 107. 1988; Murti in B.D. Sharma & Sanjappa, Fl. India 3: 562. 1993. *E. monocera* sensu Mast. in Hook.f., Fl. Brit. India 1: 405. 1874 p.p., non Cav. 1800.

Tree, 10 - 15 m tall; branchlets glabrous. Leaves elliptic-oblancoolate or obovate, attenuate to acute at base, minutely cuspidate-serrate at margin, acute, retuse or rounded at apex, 6 - 12(- 13.5) x 3 - 6 cm, coriaceous, glabrous; nerves prominently impressed; axils of primary nerves with glands beneath; petioles 1 - 3 cm long, glabrous. Racemes axillary, 4 - 7 cm long, glabrous. Flower buds ovoid or oblong-ellipsoid, acute; flowers 2 - 2.5 cm across, white; pedicels (1 -) 1.5 - 2 cm long, glabrous. Sepals 5, lanceolate to oblong-ovate, acute at apex, 1 - 1.5 cm long, villous at margin, glabrous. Petals 5, obovate, laciniate, 1.5 - 2 x 0.6 - 0.8 cm, silky-pubescent to frills, densely pubescent inside to middle, white; apical frills to 10, blunt at apex. Stamens 30 - 50, equal; filaments 3 - 4 mm long, glabrous; anthers 3 - 4 mm long, shortly awned or mucronate, minutely puberulous. Disc 10-lobed. Ovary ellipsoid, ca 3 x 2 mm, glabrous, 2-loculed; style subulate, 6 - 7 mm long, very slightly hairy; stigma simple. Drupes oblong-ovoid to ellipsoid, 4 - 5 x ca 2.5

cm, smooth, shining, green; pyrenes ovoid, tubercled, 1-loculed.

Fl.: July - Sept. *Fr.*: Oct. - Feb.

Habitat: Evergreen forests, 1000 - 1500 m.

Distrib.: Thiruvananthapuram (Chemunji, Bourdillon, *l.c.*; Rama Rao, *l.c.*). Western Ghats of Tamil Nadu. Endemic and vulnerable.

Muntingia calabura L., Sp. Pl.: 509. 1753; Manilal & Sivar., Fl. Calicut: 54. 1982.

Large shrub or small tree, 4 - 7 m high; branches spreading. Leaves lanceolate or oblong-lanceolate, obliquely semicordate at base, serrate at margin, acuminate at apex, 6 - 11 x 2 - 4 cm, chartaceous, glandular-hairy above, woolly beneath. Flowers in supra-axillary fascicles, 1.5 - 3 cm across. Sepals 5, valvate, lanceolate, caudate-acuminate, 1.5 cm long. Petals 5, obovate, ovate or suborbicular, white, rarely pink. Stamens many, ca 1 cm long; filaments filiform; anthers elliptic. Ovary ellipsoid, 5 - 6 mm long; style short or absent; stigmas capitate. Berries subglobose, 1 - 1.5 cm across, red or yellow.

Fl. & *Fr.*: Almost throughout the year.

Native to tropical S. America. Cultivated in India.

Uses: Commonly cultivated as an ornamental for its showy flowers and edible fruits. Fibre from inner bark is used for making ropes and cordage.

LINACEAE

(J.L. ELLIS & W. ARISDASON)

Herbs, shrubs or rarely trees; stems glabrous, rarely hirsute or tomentose. Leaves alternate, rarely opposite, usually sessile, simple, entire; stipules small, often modified into glands or absent. Inflorescences racemose, fascicled, corymbose, spiciform, rarely lax. Flowers bisexual, hypogynous, actinomorphic, 5-merous. Sepals free or connate at base, imbricate. Petals free, contorted, usually clawed, caducous; extrastaminal glands present. Stamens as many as petals; filaments broad, connate at base forming a tube; anthers 2-loculed, introrse, opening by longitudinal slits. Ovary superior, 3 - 5-loculed with locules often subdivided nearly to placentae; placentae axile or apical; ovules 2 in each locule, collateral, pendulous, epitropous, with micropyle directed upwards and outwards, anatropous, 2-tegmic, crassinucellar or tenuinucellar, with an integumentary tapetum;

styles 3 - 5, distinct, free or connate at base; stigmas terminal, subcapitate. Fruits septicidal capsules with 1-seeded mericarps; seeds compressed, with oily straight spatulate embryo and scanty endosperm.

Cosmopolitan, 14 genera and 250 species, 5 and 12 in India and, 2 and 3 in Kerala.

Literature: Hajra, P.K. 1983. *Linaceae: Fasc. Fl. India* 13: 1 - 16.

Key to genera

- 1a. Straggling shrubs; branchlets coiled and hooked; staminodes absent 1. **Hugonia**
- b. Erect herbs or undershrubs; branchlets neither coiled nor hooked; staminodes present 2. **Linum**

1. HUGONIA L.

Scandent or straggling shrubs, often tomentose; branchlets short, coiled and hooked. Leaves alternate, entire, crenate or serrate, pinnately nerved, stipuled. Inflorescences cymose, terminal or axillary or flowers solitary or fascicled. Sepals 5, imbricate, unequal. Petals 5, contorted, yellow, caducous. Stamens 10, alternately long and short, connate at base into a short tube. Ovary 5-loculed; ovules 2 in each locule, collateral; styles 5, filiform; stigmas capitate, lobed. Fruits drupaceous, globose, fleshy; seeds compressed.

Old World tropics, 32 species and 2 in India.

Key to species

- 1a. Leaves elliptic or lanceolate, crenate, ferruginous-tomentose; lateral nerves 16 - 19 pairs 1. **H. belli**
- b. Leaves elliptic-obovate or obovate-oblong, entire, glabrous; lateral nerves 8 - 14 pairs 2. **H. mystax**

1. **Hugonia belli** Sedgw. in *Indian Forester* 46: 424. 1920; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 74. 1988; Hajra in B.D. Sharma & Sanjappa, *Fl. India* 3: 574. 1993.

Scandent shrub, densely tomentose. Leaves tapering at base, narrowly obtuse or acute at apex, 7 - 20 x 2 - 7 cm, ferruginous-tomentose; nerves con-

spicuous on both surfaces; petioles 6–11 mm long, tomentose; stipules linear, lacinate, ca 15 mm long. Lower peduncles modified into circinate hooks; upper ones ca 15 mm long; bracts ca 1 cm long. Sepals ovate, acute, ca 6 x 5 mm. Petals ca 15 mm long, yellow, withering quickly. Stamens ca 10 mm long; filaments unequal. Ovary globose; styles filiform; stigma 2-lobed. Drupes globose, ca 2 mm, longitudinally striate, 10-loculed, dark brown.

Fl. & Fr.: Nov.–Jan.

Habitat: Dense evergreen forests.

Distrib.: Kannur. Western Ghats of Karnataka. Endemic.

2. **Hugonia mystax** L., Sp. Pl.: 675. 1753 (as *myxstrax*); Hook.f., Fl. Brit. India 1: 413. 1874; Rama Rao, Fl. Pl. Travancore: 56. 1914; Dunn in Gamble, Fl. Madras: 126(90). 1915; Nicolson & al. in Regnum Veg. 119: 162. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 75. 1988; Hajra in B.D. Sharma & Sanjappa, Fl. India 3: 576. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 93. 1994.

Mal.: *Modirakanni*

Rambling or climbing shrub; branches yellow-tomentose; branchlets short, horizontal with leaflets towards base. Leaves tapering at base, obtuse or subacute at apex, 3–8 x 1–3.5 cm, hairy on midnerve; lateral nerves prominent on both surfaces; petioles ca 4 mm long, hairy. Peduncles ca 1 mm long, yellow-tomentose; bracts subulate, ca 7 mm long. Flowers ca 2.5 cm across. Sepals imbricate, ovate-lanceolate, ca 7 x 3 mm, fulvous-pubescent. Petals shortly unguiculate, ca 12 x 7 mm, unequal, twisted, yellow. Stamens 8–10 mm long, alternately long and short; anthers cordate-ovate, erect, 2-loculed, opening by 2-longitudinal clefts. Ovary globose, glabrous; ovules pendulous; styles ca 4 mm long; stigmas lobed. Drupes globose, ca 1 mm, surrounded by persistent scarlet sepals.

Fl. & Fr.: Aug.–Oct.

Distrib.: Idukki, Kannur, Kollam, Kozhikode and Thiruvananthapuram. Peninsular India. Sri Lanka.

Uses: The yellow root bark is aromatic and is employed as an antidote to poison. Bruised root is applied to inflammatory swellings. Root powder is administered as an anthelmintic and febrifuge.

Note: Nicolson & al. (*l.c.*) stated that Linnaeus (*l.c.*) misspelt the epithet (*myxstrax*) and that they corrected it (*mystax*). However, beginning with Wallich (*Numer.*

List: No. 1201) it has been spelt as *mystax* in Indian literature (*vide* Wight & Arnott, *l.c.*; Hook.f., *l.c.*; Rama Rao, *l.c.*; Dunn, *l.c.*).

2. LINUM L.

Erect herbs, often suffrutescent, usually glabrous. Leaves alternate, 1 many-nerved; stipules glanduliform or absent. Sepals 5, entire. Petals 5, contorted, caducous. Stamens 5, often with 5 alternating staminodes; glands 5, opposite petals, often adnate to staminal tube outside. Ovary 5-loculed, sometimes becoming 10-loculed by intrusion of complete or incomplete septa; ovules 2 in each locule, pendulous; styles 5, mostly free; stigma capitate or linear. Fruit capsular, splitting into 5 simple 1-seeded cocci; seeds flat; endosperm scanty; embryo straight.

Temperate and subtropical regions, ca 180 species, 5 in India (of which one is cultivated) and 1 in Kerala.

Linum mysurense B. Heyne ex Benth. in Edwards, Bot. Reg. 16: sub t. 1830; Hook.f., Fl. Brit. India 1: 411. 1872; Rama Rao, Fl. Pl. Travancore: 56. 1914; Dunn in Gamble, Fl. Madras: 125(89). 1915; Hajra in B.D. Sharma & Sanjappa, Fl. India 3: 578. 1993.

Annual herb, erect, 15 (45) cm high; stems striate. Leaves sessile, linear-ovate, obovate or oblong-elliptic, acute or obtuse at base, mucronulate or short-apiculate at apex, 1.3 (2) x 0.3 (0.7) cm, glabrous, 3-nerved at base. Flowers ca 0.4 cm across, solitary or rather congested and grouped together forming a terminal ca 10 cm long corymbose panicle of cymes; pedicels 2 - 5 mm long. Sepals 5, ovate, obovate or elliptic-lanceolate, acute at base, apiculate at apex, ca 3 x 2 mm, thin and laterally scarious, finely serrulate at top, 3-nerved. Petals obovate to orbicular, acutely narrow at base, obtuse at apex, ca 5 mm long, yellow. Stamens 5, included; filaments dilated and connate at base. Ovary glabrous; styles 2, connate at base. Capsules globose, ca 1 cm, short-apiculate, surrounded by persistent sepals at base; seeds 10, elliptic, flat.

Fl.: Oct. *Fr.*: Dec.

Habitat: Wastelands in hills, 800 - 1200 m.

Distrib.: Idukki, Kottayam and Thiruvananthapuram. Central, S. & W. India. Sri Lanka.

Linum usitatissimum L., the well known flax plant, is cultivated for oil

and fibre, rarely in Kerala.

ERYTHROXYLACEAE

(V.P. PRASAD)

Shrubs or small trees. Leaves alternate, rarely opposite, simple, entire; stipules intra-, rarely extrapetiolar, persistent or not. Flowers solitary or in axillary clusters, bisexual, actinomorphic. Calyx campanulate, 5-lobed, persistent; lobes imbricate. Petals 5, free, imbricate or convolute, mostly ligulate with a 2-fid appendage inside, caducous. Stamens 10, 2-seriate, obdiplostemonous; filaments connate at base; anthers ellipsoid, 2-loculed, dehiscing longitudinally. Ovary 3-carpelled, 3-loculed, usually 1 locule fertile; ovules 1 or 2 in fertile locule, pendulous, anatropous, crassinucellar; styles 3, free or basally connate; stigma oblique, depressed-capitate or clavate. Fruit a drupe; seeds endospermous; embryo straight; cotyledons thin.

Tropics especially America, 4 genera and 240 species, 1 and 6 in India and, 1 and 4 in Kerala.

Literature: Payson, J.P.D.W. 1958. *Erythroxylaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 5: 543 - 552. Schulz, O.E. 1907. *Erythroxylaceae*. In: Engler, H.G.A. (ed.), *Pflanzenr.* 29 (IV. 134): 1 - 176. Schulz, O.E. 1931. *Erythroxylaceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Pflanzenfam.* ed. 2, 19a: 130 - 143.

ERYTHROXYLUM P. Browne

Shrubs or small trees. Leaves alternate, entire, involute in bud; lateral nerves forming 2 more or less longitudinal lines near margin; stipules usually entirely connate, rarely 2-fid, intrapetiolar, sometimes emarginate or 2-toothed at apex, long-persistent or caducous leaving a distinct usually oblique scar. Flowers axillary, solitary or in clusters, often 2- or 3- or 4-merous, 5-merous, actinomorphic; pedicels often slightly swollen below calyx; bracteoles 2 at base. Sepals 6 or 5, free or connate at base. Petals 6 or 5, alternating with calyx lobes, ligulate, clawed, scaly inside at base. Stamens 10 (- 12), connate at base into a staminal tube; staminal tube often toothed at margin, persistent; anthers cordate at base, basifixed. Ovary 4- or 3-loculed; ovules 1 or 2 in each locule, usually only 1 locule fertile, sometimes all enlarged in fruit. Fruit a drupe, 1-loculed, 1-seeded; seed

endospermous or not; embryo oblong, straight.

Tropics especially America, 230 species, 6 in India and 4 in Kerala.

Literature: Plowman, T. 1976. Orthography of *Erythroxylum* (*Erythroxylaceae*). *Taxon* 25: 141-144.

Key to species

- 1a. Stipules lanceolate, longer than or as long as petioles, caducous 2
- b. Stipules 3-angled, shorter than petioles, persistent 2. *E. monogynum*
- 2a. Leaves acute at apex 3
- b. Leaves caudate-acuminate at apex 3. *E. moonii*
- 3a. Lateral nerves in leaves faint on both surfaces; fruit stalks ca 2 cm long 1. *E. lanceolatum*
- b. Lateral nerves in leaves distinct on both surfaces; fruit stalks ca 3 mm long 4. *E. obtusifolium*

1. *Erythroxylum lanceolatum* (Wight) Walp., Repert. Bot. Syst. 1: 407. 1842; Hook.f., Fl. Brit. India 1: 415. 1874; Dunn in Gamble, Fl. Madras: 127(91). 1915; U. Chatterjee & B.D. Sharma in B.D. Sharma & Sanjappa, Fl. India 3: 590. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 122. 2002. *Sethia lanceolata* Wight, Ill. Ind. Bot. 1: 136. 1840.

Shrub or small tree, 4-6 m high. Leaves elliptic to lanceolate, cuneate at base, acute at apex and usually with an obtuse tip, 3.5-7.5 x 1.5-2.7 cm; midnerve very prominent beneath, sunken above; lateral nerves 8-11 pairs, faint on both surfaces; petioles 3-5 mm long; stipules lanceolate, acuminate at apex, ca 5 mm long, caducous leaving a distinct usually oblique scar. Flower axillary, solitary, white; pedicels ca 8 mm long, to 2 cm in fruit, swollen below calyx. Calyx lobes ovate, acute at apex, ca 1.5 x 1 mm. Petals ca 3.5 x 1.5 mm. Stamens equal; staminal tube ca 1.5 mm long. Ovary ellipsoid or ovoid, ca 1.5 x 1 mm; style ca 1.5 mm long, connate for 2/3 at base; stigma clavate. Drupes linear-oblong, ca 1.3 x 0.3 cm, white turning deep purple when ripe; stalks ca 2 cm long, very thin in mature fruit.

Fl. & Fr.: June (based on a single collection).

Habitat: Along streams in dry evergreen forests, to 950 m, rare.

Distrib.: Thiruvananthapuram, Western Ghats of Tamil Nadu (Tirunelveli). Sri Lanka.

2. *Erythroxylum monogynum* Roxb., Pl. Coromandel 1: 61, t 88. 1798; Hook.f., Fl. Brit. India 1: 414. 1874; Bourd., Forest Trees Travancore: 61. 1908; Rama Rao, Fl. Pl. Travancore: 56. 1914; Dunn in Gamble, Fl. Madras: 127(90). 1915; U. Chatterjee & B.D. Sharma in B.D. Sharma & Sanjappa, Fl. India 3: 590. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 94. 1994. *Sethia indica* DC., Prodr. 1: 576. 1824; Wight, Ill. Ind. Bot. 1: t. 48. 1840. *Erythroxylum indicum* (DC.) Bedd., Fl. Sylv. S. India: t. 81. 1871.

Shrub or small tree, 2 - 4 m high. Leaves obovate to oblanceolate, cuneate at base, obtuse at apex, 2 - 4 x 1 - 2 cm; petioles 3 - 6 mm long; midnerve very prominent beneath, not sunken above; lateral nerves 6 - 12 pairs, very faint beneath, comparatively distinct above; stipules 3-angled, ca 2 mm long, shorter than petioles, long-persistent. Flowers axillary, solitary or in groups of 2 or 3, white; pedicels 3 - 9 mm long, slightly elongating in fruit. Calyx lobes ovate, acute at apex, ca 1 mm long. Petals oblong, obtuse at apex, ca 3.5 x 1.5 mm. Stamens equal; staminal tube ca 1.5 mm long. Ovary obovoid, ca 2 x 1 mm; styles ca 3 mm long, connate for 2/3 at base. Drupes broadly oblong, ca 8 x 4 mm, red when mature, usually free part of filaments also persistent along with staminal tube.

Fl. & Fr.: July - Dec.

Habitat: Dry hilly regions and evergreen forests, to 1000 m.

Distrib.: Kollam, Thiruvananthapuram and Wynad. Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. Sri Lanka.

Uses: Leaf and fruit are edible. Wood is a substitute for sandalwood. Heartwood on distillation yields a tar which is used for preserving wooden boats. Leaf is used as a vegetable and fodder. Wood, oil from wood, leaf, fruit pulp etc. are used with many other ingredients to cure several diseases.

3. *Erythroxylum moonii* Hochr. in Bull. Inst. Bot. Buitenzorg 22: 54. 1905; Vajr., Fl. Palghat: 97. 1990; U. Chatterjee & B.D. Sharma in B. D. Sharma & Sanjappa, Fl. India 3: 593. 1993; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 94. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 123. 2002. *Sethia acuminata* Arn. in Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. 18: 324. 1836; Wight, Ill. Ind. Bot. 1: 135. 1840. *Erythroxylum acuminatum* (Arn.) Walp., Repert. Bot. Syst. 1: 407. 1842, non Ruiz & Pavon 1802; Dunn in Gamble, Fl. Madras: 127(91). 1915. *E. lucidum* Moon ex Hook. f., Fl. Brit. India 1: 415. 1874, non Kunth 1821.

Large shrub or small tree, 3–6 m high. Leaves lanceolate or elliptic, cuneate to obtuse at base, caudate-acuminate at apex, 4–15 x 1.5–4 cm; petioles 2–5 mm long; midnerve very prominent beneath, sunken but distinct above; lateral nerves 7–13 pairs, faint on both surfaces; stipules lanceolate, acuminate at apex, ca 5 mm long, longer than or as long as petiole, caducous leaving a distinct usually oblique scar. Flower axillary, solitary, pendulous, white or greenish to yellowish white; pedicel ca 5 mm long, elongating to ca 1.2 cm in fruit, swollen below calyx. Calyx lobes ovate, acute at apex, ca 1.5 mm long. Petals oblong, obtuse at apex, ca 3.5 x 1.5 mm. Stamens equal; staminal tube ca 2 mm long. Ovary ca 2 x 1 mm; styles ca 2.5 mm long, free; stigma depressed-capitate. Drupes oblong, often slightly curved, ca 1.5 x 0.3 cm, longitudinally ridged, pink when mature.

Fl. & Fr.: July - May.

Habitat: Evergreen forests, to 1100 m.

Distrib.: Idukki, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Wynad. Tamil Nadu. Sri Lanka.

Use: Juice of fresh leaf is reported to possess anthelmintic property.

Note: There are specimens with unequal stamens and styles connate for halfway.

4. *Erythroxylum obtusifolium* (Wight) Hook.f., Fl. Brit. India 1: 415. 1874; Dunn in Gamble, Fl. Madras: 127(91). 1915; Manilal, Fl. Silent Valley: 37. 1988; U. Chatterjee & B.D. Sharma in B.D. Sharma & Sanjappa, Fl. India 3: 593. 1993; N. Mohanan & Sivad., Fl. Agasthyamala: 123. 2002. *Sethia lanceolata* Wight var. *obtusifolia* Wight, Ill. Ind. Bot. 1: 136. 1840. *Erythroxylum lanceolatum* (Wight) Walp. var. *obtusifolium* (Wight) Walp., Repert. Bot. Syst. 1: 407. 1842.

Shrub. Leaves elliptic to obovate, cuneate to obtuse at base, acute at apex with an obtuse tip, 4–9 x 2–5 cm, reddish brown when dry; midnerve prominent beneath, sunken above; lateral nerves 8–11 pairs, distinct on both surfaces; petioles 4–7 mm long; stipules lanceolate, 5–7 mm long, longer than or as long as petiole, caducous leaving a scar. Flowers axillary, solitary or in pairs, yellowish white; pedicels ca 3 mm long, elongating to ca 5 mm in fruit, swollen (even in fruit). Calyx lobes ovate, acute at apex, ca 1.5 mm long. Petals oblong, rounded at apex, ca 4.5 x 1.5 mm. Stamens equal; staminal tube ca 1.5 mm long. Ovary obovoid, ca 2 mm long; styles ca 1 mm long, free; stigma depressed-capitate.

Fruits oblong, ca 1.3 x 0.4 cm, longitudinally ridged, red when mature; free parts of filaments also persistent along with staminal tube.

Fl. & Fr.: Feb. - July.

Habitat: Forests, to 1500 m, scarce.

Distrib.: Idukki, Palakkad (Silent Valley) and Thiruvananthapuram. Western Ghats from S. Canara to Nilgiris. Sri Lanka.

Note: Schulz (1907) reported that in dolichostylous flowers stamens are unequal and style connate for 3/5 of its length.

Erythroxylum coca Lam., *Encycl.* 2: 393. 1786.

Deciduous, small tree or shrub; twigs warty when young. Leaves broadly elliptic to oblong-obovate, dark green above, paler and glaucous beneath; stipules persistent. Bracts numerous. Flowers yellow or yellowish green, heterostylous; styles free. Drupes red, almost always on bare branches; seeds subtrigonal; endosperm abundant.

Native to S. America. Cultivated in Assam, Bihar, Karnataka, Kerala, Maharashtra, Tamil Nadu and W. Bengal.

Uses: This species is of great importance since cocaine is extracted from its leaf. Cocaine is used as a stimulant and as an anaesthetic specially in eye surgery. Leaf is bitter in taste and somewhat astringent. Cultivation of the plant and production of cocaine (in drug form) is prohibited by law.

MALPIGHIACEAE

(V. CHANDRASEKARAN)

Woody climbers, lianas, shrubs or trees; indumentum of appressed medifixed (T-shaped) hairs, often mixed with simple hairs. Leaves usually opposite, rarely alternate or verticillate, mostly petioled, simple, entire, rarely sinuate-serrate or lobed; glands often present on petiole, lower surface or margin of leaves; stipules caducous, rarely absent, sometimes large, connate and more or less persistent in leaf axils. Inflorescences terminal or sometimes axillary, racemose, corymbose or umbelled. Flowers bisexual, rarely polygamous, actino- to zygomorphic; pedicels jointed, bracteoid. Sepals 5, mostly free, sometimes basally connate, imbricate, very rarely valvate, often with 2 large glands on dorsal

surface of some or all, rarely eglandular. Petals 5, free, clawed or not, mostly equal, fimbriate or dentate, convolute in bud. Stamens usually 10, in 2 series, obdiplostemonous, equal or, 1 or more longer than others, sometimes reduced to staminodes; filaments elongate, often connate at base; anthers 2-loculed, introrse, dehiscent longitudinally; connectives often produced. Disc small. Ovary superior, generally 3-, rarely 2- or 4-loculed; ovule 1 in each locule, 2-tegmic, crassinucellar, ana- or campylotropous; styles usually 3, sometimes 2 or 4, free, rarely connate; stigma terminal or subterminal, punctiform, inconspicuous. Fruit a schizocarp or often samaroid with mericarps mostly winged in various ways; seeds nonendospermous; embryo mostly straight, rarely curved; cotyledons often unequal, sometimes planoconvex.

Tropics and subtropics especially S. America, 67 genera and ca 1100 species, 2 and 23 in India and, 2 and 3 in Kerala.

Key to genera

- 1a. Flowers actinomorphic; styles 3; samaras surrounded by orbicular or lanceolate wing
1. *Aspidopterys*
- b. Flowers zygomorphic; style 1; samaras terminated by 1 - 3 lanceolate wings
2. *Hiptage*

1. ASPIDOPTERYS A. Juss.

Climbing shrubs. Leaves opposite, exstipulate, entire, eglandular. Flowers in axillary or terminal panicles or racemes; pedicels usually slender with a bract at base and 2 bracteoles in middle or at apex. Calyx short, 5-partite, eglandular. Petals entire. Stamens 10, all perfect; filaments filiform, free or connate at base; anthers ovoid, glabrous. Ovary 3-lobed; lobes flat on back, winged on sides; styles 3, glabrous; stigmas capitate. Samaras 3, surrounded by a wing; wing, orbicular or lanceolate, membranous, sometimes shortly crested in middle; seeds oblong, subterete; cotyledons straight, equal.

Indomalesia, 15 - 20 species, 14 in India and 1 in Kerala

Literature: Hutchinson, J. 1917. Revision of *Aspidopterys*. *Bull. Misc. Inform.* 1917: 91-103.

Aspidopterys canarensis Dalzell in Hooker's J. Bot. Kew Gard. Misc.

3: 37. 1851; Hook.f., Fl. Brit. India 1: 420. 1874; Dunn in Gamble, Fl. Madras: 129(92). 1915; R.C. Srivast. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 194. 1987; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 75. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 75. 1996; R.C. Srivast. in Hajra & al., Fl. India 4: 3. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 124. 2002. *A. glomerata* Wight, Icon. Pl. Ind. Orient.: t. 1986. 1853.

Climbing shrub; branches with wrinkled bark, glabrous. Leaves ovate, elliptic-lanceolate or sometimes -obovate, rounded or subacute at base, repand at margin, obtusely acuminate at apex, 5.5 - 10.5 x 2.5 - 5 cm, glabrous, sparsely clothed with fusiform hairs when young; petioles 3 - 8 mm long, channelled, glabrous. Inflorescences reduced to axillary 5 - 10-flowered fascicles borne on wood itself. Flowers 4 - 5 mm across; pedicels filiform, ca 4.5 mm long, rusty-puberulous, not jointed. Calyx lobes ovate, obtuse, ca 1 x 0.75 mm. Petals oblong, obtuse, ca 4 x 2 mm, white. Filaments ca 1 mm long; anthers oblong, ca 1.5 x 0.5 mm. Ovary glabrate; styles 3; stigma capitate. Samaras suborbicular, truncate at top, 3.5 - 4 x 3 - 3.5 cm, membranous.

Fl. & Fr.: Feb. - May.

Habitat: Evergreen forests, ca 800 m.

Distrib.: Kannur, Thiruvananthapuram and Thrissur. Western Ghats. Endemic and rare.

2. HIPTAGE Gaertn., nom. cons.

Climbing shrubs. Leaves opposite, entire, coriaceous; stipules minute, gland-like or absent. Racemes terminal and axillary, sometimes branched; peduncles bracteate, jointed; pedicels 2-bracteoid. Flowers fragrant. Calyx 5-partite with a large gland partly adnate to pedicel. Petals clawed, unequal, silky white, fifth one discoloured. Stamens 10, declinate, all fertile, 1 much longer than others; filaments connate at base. Ovary 3-lobed; styles 1 or 2, filiform, at first circinate; stigma capitellate. Samaras terminated by 1 - 3 lanceolate wings; seeds subglobose; cotyledons unequal, thick, curved.

Asia from India to W. China and through Malesia to the Pacific Islands, 20 - 30 species, 9 in India and 2 in Kerala.

Key to species

- 1a. Petioles silky-pubescent; racemes 10 - 20 cm long 2. *H. benghalensis*
 b. Petioles glabrous; racemes 1.5 - 4 cm long 1. *H. acuminata*

1. ***Hiptage acuminata*** Wall. ex A. Juss. in Ann. Sci. Nat. Bot. 2, 13: 269. 1840 & Arch. Mus. Hist. Nat. 3: 503. 1843; Hook.f., Fl. Brit. India 1: 419. 1874; Nied. in Engl., Pflanzenr. IV (141): 80. 1928; Arènes in Reinwardtia 3: 72. 1954; Pandur. & al. in J. Econ. Tax. Bot. 6: 227. 1985; R.C. Srivast. in Hajra & al., Fl. India 4: 14. 1997.

Straggling shrub. Leaves opposite, lanceolate, rounded at base, caudate-acuminate at apex, 8 - 15 x 4.5 - 5 cm, glabrous; lateral nerves 4 - 7 pairs, oblique to arcuate; petioles 0.5 - 1 cm long, glabrous. Racemes axillary, 1.5 - 4 cm long, brown-tomentose, with a bract and a pair of bracteoles. Calyx 5-partite with a large gland outside partly on pedicel; lobes 2 - 3 mm long, unequal, hairy. Petals 5, ca 4 mm long, brown-tomentose, pale pink. Stamens 8 - 10, one much larger than the rest; filaments 0.5 - 2 mm long, connate at base. Ovary 3-loculed; style 1, ca 3.5 mm long, coiled; stigma capitate. Fruit not seen.

Fl.: Feb.

Habitat: Evergreen forests, ca 700 m.

Distrib.: Idukki. Northeast India.

Note: Inclusion is based on the report of Pandurangan & al. (*l.c.*) which now makes the species a disjunct one. This report was overlooked by Srivastava (*l.c.*).

2. ***Hiptage benghalensis*** (L.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43: 136. 1874; Nied. in Engl., Pflanzenr. IV (141): 77. 1928; M. Jacobs in Steenis, Fl. Males. I, 5: 132. 1955; Manilal & Sivar., Fl. Calicut: 55. 1982; Manilal, Fl. Silent Valley: 38. 1988; Nicolson & al. in Regnum Veg. 119: 169. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 75. 1988; Vajr., Fl. Palghat: 97. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 75. 1996; R.C. Srivast. in Hajra & al., Fl. India 4: 14. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 125. 2002. *Banisteria benghalensis* L., Sp. Pl.: 427. 1753. *Hiptage madablotia* Gaertn., Fruct. Sem. Pl. 2: 169, t. 116. 1790; Hook.f., Fl. Brit. India 1: 418. 1874; Rama Rao, Fl. Pl. Travancore: 57. 1914; Dunn in Gamble, Fl. Madras: 128(91). 1915. *Gaertnera racemosa* Roxb., Pl. Coromandel 1: 74, t. 18. 1795 & Fl. Ind. 2: 368. 1832.

Large, woody, climbing shrub; young parts silky. Leaves ovate-lanceolate to elliptic-oblong, acute at base, acute or acuminate at apex, 9 - 21 x 4 - 9 cm, subcoriaceous to coriaceous, glabrous; petioles ca 1 cm long, silky-pubescent. Racemes erect, 10 - 20 cm long, tomentose; pedicels 1.5 - 2 cm long, swollen above. Flowers 1.5 - 2 cm across, fragrant. Calyx lobes ovate, elliptic or oblong, 8 - 10 x 2 - 4 mm, fulvous-sericeous outside; glands oblong, elliptic or lanceolate, 4 - 5 mm long, decurrent on pedicel. Petals suborbicular to obovate, clawed, fringed at margin, ca 1 cm long, hairy outside. Filaments ca 6 mm long in short ones, ca 10 mm long in long ones; anthers ovoid, ca 2 mm long. Ovary pubescent; style terete, acute, 14 - 15 mm long, slightly curved. Samaras variable; midwing oblanceolate or linear-oblong, acute, obtuse or rounded at apex, 4 - 6 x 1 - 1.5 cm; lateral wings lanceolate-oblong, 2 - 3 x 0.8 - 1.5 cm; dorsal crista ca 10 mm long.

Fl. & Fr.: Jan. - April.

Habitat: Rocky ravines and swampy localities, to 1650 m, common.

Distrib.: Idukki, Kannur, Kasaragod, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Tropical India. China, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka and Taiwan.

Uses: Plant is used in chronic rheumatism, asthma and cutaneous diseases. Wood is used for tools and as fuel.

Excluded species

Srivastava (*l.c.*: 27) also included Kerala under distribution of *Hiptage sericea* Hook.f. But then, there is no specimen from Kerala.

Galphimia gracilis Bartl. in *Linnaea* 13: 552. 1839. *G. glauca* Merr., *Fl. Manila*: 277. 1912.

Shrub; young parts appressed-reddish-hairy, glabrescent with age. Leaves elliptic-oblong, acute at base, obtuse to rounded at apex with an acute tip, 3 - 5 x 1 - 2 cm. Inflorescences overtopped by 2 lateral branches. Flowers 1 - 2 cm across. Calyx lobes ovate, rounded or subacute at apex, sometimes recurved. Petals unequal, clawed, yellow; limbs 3-angled, entire. Fruits globose, brown.

Fl. & Fr.: Throughout the year.

Native to tropical America; grown in gardens as an ornamental.

Malpighia coccigera L., *Sp. Pl.*: 426. 1753; M. Jacobs in Steenis, *Fl. Males.*

1, 5: 144. 1955; Manilal & Sivar., Fl. Calicut: 55. 1982.

Shrub. Leaves suborbicular to elliptic, rounded to truncate at base, rounded or slightly notched at apex, 1 - 1.5 x 0.75 - 1.2 cm, glabrous. Flowers on dwarf shoots, axillary, single or paired. Calyx lobes 2 - 2.5 mm long, blunt; glands 6 - 10, elliptic, flat. Petals 7 - 11 x 3 - 7 mm, whitish to pale pink or light red. Fruits with 1 or 2 mericarps, red.

Fl. & Fr.: Oct. - Dec.

Native to C. America; cultivated in gardens for the edible fruit and as an ornamental hedge plant.

ZYGOPHYLLACEAE

(E. VAJRAVELU)

Annual or perennial herbs, shrubs or rarely trees; branches usually jointed or swollen at nodes. Leaves opposite, rarely spiral, pari-, rarely imparipinnate or 1 - 3-foliolate, petioled or not; stipules free, foliaceous, sometimes spinescent, rarely caducous. Flowers terminal or pseudoaxillary, solitary or 1 - 3 together in dichasial cymes, usually bisexual, actino-, rarely zygomorphic, bracteoid. Sepals 3 - 5, free or connate at base, imbricate or valvate, or absent. Petals 3 - 5, free, often clawed, imbricate or convolute, or absent. Disc convex or concave, rarely annular. Stamens in 1 - 3 whorls of 5 each, free, outermost whorl usually opposite petals; filaments free, with scaly appendages at base or not; anthers 2-loculed, basifixed to versatile, introrse, dehiscent longitudinally. Ovary superior, sessile or short-stipitate, angled or winged, 5 - 10-loculed; ovules 1 - many on axile placenta, anatropous; style simple, angled or furrowed, rarely 5; stigma simple, capitate or 1 - 5-lobed. Fruits capsular or schizocarpic with 1 - several-seeded indehiscent mericarps, rarely drupaceous or baccate; endosperm copious or absent; embryo straight or curved; cotyledons flat.

Tropics and subtropics especially arid regions, sometimes in saline areas, 27 genera and 285 species, 8 and 18 in India and, 2 and 2 in Kerala.

Literature: Dassanayake, M.D. 1987. *Zygophyllaceae*. *Rev. Handb. Fl. Ceylon* 6: 421-424. Steenis, C.G.G.J. van 1949. *Zygophyllaceae*. *Fl. Males.* 1, 4: 64. Hadidi, M.N.E. 1972. *Zygophyllaceae*. In: Rechinger, K.H. (ed.), *Fl. Iran*. 98: 1 - 32.

Key to genera

- | | | |
|-----|--|---------------------|
| 1a. | Small trees or shrubs; leaves 2-foliolate; fruits drupaceous, fleshy | 1. Balanites |
| b. | Herbs; leaves multifoliolate; fruits schizocarpic, dry | 2. Tribulus |

1. **BALANITES** Delile, nom. cons.

Shrubs or small trees; thorns axillary, simple or forked; bark bitter. Leaves alternate, exstipulate, 2-foliolate; leaflets entire. Flowers in axillary cymes. Sepals 5, free, imbricate. Petals 5, oblong, spreading, glabrous or villous. Stamens 10; filaments filiform. Disc thick, 10-grooved. Ovary globose, 5- or 1-loculed by suppression, with 1 ovule in each; style short; stigma minute. Fruit a fleshy 5-angled 1-seeded drupe; seed pendulous.

Tropical Africa to Myanmar, ca 25 species and 1 in India.

Balanites roxburghii Planch. in Ann. Sci. Nat. Bot. 4, 2: 258. 1854; A.W. Benn. in Hook.f., Fl. Brit. India 1: 522. 1875; Rama Rao, Fl. Pl. Travancore: 69. 1914; Gamble, Fl. Madras: 164(117). 1915; P. Singh & V. Singh in Hajra & al., Fl. India 4: 40. 1997. *B. aegyptiaca* auct. non (L.) Delile 1813: Wight, Icon. Pl. Ind. Orient.: t. 274. 1840; R.K. Basak in Fasc. Fl. India 4: 20. 1980.

Shrub or small tree, 3 - 5 m high, bushy, deciduous; bark whitish, bitter; young parts pubescent; thorns to 6 cm long, simple or forked, often leaf- and flower-bearing. Leaflets 2, elliptic-oblong, obovate, oblong or oblanceolate, rounded or cuneate at base, obtuse, acute or rarely mucronulate at apex, 1 - 5 x 1 - 3 cm, glaucous, pubescent; petiolules 3 - 5 mm long. Flowers 4 - 12 in axillary fascicled cymes, pale greenish yellow, fragrant; pedicels 5 - 15 mm long, pubescent. Sepals 5, imbricate, elliptic-ovate, ca 3 mm long, densely pubescent outside, long-silky-hairy inside. Petals 5, elliptic-oblong, glabrous outside, silky-hairy inside. Stamens 10, 2 - 3 mm long; filaments 1.5 - 2 mm long. Ovary globose, ca 2 mm; style ca 1 mm long. Drupes ovoid or subglobose, 3 - 6 x 2 - 4 cm, 5-grooved, puberulous, yellow when ripe with a foetid pulp; seed 1, stony with fibrous testa.

Fl. & Fr.: Almost throughout the year.

Habitat: Scrub forests and sandy wastelands.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*). Almost throughout India. Myanmar and Pakistan.

Uses: Fruit pulp is edible; used medicinally in whooping cough; also used for washing silk and cotton. Bark is used as an anthelmintic for cattle and its juice is used as a fish poison.

Note: Planchon (*l.c.*) based the name *B. roxburghii* on *Ximenia aegyptiaca* sensu Roxb. (1832) and considered it distinct from *X. aegyptiaca* L. (1753). He pointed out that *B. roxburghii* differs from the African *B. aegyptiaca* (L.) Delile in the petals being villous on inner surface. The former also differs from the latter in having shorter petioles and the ovary which does not lengthen out after flowering (*vide* Basak in *Fasc. Fl. India* 4: 21. 1980; also Amalraj in *J. Econ. Tax. Bot.* 6: 749. 1985).

TRIBULUS L.

Annual to perennial, prostrate to semierect, branching herbs, hairy to glabrescent; taproot very long. Leaves opposite, 1 in each pair alternately smaller or sometimes abortive, paripinnate, stipuled; leaflets 6 - 20, opposite, petioled or not. Flowers solitary or in many-flowered dichasia, axillary or pseudoaxillary, pedicelled. Sepals 5, imbricate, pubescent, persistent or not. Petals 5, imbricate, obovate to obovate-oblong, membranous, caducous. Disc annular, 10-lobed. Stamens 5 - 10, outer whorl of 5 slightly longer and opposite petals; filaments filiform; anthers oblong to ovoid; each of inner whorl of 5 stamens adaxially subtended by intrastaminal gland and abaxially by extrastaminal gland. Ovary sessile, globose, densely covered with bulbous-based stiff hairs, 5-loculed with 1 - 5 ovules in each; style simple, cylindrical, 5-ridged; stigma 5-rayed. Fruits 5-lobed or 5 - 12-winged, separating into 4 or 5 dorsally spiny-winged or tubercled indehiscent mericarps; seeds obliquely pendulous, separated by transverse partitions developing after fertilization; cotyledons ovoid.

Tropics and subtropics especially dry Africa, ca 25 species, 5 in India and 1 in Kerala.

Tribulus terrestris L., Sp. Pl.: 387. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 423. 1874; Rama Rao, Fl. Pl. Travancore: 57. 1914; Dunn in Gamble, Fl. Madras: 130(92). 1915; M.P. Nayar & G.S. Giri in Bull. Bot. Surv. India 24: 164. 1982; P. Singh & V. Singh in Hajra & al., Fl. India 4: 55. 1997.

Annual, prostrate to procumbent or suberect hairy herb; branches radiat-

ing from crown of main stem, to 1 m long, hirsute to sericeous. Leaves: larger ones 3 - 7 cm long with 4 or 5 pairs of pinnae; smaller ones to 3.5 cm long with 2 - 4 pairs; rachises ending in a mucro; leaflets 8 - 14, ovate to elliptic, oblique, acute or obtuse at apex, 4 - 11 x 2 - 5 mm, silky-hairy on both surfaces; stipules subulate to falcate, 2 - 5 x 1 - 1.5 mm. Flowers 8 - 10 mm across; pedicels 1 - 1.5 cm long, pubescent. Sepals ovate-lanceolate, acute, 2 - 7 x 1.5 - 3 mm, hirsute with scarios margin, minutely ciliate, yellowish green. Petals obovate-oblong, obtuse-truncate, 2.5 - 6 x 1 - 3 mm, bright yellow. Stamens 10; filaments of shorter stamens ca 2 mm long, those of longer ones 2.5 - 3.5 mm long; anthers oblong, ca 0.5 mm long. Intrastaminal glands 3-angled, free; extrastaminal glands thick, truncate. Ovary 1 - 1.5 mm across with stiff upward spreading bulbous-based hairs; style 1 - 2.5 mm long; stigma pyramidal, 5-rayed. Fruits 8 - 15 mm across; mericarps 4 - 8 x 5 - 7 mm, dorsally tubercled; spines 4 or 2.

Fl. & Fr.: Almost throughout the year; flowers opening in the morning and closing early in the afternoon.

Habitat: Sandy and gravelly places in wastelands, roadsides and fallow lands.

Distrib.: Kollam (Rama Rao, *l.c.*), Kottayam and Thiruvananthapuram (Nayar & Giri, *l.c.*). Almost throughout India. Pantropical.

Uses: Leaf and tender branch are used as a vegetable. Fruit is used as a tonic, aphrodisiac and is useful in kidney diseases, chronic cystitis and gonorrhoea.

Excluded species

Nayar and Giri (*l.c.*) included Kerala as well under distribution of *T. cistoides* L. following Edgeworth and Hook.f. (*l.c.*). But then, specimens at BSI, CAL and MH are all from plants introduced from America into the botanic garden at Howrah (*vide* Singh & Singh, *l.c.*: 59).

Guaiacum officinale L., an American tree, is cultivated as an ornamental in gardens.

GERANIACEAE

(N.P. BALAKRISHNAN)

Herbs, shrubs or rarely trees, occasionally armed. Leaves alternate or opposite, simple, dissected or compound, lobed or toothed, petioled, stipuled. In-

florescences axillary or pseudoterminal, often cymose, subumbelled or flower solitary. Flowers bisexual, actino- or slightly zygomorphic. Sepals 5 (or 4), free or basally connate, imbricate, sometimes 1 spurred, persistent. Petals 5 (rarely 2, 4 or 8), caducous, very rarely absent, equal or posterior ones different from anterior ones, imbricate, rarely contorted. Stamens 10 or 15 in 1 - 3 series of 5 (or 4) each, obdiplostemonous, often partly reduced to staminodes; filaments usually connate at base, rarely connate in 5 bundles; anthers globose or oblong, about as long as wide, 2-loculed, dorsi-, rarely basifixed, dehiscent longitudinally; glands usually present and alternate with stamens. Receptacle produced above ovary into a column becoming connate with styles. Carpels 5 (- 3); ovary superior, 3- 5- or 8-lobed, 5 (- 3)-loculed; ovules 1 or 2, or numerous in each locule on axile placenta, 2-tegmic, crassinucellar, ana-, campylo- or amphitropous; styles 1 (- 5); stigmas 5, apical, linear, ventrally decurrent. Fruits schizocarpic, mostly beaked, divided into 5 (rarely 3 - 8) mericarps whereby styles separate from below upwards carrying 1 many-seeded mericarps; embryo folded; endosperm scanty or absent.

Mostly temperate and a few tropical, 11 genera and ca 700 species, 4 and 45 in India and, 1 and 1 in Kerala.

GERANIUM L.

Annual or perennial herbs or undershrubs, decumbent-ascending, erect, straggling or caespitose. Leaves simple, pinnatifid or crenulate, partly crowded at base of stem, orbicular; segments tipped by callous tubercles. Inflorescences axillary, panicled, 1- or 2-flowered or subumbelled. Flowers pedicelled, bracteoid, actinomorphic. Sepals 5, imbricate, ovate to oblong-elliptic, rounded, enlarged after anthesis, appressed-pubescent outside. Petals 5, imbricate, obovate-oblong, rounded, entire or slightly notched. Disc represented by interpetaline glands. Stamens 10, all fertile; filaments free or connate at base; anthers 10, rarely 5. Ovary 5-lobed, 5-loculed, beaked; ovules 2 or 3 in each locule, superposed. Fruit a 5-lobed and 5-loculed capsule; each locule (mericarp) 1-seeded, usually separating from axis by elastic curving of lower portion of beak carrying lower portion of beak and dehiscent mericarps and ejaculating seed with it; seed areolate.

Temperate and montane tropics, ca 300 species, 27 in India and 1 in Kerala.

Geranium nepalense Sweet, Geraniaceae 1: t. 12. 1820; Edgew. & Hook.f.

in Hook.f., Fl. Brit. India 1: 430. 1874; Dunn in Gamble, Fl. Madras: 131(94). 1915; Malhotra in Hajra & al., Fl. India 4: 75. 1997. *G. affine* Wight & Arn., Prodr. Fl. Ind. Orient.: 133. 1834, non Ledeb. 1831; Wight, Icon. Pl. Ind. Orient.: t. 59. 1838.

Perennial herb, diffusely decumbent-ascending, usually several-stemmed, hairy or villous with reflexed hairs especially on young parts; stems with reflexed long white hairs; branches rooting at nodes. Leaves opposite, spreading, 2 - 6 cm across, 5-angled or deeply 3 - 5-lobed or -partite into strap-shaped segments, sparsely pubescent, 5-fid far beyond middle; median segment rhomboid-obovate, incised at apex; main nerves 3 - 5; petioles 2 - 15 mm long, villous with reflexed white hairs; stipules subulate-lanceolate to filiform, 5 - 7 mm long. Flowers solitary or 2-flowered on 2 - 4 cm long slender peduncles, 1 - 1.5 cm across, pale purple, pink or mauve with red nerves; bracts 4, thin, 1 - 4 cm long; pedicels 1 - 4 cm long, elongating to 6 cm in fruit, sparsely pubescent. Sepals elliptic-lanceolate, short-mucronate at apex, 6 - 7 x 3 - 4 mm, pilose outside, persistent. Petals ovate-oblong, entire, ca 5 x 3 mm, pale red-purple. Stamens 10, free or shortly monadelphous; filaments dilated at base, 1.5 - 2 mm long, puberulous; connectives prolonged into a beak; styles connate at base for more than half, 5-lobed at apex; stigma linear, recurved. Capsules ellipsoid to subglobose, 5-lobed, 3 - 4 x ca 3 mm, prolonged into a linear-lanceolate 2 - 2.5 cm long beak; mericarps 2 - 2.5 mm long, sparsely patent-hairy, dehiscent ventrally and septifragally from axis and their beaks elastically curving upwards bearing mericarps at base; seed 1 in each mericarp, ellipsoid, ca 2 mm long, smooth, shining, black.

Fl. & Fr.: Oct. - Jan.

Habitat: Grassy slopes, roadsides and sometimes walls, 2000 - 2300 m.

Distrib.: Idukki. Northeast India and Tamil Nadu. Afghanistan, China, Japan and Sri Lanka.

Use: Root is used for colouring medicinal oils.

Pelargonium graveolens Aiton and **Tropaeolum majus** L. are sometimes cultivated in gardens in Idukki District particularly in Munnar and Devicolam.

BALSAMINACEAE

(N.C. RATHAKRISHNAN, K. VIVEKANANTHAN & V.J. NAIR)

Shrubs or, annual or perennial herbs, sometimes succulent, inhabiting moist places, rarely epiphytes; stems erect or procumbent, often rooting at lower nodes, occasionally acaulous. Leaves alternate, opposite, verticillate or spiral, simple, petioled, sometimes sessile, crenate, dentate or serrate at margin with teeth or crenatures generally apiculate, the lowermost sometimes with glands, glabrous or pubescent; petioles occasionally glandular. Flowers bisexual, zygomorphic, in axillary racemes or umbels or solitary, 2-nate or fascicled. Sepals 3, rarely 5, free; lateral 2 small; lower one (anterior by resupination) the lip, large, petaloid, often tapering or abruptly constricted into a nectariferous spur. Petals 5; posterior one standard, flat or cucullate; lower 4 usually connate in lateral pairs; wings entire or, 2- or 3-lobed, sometimes with an auricle descending into spur. Stamens 5; anthers cohering into a ring. Ovary superior, 5-loculed; ovules many; style short or absent; stigma sessile, 5-toothed. Fruit a berry or capsule; seeds smooth or tubercled.

Tropical and subtropical montane forests of the Old World, 2 genera and ca 850 species, 2 and 203 in India and, 2 and 64 in Kerala.

Literature: Grey-Wilson, C. 1985. *Balsaminaceae*. In: Dassanayake M.D. (ed.), *Rev. Handb. Fl. Ceylon* 5: 76 - 120.

Key to genera

- 1a. Lateral sepals 4, petaloid; lateral petals free from one another; fruit a capsular berry **1. Hydrocera**
- b. Lateral sepals 2, green; lateral petals united laterally into 2 pairs; fruit a loculicidal (dehiscent) capsule **2. Impatiens**

1. HYDROCERA Blume ex Wight & Arn.

Aquatic or semiaquatic perennial along streams, marshy places and rice fields. Stems soft, often spongy. Leaves alternate or spiral, sessile or subsessile, simple, serrate. Inflorescences axillary, cymose, 3 - 10-flowered. Lateral sepals 4 in 2 pairs, lower sepals spurred. Petals 5, free. Ovary glabrous. Fruit a capsular berry.

Indomalesia, unispecific.

Note: Raju & al. (*Taxon* 51: 383–384, 2002) proposed to conserve the superfluous generic name *Hydrocera* Blume ex Wight & Arn. (1834) against the priorable *Tytonia* G. Don (1831) in the interest of stability of nomenclature.

Hydrocera triflora (L.) Wight & Arn. in Wight, Cat. Ind. Pl.: 28, No. 445, 1833 & Prodr. Fl. Ind. Orient.: 140, 1834; Hook.f., Fl. Brit. India 1: 483, 1875; Gamble, Fl. Madras: 145(104), 1915; N.C. Nair & al. in J. Econ. Tax. Bot. 2: 224, 1981. *Impatiens triflora* L., Sp. Pl.: 938, 1753.

Aquatic or semiaquatic perennial, 1–2 m high; stems soft, often spongy and rooting at lower nodes. Leaves alternate or spiral, sessile or subsessile, linear-lanceolate to -elliptic, cuneate at base, serrate at margin, acute to long-acuminate at apex, 3–12 x 0.8–1.5 cm, greenish above, pale beneath; stipular glands 2, sessile. Peduncles 5–8 mm long; bracts lanceolate, caducous; pedicels 12–15 mm long. Flowers in 3–10-flowered axillary cymes, white with purple. Lateral sepals 4 in 2 pairs; outer pair elliptic to elliptic-oblong, apiculate; the inner elliptic-oblong, obtuse. Lower sepal navicular, tapering into a spur. Dorsal petal obovate, cucullate; lateral petals 4, free; lower pair oblong; the upper elliptic to elliptic-obovate. Ovary glabrous. Fruit a septicidally dehiscent capsular globose berry, 8–10 mm, red turning purple, 5-seeded.

Fl. & Fr.: Almost throughout the year.

Habitat: Along streams, marshy places and rice fields, to 100 m.

Distrib.: Alappuzha, Kottayam and Pathanamthitta. Andhra Pradesh, Assam, Tamil Nadu, Uttar Pradesh and W. Bengal. China, Cambodia, Indonesia, Laos, Malaya Peninsula, Sri Lanka and Thailand.

Note: The number of flowers in a cyme varies from 3–10 as stated by Nair & al. (*l.c.*). Hook.f. (*l.c.*) and Gamble (*l.c.*) recorded only a 3-florous condition.

2. IMPATIENS L.

Terrestrial or occasionally epiphytic annuals, perennial herbs or shrubs in moist or shaded places. Leaves alternate, opposite or verticillate, petioled or not, simple, entire or serrate, pinnately or rarely palmately nerved. Flowers axillary, solitary, fascicled or in racemes or umbels. Lateral sepals 2, much smaller than lip. Lip saccate, cymbiform, funnel-shaped or rarely bowl-shaped with a long, short or

obsolete spur. Standard obovate or suborbicular, sometimes keeled on dorsal side. Lateral petals 4, united into 2 pairs. Fruit a capsule, dehiscing loculicidally; valves 5, elastically springing away from placentariferous axis; seeds smooth or tubercled, glabrous or hairy, nonendospermous.

Tropics and subtropics especially montane forests of Asia and Africa, few in temperate Asia, Europe and N. America, ca 850 species, 202 in India and 64 in Kerala.

Key to species

- | | | |
|------|--|---------------------------|
| 1a. | Plants scapigerous; leaves radical | 2 |
| b. | Plants not scapigerous; leaves cauline | 9 |
| 2a. | Wings 2-lobed | 1. <i>I. acaulis</i> |
| b. | Wings 3-lobed | 3 |
| 3a. | Standard crenate | 12. <i>I. crenata</i> |
| b. | Standard not crenate | 4 |
| 4a. | Lobes of wings subequal | 5 |
| b. | Lobes of wings clearly unequal | 6 |
| 5a. | Plant epiphytic; lateral sepals ovate; spur of lip straight | 38. <i>I. modesta</i> |
| b. | Plant terrestrial; lateral sepals obliquely ovate; spur of lip incurved | 8. <i>I. clavicornu</i> |
| 6a. | Spur of lip absent or obscure (ca 2 mm) | 7 |
| b. | Spur of lip very prominent and long | 8 |
| 7a. | Plant terrestrial; spur of lip absent; seeds not tufted-ciliate at apex | 43. <i>I. pandata</i> |
| b. | Plant epiphytic; spur of lip present (ca 2 mm); seeds tufted-ciliate at apex | 52. <i>I. sivarajanii</i> |
| 8a. | Lip saccate; basal lobe of wings without a dorsal filiform auricle | 50. <i>I. scapiflora</i> |
| b. | Lip not saccate; basal lobe of wings with a dorsal filiform auricle | 15. <i>I. denisonii</i> |
| 9a. | Plants epiphytic | 10 |
| b. | Plants terrestrial | 16 |
| 10a. | Wings 2-lobed | 11 |
| b. | Wings 3-lobed | 14 |
| 11a. | Wings purple, whitish or lilac | 12 |
| b. | Wings yellow | 13 |
| 12a. | Leaves cordate at base | 11. <i>I. cordata</i> |
| b. | Leaves cuneate at base | 4. <i>I. auriculata</i> |

- 13a. Lateral sepals elliptic; lip laterally compressed **27. I. jerdoniae**
- b. Lateral sepals linear; lip saccate **44. I. parasitica**
- 14a. Leaves with violet tinge; nerves, petioles and flowers including spur violet **61. I. violacea**
- b. Leaves without violet tinge; nerves and petioles greenish; flowers yellowish green; spur crimson or not 15
- 15a. Lip to 1.5 cm long, without a prominent hook near mouth, hairy outside; seeds smooth **29. I. kulamavuensis**
- b. Lip to 3.5 cm long, with a prominent hook near mouth, glabrous; seeds tufted-ciliate at apex **51. I. sholayarensis**
- 16a. Flowers peduncled, in racemes, umbels or subumbels (at times solitary or 2-nate then with distinct peduncle) 17
- b. Flowers not peduncled, solitary, 2-nate or fascicled 36
- 17a. Lamina decurrent into petiole **47. I. platyadena**
- b. Lamina not decurrent into petiole 18
- 18a. Leaves rosulate 19
- b. Leaves not rosulate 20
- 19a. Spur of lip ca 3 mm long; flowers white with purple tinge **55. I. travancorica**
- b. Spur of lip 2.5 - 3.5 cm long; flowers red **57. I. umbellata**
- 20a. Spur of lip inflated in middle 21
- b. Spur of lip not inflated in middle 22
- 21a. Leaves alternate; spur of lip hooked at apex **58. I. uncinata**
- b. Leaves usually opposite (very rarely alternate); spur of lip not hooked at apex **63. I. viscosa**
- 22a. Peduncles and pedicels viscid **62. I. viscida**
- b. Peduncles and pedicels not viscid 23
- 23a. Leaves alternate and opposite **45. I. parvifolia**
- b. Leaves either alternate or opposite 24
- 24a. Leaves opposite or in verticels of 3 - 6 25
- b. Leaves alternate 26
- 25a. Flowers pale pink; spur of lip straight, to 7 mm **22. I. goughii**
- b. Flowers red; spur of lip curved upwards, 2 - 3.5 cm **60. I. verticillata**
- 26a. Spur of lip trumpet-shaped **46. I. phoenicea**
- b. Spur of lip not trumpet-shaped 27
- 27a. Bracts subfoliaceous, ca 1.2 cm long **6. I. campanulata**

b.	Bracts not subfoliaceous, much less than 1 cm long	28
28a.	Lip not spurred	17. <i>I. elegans</i>
b.	Lip spurred	29
29a.	Spur of lip much less than 1 cm long	30
b.	Spur of lip 1.2 - 4 cm long	32
30a.	Bracts ovate; flowers white; spur hooked	64. <i>I. wightiana</i>
b.	Bracts lanceolate; flowers rose or crimson; spur not hooked	31
31a.	Flowers rose; standard apiculate; spur elongate	59. <i>I. verecunda</i>
b.	Flowers crimson; standard not apiculate; spur only a small boss-like projection, not elongate	3. <i>I. anaimudica</i>
32a.	Leaves cordate at base	11. <i>I. cordata</i>
b.	Leaves rounded or cuneate at base	33
33a.	Stem purple-blotched; basal lobe of wings minute	36. <i>I. maculata</i>
b.	Stem not purple-blotched; basal lobe of wings well developed	34
34a.	Lobes of wings truncate at apex	53. <i>I. tangachee</i>
b.	Lobes of wings not truncate at apex	35
35a.	Culms to 2.75 m, with prominent leaf scars; bracts minute; standard spurred	23. <i>I. grandis</i>
b.	Culms to 60 cm, without prominent leaf scars; bracts well developed, ca 4 mm; standard not spurred	31. <i>I. leptura</i>
36a.	Basal lobe of wings minute or absent	37
b.	Basal lobe of wings well developed	40
37a.	Leaves decussate	7. <i>I. chinensis</i>
b.	Leaves not decussate	38
38a.	Leaves cordate at base	16. <i>I. diversifolia</i>
b.	Leaves not cordate at base	39
39a.	Flowers ca 2 cm across	42. <i>I. pallidiflora</i>
b.	Flowers ca 8 mm across	37. <i>I. minor</i>
40a.	Wings 3-lobed	41. <i>I. oppositifolia</i>
b.	Wings 2-lobed	41
41a.	Spur of lip absent	42
b.	Spur of lip present	45
42a.	Lamina decurrent into petiole	39. <i>I. munnarensis</i>
b.	Lamina not decurrent into petiole	43

43a.	Leaves alternate	49. I. scabriuscula
b.	Leaves opposite	44
44a.	Lip cymbiform: capsules ovoid	25. I. herbicola
b.	Lip saccate; capsules ellipsoid	26. I. inconspicua
45a.	Lip cymbiform	46
b.	Lip not cymbiform	62
46a.	Petioles with glands	47
b.	Petioles without glands	54
47a.	Standard spurred	48
b.	Standard not spurred	49
48a.	Flowers purple or red; standard 2-lobed	30. I. latifolia
b.	Flowers white with yellow tinge; standard not lobed	32. I. leschenaultii
49a.	Lobes of wings subequal or basal one larger	50
b.	Lobes of wings unequal with basal one smaller	53
50a.	Lamina decurrent into petiole	19. I. floribunda
b.	Lamina not decurrent into petiole	51
51a.	Basal and distal lobes of wings subequal	52
b.	Basal lobe of wings larger than distal lobe	13. I. cuspidata
52a.	Lobes of wings divergent; spur of lip much less than 1.5 cm long; capsules obliquely ovoid	14. I. dasysperma
b.	Lobes of wings not divergent; spur of lip 1.5 - 2.5 cm long; capsules ellipsoid	18. I. flaccida
53a.	Stem 4-gonous; leaves opposite, entire or minutely serrulate; dorsal lobe of wings semilunate	48. I. rupicola
b.	Stem not 4-gonous; leaves alternate, serrate; dorsal lobe of wings suborbicular	5. I. balsamina
54a.	Lateral sepals ciliate at margin	55
b.	Lateral sepals not ciliate at margin	56
55a.	Basal lobe of wings much smaller than distal lobe	28. I. johnii
b.	Basal lobe of wings equal or subequal to distal lobe	21. I. gardneriana
56a.	Lateral sepals linear	57
b.	Lateral sepals ovate to ovate-triangular	58
57a.	Spur of lip saccate, well developed	2. I. aliciae
b.	Spur of lip neither saccate nor well developed, represented by a small projection	

		25. <i>I. herbicola</i>
58a.	Standard spurred	24. <i>I. henslowiana</i>
	b. Standard not spurred	59
59a.	Lip pubescent	60
	b. Lip not pubescent	61
60a.	Standard 2-lobed; spur of lip slender, twice as long as lip; dorsal auricle rotundate	9. <i>I. cochinica</i>
	b. Standard not 2-lobed; spur robust, shorter than lip; dorsal auricle decurved, not rotundate	56. <i>I. trichocarpa</i>
61a.	Flowers pink; capsules ellipsoid, ca 8 mm long, not beaked	34. <i>I. lucida</i>
	b. Flowers white; capsules obliquely obovoid, 1.5 - 2 cm long, beaked	35. <i>I. macrocarpa</i>
62a.	Leaves alternate	63
	b. Leaves opposite	64
63a.	Branchlets glaucous; leaves pubescent; lip trumpet-shaped	20. <i>I. fruticosa</i>
	b. Branchlets not glaucous; leaves glabrous; lip saccate	10. <i>I. coelotropis</i>
64a.	Lip saccate; capsules ellipsoid	65
	b. Lip funnel-shaped; capsules globose	40. <i>I. nataliae</i>
65a.	Spur ca 2 cm long, undulate	33. <i>I. ligulata</i>
	b. Spur much shorter, not undulate	66
66a.	Spur hooked; lateral sepals ciliate	54. <i>I. tomentosa</i>
	b. Spur not hooked; lateral sepals not ciliate	26. <i>I. inconspicua</i>

1. *Impatiens acaulis* Arn. in Companion Bot. Mag. 1: 325. 1835; Hook. f., Fl. Brit. India 1: 443. 1874 & in Rec. Bot. Surv. India 4: 44. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 138(98). 1915; Manilal, Fl. Silent Valley: 39. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 78. 1988; Vivek. & al. in Hajra & al., Fl. India 4: 111. 1997.

Perennial herb, to 10 cm high; rootstock tuberous. Leaves radical, suborbicular to ovate-cordate, entire or crenate at margin, 3 - 12 x 4 - 13 cm, pubescent; nerves flabellate; petioles 5 - 10 cm long. Scape to 25 cm long; bract ovate, ca 3 mm long; pedicels 1 - 2.5 cm long. Flowers in racemes, ca 3 cm across, pink. Lateral sepals ovate, ca 2.5 mm long. Lip ca 6 x 8 mm; spur ca 4 cm long, slender, incurved. Standard obovate-orbicular, cucullate, ca 8 x 6 mm. Wings ca 1.5 - 3 cm long, 2-lobed; distal lobe larger. Capsules ellipsoid, acute at both ends, 6 - 8 mm long.

Fl. & Fr.: July - Dec.

Habitat: Wet rocks and near streams, 700 - 1000 m.

Distrib.: Idukki, Kannur, Malappuram and Palakkad. Western Ghats. Sri Lanka.

2. *Impatiens aliciae* C.E.C. Fisch. in Bull. Misc. Inform. 1934: 389. 1934 & Gamble, Fl. Madras, Add.: 1870(1295). 1935; Vivek. & al. in Hajra & al., Fl. India 4: 116. 1997.

Annual herb, 20 - 35 cm high, often procumbent, stems branched; internodes 5 - 7 cm long. Leaves opposite, sessile, linear-lanceolate, narrow at base, serrate at margin, apiculate at apex, 2 - 10 x 0.3 - 0.9 cm, glabrous or minutely papillose-hispidulous above, glabrous and glaucous beneath, with 1 - 3 glandular teeth at lower margin. Flowers axillary, solitary or 2-nate, pink or white with purple streaks; pedicels capillary, 1.5 - 2 cm long, deflexed in fruit. Lateral sepals linear, ca 4 mm long. Lip cymbiform, ca 7 mm long; spur subsaccate, ca 3 mm long. Standard obovate, keeled, acute, 4 - 5 mm long. Wings 10 - 11 mm long, 2-lobed; basal lobe falcate; distal lobe obovate, larger; dorsal auricle filiform, 5 - 6 mm long, descending into spur. Capsules ellipsoid, acuminate, 10 - 11 mm long; seeds 10 - 20, subglobose, shining, black.

Fl. & Fr.: July - Sept.

Habitat: Grassy slopes, 600 - 800 m.

Distrib.: Idukki (Munnar) and Travancore (Fischer, *l.c.*). Western Ghats of Karnataka. Endemic.

3. *Impatiens anaimudica* C.E.C. Fisch. in Bull. Misc. Inform. 1935: 92. 1935 & Gamble, Fl. Madras, Add.: 1871(1295). 1935; Vivek. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 54. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 117. 1997.

Herb, branched or not; stems erect or prostrate, 15 - 25 cm, reddish, rooting at lower nodes. Leaves alternate, ovate-suborbicular, subtruncate, rounded or shortly cuneate at base, acute at apex, 2 - 6.3 x 1.4 - 4.2 cm, membranous, evenly crenate at margin, nearly entire at base; teeth apiculate or ciliate, glabrous or with scattered hairs on nerves above, often with crisp hairs on nerves beneath; petioles 1 - 4 cm long, glabrous or sparsely hairy. Inflorescence a subumbel; peduncles capillary, 2.2 - 4.5 cm long; pedicels capillary, 7 - 10 mm long; bracts lanceolate, 2 - 3 mm long. Flowers crimson. Lateral sepals ovate, asymmetric,

cuspidate, ca 6 mm long. Lip oblong-ovate, cucullate, cuspidate, 1 - 1.2 cm long with a short boss-like spur. Standard ovate-oblong, cuspidate, ca 8 mm long. Wings ca 1.4 cm long, 2-lobed; basal lobe oblong-lanceolate, ca 3 mm long; distal lobe semiobovate. Capsules ellipsoid, cuspidate-acuminate, 6 - 7 mm long; seeds few or often 1, 3 - 4 mm long, dotted with tufts of papillae.

Fl. & Fr.: Sept. - Dec.

Habitat: Dense undergrowth in sholas, ca 2400 m.

Distrib.: Idukki (Anaimudi). Endemic.

4. *Impatiens auriculata* Wight in Madras J. Lit. Sci. 1, 5: 8, t. 3. 1837; Hook.f., Fl. Brit. India 1: 460. 1874 & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 139(99). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 97. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 77. 1996; Vivek. & al. in Hajra & al., Fl. India 4: 121. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 130. 2002.

Succulent herb, epiphytic on tree trunks, 6 - 30 cm high; stems short, swollen at internodes. Leaves alternate, fascicled at ends of branches, ovate-elliptic, obscurely crenulate with a few glandular setae at base, obtuse or acute at apex, 3 - 10 x 1.5 - 6 cm; petioles 1 - 4 cm long, stout. Pedicels 2 - 4 cm long; bracts ovate. Flowers in axillary, few-flowered fascicles, ca 2.5 cm across, red. Lateral sepals obliquely oblong, acute, larger than wings, scarlet. Lip saccate, large, wrinkled; spur hooked, short. Standard small, green. Wings 2-lobed, hooded, purple; basal lobe smaller. Capsules ovoid, many-seeded.

Fl.: Aug. - Oct.

Habitat: Rocky slopes in sholas, 1400 - 1700 m.

Distrib.: Kottayam, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic and endangered.

5. *Impatiens balsamina* L., Sp. Pl.: 938. 1753; Hook.f., Fl. Brit. India 1: 453. 1874 & in Rec. Bot. Surv. India 4: 47. 1906; Rama Rao, Fl. Pl. Travancore: 761. 1914; Gamble, Fl. Madras: 142(101). 1915; Manilal & Sivar., Fl. Calicut: 57. 1982; Nicolson & al. in Regnum Veg. 119: 70. 1988; Sivar. & P. Mathew, Fl. Nilambur: 116. 1997; Vivek. & al. in Hajra & al., Fl. India 4: 123. 1997.

Mal.: *Mechingom*

Erect, annual herb, to 80 cm high; stems branched or not, glabrous or pubescent when young. Leaves alternate, linear or lanceolate-elliptic, serrate at margin, acuminate at apex, 3 - 10 x 0.5 - 1.5 cm; petioles 3 - 8 cm long, glandular. Flowers solitary or in fascicles of 2 or 3, purple or white; pedicels 1 - 2 cm long, glabrous or pubescent. Lateral sepals ovate-lanceolate, 2 - 3 mm long. Lip cymbiform, 1.2 - 1.8 cm long, petaloid with yellowish blotch; spur filiform, incurved, 1.5 - 3 cm long. Standard ca 1.2 cm long with a crest terminating in a mucro. Wings 2-lobed, 2 - 2.5 cm long; basal lobe oblong; distal lobe suborbicular, larger. Capsules ellipsoid, 1.5 - 2 cm long, tomentose; seeds globose, reticulate.

Fl. & Fr.: Almost throughout the year.

Habitat: Moist places, to 650 m, common.

Distrib.: Cultivated throughout, sometimes an escape. Throughout India. Central, S. and SE. Asia, Europe and New Guinea; introduced into many countries.

Uses: Seed is edible. Alcoholic extract of the flower possesses marked antibiotic activity against pathogenic fungi and bacteria. Flower is reportedly used as a substitute for henna for dyeing finger nails.

Note: It is an extremely variable species particularly with regard to size of leaves and flowers. Moore (in Tutin & al., *Fl. Europ.* 2: 241. 1968) stated that in European specimens the spur is often absent whereas 3 sepals developing into spur was reported by Bhaskar (*Indian J. Forest.* 9: 276 - 278. 1986) in cultivated specimens.

6. *Impatiens campanulata* Wight in Madras J. Lit. Sci. 1, 5: 11, t. 4. 1837 & Icon. Pl. Ind. Orient.: t. 744. 1844; Hook.f., *Fl. Brit. India* 1: 463. 1874 & in *Rec. Bot. Surv. India* 4: 48. 1906; Rama Rao, *Fl. Pl. Travancore*: 60. 1914; Gamble, *Fl. Madras*: 143(102). 1915; Vivek. & al. in Hajra & al., *Fl. India* 4: 130. 1997.

Erect, robust herb, 25 - 75 cm high, sparingly branched. Leaves alternate, elliptic or ovate-lanceolate, crenate at margin with cilia on crenatures, acuminate at apex, 4 - 8 x 2.5 - 4.5 cm, membranous, glaucous beneath, usually 2-glandular at base; nerves prominent; petioles 2 - 4 cm long, eglandular. Peduncles 4 - 6 cm long, stout, erect; bracts subfoliaceous, ovate-lanceolate, ca 1.2 cm long, caducous. Flowers in 3-flowered umbels, white and yellow speckled with purple. Lat-

eral sepals ovate, aristately acuminate, very large. Lip cymbiform; spur to 2 mm long or absent. Standard orbicular, apiculate, keeled on back. Wings cucullate, 2-lobed, incurved; basal lobe obovate; distal lobe hatchet-shaped, larger, protruding. Capsules ovoid to ellipsoid; seeds globose, echinate.

Fl. & Fr.: June - Sept.

Habitat: Moist forests, 1800 - 2200 m.

Distrib.: Idukki, Western Ghats of Tamil Nadu. Endemic.

7. *Impatiens chinensis* L. var. *brevicornis* E. Barnes in J. Indian Bot. Soc. 18: 99. 1939; Vivek. & al. in Hajra & al., Fl. India 4: 131. 1997. *I. fasciculata* Lam., Encycl. 1: 363. 1785; Wight, Icon. Pl. Ind. Orient.: t. 748. 1844. *I. chinensis* auct. non L. 1753; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 139(99). 1915; Manilal, Fl. Silent Valley: 39. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 78. 1988; Nicolson & al. in Regnum Veg. 119: 70. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 97. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 77. 1996; N. Mohanan & Sivad., Fl. Agasthyamala: 130. 2002.

Mal.: *Onapu, Pily*

Annual, 10 - 60 cm high; stems erect from a prostrate rooting base, angled, glabrescent or villous. Leaves opposite, subsessile, linear-oblong or lanceolate, acute or rounded at base, serrate at margin, 3 - 7 x 0.5 - 1.5 cm, villous above, glaucous beneath, pinkish-nerved; stipules subulate, recurved, glandular. Pedicels 3 - 5 cm long, deflexed in fruit. Flowers axillary, solitary or in fascicles, 1.2 - 2.5 cm across, rose or pink. Lateral sepals linear or falcate, acute with a callous point, ca 8 mm long. Lip cymbiform, ca 1.2 x 0.7 cm, slender, incurved; spur to 3.5 cm long. Standard orbicular, acuminate or horned. Wings orbicular or obovate, auricled at base. Capsules ellipsoid, tapering at both ends, 1.2 - 1.8 cm long; seeds oblong, shining, black.

Fl. & Fr.: July - Feb.

Habitat: Marshy places in grasslands.

Distrib.: Idukki, Kannur, Kollam, Kozhikode, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Karnataka. Endemic.

Uses: The whole plant is made into a paste and applied to burns; it is taken internally with milk in gonorrhoea.

8. *Impatiens clavicornu* Turcz. in Bull. Soc. Imp. Naturalistes Moscou 32: 271. 1859; Vivek. & al. in Hajra & al., Fl. India 4: 133. 1997. *I. beddomei* Hook.f., Fl. Brit. India 1: 442. 1874 & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 138(98). 1915. *I. levingei* Gamble ex Hook.f. in Rec. Bot. Surv. India 4: 45. 1906; Gamble, Fl. Madras: 138(98). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 99. 1994. *I. scapiflora* sensu Wight & Arn., Prodr. Fl. Ind. Orient.: 137. 1834 p.p., non B. Heyne ex Roxb. 1824; Wight, Icon. Pl. Ind. Orient.: t. 967. 1845.

Herb, 10 - 20 cm high; rootstock tuberous. Leaves radical, fleshy, orbicular or reniform-cordate, entire or obscurely crenate-serrate at margin, 2.5 - 8 cm across; nerves flabellate; petioles 2.5 - 8 cm long. Scape longer than leaves, to 15 cm long; bracts ovate; pedicels slender, to 2.5 cm long. Flowers in racemes, ca 1.2 cm across, pink. Lateral sepals obliquely ovate. Spur ca 1 cm long, incurved, inflated at tip. Standard broader than long. Wings with 3 subequal truncate retuse lobes. Capsules ellipsoid, ca 8 mm long; seeds minute, clothed with spiral hairs.

Fl. & Fr.: June - Oct.

Habitat: Crevices of rocks in high altitude grasslands.

Distrib.: Kottayam, Thiruvananthapuram and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

9. *Impatiens cochinnica* Hook.f. in Bull. Misc. Inform. 1911: 355. 1911; Gamble, Fl. Madras: 142(101). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 133. 1997.

Shrub, to 50 cm high, glabrous or puberulous; branches stout. Leaves alternate at base, whorled above and on branches, ovate or ovate-lanceolate, crenate at margin, 6 - 10 cm long; petioles slender, 2 - 4 cm long. Pedicels shorter than leaves. Flowers solitary or in fascicles. Lateral sepals ovate-triangular, ca 1 mm long. Lip cymbiform, ca 6 mm long, pubescent; spur slender, incurved, ca 1.8 cm long. Standard orbicular, 2-lobed with a mucro in sinus. Wings ca 8 x 8 mm, 2-lobed; lobes broadly obcordate; basal lobe smaller; dorsal auricle rotundate. Capsules ovoid, gibbous, beaked, ca 1.5 cm long, few-seeded; seeds obovoid, ca 2 mm long, pubescent.

Fl. & Fr.: Not known.

Habitat: Along streams in evergreen forests, ca 610 m.

Distrib.: Ernakulam (Kochi (Kavalay), Hook.f., *l.c.*). Endemic.

10. *Impatiens coelotropis* C.E.C. Fisch. in Bull. Misc. Inform. 1934: 390. 1934 & Gamble, Fl. Madras, Add.: 1871(1295). 1936; E. Barnes in J. Indian Bot. Soc. 18: 99. 1939; B.V. Shetty & Vivek. in Bull. Bot. Surv. India 14: 20. 1975; Vivek. & al. in Hajra & al., Fl. India 4: 134. 1997.

Undershrub, ca 1 m high; branches slender. Leaves alternate, succulent, ovate-lanceolate, cuneate, acute or rounded at base, distantly serrate at margin, acute or short-acuminate at apex, 5 - 12 x 2.5 - 5.5 cm. Flowers axillary, solitary or 2-nate, ca 2.7 cm across, scarlet; peduncles 1 - 3 cm long. Lateral sepals ovate-lanceolate, cucullate, keeled. Lip saccate, ca 1 cm across, bright green; spur tubular, upcurved and appressed to lip, 6 - 10 mm long. Standard suborbicular, cucullate with a hollow keel. Wings 2-lobed; basal lobe semiovate, larger than oblong-falcate distal one. Capsules ellipsoid-fusiform, ca 1.5 cm long; seeds to 15, more or less reniform, compressed, papillose, pale brown.

Fl. & Fr.: Aug. - Nov.

Habitat: Open grasslands, along streams and amongst undergrowth in sholas, 1800 - 2100 m.

Distrib.: Idukki (Nemakad Gap). Endemic.

11. *Impatiens cordata* Wight in Madras J. Lit. Sci. 1, 5: 10. 1837; Hook.f., Fl. Brit. India 1: 462. 1874 & in Rec. Bot. Surv. India 4: 48. 1906, excl. syn. *I. leptura* Hook.f. 1875; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 144(103). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 135. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 131. 2002.

Erect, flaccid herb, 15 - 40 cm high; stems prostrate, rooting below. Leaves alternate, ovate-cordate, obscurely crenate at margin with minute cilia on crenatures, acuminate at apex, 4 - 7 x 3 - 4.5 cm, membranous; nerves slender with scattered hairs on both surfaces; petioles 2.5 - 7 cm long. Peduncles 4 - 7 cm long; bracts ovate, ca 7 mm long; pedicels 1 - 2.5 cm long. Flowers in axillary or subterminal 3- or 4-flowered umbels, lilac. Lateral sepals ovate, subequal to standard (petal). Lip cymbiform; spur slender, incurved, ca 2 cm long. Wings 2-lobed; distal lobe almost orbicular, spreading; basal lobe smaller, fleshy, incurved vaulting over stamens. Capsules ellipsoid, beaked, ca 8 mm long; seeds almond-shaped, ca 2.5 mm long, hairy.

Fl. & Fr.: March - Sept.

Habitat: Along streams and sometimes on trees in evergreen forests, to 2000 m.

Distrib.: Idukki, Thiruvananthapuram and Wynad. Western Ghats of Tamil Nadu. Endemic.

12. *Impatiens crenata* Bedd. in Madras J. Lit. Sci. 2, 4: 69, t. 7, f. 10. 1859 & Icon. Pl. Ind. Orient.: t. 31. 1868 - 1874; Hook.f., Fl. Brit. India 1: 442. 1874 & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 139(99). 1915; Bhaskar & Razi in Indian J. Forest. 1: 71. 1978; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 78. 1988; Vivek. & al. in Hajra & al., Fl. India 4: 136. 1997. *I. stocksii* Hook. f. & Thomson in J. Proc. Linn. Soc., Bot. 4: 156. 1860; Hook.f., Fl. Brit. India 1: 442. 1874 & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; C.E.C. Fisch. in Gamble, Fl. Madras, Add.: 1870(1294). 1935.

Slender herb, to 15 cm high. Leaves radical, variable, orbicular-reniform, cordate or oblong-ovate, crenate at margin, 1.5 - 4.8 x 1.3 - 1.5 cm, pubescent above, glabrous beneath; nerves flabellate. Scapes to 10 cm long; bracts ovate, small; pedicels stout, ca 1 cm long. Flowers 3 - 6 in racemes, ca 2 cm across, pink. Lateral sepals ovate, obtuse. Lip cymbiform; spur short or absent. Standard somewhat rhomboid, cucullate, crenate, as broad as long or broader. Wings 3-lobed; distal lobe longer. Capsules ellipsoid, acute; seeds linear-oblong, minute.

Fl. & Fr.: July - Oct.

Habitat: Tree trunks, ca 1000 m.

Distrib.: Idukki and Kannur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

13. *Impatiens cuspidata* Am. in Companion Bot. Mag. 1: 321. 1835; Wight, Icon. Pl. Ind. Orient.: t. 741. 1844; Hook.f. in Rec. Bot. Surv. India 4: 47. 1906; Gamble, Fl. Madras: 142(101). 1915; E. Barnes in J. Indian Bot. Soc. 18: 101. 1939; Vivek. & al. in Hajra & al., Fl. India 4: 137. 1997. *I. latifolia* sensu Hook.f., Fl. Brit. India 1: 450. 1874 p.p., non L. 1753.

Shrub, 50 - 100 cm high; stems and branches glaucous; internodes swollen. Leaves opposite, alternate or whorled, elliptic-lanceolate, serrate at margin, 5 - 11 x 2 - 4.5 cm, glandular at lower margin; nerves hairy beneath; petioles 1.5 - 5 cm long, glandular. Pedicels to 8 cm long. Flowers axillary, solitary or in fascicles,

pale pink or white. Lateral sepals ca 4 mm long. Petals white, purple-tinged; lip cymbiform; spur stout, 1.5 - 2 cm long. Standard ca 1.6 x 0.8 cm, larger than wings. Wings 2-lobed; basal lobe larger. Capsules ellipsoid, ca 2.2 x 1.2 cm, cuspidate, 7 - 11-seeded.

Fl. & Fr.: April - Dec.

Habitat: Evergreen forests, 1700 - 1900 m.

Distrib.: Idukki. Western Ghats of Karnataka and Tamil Nadu. Endemic.

14. *Impatiens dasysperma* Wight in Madras J. Lit. Sci. 1, 5: 7, t. 2. 1837 & Icon. Pl. Ind. Orient.: t. 742. 1844; Hook.f., Fl. Brit. India 1: 457. 1874 & in Rec. Bot. Surv. India 4: 47. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 143(102). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 79. 1988; Vivek. & al. in Hajra & al., Fl. India 4: 139. 1997.

Erect, flaccid herb, 30 - 60 cm high, branched or not. Leaves alternate, elliptic or ovate, crenate at margin, acuminate at apex, 4 - 8 x 1.5 - 4 cm, sparsely hairy above, glabrous beneath; petioles 1 - 3 cm long, often with stipitate glands. Pedicels slender, decurved, 1 - 2.2 cm long. Flowers axillary, usually solitary or 2-nate, rose or pink. Lateral sepals ovate, minute. Lip cymbiform; spur incurved, to 1.5 cm long, hairy. Standard obcordate, cuspidate. Wings divergently 2-lobed; lobes obovate, retuse, subequal. Capsules obliquely ovoid, ca 8 mm long, turgid in middle, glabrous; seeds subglobose, papillose.

Fl. & Fr.: Oct. - Dec.

Habitat: Moist places in low elevations, to 900 m.

Distrib.: Kannur, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

15. *Impatiens denisonii* Bedd. in Madras J. Lit. Sci. 3, 1: 41. 1864 & Icon. Pl. Ind. Orient.: t. 151. 1868 - 1874; Hook.f., Fl. Brit. India 1: 444. 1874 & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 139(99). 1915; Manilal, Fl. Silent Valley: 40. 1988; Vivek. & al. in Hajra & al., Fl. India 4: 140. 1997.

Acaulescent herb. Leaves deeply 2-lobed at base with a broad sinus, ovate-cordate, crenate at margin, 7 - 8 cm long, pubescent above. Flowers 7 - 11, in racemes, pink. Spur recurved, long. Standard ovate, vaulted. Wings 3-lobed, bearded on inner face; basal lobes with dorsal auricle produced into spur. Capsules ellip-

soid; seeds minute with spiral hairs.

Fl. & Fr.: July - Nov.

Habitat: Moist rocks and tree trunks, to 900 m.

Distrib.: Palakkad (Silent Valley). Western Ghats of Tamil Nadu (Nilgiris). Endemic.

16. *Impatiens diversifolia* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 139. 1834; Hook.f., Fl. Brit. India 1: 446. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 140(99). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 79. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 97. 1994; Vivek. & al. in Hajra & al., Fl. India 4: 141. 1997.

Diffuse, flaccid herb, 15 - 40 cm high; stems rooting at lower nodes. Leaves opposite, 1 - 8 x 0.8 - 1.2 cm; lower ones short-petioled, elliptic or oblong; the upper sessile, linear-oblong or ligulate, cordate at base; stipules obscure, glandular. Pedicels 1 - 2 cm long, pubescent, deflexed in fruit. Flowers ca 2 cm across, axillary, solitary or 2-nate, pink or rose. Lateral sepals linear, acuminate. Spur filiform. 1 - 1.5 cm long. Standard small. Wings semiobovate, ca 1.2 x 0.8 cm. Capsules ellipsoid, ca 8 mm long, turgid; seeds globose, smooth, shining, dark brownish.

Fl. & Fr.: July - Nov.

Habitat: Marshy places, to 1000 m.

Distrib.: Alappuzha, Idukki, Kannur, Kollam, Thiruvananthapuram and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

17. *Impatiens elegans* Bedd. in Madras J. Lit. Sci. 2, 4: 67. 1859 & Icon. Pl. Ind. Orient.: t. 145. 1868 - 1874; Hook.f., Fl. Brit. India 1: 465. 1875 & in Rec. Bot. Surv. India 4: 49. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 145(103). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 144. 1997.

Erect herb, 15 - 35 cm high; stems branched or not, often rooting at lower nodes. Leaves alternate, ovate, rounded-cordate at base, crenate at margin with incurved bristles, acuminate at apex, 4 - 10 x 2 - 4 cm, sparsely hairy above, glabrous beneath; petioles 2.5 - 5 cm long. Peduncles 3 - 7 cm long; bracts ovate-lanceolate, recurved, ca 6 mm long. Flowers ca 2.5 cm across, in axillary or terminal racemes or umbels, pale rose (white) with a purple eye. Lateral sepals

ovate. Lip cymbiform, small; spur absent. Standard orbicular-ovate, apiculate with a ridge on dorsal side. Wings 2-lobed; basal lobe small, rounded, vaulting over stamens; distal lobe larger, obliquely ovate, acute. Capsules ellipsoid, beaked, ca 1.2 cm long, turgid in middle; seeds subglobose, hairy.

Fl. & Fr.: Jan. May; July Dec.

Distrib.: Travancore hills, 2500 - 5000 ft. (Beddome, *vide* Gamble, *l.c.*). Western Ghats of Tamil Nadu (Anamalais). Endemic.

18. *Impatiens flaccida* Arn. in Companion Bot. Mag. 1: 322. 1835; Hook. in Curtis, Bot. Mag. 87: t. 5276. 1861; Hook.f., Fl. Brit. India 1: 457. 1874, excl. syns. *I. bipartita* Arn. 1835 & *I. floribunda* Wight 1837 & in Rec. Bot. Surv. India 4: 47. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 143(101). 1915; Manilal & Sivar., Fl. Calicut: 57. 1982; Sasidh. & Sivar., Fl. Pl. Thrissur: 78. 1996; Vivek. & al. in Hajra & al., Fl. India 4: 146. 1997.

Erect or decumbent herb, to 40 cm high, rooting at lower nodes; stems slender, sparingly branched in lower half, green or flushed with pink. Leaves alternate, ovate-lanceolate or lanceolate-elliptic, crenate at margin, 3 - 8 x 1.2 - 3.5 cm, sparsely pubescent; petioles 1.2 - 3.5 cm long with stipitate glands. Bracts linear, inconspicuous; pedicels 2 - 3 cm long. Flowers solitary or in fascicles of 2 or 3, pale to deep pink. Lateral sepals ovate. Lip cymbiform, 8 - 10 mm long; spur filiform or slender, incurved, 1.5 - 2.5 cm long. Standard obcordate with a crest on dorsal side terminating in an acute point. Wings 2-lobed; lobes subequal. Capsules ellipsoid, ca 1.5 cm long, glabrous; seeds globose, glabrous or papillose.

Fl. & Fr.: Aug. Dec.

Habitat: Evergreen forests, 780 - 1100 m.

Distrib.: Idukki, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

19. *Impatiens floribunda* Wight in Madras J. Lit. Sci. 1, 5: 7. 1837; Hook.f. in Rec. Bot. Surv. India 4: 47. 1906; Gamble, Fl. Madras: 142(101). 1915, excl. syn. *I. flaccida* Arn. 1835; Vivek. & al. in Hajra & al., Fl. India 4: 147. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 131. 2002. *I. flaccida* sensu Hook.f., Fl. Brit. India 1: 457. 1874 p.p., non Arn. 1835.

Erect or decumbent herb, to 70 cm high; stems branched, greenish. Leaves alternate or opposite, rarely whorled, elliptic-lanceolate, decurrent, serrate or

crenate-serrate at margin, apiculate from apex of teeth, caudate-acuminate at apex. 2-10 x 1.2-4 cm. glaucous beneath; petioles 1.5-3.5 cm long with stipitate glands. Pedicels to 2.5 cm long. Flowers solitary or in fascicles, pink. Lateral sepals ovate, small. Lip cymbiform; spur slender, straight. Wings 2-lobed; lobes subequal or basal lobe larger. Capsules ellipsoid; seeds globose, tubercled.

Fl. & Fr.: July - Nov.

Habitat: Evergreen forests, 1800-2300 m.

Distrib.: Kasaragod, Kollam, Idukki and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

20. *Impatiens fruticosa* Lesch. ex DC., Prodr. 1: 687. 1824; Wight, Icon. Pl. Ind. Orient.: t. 966. 1845; Hook.f., Fl. Brit. India 1: 459. 1874 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 143(102). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 149. 1997.

Erect, much branched shrub, to 2.5 m high; branches glaucous with scars at nodes. Leaves alternate, ovate-elliptic, 7-10 x 3.5-4 cm, pubescent on both surfaces, sometimes almost silky beneath, ciliate and glandular at base of margin; nerves many, stout; petioles stout, 2-6 cm long, often villous, glandular or not. Bracts linear-subulate, ca 7 mm long; pedicels to 7 cm long. Flowers ca 3.5 cm across, axillary, solitary or 2-nate, pink or white. Lateral sepals ovate, ca 15 x 6 mm. Lip trumpet-shaped, ca 1 cm long; spur curved, ca 2.5 cm long. Standard orbicular, ca 1.5 cm. Wings ca 1.5 cm long, 2-lobed; lobes oblong, subequal, divaricate. Capsules ellipsoid, beaked, ca 2.5 cm long, many-seeded.

Fl.: Oct. - Jan. *Fr.*: Nov. onwards.

Habitat: Margins of sholas, ca 1000 m.

Distrib.: Idukki. Western Ghats of Tamil Nadu. Endemic.

21. *Impatiens gardneriana* Wight, Icon. Pl. Ind. Orient.: t. 1050. 1846; Hook.f., Fl. Brit. India 1: 445. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 141(101). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 79. 1988; Vajr., Fl. Palghat: 99. 1990; Sivar. & P. Mathew, Fl. Nilambur: 116. 1997; Vivek. & al. in Hajra & al., Fl. India 4: 150. 1997. *I. setosa* Hook.f. & Thomson in J. Proc. Linn. Soc., Bot. 4: 123. 1860; Hook.f., Fl. Brit. India 1: 445. 1874; Rama Rao, Fl. Pl. Travancore: 59. 1914.

Annual, 30 - 40 cm high; stems creeping at base and rooting, ascending, branched or not. Leaves opposite and whorled, ovate-oblong or elliptic-lanceolate, cuneate at base, serrate at margin, acuminate at apex, 3 - 12 x 1 - 4 cm, ciliate at margin towards base, sparsely pubescent; petioles 1.2 - 3.5 cm long, pubescent. Peduncles filiform, 2 - 3.5 cm long, glabrous. Flowers axillary, solitary or in fascicles, ca 2.5 cm across, pink. Lateral sepals ovate or ovate-lanceolate, acuminate, ciliate. Lip cymbiform; spur curved upwards, ca 1.8 cm long, slender. Standard suborbicular-obovate, apiculate, dorsally keeled. Wings 2-lobed; lobes obovate; distal lobe larger. Capsules terete, ca 1.5 cm long; seeds hairy.

Fl. & Fr.: July - Dec.

Habitat: Perennially wet places in evergreen forests, to 875 m.

Distrib.: Idukki, Kannur, Kottayam, Malappuram, Palakkad and Wynad.

Western Ghats of Tamil Nadu. Endemic.

22. *Impatiens goughii* Wight, Ill. Ind. Bot. 1: 160. 1840 & Icon. Pl. Ind. Orient.: t. 1603. 1850; Hook.f., Fl. Brit. India 1: 452. 1874 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 141(102). 1915; Bhaskar & Razi in Indian J. Forest. 1: 196. 1978; Sasidh. & Sivar., Fl. Pl. Thrissur: 78. 1996; Vivek. & al. in Hajra & al., Fl. India 4: 152. 1997.

Annual, flaccid herb, 20 - 50 cm high; stems branched or not, rooting below. Leaves opposite, ovate, subacute, crenate-serrulate at margin, 1.5 - 3.5 x 0.8 - 1.5 cm, glabrous, rarely hairy beneath; petioles to 2 cm long. Peduncles to 6 cm long; bracts lanceolate, minute; pedicels capillary, to 1.5 cm long. Flowers in axillary or terminal subumbels, ca 8 mm across, pale pink. Lateral sepals falcate, ca 2 mm long. Lip cymbiform; spur straight, ca 7 mm long. Standard obovate, mucronate at retuse apex. Wings ca 4 mm long, 2-lobed; basal lobe oblong, rounded at apex; distal lobe longer; dorsal auricle produced into spur. Capsules ellipsoid, ca 4 mm long, 6 - 12-seeded; seeds almond-shaped, granular-hairy, chestnut-coloured.

Fl. & Fr.: Sept. - Dec.

Habitat: Marshy places and along streams in evergreen forests, 1000 - 1675 m.

Distrib.: Idukki, Kollam, Pathanamthitta, Thrissur and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

23. *Impatiens grandis* B. Heyne ex Wall. in Roxb., Fl. Ind. 2: 464. 1824;

Bedd., *Icon. Pl. Ind. Orient.*: t. 153. 1868-1874; Hook.f., *Fl. Brit. India* 1: 463. 1874 & in *Rec. Bot. Surv. India* 4: 48. 1906; Rama Rao, *Fl. Pl. Travancore*: 60. 1914; Gamble, *Fl. Madras*: 143(102). 1915; Vivek. & al. in Hajra & al., *Fl. India* 4: 153. 1997. *I. hookeriana* Arn. in *Companion Bot. Mag.* 1: 324. 1835; Hook.f., *Fl. Brit. India* 1: 463. 1874.

Erect, robust herb, often shrubby, 1-2.75 m high; branches terete, glabrous with prominent leaf scars. Leaves at ends of branches, alternate, ovate-lanceolate or elliptic, rounded or acute at base, crenate with bristles on crenatures, acuminate at apex; petioles 2-9 cm long with 2 glands near apex. Peduncles 7-9 cm long; bracts small, caducous. Flowers in subumbels, white or rose with purple. Lateral sepals ovate-oblong. Lip saccate, prolonged into a ca 4 cm long straight spur. Standard oblong to orbicular, spurred on dorsal side. Wings 2-lobed, spreading; basal lobe oblong to obovate; distal lobe larger, rounded, notched. Capsules ellipsoid, beaked, 1.2-2 cm long, obscurely angled.

Fl. & Fr.: Sept. - Nov. & March.

Habitat: Evergreen forests, 300-500 m.

Distrib.: Mountains of Malabar, 350-1500 m (Hook.f., 1874), hills of S. Travancore (Gamble, *l.c.*). Western Ghats of Tamil Nadu (Madurai and Tirunelveli). Sri Lanka.

24. *Impatiens henslowiana* Arn. in *Companion Bot. Mag.* 1: 322. 1835; Hook.f., *Fl. Brit. India* 1: 458. 1874; Rama Rao, *Fl. Pl. Travancore*: 60. 1914; Gamble, *Fl. Madras*: 143(102). 1915; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 98. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 78. 1996; Vivek. & al. in Hajra & al., *Fl. India* 4: 155. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 132. 2002. *I. albida* Wight in *Madras J. Lit. Sci.* 1, 5: 7, t. 1. 1837 & *Icon. Pl. Ind. Orient.*: t. 743. 1844.

Undershrub, 1-1.5 m high; stems branched or not, succulent when young, covered with prominent leaf scars. Leaves alternate or spiral, elliptic-lanceolate, serrate and glandular at margin, 3.5-8 x 1.2-3.5 cm, subglabrous to pilose; petioles 0.8-4.5 cm long, glabrescent to pilose. Pedicels slender, 3-5 cm long, glabrous or pilose. Flowers axillary, solitary, ca 3 cm across, white or yellow. Lateral sepals ovate, acuminate. Lip cymbiform; spur incurved, 3.5-4.5 cm long, slender, pubescent to middle, pink. Standard suborbicular, emarginate with a spur on back, ca 2 cm across. Wings 2-lobed; lobes semiobovate, subequal. Capsules

fusiform, 2 - 2.5 cm long, pilose; seeds almond-shaped, furrowed, ca 3 mm long, rusty brown.

Fl. & Fr.: March - April.

Habitat: Moist places, ravines and crevices of rocks, to 1800 m.

Distrib.: Idukki, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu, Sri Lanka.

25. *Impatiens herbicola* Hook.f. in Bull. Misc. Inform. 1911: 354. 1911; Gamble, Fl. Madras: 141(100). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 156. 1997.

Succulent herb, 20 - 40 cm high. Leaves opposite, sessile or short-petioled, linear-lanceolate, rounded or cordate at base, serrate at margin, acuminate at apex, 3 - 6 x 0.4 - 0.6 cm. Peduncles 2.5 - 3 cm long; pedicels 5 - 15 mm long, 2 - 3 cm in fruit, erect or deflexed. Flowers axillary, solitary or in fascicles, ca 5 mm across, white or pink. Lateral sepals linear, acuminate, 4 - 5 mm long. Lip cymbiform, 4 - 5 mm long; spur absent or provided with a pouch-like structure at base. Standard orbicular, apiculate, ca 4 mm, dorsally keeled. Wings 7 - 8 mm long, clawed, 2-lobed; basal lobe somewhat oblong; distal lobe rotundate or semilunate; dorsal auricle prominent. Capsules ovoid, gibbous, beaked, 7 - 10 mm long, few-seeded; seeds compressed, 2 - 5 mm, shining, black.

Fl. & Fr.: Sept. - Nov.

Habitat: Marshy places and grassy slopes, to 1525 m.

Distrib.: Idukki, Kottayam and Pathanamthitta. Western Ghats of Tamil Nadu. Endemic.

26. *Impatiens inconspicua* Benth. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 139. 1834; Wight, Icon. Pl. Ind. Orient.: t. 970. 1845; Hook.f., Fl. Brit. India 1: 447. 1874, incl. var. *filiformis* (Wight & Arn.) Hook.f. & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 79. 1988; Vajr., Fl. Palghat: 100. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 98. 1994; Vivek. & al. in Hajra & al., Fl. India 4: 158. 1997. *I. pusilla* B. Heyne ex Hook.f. & Thomson in J. Proc. Linn. Soc., Bot. 4: 122. 1860; Gamble, Fl. Madras: 140(100). 1915.

Slender annual, 15 - 30 cm high; stems erect, flaccid. Leaves opposite, ovate-lanceolate, oblong or linear, serrate at margin, 2 - 10 x 0.5 - 1.5 cm, glabrous

or pubescent above, pale or glaucous beneath. Pedicels to 2 cm long, deflexed in fruit. Flowers axillary, solitary or fascicled, pink or white. Lateral sepals linear-subulate. Lip saccate; spur short or absent. Standard ca 4 x 3 mm, mucronate. Wings 2-lobed; basal lobe linear, small; distal lobe rhomboid-obovate, ca 6 mm long, clawed. Capsules ellipsoid, ca 8 mm long, acute at both ends; seeds almost globose, shining, black.

Fl. & Fr.: Aug. - Dec.

Habitat: Wet rocks, marshy places and grasslands, 675 - 1150 m.

Distrib.: Idukki, Kannur, Kollam, Pathanamthitta, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

27. *Impatiens jerdoniae* Wight in Madras J. Lit. Sci. 1, 5: 8. 1837 & Icon. Pl. Ind. Orient.: t. 1602. 1850; Hook.f., Fl. Brit. India 1: 460. 1874, excl. var. *parasitica* (Bedd.) Hook.f. & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 139(90). 1915; Manilal, Fl. Silent Valley: 40. 1988; Vivek. & al. in Hajra & al., Fl. India 4: 159. 1997.

Succulent herb, 8 - 16 cm high; stem tumid, green or yellow. Leaves few, elliptic, serrate at margin, 5 - 7 cm long, glandular-ciliate at base and on top of petiole, few-nerved. Pedicels 2 - 7 cm long; bracts setaceous. Flowers solitary or 2-nate, 3.5 - 5 cm long. Lateral sepals elliptic, green. Lip laterally compressed, scarlet; spur large, ventricose, wrinkled. Standard orbicular, apiculate, narrowly keeled on back, yellow. Wings 2-lobed, concealed under lip, yellow; lobes rounded, overlapping. Capsules ellipsoid.

Fl. & Fr.: Aug. - Dec.

Habitat: Tree trunks and crevices of rocks in evergreen forests, 800 - 1500 m.

Distrib.: Palakkad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

28. *Impatiens johnii* E. Barnes in J. Indian Bot. Soc. 18: 102. 1939; Vivek. & Malathi in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 55. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 161. 1997; Biju & V.M. Kumar in Indian J. Forest. 22: 174, f. 1. 1999.

Erect shrub, to 1 m high; stems branched at base, swollen at nodes. Leaves opposite, alternate or whorled, ovate-elliptic, crenate-serrate at margin, acuminate at apex, ca 13.5 x 5 cm, hairy above and on nerves beneath; petioles to 8 cm long, hairy. Bracts lanceolate, ca 3 mm long; pedicels to 6.5 cm long, hairy. Flower

axillary, solitary, ca 3 cm across. Lateral sepals ovate, ca 1.3 cm long, ciliate at margin. Lip cymbiform, mucronate; spur curved, slender, to 4 cm long, crimson at base. Standard cymbiform, keeled at base, glabrous, pink. Wings 2-lobed, deep pink; distal lobe longer. Capsules ca 2.8 cm long, beaked; seeds 5, pyriform, tubercled.

Fl. & Fr.: June - Sept.

Habitat: Along streams in evergreen forests, ca 1400 m.

Distrib.: Idukki (Kallar Valley). Endemic.

29. *Impatiens kulamavuensis* Pandur. & V.J. Nair in Novon 5: 57, f. 1. 1995; Vivek. & al. in Hajra & al., Fl. India 4: 165. 1997.

Stoloniferous herb; stems less than 1 cm long, stout, fleshy. Leaves alternate, ovate-lanceolate, cuneate at base, entire to obscurely crenate-serrate at margin with crenules 2 - 4 mm apart, acuminate at apex, 2 - 5.5 x 1.5 - 2.5 cm, membranous, gland-dotted above, glabrous beneath; lateral nerves 4 - 6 pairs, indistinct; petioles gland-dotted, 2 - 7 cm long with 2 stipitate glands near base of blade. Inflorescences 1 - 3-flowered racemes; peduncles 2.5 - 5 cm long; pedicels 3.5 - 5 cm long. Flowers greenish yellow. Lateral sepals linear, 8 - 10 x 2 - 3 mm, hairy outside, glabrous inside. Lip saccate, compressed, 12 - 15 x 5 - 7 mm, glabrous; spur strongly curved, obtuse at tip, 7 - 8 x 3 - 5 mm. Standard erect, orbicular to ovate, 6 - 7 x 8 - 9 mm, hairy at base. Wings united close to base, 3-lobed; basal lobes smaller, 7 - 8 x 9 - 10 mm. Capsules ellipsoid, 10 - 12 x 4 - 5 mm, glabrous; seeds pyriform, smooth.

Fl. & Fr.: Oct. - Dec.

Habitat: Moss-clad tree trunks in evergreen forests, 600 - 850 m.

Distrib.: Idukki (Meenmutty-Kulamavu). Endemic.

30. *Impatiens latifolia* L., Sp. Pl.: 937. 1753; Hook.f., Fl. Brit. India 1: 450. 1874, excl. syn. *I. cuspidata* Arn. 1835; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 141(101). 1915; Fyson, Fl. S. Indian Hill Stat. 1: 91, t. 69. 1932; Nicolson & al. in Regnum Veg. 119: 70. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 98. 1994; Vivek. & al. in Hajra & al., Fl. India 4: 168. 1997. *I. bababudanensis* Hook.f. in Bull. Misc. Inform. 1910: 295. 1910.

Erect, fleshy shrub, 20 - 50 cm high; stems branched. Leaves alternate, subopposite or whorled, often crowded at ends of branches, ovate-lanceolate,

crenate-serrate at margin, acuminate or caudate-acuminate at apex, 5 - 11 x 2 - 3.5 cm, membranous, glandular at lower margin; nerves 7 - 10 pairs; petioles 2 - 5 cm long, glandular. Pedicels slender, 2 - 6 cm long, often recurved in fruit. Flowers solitary, 2-nate or in fascicles, purple or red. Lateral sepals ovate, cuspidate, small or minute. Lip cymbiform, cucullate, acuminate; spur straight or incurved, slender, 1.2 - 1.8 cm long, white. Standard larger than wings, 2-lobed, spurred on dorsal side. Wings 2-lobed; basal lobe smaller. Capsules ellipsoid, 1.8 - 2.4 cm long; seeds obovoid, rugose or papillose.

Fl. & Fr.: March - Sept.

Habitat: Shady places, 800 - 1000 m.

Distrib.: Idukki, Kottayam and Thiruvananthapuram. Western Ghats. Endemic.

Note: Hook.f. (1874) who reduced *I. cuspidata* Arn. to a synonym of *I. latifolia* L. later (Hook.f., 1906) treated it as a distinct species.

31. *Impatiens leptura* Hook. f., Fl. Brit. India 1: 467. 1875; C.E.C. Fisch. in Bull. Misc. Inform. 1934: 392. 1934 & Gamble, Fl. Madras, Add.: 1871(1295). 1935; Vivek. & al. in Hajra & al., Fl. India 4: 173. 1997. *I. cordata* sensu Hook.f. in Rec. Bot. Surv. India 4: 48. 1906 p.p., non Wight 1837.

Erect herb; stems somewhat angled, greenish. Leaves alternate, ovate to elliptic-lanceolate, cuneate-acute at base, crenate at margin with cilia in sinuses, acute or acuminate at apex, 4.5 - 10 x 2 - 5 cm, membranous, glabrous or with short hairs on nerves above, subglaucous beneath; petioles slender, 1 - 7 cm long. Peduncles 4 - 6.5 cm long; bracts ovate, ca 4 mm long, greenish, caducous; pedicels 1 - 2 cm long. Flowers in 2- or 3-flowered umbels, ca 2.5 cm across, pinkish. Lateral sepals ovate, 4 - 5 mm long, greenish. Lip bowl-shaped, 1 - 1.3 cm across with 2.5 - 3 cm long tapering spur bent on one side. Standard vaulted, small. Wings ca 2.5 cm long, 2-lobed; basal lobe oblong, concave, overlapping larger suborbicular distal one. Capsules ellipsoid, beaked, ca 1.5 cm long; seeds orbicular, pilose when young glabrous later.

Fl. & Fr.: May - Nov.

Habitat: Fringes of evergreen forests, 1000 - 1500 m.

Distrib.: Idukki and Kollam. Western Ghats of Tamil Nadu. Endemic.

32. *Impatiens leschenaultii* (DC.) Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 136. 1834; Wight, Icon. Pl. Ind. Orient.: t. 970. 1845; Hook.f., Fl.

Brit. India 1: 450. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 141(101). 1915; Manilal, Fl. Silent Valley: 40. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 98. 1994; Sivar. & P. Mathew, Fl. Nilambur: 117. 1997; Vivek. & al. in Hajra & al., Fl. India 4: 117. 1997. *Balsamina leschenaultii* DC., Prodr. 1: 686. 1824.

Undershrub, 1 - 1.5 m high. Leaves opposite, alternate or whorled, ovate-lanceolate or elliptic, crenate at margin sometimes ciliate in sinuses, acute or acuminate at apex, 2.5 - 12.5 x 1.2 - 4 cm; nerves 4 - 6 pairs; petioles to 5 cm long, glandular in upper half. Pedicels to 4 cm long. Flowers solitary, 2-nate or in fascicles, white with yellow tinge. Lateral sepals ovate-lanceolate, ca 3 mm long. Lip cymbiform, 5 - 7 mm long, yellow; spur incurved, slender, 1 - 2.2 cm long. Standard suborbicular, spurred on dorsal side. Wings 2-lobed; basal lobe smaller. Capsules ellipsoid, beaked, ca 1.2 cm long, 3 - 5-seeded; seeds obovoid, ca 3 mm long, rugose or papillose, dark purplish brown.

Fl. & Fr.: April - Dec.

Habitat: Evergreen forests, 1800 - 2000 m.

Distrib.: Idukki, Malappuram, Palakkad and Thiruvananthapuram. Western Ghats of Maharashtra and Tamil Nadu. Endemic.

Note: Wight and Arnott (*l.c.*) opined that this species is a connecting link between *I. latifolia* L. and the commonly cultivated *I. balsamina* L.

33. *Impatiens ligulata* Bedd. in Madras J. Lit. Sci. 2, 4: 67, t. 7, f.6. 1859 & Icon. Pl. Ind. Orient.: t. 149. 1868 - 1874; Hook.f., Fl. Brit. India 1: 446. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 140(99). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 174. 1997.

Erect herb, 30 - 60 cm high; branches slender, spreading. Leaves opposite, subsessile, linear-lanceolate, serrate at margin, mucronate at apex, 7.5 - 10 cm long, hispid above; stipules setaceous or absent. Pedicels slender, ca 3.5 cm long. Flowers solitary or in fascicles, pink or white. Lateral sepals linear-lanceolate. Lip saccate; spur undulate, ca 2 cm long, stout. Standard small with a pubescent line on dorsal side. Wings 2-lobed; distal lobe slender; dorsal auricle filiform, descending into spur. Capsules ellipsoid; seeds ca 12, shining.

Fl. & Fr.: July - Oct.

Habitat: Hill slopes, ca 600 m.

Distrib.: Thrissur. Western Ghats of Tamil Nadu. Endemic.

Note: Hook.f. (1874) described the basal lobe of wings as "broad almost hatchet-shaped" but later (Hook.f., 1906) he contradicted himself saying that the basal lobe of wings absent.

34. *Impatiens lucida* B. Heyne ex Hook.f., Fl. Brit. India 1: 451. 1874 & in Rec. Bot. Surv. India 4: 47. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 142(101). 1915; Manilal & Sivar., Fl. Calicut: 56. 1982; Manilal, Fl. Silent Valley: 41. 1988; Sivar. & P. Mathew, Fl. Nilambur: 118. 1997; Vivek. & al. in Hajra & al., Fl. India 4: 175. 1997.

Slender, annual herb, 10 - 20 cm high. Leaves subopposite or whorled, ovate or ovate-lanceolate, cuneate at base, crenate-serrate at margin, acuminate at apex, 3.5 - 8 x 1.5 - 4 cm, glabrous or sparsely hairy above; petioles 0.8 - 3.5 cm long. Flowers solitary or in fascicles, ca 8 mm across, pink. Lateral sepals small, ovate, acute. Lip cymbiform; spur incurved, slender, much longer than flower. Standard suborbicular, dorsally keeled. Wings 2-lobed; distal lobe larger, orbicular. Capsules ellipsoid, ca 8 mm long, glabrous; seeds smooth, black.

Fl. & Fr.: April - Nov.

Habitat: Marshy slopes.

Distrib.: Kozhikode, Malappuram and Palakkad. Western Ghats. Endemic.

35. *Impatiens macrocarpa* Hook. f. in Bull. Misc. Inform. 1911: 3. 1911; Gamble, Fl. Madras: 142(101). 1915; Vivek. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 58. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 176. 1997.

Small shrub with spreading branches. Leaves opposite at base, in whorls of 3 - 5 above, obovate-oblongate, serrulate at margin, 8 - 10 cm long; petioles 3 - 5 cm long. Pedicels 3.5 - 5 cm long, 5 - 8 cm in fruit, stout, decurved. Flowers solitary or 2-nate, white with mauve. Lateral sepals ovate, cuspidate-acuminate, 4 - 6 mm long, coriaceous. Lip cymbiform, ca 6 mm long; spur stout, incurved, ca 1.2 cm long. Standard obovate-reniform, cuspidate, 1.5 - 2 cm across. Wings sessile, stout, 2-lobed; basal lobe oblong-obovate, spreading or recurved; distal lobe oblong, erect, smaller. Capsules obliquely obovoid, beaked, 1.5 - 2 cm long, many-seeded; seeds ca 5 mm long, granulate, chestnut-coloured.

Fl. & Fr.: Not known.

Habitat: Evergreen forests, ca 1800 m.

Distrib.: Idukki (Devicolam, Hook.f., *l.c.*). Endemic.

36. *Impatiens maculata* Wight in Madras J. Lit. Sci. 1, 5: 12. 1837; Hook.f., Fl. Brit. India 1: 465. 1875 & in Rec. Bot. Surv. India 4: 49. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 145(103). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 177. 1997.

Slender herb, 0.6 - 1.5 m high; stems branched, ribbed, laxly hairy or glabrate. Leaves alternate, elliptic or ovate-lanceolate, serrate at margin, acuminate at apex, 6 - 11 x 3 - 5 cm, membranous, often 2-glandular at base of margin, glabrous on both surfaces; petioles 2 - 4 cm long, often with 2 or more long-stipitate glands. Peduncles to 6 cm long; bracts ovate, persistent; pedicels ca 2.5 cm long. Flowers in terminal racemes, ca 2.5 cm long, pink or white. Lateral sepals ovate, large. Lip conic; spur slender, curved upwards, ca 2 cm long. Standard orbicular, acuminate. Wings 2-lobed; basal lobe minute, concealed under standard; distal lobe suborbicular, larger. Capsules ellipsoid, beaked, ca 8 mm long, glabrous; seeds suborbicular, hairy.

Fl. & Fr.: June - Feb.

Habitat: Along streams and in marshy places in hills.

Distrib.: Idukki and Palakkad. Western Ghats of Tamil Nadu. Endemic.

37. *Impatiens minor* (DC.) Bennet in Indian J. Forest. 2: 283. 1979; Nicolson & al. in Regnum Veg. 119: 71. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 80. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 78. 1996; Sivar. & P. Mathew, Fl. Nilambur: 118. 1997; Vivek. & al. in Hajra & al., Fl. India 4: 181. 1997. *Balsamina minor* DC., Prodr. 1: 140. 1824. *Impatiens kleinii* Wight & Arn., Prodr. Fl. Ind. Orient.: 140. 1834; Wight, Icon. Pl. Ind. Orient.: t. 884. 1844 - 1845; Hook.f., Fl. Brit. India 1: 445. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Gamble, Fl. Madras: 140(100). 1915; Manilal, Fl. Silent Valley: 40. 1988; Vajr., Fl. Palghat: 100. 1990.

Annual herb, 15 - 60 cm high; stems slender, branched. Leaves opposite, elliptic-lanceolate, oblong or obovate, serrulate at margin, acute or acuminate at apex, 2 - 7 x 1 - 2.5 cm, glabrous or pilose above, glaucous beneath; petioles to 1 cm long, rarely absent. Pedicels ca 1.2 cm long, filiform, deflexed in fruit. Flowers

axillary, solitary or 2-nate, ca 8 mm across, pink. Lateral sepals linear, subulate, 1-3-nerved. Spur slender, incurved, longer than wings, greenish. Standard orbicular, dorsally keeled, ca 8 mm across. Wings obovate, entire, clawed. Capsules ellipsoid, beaked, ca 1.2 cm long; seeds globose, shining, black.

Fl. & Fr.: June - Nov.

Habitat: Wet situations and crevices of rocks, 100 - 1000 m.

Distrib.: Idukki, Kannur, Kasaragod, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thrissur. Western Ghats. Endemic.

38. *Impatiens modesta* Wight in Madras J. Lit. Sci. 1, 5: 13. 1837 & Icon. Pl. Ind. Orient.: t. 968. 1845; Hook.f., Fl. Brit. India 1: 443. 1874 & in Rec. Bot. Surv. India 4: 45. 1906; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 138(98). 1915; Vajr., Fl. Palghat: 100. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 183. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 132. 2002.

Perennial herb, to 30 cm high; rootstock tuberous. Leaves radical, ovate-cordate, crenate-serrate at margin, acute at apex, 2.5 - 14 x 2 - 9 cm, sparsely hairy above, glabrous and pale shining-glaucous beneath. Scapes slender, to 17 cm long; racemes 2 - 5 cm long; pedicels filiform, ca 1.5 cm long; bracts lanceolate, swollen at tip. Flowers ca 1 cm across, pinkish. Lateral sepals ovate, small. Spur straight. Standard broader than long. Wings 3-lobed; lobes obtuse, subequal. Capsules ellipsoid, acute at both ends, 4 - 6 mm long, glabrous; seeds minute with spiral hairs.

Fl. & Fr.: July - Oct.

Habitat: Moss-covered tree trunks and wet rocks, 800 - 2025 m.

Distrib.: Idukki, Palakkad and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

39. *Impatiens munnarensis* E. Barnes in Bull. Misc. Inform. 1938: 32. 1938; Vivek. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 60. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 183. 1997.

Erect or semierect herb, to 1 m high; stems slender, often procumbent below and rooting at nodes. Leaves variable, usually ovate-lanceolate, cordate or subacute at base, serrate at margin, acute at apex, to 5.5 x 1.7 cm, pubescent above, glabrous, sometimes glaucous beneath; petioles to 5.5 cm long, decurrent on stem, red above;

stipules bent downwards, red. Flowers axillary, solitary or fascicled, 1 - 1.3 cm long. Lateral sepals curved, ca 6 mm long, filiform. Lip cymbiform with a flat bottom and a depression underside; spur absent. Standard ovate, mucronate, keeled. Wings white with lilac or violet streaks, 2-lobed; basal lobe 3-angled; distal lobe obovate-triangular; dorsal auricle conic or rounded, dark purple. Capsules fusiform, 1.3 - 1.5 cm long; seeds ca 1.5 mm long, shining, black.

Fl. & Fr.: Sept. - Dec.

Habitat: Along streams and in marshy places, ca 1300 m.

Distrib.: Idukki (Munnar). Endemic.

40. *Impatiens nataliae* Hook. f. in Bull. Misc. Inform. 1910: 294. 1910; Gamble, Fl. Madras: 141(100). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 184. 1997.

Herb, ca 20 cm high. Leaves opposite, sessile, oblong or oblong-linear, spinulose-serrate or entire at margin, acute or obtuse at apex, 2 - 3 cm long; lower ones obovate. Pedicels capillary, ca 2.5 cm long, deflexed in fruit. Flower solitary, ca 1 cm across, white. Lateral sepals linear, acuminate, 4 - 5 mm long, 1-nerved. Lip funnel-shaped; spur short, attenuate, barbed, pink. Standard orbicular or elliptic, slightly arched, mucronate, dorsally keeled. Wings 9 - 10 mm long, clawed, 2-lobed; basal lobe somewhat 3-gonous; distal lobe much larger, obovate or dolabriform; dorsal auricle decurved, exserted. Capsules somewhat globose, beaked, ca 1 cm, few-seeded; seeds globose, ca 2 mm, smooth, shining, black.

Fl. & Fr.: Oct. - Nov.

Habitat: Evergreen forests, ca 700 m.

Distrib.: Wynad. Western Ghats of Karnataka. Endemic.

41. *Impatiens oppositifolia* L., Sp. Pl.: 937. 1753; Wight, Icon. Pl. Ind. Orient.: t. 883. 1844 - 1845; Hook.f., Fl. Brit. India 1: 448. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 141(100). 1915; Sasidh. & Sivar., Fl. Pl. Thrissur: 78. 1996; Vivek. & al. in Hajra & al., Fl. India 4: 187. 1997.

Erect, annual herb, to 60 cm high; branches slender, glabrous. Leaves opposite, subsessile, linear-oblong, serrate at margin, 2.5 - 7 cm long, glabrous or sparsely hairy above; stipules subulate. Pedicels elongate, slender, glabrous. Flowers

axillary, solitary or in fascicles, ca 1.2 cm across, pink. Lateral sepals lanceolate-linear, apiculate. Lip saccate; spur incurved, stout, short. Standard orbicular. Wings 3-lobed; basal lobe falcate, small; distal lobes obovate, clawed. Capsules ellipsoid, 1 - 1.25 cm long; seeds subglobose, blackish.

Fl. & Fr.: July - Oct.

Habitat: Open grasslands and pastures, to 600 m.

Distrib.: Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

42. *Impatiens pallidiflora* Hook.f. in Bull. Misc. Inform. 1911: 354. 1911; Gamble, Fl. Madras: 141(100). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 188. 1997.

Slender herb, 30 - 50 cm high; stems branched, often pubescent. Leaves opposite, short-petioled, oblong or linear-oblong, truncate or rounded at base, entire or minutely spinulose-serrulate at margin, acute or acuminate at apex, 3 - 5 cm long, glabrous or pubescent above, almost glaucous beneath. Flowers in fascicles, ca 2 cm across, rose or pink turning yellow when dry. Lateral sepals linear, 6 - 7 mm long. Lip cymbiform, acute; spur subequal to limb of lip or longer. Standard orbicular with an obscure dorsal keel, short. Wings ca 1.5 cm long, clawed; basal lobe almost absent; distal lobe dolabriform; dorsal auricle present. Capsule not known.

Fl. & Fr.: Not known.

Habitat: Grassy slopes, ca 2100 m.

Distrib.: Idukki (Devicolam, Hook.f., *l.c.*). Endemic.

43. *Impatiens pandata* E. Barnes in Bull. Misc. Inform. 1938: 33. 1938; Vivek. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 61. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 189. 1997.

Scapigerous, succulent herb, 12 - 15 cm high; tubers globose, ca 7 mm. Leaves radical, solitary or few, orbicular-reniform, shallowly crenate at margin, 1.7 - 4.5 cm across, fleshy, greenish above, purplish beneath; petioles 2.5 - 3 cm long. Pedicels 2 - 2.4 cm long. Flowers in 3 - 9-flowered racemes, white. Lateral sepals ovate, ca 5 mm long, purple. Lip spoon-shaped, purple shaded with white, spurless. Standard elliptic, cucullate, ca 1 cm long. Wings 2.5 - 2.9 cm long, 3-lobed; lobes oblong, rounded; upper 2 curved outwards, hairy at base inside, white

slightly tinged with dark shade of blue inside. Capsules turgid, ca 1.2 cm long; seeds numerous, ovoid, ca 1 mm long, reddish brown, covered with scattered white granules becoming hairs when wet.

Fl. & Fr.: Aug. - Sept.

Habitat: Wet rocks and cushions of moss, 2025 - 2100 m.

Distrib.: Idukki (Anaimudi). Endemic.

44. *Impatiens parasitica* Bedd. in Madras J. Lit. Sci. 2, 4: 66, t. 7, f. 2. 1859 & Icon. Pl. Ind. Orient.: t. 140. 1868 - 1874; Hook.f. in Rec. Bot. Surv. India 4: 45. 1906; Gamble, Fl. Madras: 139(99). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 191. 1997. *I. jerdoniae* Wight var. *parasitica* (Bedd.) Hook. f., Fl. Brit. India 1: 460. 1874.

Perennial, succulent herb; stems moniliform, 10 - 25 cm long, green or purple. Leaves crowded at ends of branches, elliptic, serrate with glandular cilia at base, acute at apex, 3 - 7 x 2 - 3 cm; petioles 2 - 6 cm long. Peduncles to 3.5 cm long bearing 1-3 flowers; pedicels ca 5 cm long. Lateral sepals linear, green with a foliaceous crest. Lip saccate; spur ca 5 mm across at mouth, recurved at tip, red. Standard dorsally winged, green. Wings yellow, 2-lobed, concealed under lip. Capsules gibbous; seeds numerous, small.

Fl. & Fr.: June - Nov.

Habitat: Tree trunks, 1000 - 2000 m.

Distrib.: Idukki and Palakkad. Western Ghats of Tamil Nadu. Endemic.

45. *Impatiens parvifolia* Bedd. in Madras J. Lit. Sci. 2, 4: 66, t. 7, f. 1. 1859 & Icon. Pl. Ind. Orient.: t. 142. 1868 - 1874; Hook.f., Fl. Brit. India 1: 453. 1874 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 144(103). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 191. 1997. *I. omissa* Hook. f. in Rec. Bot. Surv. India 4: 48. 1906; Gamble, Fl. Madras: 144(103). 1915.

Succulent, slender herb, 12 - 25 cm high, branched or not. Leaves opposite and alternate, sessile, ovate-elliptic, crenate-serrate at margin, 0.8 - 3 x 0.5 - 1.5 cm. Peduncles to 5 cm long. Flowers in axillary racemes, blue or white with crimson blotches. Lateral sepals falcate, small. Lip cymbiform; spur blunt, short, green. Standard suborbicular, dorsally keeled. Wings to 1.2 cm long, 2-lobed;

distal lobe 3-angled, thrice larger; dorsal auricle minute. Capsules ellipsoid, ca 4 mm long; seeds ovoid, villous.

Fl. & Fr.: March - Oct.

Habitat: Crevices of rocks, 1800 - 2500 m.

Distrib.: Idukki. Western Ghats of Tamil Nadu. Endemic.

Note: Hook.f. (1906) distinguished *I. omissa* Hook.f. from *I. parvifolia* Bedd. based on the presence of filiform dorsal auricle in wing in the former which is reduced to a minute appendage in the latter. But then, this character is inconsistent.

46. *Impatiens phoenicea* Bedd. in Madras J. Lit. Sci. 2, 3: 175. 1858 & Icon. Pl. Ind. Orient.: t. 148. 1868 - 1874; Hook.f., Fl. Brit. India 1: 466. 1875 & in Rec. Bot. Surv. India 4: 49. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 145(103). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 193. 1997.

Erect, suffruticose herb, 0.3 to 1 m high, branched or not. Leaves alternate, ovate-lanceolate, crenate-serrate at margin, with cilia in crenatures, 5 - 10 x 2 - 3.5 cm, membranous; petioles 1.5 - 2 cm long. Bracts cordate, ca 5 mm long, persistent; pedicels slender, ca 1 cm long. Flowers in axillary racemes, scarlet. Lateral sepals obliquely ovate. Spur trumpet-shaped, incurved with a swollen tip, stout. Standard ovate, dorsally winged. Wings 2-lobed; basal lobe cordate, overlapping larger oblong distal one. Capsules 4- or 5-seeded; seeds compressed, ca 3 mm long, furrowed.

Fl. & Fr.: Sept. - Nov.

Habitat: Sholas above 2100 m.

Distrib.: Idukki. Western Ghats of Tamil Nadu. Endemic.

47. *Impatiens platyadena* C.E.C. Fisch. in Bull. Misc. Inform. 1934: 393. 1934 & Gamble, Fl. Madras, Add.: 1871(1295). 1935; Vivek. & al. in Hajra & al., Fl. India 4: 193. 1997.

Undershrub, to 1 m high; stems angled. Leaves alternate, elliptic-lanceolate, crenate-serrate with apiculate crenatures at margin, acuminate at apex, 8 - 17 x 3.5 - 7.2 cm, decurrent into petiole with decurrent part with 4 - 8 marginal flat white glands; nerves impressed above, slightly prominent beneath. Racemes axillary; peduncles patent or slightly drooping, slender, 2.5 - 4.5 cm long; bracts ovate,

8 - 15 mm long, persistent. Flowers ca 1.5 cm long. Lateral sepals suborbicular, ca 6 mm across, cream-coloured. Lip funnel-shaped, ca 1.2 cm long, pinkish; spur tubular, upcurved into a semicircle, cream-coloured. Standard ovate, 7 - 8 mm long. Wings 1.5 - 1.6 cm long, 2-lobed; basal lobe ovate-triangular, acute or obtuse; distal lobe semiovate, subacute, 1 - 1.2 cm long, scarlet. Capsules ovoid, acute, ca 6 mm long, accrescent; seeds pyriform, 1.5 - 2 mm long, minutely papillose, mottled brown.

Fl. & Fr.: Sept.

Habitat: Grasslands, ca 2000 m.

Distrib.: Idukki (Nemakkad Gap). Endemic.

48. *Impatiens rupicola* Hook.f. in Bull. Misc. Inform. 1910: 292. 1910; Gamble, Fl. Madras: 140(99). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 206. 1997. *I. rivulicola* Hook.f. in Bull. Misc. Inform. 1911: 354. 1911; Gamble, Fl. Madras: 140(99). 1915.

Slender herb, 20 - 30 cm high; stems 4-gonous. Leaves opposite, short-petioled, linear, entire or minutely serrulate at margin, acute or acuminate at apex, 3 - 4 cm long, coriaceous with stipitate glands at base of petiole. Pedicels 1 - 1.5 cm long, 2 - 2.5 cm in fruit, deflexed. Flowers solitary or in 2- or 3-flowered fascicles, 5 - 10 mm long, violet. Lateral sepals linear, acuminate, ca 1 cm long. Lip cymbiform; spur incurved, short. Standard orbicular, dorsally keeled. Wings 1 - 1.6 cm long, clawed, 2-lobed; basal lobe oblong, erect or decurved, small; distal lobe semilunate, fleshy; dorsal auricle short. Capsules pendulous, ovoid, 8 - 10 mm long, few-seeded; seeds globose, hardly 2 mm, shining, black.

Fl. & Fr.: Not known.

Habitat: Along streams, ca 1220 m.

Distrib.: Thiruvananthapuram (Hook. f., l.c.). Endemic.

49. *Impatiens scabriuscula* B. Heyne ex Roxb., Fl. Ind. 2: 464. 1824; Bedd., Icon. Pl. Ind. Orient.: t. 144. 1868 - 1874; Hook.f., Fl. Brit. India 1: 454. 1874 & in Rec. Bot. Surv. India 4: 47. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 142(101). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 80. 1988; Vajr., Fl. Palghat: 100. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 207. 1997.

Erect herb, 20 - 40 cm high; stems white, branching from base, hairy.

Leaves alternate, elliptic-lanceolate, serrate at margin, 1.8 – 6 x 0.6 – 1.2 cm, sparsely hairy above, hairy on nerves beneath; petioles ca 3 mm long, sometimes glandular. Pedicels to 6 mm long, scabrid. Flowers axillary, solitary or in fascicles, pink or white with purplish tinge. Lateral sepals linear-lanceolate, minute, hairy. Lip cymbiform, hairy; spur absent. Standard orbicular, beaked, dorsally hairy. Wings 2-lobed; basal lobe smaller than oblong-obovate distal lobe. Capsules ellipsoid, mucronate, ca 8 mm long, villous; seeds globose, tubercled, brown.

Fl. & Fr.: Aug. – Jan.

Habitat: Marshy slopes, 725 – 850 m.

Distrib.: Kannur, Palakkad and Wynad. Western Ghats. Endemic.

50. *Impatiens scapiflora* B. Heyne ex Roxb., *Fl. Ind.* 2: 464. 1824; Hook.f., *Fl. Brit. India* 1: 443. 1874 & in *Rec. Bot. Surv. India* 4: 44. 1906; Gamble, *Fl. Madras*: 138(98). 1915; Manilal, *Fl. Silent Valley*: 41. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 80. 1988; Vajr., *Fl. Palghat*: 101. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 99. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 79. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 119. 1997; Vivek. & al. in Hajra & al., *Fl. India* 4: 208. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 133. 2002. *I. rivalis* Wight in *Madras J. Lit. Sci.* 1, 5: 13, t. 8. 1837 & *Icon. Pl. Ind. Orient.*: t. 751. 1844; Hook.f., *Fl. Brit. India* 1: 444. 1874; Rama Rao, *Fl. Pl. Travancore*: 59. 1914.

Herb, 15 - 45 cm high; rootstock tuberous. Leaves radical, orbicular, ovate or reniform with a deep sinus, crenate-serrate at margin, 5 – 15 x 3 – 12 cm, hairy above, fleshy, palmately nerved; petioles to 15 cm long. Scapes 7 – 30 cm long; bracts ovate, ca 3 mm long; pedicels 1.5 - 2.5 cm long. Flowers in racemes, ca 2.5 cm across, pink. Lip saccate; spur incurved, ca 2.5 cm long. Standard orbicular-rhomboid, vaulted. Wings 3-lobed; lobes linear, falcate. Capsules fusiform, ca 1.2 cm long.

Fl. & Fr.: July – Dec.

Habitat: Crevices of rocks and moist places in evergreen forests, 650 – 1100 m.

Distrib.: Idukki, Kannur, Kasaragod, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

51. *Impatiens sholayarensis* M. Kumar & S. Seq. in *Sida* 19: 795, ff. 1 & 2. 2001.

Epiphytic, glabrous herb; stem to 4 cm long, green, fleshy. Leaves crowded towards apex, ovate to elliptic-lanceolate, attenuate at base, crenulate at margin, acute at apex, 2.3 - 8 x 1.3 - 3.2 cm, membranous, glabrous, light green, silvery white beneath; lateral nerves to 4 pairs, indistinct; petioles 2.5 - 8 cm long, channelled, light green, with 2 stipitate glands near base. Racemes 2-flowered; peduncles 1.3 - 2 cm long; pedicels 2.5 - 5 cm long, filiform, greenish white. Lateral sepals linear-ovate, slightly falcate, 0.8 - 1 x ca 0.2 cm, glabrous. Lip saccate, compressed, 1 - 3.5 x 0.5 - 1.1 cm, glabrous, greenish yellow with crimson red; mouth descended, prominently hooked below; spur curved, obtuse, white. Standard erect, 0.6 - 1.1 x 0.4 - 0.9 cm, glabrous, gland-dotted. Wing connate at base, 1.7 - 1.9 x 1 - 1.2 cm, 3-lobed; upper lobes with a small spine and pouch. Stamens 5, 0.8 - 1 cm long. Ovary elliptic-lanceolate, slightly falcate, 1 - 1.2 x ca 0.3 cm, glabrous; stigma straight, toothed. Capsules elliptic-lanceolate, to 1.2 cm long, glabrous; seeds pyriform, ciliate-tipped.

Fl. & Fr.: Oct.

Habitat: Evergreen forests, 700 - 900 m; ? critically endangered.

Distrib.: Thrissur. So far known only from the type locality, Sholayar.

52. *Impatiens sivarajanii* M. Kumar & S. Seq. in *Rheedea* 6: 51, t. 1. 1996; Hajra & al., *Fl. India* 4(Add.): 532. 1997.

Perennial, scapigerous, tuberous herb; tubers white with light violet tinge. Leaves 1 or 2, radical, ovate, obliquely subcordate at base, distantly subcrenate at margin with minutely apiculate crenules, acute or acuminate at apex, glabrous except nerves; petioles 4 - 5 cm long. Racemes 1 -3-flowered; peduncles filiform, ca 10 cm long, glabrous; bracts linear-lanceolate; pedicels 1.4 - 1.8 cm long. Flowers ca 2 x 1.25 cm, creamy white. Lateral sepals ovate-elliptic, acute or acuminate, ca 0.5 x 2.5 mm, glabrous, green. Lip broadly obovate, acuminate, concave, ca 1.2 x 0.75 mm, glabrous; spur rounded at apex, ca 2 mm long. Standard depressed, obovate, concave, ca 0.75 x 1 cm, glabrous. Wings 3-lobed, ca 1.75 x 0.9 cm; basal lobe ovate-oblong, obtuse; midlobe more or less confluent with distal one; distal lobe minutely lobuled; dorsal auricle absent. Stamens 5, connate, ca 4 mm long; anthers ca 1 mm long. Ovary ovate-elliptic, acute, ca 3 x 1.4 mm, glabrous; stigma sessile, toothed. Capsules oblong-ovoid, beaked, glabrous, many-seeded; seeds narrowly ellipsoid, ca 0.8 x 0.3 mm, orange, tufted-ciliate at apices, glabrous otherwise.

Fl. & Fr.: Aug. - Oct.

Habitat: Moss-clad tree trunks, 1700 - 1800 m.

Distrib.: Palakkad (Silent Valley). Endemic.

Note: This species is closely allied to *I. agumbeana* Bhaskar & Razi but differs mainly in the presence of glabrous (except nerves) lamina, creamy white flowers, broadly obovate lip, absence of dorsal auricle and unbanded seeds that are glabrous except at apex.

53. *Impatiens tangachee* Bedd. in Madras J. Lit. Sci. 2, 4: 66. 1859 & Icon. Pl. Ind. Orient.: t. 147. 1868 - 1874; Hook.f., Fl. Brit. India 1: 467. 1875 & in Rec. Bot. Surv. India 4: 49. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 145(104). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 215. 1997.

Herb, 20 - 40 cm high; stems forked, subprocumbent, rooting at lower nodes. Leaves alternate, subsessile, elliptic, serrate at margin, acuminate at apex, 3.2 - 10 x 1 - 1.2 cm; nerves few, slender. Peduncles erect, stout, 3.5 - 10 cm long; pedicels erect, 1 - 2.5 cm long. Flowers 4 - 8 in racemes, ca 2.5 cm across, bright rose. Lateral sepals orbicular-oblong. Lip cymbiform; spur straight or incurved, ca 2.5 cm long. Standard short, broad. Wings 2-lobed; basal lobe broadly truncate; distal lobe truncate with erose apex. Capsules gibbous, ca 8 mm long, glabrous; seeds many, small.

Fl. & Fr.: Nov. - Feb.

Habitat: Along streams and in riverbeds, 1950 - 2100 m.

Distrib.: Idukki. Western Ghats of Tamil Nadu. Endemic.

54. *Impatiens tomentosa* B. Heyne ex Wight & Arn., Prodr. Fl. Ind. Orient.: 139. 1834; Wight, Icon. Pl. Ind. Orient.: t. 749. 1844; Hook.f., Fl. Brit. India 1: 449. 1874 & in Rec. Bot. Surv. India 4: 46. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 141(100). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 217. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 133. 2002.

Herb, 30 - 45 cm high; stems erect, rufous-hairy above. Leaves opposite, elliptic to ovate-oblong, serrulate at margin, obtuse or acute at apex, 1.2 - 3 x 0.6 - 1.2 cm, hispid above, scabrid or tomentose on nerves beneath; petioles ca 3 mm long. Pedicels 2 - 2.5 cm long, deflexed in fruit, hairy. Flower axillary, solitary, 8 -

10 mm across, pink. Lateral sepals linear-lanceolate, ciliate. Lip deeply saccate; spur hooked, short. Standard oblong-orbicular, apiculate, dorsally keeled. Wings 2-lobed; basal lobe oblong; distal lobe rotund, larger. Capsules ellipsoid, ca 1.2 cm long; seeds subglobose.

Fl. & Fr.: June - Feb.

Habitat: Boggy places and swamps, 1400 - 2300 m.

Distrib.: Idukki, Pathanamthitta and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

55. *Impatiens travancorica* Bedd., *Icon. Pl. Ind. Orient.*: t. 142. 1868 1874; Hook.f., *Fl. Brit. India* 1: 464. 1874 & in *Rec. Bot. Surv. India* 4: 49. 1906; Rama Rao, *Fl. Pl. Travancore*: 60. 1914; Gamble, *Fl. Madras*: 145(103). 1915; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 99. 1994; Vivek. & al. in Hajra & al., *Fl. India* 4: 217. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 134. 2002.

Annual herb, 10 - 15 cm high; stems branched, rarely glabrous. Leaves rosulate at top, ovate-elliptic, crenate and ciliate on crenatures at margin, subacute at apex, 1 - 3 x 1 - 2 cm; petioles slender, 1.5 - 4 cm long. Peduncles 2 - 5 cm long; bracts subulate-lanceolate; pedicels ca 1 cm long. Flowers in subterminal umbels, ca 1.2 cm across, white with purplish tinge. Lateral sepals obliquely ovate, acuminate. Lip cymbiform; spur stout, ca 3 mm long. Standard cucullate, small. Wings 2-lobed; basal lobe small; distal lobe larger. Capsules ellipsoid, ca 6 mm long.

Fl. & Fr.: Aug. - Oct.

Habitat: Grasslands above 1400 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic.

56. *Impatiens trichocarpa* Hook.f. in Hooker's *Icon. Pl.* 30: t. 2914. 1910; Gamble, *Fl. Madras*: 142(101). 1915; Vivek. & al. in Hajra & al., *Fl. India* 4: 218. 1997.

Annual herb, 20 - 30 cm high, branched, appressed-hairy. Leaves alternate, subsessile, elliptic-lanceolate, serrulate at margin, acute at apex, 4 - 7 x 2.5 - 3.5 cm, coriaceous. Pedicels 1 - 1.5 cm long, glabrous or puberulous. Flowers solitary or 2-nate. Lateral sepals ovate, acute. Lip cymbiform, ca 8 mm long, pubescent; spur robust, incurved, shorter than lip. Standard orbicular, ca 7 mm, cucullate, dorsally keeled ending in a mucro. Wings ca 1.2 cm long, 2-lobed; basal

lobe rotund; distal lobe larger, semilunate or dolabriform; dorsal auricle prominent, decurved. Capsules ellipsoid, 1 - 1.2 cm long, turgid, tomentose; seeds globose, ca 2 mm, papillose.

Fl.: Nov.

Habitat: Evergreen forests, to 1500 m.

Distrib.: Pathanamthitta. Western Ghats of Karnataka and Tamil Nadu. Endemic.

57. *Impatiens umbellata* B. Heyne ex Roxb., Fl. Ind. 2: 464. 1824; Wight, Icon. Pl. Ind. Orient.: t. 745. 1844; Hook.f., Fl. Brit. India 1: 461. 1874 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 145(103). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 100. 1994; Vivek. & al. in Hajra & al., Fl. India 4: 222. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 134. 2002.

Annual herb, 15 - 30 cm high; stems branched, naked below. Leaves rosulate, ovate-elliptic, rarely orbicular, crenate and ciliate on crenatures at margin, obtuse or acute at apex, 2.5 - 5 cm long, membranous; petioles 0.6 - 3.5 cm long. Peduncles 2.5 - 4.5 cm long; bracts lanceolate, ca 4 mm long, green; pedicels ca 2 cm long. Flowers in subterminal umbels, rarely in racemes, red. Lateral sepals broadly ovate. Lip cymbiform; spur incurved, slender, 2.5 - 3.5 cm long. Standard orbicular. Wings 2-lobed; lobes subequal. Capsules ellipsoid, ca 8 mm long, turgid; seeds echinate.

Fl. & Fr.: Aug. - Dec.

Habitat: Moist places and crevices of rocks along streams.

Distrib.: Idukki, Kollam and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

58. *Impatiens uncinata* Wight in Madras J. Lit. Sci. 1, 5: 11, t. 6. 1837 & Icon. Pl. Ind. Orient.: t. 747. 1844; Hook.f., Fl. Brit. India 1: 465. 1875 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 144(103). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 100. 1994; Vivek. & al. in Hajra & al., Fl. India 4: 223. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 135. 2002.

Slender, erect herb, to 25 cm high; stems sparingly branched, leafy. Leaves alternate, ovate or suborbicular, acute or cordate at base, crenate at margin, acute

or acuminate at apex, 3 - 7 x 2 - 4 cm, membranous, often ciliate at base, glabrous or hairy on nerves above; petioles 1.5 - 4 cm long, glanduliferous at apex. Peduncles axillary, solitary, to 8 cm long; pedicels 1 - 2 cm long. Flowers 4 - 8 in subumbels or short racemes, ca 2 cm across, pink. Lateral sepals obliquely ovate. Lip subcampanulate; spur inflated in middle, hooked at tip, short, stout. Standard elliptic. Wings 2-lobed, divaricate; distal lobe obovate or falcate; basal lobe oblong, smaller. Capsules ellipsoid, beaked, ca 8 mm long; seeds few, globose.

Fl. & Fr.: May - Oct.

Habitat: Moist humus soil and shady places in evergreen forests, 900 - 1600 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Kanyakumari and Tirunelveli). Endemic.

59. *Impatiens verecunda* Hook.f. in Bull. Misc. Inform. 1911: 356. 1911; Gamble, Fl. Madras: 145(103). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 224. 1997.

Flaccid herb, 10 - 15 cm high; stems branched or not. Leaves alternate, ovate or ovate-rotundate, crenate at margin, acute or acuminate at apex, 4 - 6 cm long, membranous; petioles slender, 2 - 3 cm long. Bracts lanceolate, 3 - 5 mm long; pedicels 1 - 2 cm long, deflexed in fruit. Flowers in 2 - 4-flowered subumbels, ca 2 cm across, rose. Lateral sepals ovate, truncate at base, 6 - 7 mm long, 5-nerved. Lip orbicular, 6 - 7 mm; spur obtuse, less than half as long as limb of lip. Standard orbicular or oblong, 6 - 9 mm across with a blunt or pointed apiculum. Wings sessile, 1.3 - 1.5 cm long, 2-lobed; basal lobe orbicular, minute, more or less folding distal lobe from base; distal lobe 3-gonous or dolabriform, larger; dorsal auricle obscure. Capsules ellipsoid, beaked, many-seeded; seeds obovoid or globose, compressed, 2 - 2.5 mm, pubescent.

Fl. & Fr.: Not known.

Habitat: Steep marshy embankments under trees, ca 1300 m.

Distrib.: Idukki (Periakanal and Devicolam, Gamble, *l.c.*). Endemic.

Note: Not collected after the type.

60. *Impatiens verticillata* Wight in Madras J. Lit. Sci. 1, 5: 15. 1837; Hook.f., Fl. Brit. India 1: 452. 1874 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 144(102). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 100. 1994; Vivek. & al. in Hajra & al., Fl. India

4: 225. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 135. 2002.

Succulent herb, 25 - 50 cm high; stems swollen at nodes, branching in lower half. Leaves opposite and in verticels of 3 - 6, elliptic or elliptic-lanceolate, crenate-serrulate at margin, acuminate at apex, 6 - 12 x 1.2 - 2 cm; petioles 0.5 - 1.5 cm long. Peduncles to 4 cm long; pedicels 2 - 4 cm long. Flowers in axillary or terminal 3 - many-flowered subumbels, ca 1 cm across, orange-red. Lateral sepals linear-lanceolate, 8 - 10 mm long. Lip cymbiform; spur curved upwards, slender, 2 - 3.5 cm long. Standard suborbicular, cucullate, ca 1 x 1.2 cm. Wings to 2.8 cm long, 2-lobed, clawed; lobes oblong-obovate, hairy on keel. Capsules fusiform, 0.8 - 1.2 cm long, many-seeded; seeds ca 2.5 mm long, hairy at pointed end, brown.

Fl. & Fr.: April - Dec.

Habitat: Gravelly beds near streams, 900 - 1500 m.

Distrib.: Idukki, Pathanamthitta and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

61. *Impatiens violacea* M. Kumar & S. Seq. in Sida 19: 798, ff. 3 & 4. 2001.

Glabrous herb. Leaves crowded towards apex, lanceolate to ovate-lanceolate, truncate at base, crenulate-serrate and violet at margin, acute at apex, 2 - 6 x 1.4 - 4 cm; petioles to 3.5 cm long, channelled, violet, with 2 stipitate glands near base. Racemes 1 - 4-flowered; peduncles 1.5 - 2 cm long; pedicels 2 - 4 cm long, violet. Lateral sepals linear-lanceolate, slightly keeled above, 0.8 - 1 x 0.2 - 0.3 cm, glabrous. Lip saccate, 1.75 - 2 x 0.6 - 1.1 cm, wrinkled, glabrous, violet, with a short hook at mouth. Standard erect, 0.6 - 0.8 x 0.5 - 0.7 cm, gland-dotted, greenish yellow, with a dark green hood. Wing 0.8 - 1 x 0.6 - 0.8 cm, fleshy, gland-dotted, 3-lobed with a small pouch on lateral lobes. Stamens 5, 0.5 - 0.6 cm long. Ovary elliptic-ovate, 0.4 - 0.5 x 0.15 - 0.2 cm, glabrous; style short; stigma obtuse, silky-pubescent-tipped. Capsules ellipsoid-ovoid, ca 1 x 0.35 cm, glabrous; seeds somewhat 4-gonous, smooth.

Fl. & Fr.: Aug.

Habitat: Tree trunks in sholas, 1800 - 2000 m; ? critically endangered.

Distrib.: Idukki. So far known only from the type locality, Pettimudy, Munnar.

62. *Impatiens viscida* Wight in Madras J. Lit. Sci. 1, 5: 12. 1837; Hook.f., Fl. Brit. India 1: 462. 1874; Gamble, Fl. Madras: 141(102). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 226. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 135. 2002.

Herb, 0.5 - 1 m high, branched, rooting at lower nodes; stems angled. Leaves alternate, elliptic-lanceolate, serrate at margin, 5 - 8 cm long, pubescent beneath; nerves stiff-hairy on both surfaces. Flowers in umbels or racemes, deep pink or light purple; peduncles axillary, 5 - 10 cm long, viscid; pedicels viscid. Lateral sepals suborbicular, as long as standard. Lip boat-shaped; spur long, incurved. Distal lobes of wings large, suborbicular. Capsules ellipsoid, beaked, glabrous; seeds globose, hairy.

Fl. & Fr.: April - Dec.

Habitat: Stream beds and swampy places in evergreen forests, above 1200 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu (Pulney hills). Endemic.

63. *Impatiens viscosa* Bedd. in Madras J. Lit. Sci. 2, 4: 68, t. 7, f. 7. 1859; Hook.f., Fl. Brit. India 1: 453. 1874 & in Rec. Bot. Surv. India 4: 48. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 144(103). 1915; Manilal, Fl. Silent Valley: 41. 1988; Vajr., Fl. Palghat: 45. 1990; Vivek. & al. in Hajra & al., Fl. India 4: 228. 1997. *I. ballardi* Bedd., Icon. Pl. Ind. Orient.: t. 192. 1868 - 1874; Hook.f., Fl. Brit. India 1: 482. 1875.

Succulent, erect herb, 20 - 40 cm high; stems often branched, rooting at lower nodes. Leaves opposite, rarely alternate, elliptic-ovate, serrate at margin, acute at apex, 2 - 6 x 0.8 - 3 cm, sparsely hairy above, glabrous beneath, glandular at base; petioles 1 - 3 cm long. Peduncles 2.5 - 7 cm long; pedicels slender, 0.5 - 1.5 cm long. Flowers in axillary and terminal subumbels, pink. Lateral sepals ovate-subulate. Lip cymbiform; spur incurved, inflated in middle, subulate at tip, ca 7 mm long. Standard orbicular, cucullate, obscurely keeled. Wings 2-lobed; distal lobe larger, clawed; dorsal auricle filiform, enclosed in spur. Capsules ovoid, turgid, 7 - 10-seeded; seeds echinate.

Fl. & Fr.: July - Dec.

Habitat: Marshy places and meadows, 900 - 1000 m.

Distrib.: Idukki, Kottayam, Palakkad and Pathanamthitta. Western Ghats of Tamil

Nadu. Endemic.

64. *Impatiens wightiana* Bedd. in Madras J. Lit. Sci. 2, 4: 67. 1859 & Icon. Pl. Ind. Orient.: t. 146. 1868 - 1874; Hook.f., Fl. Brit. India 1: 467. 1875 & in Rec. Bot. Surv. India 4: 49. 1906; Rama Rao, Fl. Pl. Travancore: 60. 1914; Gamble, Fl. Madras: 145(104). 1915; Vivek. & al. in Hajra & al., Fl. India 4: 229. 1997.

Erect, branched, suffruticose herb, rooting at lower nodes. Leaves alternate, elliptic-lanceolate, serrate at margin, acuminate at apex, 5 - 18 x 1.5 - 4.5 cm, membranous, lineolate, glabrescent; petioles 3 - 7 cm long with stipitate glands. Peduncles longer than petioles; pedicels capillary. Flowers in axillary racemes, ca 1 cm across, white with purple. Lateral sepals small. Lip funnel-shaped or cymbiform; spur hooked, incurved, short. Standard suborbicular-ovate, apiculate with a green keel on dorsal side. Capsules ovoid-trapezoid, acute, glabrous; seeds 4 or 5, globose, hairy.

Fl. & Fr.: June - Sept.

Habitat: Moist forests and along streams.

Distrib.: Idukki. Western Ghats of Tamil Nadu. Endemic.

OXALIDACEAE

(N.P. BALAKRISHNAN & W. ARISDASON)

Herbs, shrubs, rarely trees or lianas, often rhizomatous or with bulbs, bulbils or stolons, sometimes woody herbs. Leaves alternate, subopposite, radical or apically crowded, compound, digitately or pinnately 3-foliolate, impari- or paripinnate, sometimes 1-foliolate, stipuled or rarely not; petioles and petiolules jointed. Inflorescences radical, axillary or pseudoterminal, cymose, pseudumbelled or rarely racemose, 1 - many-flowered, sometimes cauliflorous racemes or thyrses or flower solitary, with bracts and bracteoles. Flowers bisexual, 5-merous, actinomorphic, heterostylous, sometimes cleistogamous; pedicels jointed. Sepals 5, free or basally connate, imbricate, persistent. Petals 5, hypogynous, free but usually connate above clawed base, contorted in bud. Stamens 10 or 15, sometimes 5 staminodal, in 2 or 3 series, obdiplostemonous; filaments shortly connate at base; anthers dorsifixed or versatile. 2-loculed, dehiscent extrorsely by longitudinal slits. Disc absent. Ovary superior, 5-loculed; ovules 1 or 2 - several in 1 or 2

rows in each locule, pendulous, superposed, 2-tegmic, anatropous; styles 5, terminal, free, persistent. Fruit a loculicidal capsule, rarely a 5-loculed schizocarp, sometimes a fleshy indehiscent 5-lobed berry; seeds arillate or not, often with an outer fleshy coat bursting elastically; embryo straight or cochlear; cotyledons elliptic; endosperm moderate, fleshy, rarely absent.

Mostly tropical, a few temperate, 8 genera and 575 species, 3 and 22 in India and, 3 and 15 in Kerala.

Literature: Veldkamp, J.F. 1971. *Oxalidaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* I, 7: 151-178.

Key to genera

- 1a. Small trees; leaves imparipinnate; fruits fleshy, indehiscent 1. **Averrhoa**
- b. Herbs or dwarf shrubs; leaves paripinnate or, 3- or 4-foliolate; fruit a dry capsule 2
- 2a. Leaflets 6- or more-pinnate; capsules dehiscing into a 5-rayed star without leaving a columella 2. **Biophytum**
- b. Leaflets 3- or 4-foliolate; capsules with valves attached to a central columella 3. **Oxalis**

1. AVERRHOA L.

Evergreen, small trees; young parts usually pubescent or glabrous. Leaves spiral to terminally clustered, exstipulate, imparipinnate; leaflets subopposite, subsessile, entire. Inflorescences panicle, axillary or on trunk and old branches; bracts small, caducous. Flowers in scattered stalked loose cymes. Sepals shortly connate at base. Petals free or connate above claw, creamy to dark red with white markings. Stamens unequal, shorter ones often without anthers. Ovary superior, appressed-strigose, 5-loculed; ovules (2 -)3 - 7 in each locule, pendulous. Fruits cylindrical or stellately ridged with prominent angled lobes, yellowish green and semitransparent when fresh, red when dry; seeds elliptic, flat, arillate or not, endospermous; cotyledons 6 - 8 times as long as the oblique and stout radicle.

Native to Brazil or Malesia, 2 species, now widely cultivated in tropics for their fruit.

Key to species

- 1a. Leaflets 5 - 19 pairs, pubescent beneath; panicles cauliflorous, rarely some axillary; petals

free, 10 - 20 mm long; all stamens with anthers; ovules 4 - 7 in each locule; fruits cylindric with slightly rounded lobes; seeds exarillate **1. A. bilimbi**

- b. Leaflets 3 - 6 pairs, glabrous and glaucous beneath; panicles axillary, rarely on branches; petals connate above, to 8 mm long; shorter stamens without anthers; ovules 3 - 5 in each locule; fruits stellate with angled lobes; seeds arillate **2. A. carambola**

1. *Averrhoa bilimbi* L., Sp. Pl.: 428. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 439. 1874; Bourd., Forest Trees Travancore: 62. 1908; Rama Rao, Fl. Pl. Travancore: 59. 1914; Gamble, Fl. Madras: 133(95). 1915; Manilal & Sivar., Fl. Calicut: 56. 1982; Nicolson & al. in Regnum Veg. 119: 204. 1988; Vajr., Fl. Palghat: 102. 1990; Manna in Hajra & al., Fl. India 4: 256. 1997.

Mal.: *Bilimbi, Chemmeenpuli, Ilumbipuli, Irumbanpuli, Karichakka*

Tree, to 15 m tall; young parts pale yellow to rusty-velvety. Leaves usually terminally tufted; rachises 15 - 55 cm long; leaflets 5 - 19 pairs, variable, acute to acuminate at apex, to 12 x 4 cm; lateral nerves 6 - 14 pairs. Panicles cauliflorous from tubercles on main trunk to ground level and on main leafless branches, fascicled and pendulous, to 18 cm long, rarely axillary, solitary and erect; pedicels 4 - 15 mm long, jointed near middle. Sepals elliptic to lanceolate or spatulate, acute or obtuse, 3 - 8 x 1.5 - 3 mm, sparsely puberulous outside near base, yellowish green to purplish green. Petals free, lanceolate-spatulate, 10 - 20 x 3 - 4 mm, glabrous inside, dark pink; claw 3 - 6 mm long. Stamens all fertile; filaments 2 - 12 mm long, unequal. Ovary ellipsoid, ca 4 mm long, densely appressed-pale-strigose; ovules 4 - 7 in each locule; styles to 9 mm long. Fruits cylindric, obtuse, obtusely angled, to 10 x 5 cm; seeds to 14, 6 - 7 x 4 - 6 mm, exarillate.

Fl. & Fr.: April - Sept.

Cultivated throughout Kerala for the fruit. Cultivated in most states.

Uses: Fruit is acidic and edible. Fruit juice can be used to remove stains from clothes. Decoction of flower can be used in cough. Fruit juice is useful in fever, scurvy, biliousness and piles.

2. *Averrhoa carambola* L., Sp. Pl.: 428. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 439. 1874; Gamble, Fl. Madras: 133(95). 1915; Manilal & Sivar., Fl. Calicut: 56. 1982; Nicolson & al. in Regnum Veg. 119: 204. 1988; Manna in Hajra & al., Fl. India 4: 256. 1997.

Mal.: *Chathurapuli, Pulinchi, Varippanpuli*

Tree, to 15 m tall; branches often drooping; young parts yellowish-pubescent to reddish-, glabrescent. Leaves scattered; rachises to 20 cm long; leaflets 3-6 pairs, variable, acute to acuminate at apex, to 10 x 4 cm, glaucous beneath; lateral nerves 4-10 pairs. Inflorescences axillary, rarely on branches, to 6 cm long; pedicels 3-6 mm long, jointed above middle. Sepals obovate or oblong-ovate to 3-angled, acute to obliquely emarginate, to 4 x 2 mm, subglabrous, bright red, yellowish brown with pale margin when dry. Petals obovate to lanceolate, connate above ca 1 mm long claw, glabrous or with minute septate-glandular hairs inside. Shorter stamens without anthers; filaments often swollen at base, to 4.5 mm long. Ovary ellipsoid, ca 2.5 mm long, appressed-puberulous mainly on ribs; ovules 3-5 in each locule; styles to 2 mm long. Fruits ovoid to ellipsoid with 5 acute longitudinal ridges, stellate in cross section, lobed at both ends, to 12 x 6 cm, shining, yellowish green; seeds to 10, 12 x 5 mm; aril 2-lipped, enclosing seed, fleshy.

Fl. & Fr.: May - Nov.

Cultivated throughout Kerala for the fruit. Cultivated in most states.

Uses: Fruit is acidic-sour when green, sweetish-acidic when ripe, eaten and used for making pickles and curries.

2. BIOPHYTUM DC.

Annual or perennial, erect herbs, usually dwarf, sympodially branched. Leaves tufted at ends of stems and branches, paripinnate; rachises prolonged into a mucro; stipules setaceous; leaflets opposite, subsessile, terminal pair often different from others with outer base cuneate and the inner rounded to truncate. Flowers crowded in a usually peduncled bracteate axillary pseudoumbel, heterodi- tri- or homostylous; pedicels jointed at base. Sepals more or less free, glabrous inside. Petals contorted, connate above claw. Shorter filaments with callus at base; longer ones always edentate. Styles ciliate; stigma terminal, subulate, entire or spatulate to flat, crenate to 2-fid; ovules 1-6 in each locule, alternating in 2 rows. Capsules ultimately loculicidal to base, forming a 5-rayed star; aril white, thin at maturity, 2-valved and ejaculatory.

Tropics, ca 50 species, 12 in India and 10 in Kerala.

Literature: Steenis, C.G.G.J. van 1950. The Malaysian species of *Biophytum*

(*Oxalidaceae*). Bull. Jard. Bot. Buitenzorg 3, 18: 449 - 455. Veldkamp, J.F. 1989. Notes on *Biophytum* (*Oxalidaceae*) of the Old World. *Taxon* 38: 110 - 116.

Key to species

- 1a. Leaflets densely strigose 2
- b. Leaflets glabrous or sparsely hairy 5
- 2a. Perennial herbs; stems usually branched 3
- b. Annual herbs; stems usually unbranched 4
- 3a. Leaflets 5 - 9 pairs; seed 1 in each locule 3. **B. insigne**
- b. Leaflets 15 - 22 pairs; seeds 2 - 4 in each locule 2. **B. congestiflorum**
- 4a. Sepals 5-nerved; seeds ovoid, to 7-ridged, closely tubercled on ridges 1. **B. candolleanum**
- b. Sepals 7-nerved; seeds bipyramidal, not ridged, very sparsely and unevenly tubercled
5. **B. longipedunculatum**
- 5a. Sepals strigose and glandular-hairy 6
- b. Sepals glabrous or sparsely strigose 7
- 6a. Sepals 5-nerved; seeds concentrically 9-ridged 8. **B. sensitivum**
- b. Sepals 7-nerved; seeds transversely tubercled 9. **B. umbraculum**
- 7a. Seeds not tubercled 8
- b. Seeds tubercled 9
- 8a. Terminal leaflet obovate and falcate, sparsely hairy; nerves inconspicuous
10. **B. veldkampii**
- b. Terminal leaflet broadly oblong, glabrous; nerves very prominent 6. **B. nervifolium**
- 9a. Rachises bearing leaflets throughout; persistent calyx shorter than fruit
4. **B. intermedium**
- b. Rachises barren in lower half; persistent calyx as long as or longer than fruit
7. **B. reinwardtii**

1. **Biophytum candolleanum** Wight, Ill. Ind. Bot. 1: t. 62. 1840 (as *candolianum*); Gamble, Fl. Madras: 133(95). 1915; Nicolson & al. in *Regnum Veg.* 119: 204. 1988; Sivar. & P. Mathew, Fl. Nilambur: 113. 1997. *B. sensitivum* (L.) DC. var. *candolleanum* (Wight) Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 437. 1874; Manilal, Fl. Silent Valley: 38. 1988; Manna in Hajra & al., Fl. India 4: 238. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 127. 2002.

Mal.: *Mukkutti*

Annual, (2 -)5 - 15(- 25) cm high, strigose-hairy. Leaves 2 - 9 cm long; leaflets 7 - 18 pairs, prominently nerved beneath; apical bristles to 1.5 mm long; terminal pair oblong to obovate, curved, ca 8 x 4 mm; upper middle leaflets oblong to rectangular, ca 10 x 3 mm; basal ones ovate, obtuse or rounded at base, apiculate at apex. Umbels 2 - 10, 5 - 10-flowered; peduncles 4 - 15 cm long; bracts lanceolate, acuminate; pedicels to 5 mm long. Flowers 6 - 8 mm across, yellow. Sepals 5, lanceolate, ca 3.5 mm long, strigose, 5-nerved. Petals 5, oblanceolate, ca 4 mm long. Stamens 10, unequal, 1.2 - 3.5 mm long; staminal tube to 1 mm long; filaments puberulous. Ovary glabrous, 5-loculed; style to 1 mm long. Capsules obovoid, 3 - 3.2 x 2.3 - 2.7 mm, pubescent on septa; seeds 4 in each locule, ovoid, ca 1 x 0.8 mm, to 7-ridged, prominently and closely tubercled on ridges.

Fl. & Fr.: Feb. - Dec.

Habitat: Shaded places, moist cultivated lands, wastelands, stream sides etc., to 1800 m, common.

Distrib.: Idukki, Kottayam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Karnataka and Tamil Nadu. Sri Lanka.

2. *Biophytum congestiflorum* Govind. in J. Econ. Tax. Bot. 20: 311, f. 1. 1996; Manna in Hajra & al., Fl. India 4: 231. 1997.

Perennial, to 1 m high; stems usually branched, appressed-hairy when young; branches 2 - 6, in pseudowhorls; leaf scars many, lunate. Leaves 6 - 10(12) x 2 - 3 cm; stipules linear-lanceolate, to 4 mm long; leaflets 15 - 22 pairs, falcate, undulate at margin, cuspidate at apex, densely bulbous-based-hairy beneath, margin and midnerve above with a row of bulbous-based hairs, dirty green above, glaucous beneath; terminal pair of leaflets obovate, asymmetric; intramarginal nerve thick. Inflorescence a pseudoumbel, shorter than leaves, 10 - 12-flowered; peduncles 4 - 8 cm long; pedicels 1.5 - 2 mm long, shorter than bracts, glabrous; bracts closely whorled, linear-lanceolate, 4.5 - 5 mm long, strigose at margin, membranous. Sepals ovate to lanceolate, 4 - 4.5 x 1 - 1.5 mm, sparsely strigose, 5 - 7-nerved. Petals obovate, rounded at apex, 5.2 - 5.5 x 0.5 - 0.7 mm, to 5-nerved, yellow. Filaments 1 - 1.8 mm long, glabrous; anthers ca 0.4 mm long. Ovary 5-lobed, ca 0.8 x 0.4 mm, glabrous; ovules (2 -)4 in each locule; styles ca 2.5 mm long, puberulous; stigma discoid. Capsules turbinate, ca 2.5 x 2 mm; seeds (2 -)4 in each locule, broadly ovoid, acute, 0.6 - 0.8 x 0.6 - 0.7 mm, with undulate

oblique and muricate ridges, shining, reddish brown.

Fl. & Fr.: Not known.

Habitat: Sheltered places.

Distrib.: Idukki.

3. *Biophytum insigne* Gamble, Bull. Misc. Inform. 1921: 216. 1921; C.E.C. Fisch. in Gamble, Fl. Madras, Add.: 1868(1293). 1935; Vajr. in N.C. Nair & A.N. Henry, Fl. Tamil Nadu 1: 50. 1983; Sivad. & A.E.S. Khan in Rheedea 4: 66. 1994; Manna in Hajra & al., Fl. India 4: 232. 1997.

Perennial, erect, woody, branched at base; branches 4 - 8 cm high. Leaves tufted at ends of branches, paripinnate; rachises pulvinate, mucronate at tip, 7 - 15 cm long, tomentose; leaflets 5 - 9 pairs with the lowest pair about 1/3 above rachis base, opposite, subsessile, ovate-oblong, oblique at base, mucronate at apex, 1 - 2.5 x 0.6 - 0.75 cm, tomentose when young, glabrescent when mature except nerves beneath; stipules setaceous, ca 5 mm long, hairy. Inflorescence a pseudoumbel, 8 - 12-flowered; peduncles 12 - 18 cm long, strigose; bracts ovate-lanceolate, ca 3 mm long; pedicels to 6 mm long, strigose, not jointed. Flowers 5 - 10 mm across. Sepals ovate-lanceolate, acuminate, ca 4 mm long, strigose. Corolla campanulate; petals clawed, connate below, emarginate, ca 1.2 x 4 mm, 5-nerved. Stamens 10, 5 long and 5 short; long filaments 3 - 4 mm, short ones 2 - 2.5 mm. Pistil ca 1 mm long; stigmas 2-fid; ovules usually 2, rarely 1; seed usually 1, ca 1 x 0.7 mm, subspirally tubercled. Receptacle much elongating in fruit.

Fl. & Fr.: Jan. - June.

Habitat: Sholas.

Distrib.: Kollam, Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

4. *Biophytum intermedium* Wight, Ill. Ind. Bot. 1: 162. 1840; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 438. 1874, incl. var. *pubneyensis*; Gamble, Fl. Madras: 133(95). 1915; Manna in Hajra & al., Fl. India 4: 232. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 126. 2002

Perennial, somewhat woody at base, erect, 60 - 120 cm high; nodes hairy; hairs stiff, reflexed, arranged in a ring. Leaves 5 - 10 cm long; leaflets 15 - 25 pairs, the lowest pair the smallest, scarcely overlapping, oblong, somewhat falcate, truncate at base, very obliquely apiculate, glabrous; midnerve curved at apex;

lateral nerves fine, numerous, oblique, anastomosing. Peduncles slender, densely pubescent. Flowers 4 - 8 in an umbel, ca 12 mm across; pedicels 4 - 6 mm long, densely glandular-pubescent; bracts subulate. Sepals lanceolate, 3 - 4 mm long, glandular-pubescent, 5-nerved. Petals spatulate, 9 - 10 mm long. Filaments 1 - 3.5 mm long. Pistil 3 - 5 mm long; ovary deeply furrowed; styles glandular-pubescent; stigmas papillose. Capsules longer than sepals; seeds tubercled in transverse rows. *Fl. & Fr.*: Feb. - June.

Habitat: Higher altitudes, 1200 - 1600 m.

Distrib.: Idukki and Thiruvananthapuram. Tamil Nadu. Sri Lanka.

5. *Biophytum longipedunculatum* Govind. in J. Econ. Tax. Bot. 20: 312, f. 2. 1996; Manna in Hajra & al., Fl. India 4: 234. 1997.

Annual, to 40 cm high; stems unbranched, woody, densely retrorsely strigose above. Leaves obovate, 7.5 - 12 x 2 - 3 cm; stipules linear-lanceolate, to 3 mm long; rachises adaxially sulcate, strigose, barren below; leaflets 9 - 18 pairs, asymmetric, thick at margin, cuspidate at apex, densely appressed-strigose above, glabrous at margin and beneath; terminal leaflets obovate, oblique, (13 -)8 x (6 -)10 mm; lateral leaflets elliptic or oblong, oblique at base, slightly undulate, 15 - 20 x 7 - 8(- 10) mm. Peduncles 14 - 23 cm long, densely hairy; bracts ovate-lanceolate, 1 - 1.3 mm long, hairy at margin, 1-nerved. Flowers 6 - 8 in an umbel; pedicels 7 - 10 mm long, strigose. Sepals ovate-lanceolate, acuminate, 3 - 3.5 x 0.2 - 0.3 mm, usually 7-nerved, sparsely strigose on nerves. Petals obovate, rounded at apex, 3.5 - 4.5 x 0.5 - 0.6 mm, 4-nerved. Filaments ca 2.5 mm long. Ovary ellipsoid-ovoid, 5-lobed, 1 - 1.5 x 0.4 - 0.8 mm, pubescent; ovules 3 or 4 in each locule; styles ca 0.5 mm long; stigma discoid. Capsules obovoid, ca 3 x 2.8 mm, hairy; seeds bipyramidal, 4-gonous, acute at both ends, ca 1 x 0.8 mm, sparsely and unevenly tubercled, reddish brown, arillate.

Fl. & Fr.: Not known.

Habitat: Not known.

Distrib.: Thrissur.

6. *Biophytum nervifolium* Thwaites, Enum. Pl. Zeyl.: 64. 1858; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 76. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 95. 1994; Manna in Hajra & al., Fl. India 4: 234. 1997. *B. sensitivum* (L.) DC. var. *nervifolium* (Thwaites) Edgew. & Hook.f. in Hook.f., Fl. Brit.

India 1: 437. 1874.

Annual; stem very short, erect, unbranched. Leaves many, forming a crowded rosette, almost on ground; leaflets 8–12(–14) pairs, generally overlapping, terminal one the largest, broadly oblong, apiculate at apex, glabrous, paler beneath; lateral nerves very prominent. Peduncles stiff with appressed hairs. Flowers in dense umbels, crowded; pedicels shorter than sepals; bracts hairy. Sepals linear-lanceolate, rounded at base, acuminate at apex, 4.5–5 x 0.6–0.8 mm, hyaline at margin; nerves 7, prominent, parallel. Petals oblanceolate, attenuate at base, entire at margin, rounded at apex, 6–7 x 0.7–1 mm, with a distinct red midnerve. Ovary 2.5–3 mm long; styles hairy; stigma papillose. Capsules ovoid, 3–3.5 x 2.5–3 mm, shorter than sepals; seeds 0.9–1 x 0.6–0.8 mm, strongly and transversely 6-ribbed, not tubercled.

Fl. & Fr.: Dec.–March.

Habitat: Moist shady places, ca 200 m.

Distrib.: Kannur and Thiruvananthapuram. Andhra Pradesh and Tamil Nadu. Sri Lanka.

7. *Biophytum reinwardtii* (Zucc.) Klotzsch in Peters, *Naturw. Reise Mossambique* 6: 85. 1862; Edgew. & Hook.f. in Hook.f., *Fl. Brit. India* 1: 437. 1874; Dunn in Gamble, *Fl. Madras*: 133(95). 1915; Manilal & Sivar., *Fl. Calicut*: 55. 1982; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 76. 1988; Vajr., *Fl. Palghat*: 98. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 95. 1994, incl. var.; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 76. 1996; Manna in Hajra & al., *Fl. India* 4: 237. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 126. 2002. *Oxalis reinwardtii* Zucc. in *Abh. Math.-Phys. Cl. Königl. Bayer Akad. Wiss.* 1: 274. 1830.

Annual; stem to 30 cm high. Rachises 2.5–8(–12) cm long, sparsely puberulous; leaflets 6–14 pairs, sometimes overlapping; terminal pair the largest, asymmetric, obovate, 7–18 x 4–7 mm, with a curved eccentric midnerve; other pairs elliptic, symmetric, truncate at base, rounded-apiculate at apex, glabrous or slightly strigose at margin; main lateral nerves many, slender, oblique or straight. Peduncles 7(–12) cm long, to 8-flowered, appressed-strigose to glandular-hairy; pedicels 5–7 mm long; bracts ovate, 1–1.5 mm long. Sepals ovate-lanceolate, acute, 2.5–4 x 0.5–1 mm, 3–8-nerved in fruit, as long as fruit and half as long as corolla. Petals elliptic to oblanceolate, rounded to emarginate at apex,

6-8 x 1-2 mm, yellowish or orange-yellow with purple nerves. Filaments 1-1.5 and 2-3 mm long, longer ones sparsely ciliate. Ovary 0.5-1 mm long, glabrous; ovules 3 or 4 in each locule; styles 0.5-0.75 mm long; stigma flat, 2-fid. Capsules 2-3 x 2-2.5 mm, puberulous at apex; seeds ovoid, ca 1 x 0.5 mm, transversely and spirally ridged and tubercled.

Fl. & Fr.: Feb. - Dec.

Habitat: Moist shaded places, wastelands, coconut plantations, edges of cultivated fields, along paths etc., to 1500 m.

Distrib.: Almost throughout Kerala, Karnataka, Tamil Nadu and NE. India. South and SE. Asia.

8. *Biophytum sensitivum* (L.) DC., Prodr. 1: 690. 1824; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 436. 1874 p.p.; Gamble, Fl. Madras: 133(95). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 76. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 95. 1994; Manna in Hajra & al., Fl. India 4: 238. 1997. *Oxalis sensitiva* L., Sp. Pl.: 434. 1753.

Mal.: *Nilam thangi*

Annual, to 15 cm high, downy-pubescent. Leaves 1.5-8 cm long; petioles to 2 cm long; leaflets 7-15 pairs; terminal pair the largest, obovate, curved, ca 12 x 7 mm; upper ones oblong, ca 10 x 6 mm; basal ones ovate, obtuse at base, short-apiculate at apex, ca 7 x 4 mm; apical bristles to 1.5 mm long. Umbels 5-10, 7-10-flowered; peduncles 3-7(14) cm long, appressed-strigose and glandular-hairy; bracts ovate, setaceous; pedicels 2 mm or longer. Flowers 6-8 mm across, yellow with brick red tinge or red lines inside corolla. Sepals 5, lanceolate, to 5 mm long, glandular-pubescent, 5-nerved. Petals 5, oblong, to 8 mm long. Stamens 10, short ones to 1 mm long, long ones to 3 mm long; staminal tube to 1.5 mm long; filaments sparsely puberulous. Ovary to 1.5 mm long; style to 1.8 mm long, 2-fid, puberulous at base. Capsules glandular-pubescent along septa; seeds 2(4) in each locule, concentrically 9-ridged.

Fl. & Fr.: April - Nov.

Habitat: Moist shaded places in pasture lands, cultivated fields, wastelands etc., to 1000 m.

Distrib.: Almost throughout Kerala. Throughout India. Indomalaysia.

9. *Biophytum umbraculum* Welw., Apont.: 590. 1859; E.S.S. Kumar & al. in J. Econ. Tax. Bot. 24: 746, f. 1. 2000. *B. petersianum* Klotzsch in Peters, Naturw. Reise Mossambique 6: 81, t. 15. 1862; Veldkamp in Steenis, Fl. Males. I, 7(1): 161. 1971; Manna in Hajra & al., Fl. India 4: 235. 1997. *Oxalis apodiscias* Turcz. in Bull. Soc. Imp. Naturalistes Moscou 36: 599. 1862 (as *aposcias*). *Biophytum apodiscias* (Turcz.) Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 437. 1874; Gamble, Fl. Madras: 133(95). 1915.

Annual, unbranched, to 7 cm high. Leaves (3 -)4 - 7(- 9)-jugate; rachises 0.5 - 1.5 cm long, sparsely hirsute; leaflets often overlapping; terminal ones obovate, somewhat oblique, 3.5 - 6 x 3.5 - 5 mm, with an eccentric midnerve; other leaflets 3-angled to elliptic, obtuse-apiculate at apex, sparsely hairy at margin or not, with a more or less median midnerve. Peduncles to 3 cm long, appressed-strigose and glandular-hairy; pedicels 1 - 2.5 mm long, bristly. Sepals ovate-lanceolate, 3 - 4 x ca 0.5 mm, sparsely glandular-hairy, 7-nerved. Petals rounded-retuse at apex, 5 - 6 mm long, yellow below, with red nerves above. Filaments 1 - 2 mm long, pilose to subglabrous. Style 0.5 - 1.5 mm long; stigma flat, crenate. Fruits 3.5 - 4 mm long; seeds transversely tubercled.

Fl. & Fr.: Aug. - Nov.

Habitat: Shady and wet places.

Distrib.: Thiruvananthapuram. Assam, Karnataka, Meghalaya and W. Bengal. Tropical Africa, Madagascar, S. and SE. Asia.

10. *Biophytum veldkampii* A.E.S. Khan & al. in Rheedeia 8: 79, f. 1. 1998.

Annual; stem branched or not, to 15 cm high. Leaves 7 - 16-jugate; rachises 2.5 - 12 cm long, slightly winged, sparsely patently strigose. Leaflets often overlapping; terminal one obovate and falcate, oblique, longer than the preceding, 7.5 - 16 x 3.5 - 7 mm; midnerve eccentric; other leaflets oblong, truncate at base, apiculate at apex, ciliate at margin, sparsely hairy above on acroscopic half and midnerve; nerves few, oblique to midnerve, inconspicuous. Peduncles 6 - 9 cm long, appressed- to patently strigose; bracts ovate, mucronate, 2 - 3 mm long, strigose; pedicels 1.5 - 2.5 mm long, glabrous. Flowers heterotristylous. Sepals ovate-lanceolate, 4 - 4.5 x 0.75 - 1 mm, half as long as petals, 6 - 8-nerved in fruit, longer than pedicel and capsule, sparsely strigose near apex outside. Petals oblan-

ceolate, retuse at apex, 8-10 x 4-5 mm, with greenish claw and yellow limb. Filaments 1-4 mm long, puberulous. Ovary 0.5-1 x ca 0.3 mm, apically ciliate; ovules 2 in each locule, superposed; styles 0.25-2.75 mm long; stigma flat, crenate-bifid. Fruits 3-3.5 x 2-2.5 mm, apically ciliate on ribs; seeds ca 1.4 x 0.9 mm, transversely ridged, not tubercled.

Fl. & Fr.: Throughout the year.

Habitat: Deciduous forests, 50-200 m.

Distrib.: Thiruvananthapuram.

3. OXALIS L.

Annual or perennial, acidic herbs, rarely woody, branched or not, some stemless with rhizomes or bulbs. Leaves radical or cauline and alternate, digitately or pinnately 3 (or 4)-foliolate; leaflets usually sessile; stipules when present membranous and adnate to petiole base. Inflorescences axillary, cymose or pseudoumbelled, 1-many-flowered; bracteoles 2-many, sometimes with apical calli; pedicels jointed at base and sometimes at apex too. Flowers usually 3-morphic, heterostylous. Sepals 5, shortly connate at base, imbricate, with or without apical calli. Petals 5, hypogynous, contorted, connate above claw. Stamens 5+5, obdiplostemonous, outer ones short, opposite petals; inner ones long, opposite sepals; filaments often connate at base forming a short tube, free above; lower ones sometimes bearing a dorsal tooth on free part. Ovary 5-loculed; ovules 1-11 in 2 rows in each locule, on axile placentae; stigma cylindrical, minutely 2-lobed to peltate, sometimes papillose. Fruits loculicidal capsules dehiscing by longitudinal slits or sometimes with episeptal rimae bearing persistent valves; seeds 1-11 in each locule, usually few; aril fleshy, elastic and ejaculatory; testa smooth or with transverse ridges or longitudinal furrows.

Cosmopolitan, mostly in S. America and S. Africa, ca 500 species, 10 in India and 3 in Kerala with 2 naturalized.

Key to species

- 1a. Diffuse or erect herb with overground stems and without bulbs; leaves cauline; corolla yellow 1. *O. corniculata*
- b. Stemless erect herbs with bulbs or underground rhizomes; leaves radical; corolla pink or reddish purple 2

- 2a. Stolons absent; leaflets obcordate, orange-punctate; lobes rounded without calli at notches; pedicels pubescent; long filaments 4 - 4.5 mm **2. *O. corymbosa***
- b. Stolons present, apically bulbiferous; leaflets obdeltoid, not punctate; lobes acute with 2 calli at notches; pedicels glabrous; long filaments ca 3 mm **3. *O. dehradunensis***

1. *Oxalis corniculata* L., Sp. Pl.: 435. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 436. 1874; Gamble, Fl. Madras: 94(132). 1915; Manilal & Sivar., Fl. Calicut: 55. 1982; Manilal, Fl. Silent Valley: 38. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 77. 1988; Vajr., Fl. Palghat: 98. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 96. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 76. 1996; Sivar. & P. Mathew, Fl. Nilambur: 115. 1997; Manna in Hajra & al., Fl. India 4: 242. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 128. 2002.

Mal.: *Puliyaral*

Perennial, ascending or erect herb; stems several, erect or diffusely branching, rooting at nodes, puberulous to pubescent. Leaves scattered or in small tufts; stipules indistinct to small, to 3 x 1 mm; petioles 2 - 5(- 8) cm long above joint, puberulous; leaflets sessile, elliptic-obcordate, cuneate at base, emarginate at apex, 4 - 20 x 5 - 20 mm, lobed at apex for halfway, ecallose; lobes rounded, rarely obtuse, glabrous to sericeous above, pale glaucous to sparsely pubescent beneath. Inflorescences cymose to pseudoumbelled, 1 - 5(- 8)-flowered; peduncles 3 - 15 cm long, puberulous; bracts 2 - many, subopposite to whorled, linear to ovate-lanceolate, acute at apex, to 4 mm long; pedicels 8 - 18 mm long above basal joint to apical one, sharply bent or straight at joint in fruit. Flowers ca 8 mm across. Sepals ovate-lanceolate, obtuse, rarely obliquely retuse with pale narrow margin, 2 - 5 x 0.5 - 2 mm, sparsely puberulous to sericeous. Petals spatulate-oblong to oblanceolate, obtuse to emarginate, ca 6 x 3 mm, puberulous outside, yellow, 6-nerved. Staminal tube to 1.5 mm long; filaments 1 - 4 and 3 - 6 mm long including basal connate part, glabrous, short ones rarely with sterile anthers. Ovary ellipsoid to cylindrical, 1.5 - 2 x ca 1 mm, puberulous; ovules 5 - 20 in each locule in 1 row; styles of 2 lengths in different flowers, 1 - 3 and 3 - 4 mm long, ciliate. Capsules linear-cylindrical, sometimes ellipsoid, abruptly acuminate at apex, 5-gonous, 9 - 18 x 2 - 4 mm, minutely puberulous; seeds flat, ovoid or ellipsoid, ca 1 mm across.

Fl. & Fr.: Throughout the year.

Habitat: Common weed in shaded moist places, cultivated fields, wastelands, edges of paths, plantations etc., to 2000 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Cosmopolitan.

Use: Medicinally useful in fever, piles, stomachache and skin diseases.

Note: Reddy (*Indian J. Bot.* 13: 148-153, 1990) studied in detail the pattern of heterostyly and compatibility in this species.

2. *Oxalis corymbosa* DC., Prodr. 1: 696. 1824; Calder in Rec. Bot. Surv. India 6: 337. 1919; Manna in Hajra & al., Fl. India 4: 246. 1997. *O. martiana* Zucc. in Denkschr. Königl. Akad. Wiss. München 9: 144. 1824.

Stemless herb forming basal bulbs, without rhizomes or stolons; bulbs globose to conic, ca 1 cm across, scaly; bulbils many, clustered, globose to ovoid, acute. Leaves basal, erect; petioles 8-30 cm long above basal joint, patently villous; leaflets subequal, broadly obcordate, 2-lobed; lobes rounded, sometimes overlapping, subglabrous above, puberulous beneath, orange-punctate on both surfaces especially near margin. Inflorescences often forked twice, pseudoumbelled, 2-12-flowered; peduncles 10-35 cm long; bracts many, elliptic, rounded, pale with strigose margin and often with 1-3 orange calli in middle; pedicels 2-2.5 cm long above basal joint, pubescent. Sepals oblong-lanceolate, acute, minutely 2-fid at apex with 2 orange calli, 3.5-5 x 1-2 mm, puberulous, 3-5-nerved. Petals spatulate-oblong to lanceolate, obtuse to truncate, often oblique, light reddish purple with darker nerves. Filaments including basal connate portion 2-3 and 5-6 mm long in medium-styled flowers and 3.5-4 and 5-6 mm in short-styled ones; shorter filaments glabrous; longer ones strigose. Ovary ca 2 x 1 mm, densely ciliate to subglabrous; styles 1.8-2 mm long, ciliate-hairy; stigma 2-lobed, ca 1 mm across, papillose; ovules 3-8 in each locule in 1 or 2 rows. Fruit not seen.

Fl.: Sept. - March.

Habitat: Weed in tea plantations and edges of forests, 700-1200 m.

Distrib.: Idukki, Kottayam and Palakkad. Almost throughout India. Native to subtropical S. America, naturalized in many countries.

3. *Oxalis dehradunensis* Raizada, Suppl. Fl. Gangetic Plain: 37. 1976; Manna in Hajra & al., Fl. India 4: 246. 1997. *O. intermedia* A. Rich., Hist. Phys. Cuba, Pl. Vasc.: 315. 1841, non Steud. 1841. *O. richardiana* Babu, Herbac. Fl.

Dehra Dun: 104. 1977. *O. latifolia* sensu Calder in Rec. Bot. Surv. India 6: 335. 1919, non Kunth 1821.

Stemless herb forming bulbous bases without rootstock; bulbs ovoid, acute, to 5 x 2 cm, with numerous basal somewhat erect stolons bearing a few small scales ending in ovoid acute bulbils; petioles to 20 cm long above joint; leaflets subequal, obdeltoid, incised halfway, 1.5 - 7 x 2 - 8 cm, often with 2 orange calli in notch, epunctate, glabrous, subglaucous beneath. Inflorescences umbelled, 5-12-flowered; peduncles to 25 cm long; bracts 2, ovate, ca 0.5 mm long; pedicels filiform, to 2 cm long above basal joint. Sepals oblong-lanceolate, obtuse, 4 - 4.5 (6) x 1.5 - 2 (3) mm, indistinctly 3-5-nerved; apical calli 2, ca 1 mm long, orange. Petals narrowly obtriangled, obliquely truncate, 10 - 20 x 3 - 8 mm, pinkish or reddish purple with greenish base, crumpled soon after anthesis. Filaments including basal connate portion 2.5 - 3 or 4 - 5 mm long, puberulous. Ovary ca 1.5 mm long, less than 1 mm thick, sparsely ciliate on ribs; ovules 3 - 6 in 1 or 2 rows in each locule; style ca 1 mm long; stigma peltate. Fruit not seen.

Fl.: May - July.

Habitat: Weed in gardens, plantations, cultivated fields etc., 900 - 1500 m.

Distrib.: Idukki and Kottayam. Andhra Pradesh, Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Punjab, Tamil Nadu and Uttar Pradesh. Native to tropical America; elsewhere in the tropics introduced.

Uses: Sah & al. (*Geobios* 9: 87 - 89. 1990) reported that the plant is a rich source of ascorbic and oxalic acids. One kg of the plant yields 2 gm of ascorbic acid and 7 gm of oxalic acid.

Note: The plant is functionally heterostylous but only short-styled flowers were seen in the specimens studied.

RUTACEAE

(R.K. PREMANATH)

Trees or shrubs, sometimes lianoid, rarely herbs, often armed, abounding in pellucid glands filled with essential oil, aromatic. Leaves opposite, alternate or whorled, usually compound, pellucid gland-dotted, exstipulate; petioles often jointed, cylindrical, margined, sometimes winged. Inflorescences axillary or terminal, cymose or paniced, rarely racemose or of solitary flower. Flowers bracteoid, usu-

ally bisexual, actino-, rarely zygomorphic, often fragrant. Sepals 4 or 5, rarely 3, distinct at base, usually imbricate. Petals 4 or 5, rarely 3, imbricate or sometimes valvate, glandular or not, variously coloured. Stamens usually as many or twice as many as petals, sometimes more; filaments usually free, inserted around disc; anthers 2-loculed, often dorsifixed. Disc annular or cupular, crenate or lobed, sometimes elongate, nectariferous. Ovary of 4 or 5, rarely to 20 free or connate carpels; styles as many as carpels, free or, more or less connate; stigmas entire or lobed; ovules 1 or 2, rarely many in each locule, collateral or rarely 2-seriate. Fruits of various types, capsules, follicles, berries, drupes or hesperidia; seed usually 1; locules sometimes numerous; testa various; endosperm fleshy or absent; cotyledons large, straight or curved; radicle superior.

Cosmopolitan especially tropics, 156 genera and 1800 species, 27 and 76 in India and, 18 and 32 in Kerala.

Literature: Chakraborty, D.P. 1964. Family *Rutaceae* : a biochemical systematic viewpoint. *Bull. Bot. Soc. Bengal* 18: 103 - 118. Engler, H.G.A. 1931. *Rutaceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2, 19a: 187 - 358. Stone, B.C. 1985. *Rutaceae*. In: Dassanayake, M.D. (ed.), *Rev. Handb. Fl. Ceylon* 5: 406 - 476. Tanaka, T. 1936. The taxonomy and nomenclature of *Rutaceae* - *Aurantioideae*. *Blumea* 2: 101 - 110.

Key to genera

- | | | |
|-----|---|------------------------|
| 1a. | Carpels united only by styles above, free below; fruits splitting loculicidally | 2 |
| b. | Carpels completely or incompletely connate; fruits indehiscent (except <i>Chloroxylon</i>) | 3 |
| 2a. | Perennial herbs | 14. <i>Ruta</i> |
| b. | Trees, shrubs or climbers | 4 |
| 3a. | Fruits capsular, dehiscing loculi- or septicidally; seeds winged | 4. <i>Chloroxylon</i> |
| b. | Fruits drupaceous or baccate; seeds not winged | 5 |
| 4a. | Plants usually armed with recurved conic prickles; leaves alternate | 18. <i>Zanthoxylum</i> |
| b. | Plants unarmed; leaves opposite | 10. <i>Melicope</i> |
| 5a. | Carpels 2 - 5; fruits drupaceous; seeds endospermous | 6 |
| b. | Carpels 2 - 20; fruits baccate or hesperidia; seeds nonendospermous | 7 |
| 6a. | Leaves usually opposite; flowers polygamous | 1. <i>Acronychia</i> |
| b. | Leaves alternate; flowers unisexual | 8 |
| 7a. | Plants unarmed | 9 |
| b. | Plants armed | 10 |

- | | |
|---|-----------------------|
| 8a. Plants armed | 15. <i>Toddalia</i> |
| b. Plants unarmed | 17. <i>Vepris</i> |
| 9a. Buds densely reddish brown-hairy; styles short or not distinct | 7. <i>Glycosmis</i> |
| b. Buds glabrous or if pubescent hairs white or grey; styles distinct | 11 |
| 10a. Woody climbers with recurved spines | 12 |
| b. Trees or erect shrubs with straight spines | 13 |
| 11a. Filaments dilated at base; ovary borne on a gynophore | 6. <i>Clausena</i> |
| b. Filaments not as above; ovary not borne on a gynophore | 11. <i>Murraya</i> |
| 12a. Leaves 3-foliolate; petioles not twisted; inflorescences racemose or paniced | 9. <i>Luvunga</i> |
| b. Leaves 1-foliolate; petioles twisted; flowers usually solitary or, in 2- or 3-nate clusters | 13. <i>Paramignya</i> |
| 13a. Fruits with woody pericarp; seeds wooly-pubescent | 14 |
| b. Fruits with soft pericarp; seeds glabrous | 15 |
| 14a. Leaves imparipinnate; petioles and rachises margined or narrowly winged; filaments free, wooly-pubescent at base | 8. <i>Limonia</i> |
| b. Leaves 3-foliolate; petioles and rachises neither margined nor winged; filaments irregularly connate, glabrous at base | 2. <i>Aegle</i> |
| 15a. Fruits with soft pericarp; petioles not winged | 16 |
| b. Fruits with leathery pericarp; petioles winged | 17 |
| 16a. Petals glandular; anthers linear-oblong | 16. <i>Triphasia</i> |
| b. Petals eglandular; anthers ovoid | 3. <i>Atalantia</i> |
| 17a. Leaflets sessile; stamens 8 | 12. <i>Naringi</i> |
| b. Leaflets petioluled; stamens 20 - 60 | 5. <i>Citrus</i> |

1. *ACRONYCHIA* J.R. Forst. & G. Forst., nom. cons.

Trees or shrubs. Leaves opposite or alternate, 1- or rarely 3-foliolate; leaflets entire, pellucid-punctate. Inflorescences axillary or terminal cymes or corymbs. Flowers polygamous. Sepals free or basally connate; lobes 4, imbricate. Petals 4, valvate, spreading. Stamens 8, unequal, inserted under disc; filaments ciliate at base, adaxially pilose about middle, gland-dotted; anthers ovoid or ellipsoid. Disc annular, pulvinate, 8-angled, tomentose. Ovary 4-loculed with 2 superposed ovules in each; style terminal; stigma 4-grooved. Fruits 4-loculed drupes or 4-valved loculicidal capsules; seeds 1 or 2 in each locule, ellipsoid; testa black.

Indomalesia and the W. Pacific, 43 species and 1 in India.

Literature: Hartley, T.G. 1974. A revision of the genus *Acronychia* (Rutaceae). *J. Arnold Arbor.* 55: 469 - 567.

Acronychia pedunculata (L.) Miq., *Fl. Ned. Ind., Eerste Bijv.* 3: 532. 1861; Nicolson & al. in *Regnum Veg.* 119: 230. 1988; Manilal, *Fl. Silent Valley*: 42. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 81. 1988; Vajr., *Fl. Palghat*: 102. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 101. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 80. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 120. 1997; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 392. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 137. 2002. *Jambolifera pedunculata* L., *Sp. Pl.*: 349. 1753. *Acronychia laurifolia* Blume, *Catalogus*: 63. 1823; Hook.f., *Fl. Brit. India* 1: 498. 1875; Rama Rao, *Fl. Pl. Travancore*: 62. 1914; Gamble, *Fl. Madras*: 152(108). 1915.

Mal.: *Vidukaneli*

Tree or shrub, 5 - 10 m high; branchlets cylindric, woody, glabrous or silvery-pubescent; bark smooth, shining, pale. Leaves 1-foliolate, opposite, sometimes alternate, 7 - 20 cm long; petioles to 3 cm long, grooved, swollen at both ends, glabrous; leaflets elliptic-oblong, cuneate at base, entire at margin, obtusely acuminate at apex, 5.5 - 18.5 x 3.5 - 7 cm, coriaceous, glabrous; lateral nerves 12 - 16 pairs, slender. Inflorescences axillary divaricate corymbose cymes, 5 - 17.5 cm long; peduncles terete, glabrous or pubescent; bracts and bracteoles minute, lanceolate; pedicels to 10 mm long, glabrous. Flowers to 10 x 11.5 mm. Sepals 4, connate below, imbricate, ca 1 x 1.5 mm, yellowish. Petals 4, valvate, linear-oblong, concave, glabrous. Stamens 8, inserted at base of disc, inner ones rather shorter; filaments slightly dilated at base, to 8 mm long; anthers ovoid, ca 1 mm long, basifixed. Disc annular, 8-angled, to 2 mm long, pubescent. Ovary ca 3.5 x 1.5 mm, 4-lobed, 4-loculed with 2 ovules in each; style ca 2 mm long, filiform; stigma capitate, 4-lobed. Drupes ovoid, ca 1.3 cm across, green, 2 - 4-seeded; seeds ovoid, green.

Fl.: June - Sept. *Fr.*: Oct. - April

Habitat: Semievergreen forests, to 1500 m, common.

Distrib.: Almost throughout Kerala. Andaman & Nicobar Islands, Andhra Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Mizoram, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and W. Bengal. South and SE. Asia.

Uses: Bark and wood are used in the treatment of sores and ulcers. Leaf is fragrant and yields an aromatic essential oil. Fruit is edible.

2. AEGLE Corrêa, nom. cons.

Armed trees. Leaves alternate, 3-foliolate; leaflets subcrenulate, membranous, glabrous or pubescent. Flowers in axillary panicles, bisexual. Calyx 4- or 5-lobed, caducous. Petals 4 or 5, imbricate, oblong, spreading, white. Disc inconspicuous. Stamens numerous, inserted around disc; filaments subulate; anthers elongate, erect. Ovary ovoid, 8 - 20-loculed; ovules numerous in each locule, 2-seriate; style short; stigma oblong, fusiform, caducous. Berries ovoid or globose, woody, 8 - 15-loculed; seeds many, oblong, compressed.

Indomalesia, 3 species and 1 in India.

Aegle marmelos (L.) Corrêa in Trans. Linn. Soc. London 5: 223. 1800; Wight, Icon. Pl. Ind. Orient.: t. 16. 1838; Hook.f., Fl. Brit. India 1: 516. 1875; Bourd., Forest Trees Travancore: 72. 1908; Rama Rao, Fl. Pl. Travancore: 67. 1914; Gamble, Fl. Madras: 161(115). 1915; Manilal & Sivar., Fl. Calicut: 58. 1982; Nicolson & al. in Regnum Veg. 119: 231. 1988; Vajr., Fl. Palghat: 102. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 101. 1994; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 264. 1997. *Crataeva marmelos* L., Sp. Pl.: 444. 1753.

Mal.: *Kuvalam*

Tree, to 12 m tall, deciduous; branchlets cylindrical, sometimes slightly angled, glabrous; spines axillary, solitary or paired, straight, stout, sharp. Leaves alternate, 3-foliolate, sometimes 5-foliolate, dimorphic; petioles terete, to 6 cm long, glabrous or puberulous when young; leaflets subsessile, ovate-elliptic or elliptic-lanceolate, oblique at base, shallowly crenate-serrate at margin, tapering at apex, ca 6 x 4 cm, membranous, pellucid-punctate, pale green. Inflorescences axillary and terminal, racemose or corymbose, few-flowered, 4 - 5 cm long; peduncles densely puberulent; pedicels 2 - 4 mm long. Flowers bisexual, greenish white or yellow, fragrant. Calyx cupular, finely puberulent, caducous; lobes 4 or 5, 3-angled. Petals 5, ovate-oblong, subequal, ca 12 x 6 mm, spreading, glabrous, fleshy, white. Stamens numerous in 2 or 3 series, free or basally subconnate, unequal; filaments subulate, ca 7 mm long, glandular; anthers linear-oblong, ca 8 mm long. Disc

glabrous, greenish. Ovary ovoid, 4 - 5 mm long, faintly ridged, 10-loculed; ovules many, 2-seriate; style short; stigma oblong, longitudinally grooved. Berries ovoid, 6 - 10 cm across, woody, yellowish, many-seeded; seeds oblong, flat.

Fl.: April - May *Fr.*: Oct. - Nov.

Habitat: Moist deciduous forests, to 1000 m.

Distrib.: Idukki, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thiruvananthapuram. Western Himalayas at low elevations, C. and S. India. Myanmar. Elsewhere in tropics cultivated.

Uses: Often cultivated in temples for its leaf used in various rituals. Fruit is a good remedy for chronic diarrhoea and dysentery. Root and root bark are medicinal and used for curing intermittent fever. Leaf is used in the treatment of ophthalmia, inflammations, diabetes and asthmatic complaints.

3. ATALANTIA Corrêa, nom. cons.

Shrubs or small trees, armed or not. Leaves alternate, 1-foliolate; leaflets entire or crenulate, coriaceous, shining, prominently nerved; stipule-like scales often present; petioles horizontally grooved above, often jointed with leaflet blade. Inflorescences axillary or rarely terminal racemes, panicles or fascicles. Flowers fragrant. Sepals 3 - 5, free or adnate to stamens, imbricate. Petals 3 - 5, imbricate. Stamens 6 - 8, free or irregularly connate at base; filaments free or connate into a tube; anthers ovoid. Disc annular, sometimes lobed, fleshy. Ovary ovoid, 2 - 4 (rarely 3 - 5)-loculed with 1 or 2 ovules in each; style stout, jointed, caducous; stigma capitate, subglobose, lobed. Fruit a subglobose berry, 2 - 5-loculed; seeds 2 - 4, ovoid or oblong.

Tropics and E. Asia, 11 species, 4 in India and 3 in Kerala.

Key to species

- | | |
|---|-------------------------|
| 1a. Stamens free | 3. <i>A. wightii</i> |
| b. Stamens usually connate into a tube | 2 |
| 2a. Flowers in umbels or corymbs; calyx irregularly lobed | 1. <i>A. monophylla</i> |
| b. Flowers in racemes; calyx regularly lobed | 2. <i>A. racemosa</i> |

1. *Atalantia monophylla* (L.) Corrêa in Ann. Mus. Natl. Hist. Nat. 6: 383. 1805; Hook.f., Fl. Brit. India 1: 511. 1875; Bourd., Forest Trees Travancore:

68. 1908; Rama Rao, Fl. Pl. Travancore: 64. 1914; Gamble, Fl. Madras: 159(113). 1915; Manilal, Fl. Silent Valley: 42. 1988; Nicolson & al. in *Regnum Veg.* 119: 231. 1988; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 266. 1997. *Limonia monophylla* L., Mant. Pl.: 237. 1771. *Atalantia floribunda* Wight, Icon. Pl. Ind. Orient.: t. 1611. 1850.

Mal.: *Kattunaregam*

Shrub or medium-sized tree, 4 - 12 m high; branchlets velutinous-pubescent or densely hairy, glabrous soon; bark grey, lenticelled; spines axillary, stout. Leaves 1-foliolate; petioles to 1 cm long; leaflets ovate or elliptic, obtuse or subacute at base, entire or crenulate at margin, emarginate at apex, 2 - 12 x 2 - 6 cm, coriaceous, glabrous; lateral nerves 8 - 12 pairs, slender, spreading, finely reticulate. Inflorescences axillary umbels or corymbs, ca 10-flowered; peduncles slender, puberulous or glabrous; bracteoles ca 1.5 mm long, caducous; pedicels filiform, 7 - 14 mm long. Flowers to 2 cm across, fragrant. Calyx cupular, irregularly lobed; lobes obtuse, densely puberulent to glabrous, persistent. Petals 4, oblong-elliptic, to 7 mm long, sometimes adnate to staminal tube at base, glabrous, white. Stamens 8, unequal; filaments connate into a tube; anthers ovoid, yellowish. Disc annular, fleshy. Ovary oblong, ca 2.5 mm long, 2-loculed; ovule 1 in each locule; style short, jointed; stigma capitate. Berries globose, ca 2 cm, greenish yellow; seeds ovoid, ca 7.5 x 4 mm.

Fl.: Aug. - Feb. *Fr.*: Feb. - July.

Habitat: Scrub and deciduous forests.

Distrib.: Idukki, Palakkad and Pathanamthitta. Andaman Islands, C. and Peninsular India. South and SE. Asia.

Use: Fruit oil is considered a valuable application in chronic rheumatism and paralysis.

2. *Atalantia racemosa* Wight in J. Bot. (Hooker) 1: 64, t. 122. 1834; Hook.f., Fl. Brit. India 1: 512. 1875; Rama Rao, Fl. Pl. Travancore: 65. 1914; Gamble, Fl. Madras: 159(114). 1915; Manilal, Fl. Silent Valley: 43. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 102. 1994. *Sclerostylis atalantioides* sensu Wight, Icon. Pl. Ind. Orient.: t. 71. 1838, non Wight & Arn. 1834.

Shrub or medium-sized tree, 2 - 10 m high, armed; branchlets cylindrical, pubescent; spines axillary; bark lenticelled, brown. Leaves alternate, 1-foliolate;

petioles to 10 mm long, shallowly channelled above, puberulent to glabrous; leaflets ovate-oblong, cuneate at base, crenulate at margin, short-acuminate at apex, 5-9 x 2-4 cm, coriaceous; lateral nerves 8-22 pairs, finely reticulate. Inflorescences axillary racemes, to 5 cm long, pendulous; peduncles to 4 cm long; pedicels 4-8 mm long. Flowers ca 1.5 cm across. Calyx tubular, 4-lobed; lobes 3-angled, acute, ca 1.5 mm long, ciliate at margin, soft-tomentose. Petals 4, broadly elliptic or linear-oblong, 6-8 x 2-4 mm, reflexed, glandular, adnate to staminal tube at base, white. Stamens 8; filaments inserted on disc, connate into a tube; anthers ovoid, 1-2 mm long. Disc annular, ca 1.5 mm long, fleshy, glabrous. Ovary obovoid, to 2 mm long, 2-loculed; ovules 1 or 2 in each locule; style short, jointed; stigma capitate. Berries globose, to 2 cm, orange when ripe, 2-seeded.

Key to varieties

- | | | |
|-----|---|-------------------------------|
| 1a. | Lateral nerves in leaflets 8 - 12 pairs; ovary eglandular | 2.2. var. <i>racemosa</i> |
| b. | Lateral nerves in leaflets 12 - 22 pairs; ovary glandular | 2.1. var. <i>bourdillonii</i> |

2.1. var. *bourdillonii* K.N. Nair & M.P. Nayar in Indian J. Forest. 13: 69. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 80. 1996; Sivar. & P. Mathew, Fl. Nilambur: 120. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 271. 1997.

Fl.: Dec. - April *Fr.*: April - June.

Habitat: Evergreen forests, ca 950 m.

Distrib.: Kollam, Malappuram and Thrissur. Southern W. Ghats. Endemic.

2.2. var. *racemosa*

Fl. & Fr.: April - Oct.

Habitat: Semievergreen forests, to 1800 m.

Distrib.: Kollam, Palakkad, Pathanamthitta and Thiruvananthapuram. Western Ghats. Sri Lanka.

Editors' note: Nair and Nayar (1997: 269) gave the original citation as *A. racemosa* Wight in *Hooker's J. Bot. Kew Gard. Misc.* 1: 64, t. 122. Jan. 1834. It could only be *J. Bot. (Hooker)*, the first volume of which appeared in 1834 whereas that of the former appeared only in 1849 (*vide B-P-H* 1968: 420, 460). It is also sometimes cited as *A. racemosa* Wight & Arn., *Prodr.*: 91. 1834 following Hook.f., *Fl.*

Brit. India 1: 512. 1875 (*vide* K.M. Matthew & al. in K.M. Matthew, *Fl. Tamilnadu Carnatic* 3: 201. 1983).

3. *Atalantia wightii* Tanaka in Bull. Soc. Bot. France 75: 714. 1928; Manilal, *Fl. Silent Valley*: 43. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 81. 1988; Vajr., *Fl. Palghat*: 103. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 102. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 80. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 121. 1997; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 274. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 137. 2002. *A. ceylanica* Oliv. in J. Proc. Linn. Soc., Bot. 5(Suppl.) 2: 25. 1861 p.p., excl. basionym, quoad spec. Nilgiris; Hook.f., *Fl. Brit. India* 1: 512. 1875 p.p.; Bourd., *Forest Trees Travancore*: 69. 1908 (as *zeylanica*); Rama Rao, *Fl. Pl. Travancore*: 65. 1914; Gamble, *Fl. Madras*: 160(114). 1915.

Shrub or small tree, 5 - 10 m high; branchlets woody, cylindrical, puberulent to glabrous; spines axillary, sharp; bark lenticelled, greenish. Leaves 1-foliolate; petioles 6 - 8 mm long; leaflets ovate-oblong, cuneate at base, entire, rarely crenulate at margin, emarginate at apex, 5 - 15 x 2 - 6 cm, coriaceous, glabrous; lateral nerves 10 - 18 pairs, finely reticulate. Inflorescences axillary racemes, 1 - 2 cm long, glabrous; pedicels 4 - 7 mm long. Flowers ca 6.5 mm long, fragrant. Calyx deeply 4-lobed; lobes ovate, ca 1.5 mm long, ciliate at margin, glandular. Petals 4, oblong, acute below, ca 5.5 x 3.5 mm, glabrous, glandular, white, 3 - 5-nerved. Stamens 8, free, 3 - 5 mm long; filaments dilated below; anthers 1 - 1.5 mm long, yellowish. Disc minute, glabrous. Ovary ovoid, ca 2 x 1.5 mm, 2-loculed; ovules 2 in each locule; styles cylindrical, ca 2 mm long, glandular; stigma capitate, 2-lobed. Berries ellipsoid, ca 1.5 cm across, yellowish when ripe, 2 - 4-seeded; seeds oblong-ellipsoid.

Fl.: Jan. - May *Fr.*: March - June.

Habitat: Semievergreen and evergreen forests, to 950 m, fairly common.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats. Endemic.

4. CHLOROXYLON DC., nom. cons.

Deciduous trees. Leaves alternate, pinnate, petioled; leaflets numerous, oblique, entire, gland-dotted. Inflorescences terminal and axillary pubescent panicles. Calyx 5-lobed, caducous. Petals 5, clawed, spreading, imbricate. Stamens 10,

free, in depressions of disc. Disc 10-lobed, thick, pubescent. Ovary partly within disc, pubescent, 3-lobed, 3-loculed; ovules 8 in each locule; style short, slender, glabrous; stigma capitate. Capsules oblong, 3-loculed, loculicidal; seeds 4 in each locule, compressed, angled at margin, winged above, attached to edges of septa.

India and Sri Lanka, unispecific.

Chloroxylon swietenia DC., Prodr. 1: 625. 1824; Hiern in Hook.f., Fl. Brit. India 1: 569. 1875 (sub *Meliaceae*); Bourd., Forest Trees Travancore: 93. 1908; Gamble, Fl. Madras: 153(109). 1915; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 355. 1997. *Swietenia chloroxylon* Roxb., Pl. Coromandel 1: 46, t. 64. 1796.

Tree, 10 - 15 m high, most parts greyish-pubescent; bark fissured, grey. Leaves 25 - 30 cm long; petioles slender, to 4 cm long; leaflets 10 - 20 pairs, alternate, asymmetric, ovate-oblong, cuneate at base, entire at margin, obtuse at apex, ca 2.5 x 1.2 cm, chartaceous; lateral nerves 3 or 4 pairs. Inflorescences 12 - 15 cm long, grey-pubescent; pedicels ca 5 mm long, puberulent. Flowers ca 10 mm across. Sepals 5, minute. Petals 5, imbricate, 3 - 5 x 1.5 - 3 cm, clawed, ciliolate, creamy white. Stamens 10; filaments filiform, 1.5 - 2 mm long; anthers ellipsoid, ca 0.5 mm long, cream-coloured. Disc 10-lobed, puberulent. Ovary ca 2 mm across, 3-lobed; ovules 2 - 8 in each locule; style slender, glabrous; stigma capitate, 3-lobed. Fruits ovoid-oblong, ca 2.8 x 1.6 cm, smooth, 3-valved, 12-seeded; seeds compressed, ca 15 x 3 mm, brown.

Fl.: March - April *Fr.*: July - Oct.

Habitat: Dry deciduous forests at low elevations, rare.

Distrib.: Idukki and Kottayam. Andhra Pradesh, Karnataka, Madhya Pradesh, Orissa and Tamil Nadu. Sri Lanka.

Uses: Plant yields a yellow dye and an oil. Wood is used for furniture and tool handles.

5. CITRUS L.

Shrubs or trees, usually armed with axillary spines. Leaves alternate, 1-foliolate or simple, coriaceous; petioles usually winged; leaflets entire or crenulate. Inflorescences axillary, racemose or cymose or solitary. Flowers bi- or functionally unisexual, fragrant. Calyx cupular or urceolate, 3 - 5-lobed. Petals 4 - 8,

imbricate, fleshy, pinkish or reddish. Stamens 20 - 60, inserted around disc; filaments variously connate, compressed at base; anthers oblong. Disc large, annular. Ovary depressed-subglobose, 8 - 18-loculed; ovules 4 - 8 in each locule; styles stout, cylindric, caducous; stigma capitate or globose, glandular-sticky. Fruits many-seeded berries, oblong or globose, glandular, shining, yellowish or orange when mature; juice acidic, sour or sweet; seeds horizontal or pendulous, obovoid, angled.

South and SE. Asia, now under cultivation throughout tropics and subtropics, 16 species with innumerable cultivars and hybrids, 10 in India and 5 in Kerala.

Key to species

- | | | |
|-----|--|---------------------------|
| 1a. | Petioles not winged; fruits longer than broad | 5. <i>C. medica</i> |
| b. | Petioles margined or narrowly to broadly winged; fruits not as above | 2 |
| 2a. | Petioles narrowly margined or winged | 3. <i>C. limon</i> |
| b. | Petioles narrowly to broadly winged | 3 |
| 3a. | Fruits to 5 cm across, ovoid or subglobose, yellowish | 1. <i>C. aurantifolia</i> |
| b. | Fruits more than 6 cm across, variously shaped and coloured | 4 |
| 4a. | Petiolar wings oblong-spatulate or obovate; fruits 10 - 20 cm across, pale green to yellow | 4. <i>C. maxima</i> |
| b. | Petiolar wings oblong-obovate; fruits to ca 8 cm across, orange to reddish | 2. <i>C. aurantium</i> |

1. ***Citrus aurantifolia*** (Christm. & Panz.) Swingle in J. Wash. Acad. Sci. 3: 465. 1913; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 278. 1997. *Limonia aurantifolia* Christm. & Panz., Vollst. Pflanzensyst. 1: 618. 1777. *Citrus acida* Roxb., Fl. Ind. 3: 390. 1832; Rama Rao, Fl. Pl. Travancore: 66. 1914. *C. medica* L. var. *acida* (Roxb.) Hook.f., Fl. Brit. India 1: 515. 1875; Gamble, Fl. Madras: 162(115). 1915.

Mal.: *Erumichinarakam*

Shrub or bushy tree, to 3 m high; branchlets slender with sharp spines. Petioles narrowly winged; leaflets ovate-oblong, rounded at base, crenate at margin, acute at apex, 5 - 7 x 3 - 5 cm. Inflorescences lax axillary racemes, 2 - 7-flowered, rarely flower solitary. Flowers bisexual, 20 - 25 mm across, whitish. Calyx cupular, greenish white; lobes 4, deltoid, glandular. Petals 4, oblong, glandu-

lar, white. Stamens 20 - 28; filaments polyadelphous, white; anthers oblong, yellowish. Ovary globose-depressed, greenish; style cylindrical, white; stigma capitate. Fruits oblong, 4 - 6.5 x 3.5 - 5 cm, pitted, glandular, shining, green; seeds ovoid.

Fl.: June - July *Fr.*: July - Aug.

Perhaps native to Malesia; cultivated in India and other tropical countries.

Uses: This is the most valuable *Citrus* fruit. Lime juice is a valuable remedy in pulmonary diseases, hysterical palpitation of the heart, dysentery, ulceration and sponginess of the gum.

2. *Citrus aurantium* L., Sp. Pl.: 782. 1753; Hook.f., Fl. Brit. India 1: 515. 1875, excl. var. *bergamia* (Risso) Hook.f.; Rama Rao, Fl. Pl. Travancore: 66. 1914; Gamble, Fl. Madras: 162(115). 1915; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 279. 1997. *C. madraspatana* Hort ex Tanaka in J. Indian Bot. Soc. 16: 238. 1937.

Small tree, rarely a shrub; young shoots glabrous. Leaves 1-foliolate; petioles ca 2 cm long, often broadly winged; wings spatulate to oblong-obovate, ca 15 mm broad; leaflets elliptic or ovate, cuneate or rounded at base, undulate or slightly crenulate at margin, tapering and emarginate at apex. Inflorescences axillary, few-flowered. Flowers bisexual, white. Sepals 4 or 5, deltoid, acute, ciliate at margin. Petals oblong, attenuate above, coriaceous, glandular. Stamens 22 - 27; filaments white, poly- or, 1- or 2-adelphous, sometimes free; anthers oblong, 2.5 - 3 mm long, yellow. Ovary barrel-shaped; style cylindrical, white; stigma capitate. Fruits subglobose or oblate, pitted, orange to red; seeds numerous, ovoid, smooth.

Fl. & Fr.: Most part of the year.

Probably native to S. China and Indochina; cultivated in India.

Uses: Fruit has medicinal properties and much used in the preparation of confections, marmalades, liquor and soft drinks. Wood is hard and used in cabinet works.

3. *Citrus limon* (L.) Burm.f., Fl. Indica: 173. 1768; Manilal & Sivar., Fl. Calicut: 58. 1982; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 282. 1997. *C. medica* L. var. *limon* L., Sp. Pl.: 782. 1753. *C. aurantium* L. var. *limonum* Wight & Arn., Prodr. Fl. Ind. Orient.: 98. 1834. *C. medica* L. var. *limonum* (Wight & Arn.) Hook.f., Fl. Brit. India 1: 515. 1875; Gamble, Fl. Madras: 162(115). 1915.

Mal.: *Odichukuthinaregam*

Shrub or small tree, 2 - 3 m high, armed; branchlets glabrous. Leaves 1-foliolate, ovate, rounded at base, glandular-serrulate at margin, obtuse at apex, 6 - 10 x 2 - 4 cm, coriaceous, glabrous; petioles margined or narrowly winged. Inflorescences axillary racemes, 5 - 6-flowered. Flowers short-pedicelled, bisexual or male, purplish in bud. Sepals orbicular, minute. Petals ovate-oblong, 15 - 20 x 3 - 5 mm, white tinged purplish. Stamens 20 - 30; filaments connate at base, free above, glabrous; anthers oblong, 3.5 - 6 mm long, greenish yellow. Disc annular, fleshy, greenish white. Ovary cylindric, 4 - 6 x 2 - 4 mm, greenish; style ca 3.5 mm long, caducous; stigma globose. Fruits oblong, ca 6 cm across, yellowish when ripe; seeds ovoid, 5 - 6 mm.

Fl.: Dec. - April *Fr.*: April - May.

Native to SE. Asia; cultivated in India and other tropical countries.

Uses: Fruit is used to prepare lemonade, squash and sherbet. Lemon oil is used as an effective remedy in scurvy, rheumatism, dysentery and diarrhoea. Fruit is pickled and is also useful against constipation, cough, bronchitis and heartburn.

4. *Citrus maxima* (Burm.) Merr., *Interpr. Herb. Amboin.*: 46. 1917; Scora & Nicolson in *Taxon* 35: 592. 1986; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 283. 1997. *Aurantium maximum* Burm. in Rumph., *Herb. Amboin. Actuar.*: 16. 1775. *Citrus decumana* L., *Syst. Nat. ed. 12.*: 508. 1767, nom. illeg.; Hook.f., *Fl. Brit. India* 1: 516. 1875; Rama Rao, *Fl. Pl. Travancore*: 66. 1914.

Mal.: *Madhuramlaphala*

Medium-sized tree, 6 - 8 m high: young parts grey-pubescent; bark lenticelled. Leaves 1-foliolate, ovate, crenate at margin, acute at apex, 6 - 9 x 3 - 6.5 cm, soft-pubescent beneath when young, glabrate soon; petioles winged. Inflorescences axillary, pubescent. Flowers solitary or few, bisexual; pedicels 2 - 2.5 cm long, pubescent. Calyx cupular, ca 1 x 1.5 mm, irregularly lobed; lobes pubescent, greenish white. Petals oblong, concave, ca 24 x 12 mm, glabrous, yellowish. Stamens 25 - 30; filaments linear, white; anthers oblong, ca 1 mm long. Disc ca 6 mm across, greenish white. Ovary obovoid, 4.5 - 6.5 mm, glabrous, 10-loculed; ovules many in each locule; style cylindric, ca 1 cm long; stigma glandular-sticky. Fruits pyriform, to 20 cm across, glandular, smooth, pale green to yellow; seeds wrinkled.

Fl. & Fr.: Most part of the year.

Probably native to SE. Asia; cultivated in India and other tropical countries.

Uses: Fruit is nutritive and refrigerant. Leaf is medicinal and used in epilepsy and convulsive cough.

5. *Citrus medica* L., Sp. Pl.: 782. 1753; Hook.f., Fl. Brit. India 1: 514. 1875; Bourd., Forest Trees Travancore: 70. 1908; Rama Rao, Fl. Pl. Travancore: 65. 1914; Gamble, Fl. Madras: 161(115). 1915; Manilal, Fl. Silent Valley: 58. 1988; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 284. 1997.

Mal.: *Curry narenga, Gilam, Rusakam*

Shrub or small tree, to 3 m high; branchlets angled, glabrous; spines axillary, stout, sharp, ca 3.5 cm long. Leaves simple, variable, obtuse at base, crenate at margin, acute at apex, 10 - 18 x 3 - 9 cm, glabrous; petioles 8 - 10 mm long, not winged or jointed above. Inflorescences axillary racemes, few-flowered. Flowers bisexual and male. Calyx urceolate, 4-lobed; lobes ca 3.5 mm long. Petals 4, oblong, 2 - 4 x ca 1 cm, purplish. Stamens 35 - 40; filaments polyadelphous, short-pubescent, white; anthers linear, 4.5 - 5 mm long, yellowish. Ovary cylindrical, ca 8 x 4 mm, 12-loculed; style cylindrical, 10 - 15 mm long, purplish; stigma globose, sticky. Fruits ovoid-oblong, 10 - 20 x 6 - 14 cm, yellowish; seeds numerous, ca 10 x 5 mm, smooth.

Fl.: Sept. - Dec. *Fr.*: Nov. - March.

Probably native to the Himalayas and the Khasi hills; often cultivated.

Uses: Wood is used for walking sticks. Fruit is an antidote for poison. Root is useful against constipation, colic etc. Ripe fruit is useful in cough, asthma, dysentery etc. Seed is useful in inflammations and skin diseases.

6. *CLAUSENA* Burm.f.

Shrubs or small trees, unarmed. Leaves alternate, imparipinnate; rachises terete; leaflets 5 - 11, alternate, oblique, usually crenate, gland-dotted. Inflorescences terminal or axillary, paniced or racemose. Flowers fragrant. Calyx cupular, 4- or 5-lobed. Petals 4 or 5, free, imbricate, membranous, glandular, creamy white. Stamens 8 - 10, subequal, inserted around disc; filaments dilated below tip, glabrous; anthers rather large, oblong, usually glandular. Disc elongate. Ovary entire or lobed, 2 - 5-loculed; ovules usually 2 in each locule, collateral; style cylin

dric, caducous; stigma obtuse, entire or lobed. Fruit an oblong or globose berry, yellow or reddish when ripe, 2–5-loculed, often 1-seeded; pericarp glandular; testa membranous; cotyledons equal; embryo minute.

Old World tropics, 23 species, 7 in India and 3 in Kerala.

Key to species

- 1a. Inflorescences axillary; flowers 4-merous; ovary with obscure glands 1. *C. anisata*
- b. Inflorescences terminal; flowers usually 5-merous; ovary with conspicuous glandular papillae 2
- 2a. Leaflets rhomboid-oblique, black when dry; ovary 3-loculed 3. *C. indica*
- b. Leaflets lanceolate to ovate, yellowish green when dry; ovary 4 (rarely 5)-loculed 2. *C. austroindica*

1. *Clausena anisata* (Willd.) Hook.f. ex Benth. in Hook., Niger Fl.: 256. 1849, var. *anisata*: K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 322. 1997. *Amyris anisata* Willd., Sp. Pl. 4: 337. 1799. *A. dentata* Willd., Sp. Pl. 4: 337. 1799. *Clausena willdenowii* Wight & Arn., Prodr. Fl. Ind. Orient.: 96. 1834, nom. illeg.; Wight, Icon. Pl. Ind. Orient.: t. 14. 1838; Rama Rao, Fl. Pl. Travancore: 64. 1914; Gamble, Fl. Madras: 155(110). 1915. *C. pubescens* Wight & Arn., Prodr. Fl. Ind. Orient.: 96. 1834. *C. dentata* (Willd.) M. Roem., Fam. Nat. Syn. Monogr. 1: 44. 1846; Manilal, Fl. Silent Valley: 43. 1988; N. Mohanan & Sivad., Fl. Agasthyamala: 139. 2002. *C. willdenowii* Wight & Arn. var. *pubescens* (Wight & Arn.) Hook.f., Fl. Brit. India 1: 506. 1875. *C. dentata* (Willd.) M. Roem. var. *pubescens* (Wight & Arn.) Tanaka in J. Bot. 68: 277. 1930; B.C. Stone in Dassan., Rev. Handb. Fl. Ceylon 5: 436. 1985; Sasidh. & Sivar., Fl. Pl. Thrissur: 81. 1996.

Mal.: *Kattukariveppila*

Shrub or small tree, to 5 m high; branchlets cylindrical, grey-tomentose. Leaves alternate, imparipinnate, ca 15 x 8 cm; leaflets 7–13, alternate, ovate, oblique at base, crenulate at margin, caudate or acuminate at apex, 5–10 x 1.5–3 cm, chartaceous, glabrous; lateral nerves 6–10 pairs, finely reticulate. Inflorescences slender axillary racemes; peduncles to 2.5 cm; buds globose. Flowers bisexual. Calyx 4-lobed; lobes ovate or suborbicular, 0.5–1 mm long, ciliolate or glabrescent, glandular. Petals 4, oblong, 2.5–6 x 1.5–3 mm, membranous, white.

prominently nerved. Stamens 8, inserted on disc; filaments linear, 1.5 - 4 mm long, unequal, glabrous; anthers ellipsoid, 1 - 2 mm long. Ovary oblong or ovoid, 4-loculed; ovule 1 in each locule; style thick, jointed; stigma obtuse, 4-lobed. Berries ovoid or oblong, 8 - 15 mm across, gland-dotted, red; seeds ovoid, compressed.

Fl.: Feb. - April *Fr.*: May - Sept.

Habitat: Moist deciduous and semievergreen forests, to 1700 m.

Distrib.: Kollam, Kottayam, Palakkad, Thiruvananthapuram and Thrissur. Andhra Pradesh, Karnataka, Sikkim, Tamil Nadu and W. Bengal. Africa, China, Nepal and Sri Lanka.

Uses: Leaf yields an aromatic essential oil. Fruit is edible.

2. *Clausena austroindica* B.C. Stone & K.N. Nair in Nord. J. Bot. 14: 491. 1994; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 322. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 138. 2002. *Clausena heptaphylla* auct. non (Roxb.) Wight & Arn. 1834; Gamble, Fl. Madras: 155(110). 1915; Manilal, Fl. Silent Valley: 44. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 82. 1988; Vajr., Fl. Palghat: 103. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 102. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 81. 1996; Sivar. & P. Mathew, Fl. Nilambur: 121. 1997.

Shrub or small tree, 8 - 10 m high; branchlets cylindrical, puberulous or glabrous; bark lenticelled, greenish. Leaves 30 - 40 cm long, narrowly winged; leaflets usually 5 - 9, subopposite to alternate, lanceolate-ovate, 5 - 16 x 3 - 6 cm; lateral ones slightly asymmetric, obovate, cuneate at base, subentire to undulate at margin, acuminate at apex, gland-dotted; lateral nerves 6 - 12 pairs; reticulations prominent. Inflorescences terminal or in the uppermost axils, paniced, 15 - 20 cm long. Flowers subglobose, ca 6 mm long in bud; pedicels 2 - 5 mm long, glabrescent. Calyx glabrous, 5-lobed; lobes deltoid, ca 0.5 mm long with a conspicuous gland at tip. Petals 5, elliptic, obtuse, with obscure glands, white. Stamens 10, unequal; filaments slightly swollen in middle; anthers oblong or rhomboid, ca 1.5 mm long. Ovary 4-grooved, ca 1 x 1.5 mm, glandular, 4-loculed; ovules 2 in each locule, collateral; style short, glabrous, caducous; stigma truncate. Berries globose, oblate, ca 10 mm, glandular, greenish.

Fl.: Feb. - May *Fr.*: April - Nov.

Habitat: Semievergreen forests, to 920 m, fairly common.

Distrib.: Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Andhra Pradesh, Karnataka and Tamil Nadu. Endemic.

3. *Clausena indica* (Dalzell) Oliv. in J. Proc. Linn. Soc., Bot. 5: 36. 1861; Hook.f., Fl. Brit. India 1: 505. 1875; Rama Rao, Fl. Pl. Travancore: 64. 1914; Gamble, Fl. Madras: 155(110). 1915; Manilal, Fl. Silent Valley: 44. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 81. 1988; Vajr., Fl. Palghat: 103. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 81. 1996; Sivar. & P. Mathew, Fl. Nilambur: 122. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 328. 1997. *Piptostylis indica* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 33, t. 2. 1851.

Shrub or small tree, to 12 m tall; young parts pubescent. Leaves imparipinnate, 15 - 30 cm long; rachises and petiolules puberulous or glabrous; leaflets 7 - 13, alternate, short-petiololed, elliptic to elliptic-oblong, oblique at base, crenulate with pubescent glands at margin, obtuse at apex, 4 - 7 x 2.5 - 3.5 cm, membranous, glabrous, glandular on both surfaces, shining; lateral nerves 6 - 8 pairs; reticulations obscure. Inflorescences terminal paniced cymes, to 10 cm long; peduncles densely puberulous. Flowers lax, short-pedicelled. Calyx 5-lobed; lobes ca 0.5 mm long, ciliate. Petals ovate-oblong, ca 3.5 x 1.2 mm, glabrous, white. Stamens 10; filaments slightly swollen in middle, ca 2 mm long; anthers ellipsoid, ca 1 mm long. Ovary subglobose, ca 1.5 mm long, gland-dotted, glabrous, 3-loculed; ovules 2 in each locule, pendulous; style cylindric, ca 0.5 mm long, caducous; stigma capitate. Berries globose, ca 1.5 cm, smooth, gland-dotted, cream-coloured, 1-seeded; seed green.

Fl.: Dec. - May *Fr.*: April - Aug.

Habitat: Evergreen forests, to 1300 m, occasional.

Distrib.: Idukki, Kannur, Malappuram, Palakkad and Thrissur. Western Ghats. Sri Lanka.

Uses: Fruit is edible. Leaf is used for culinary purposes. Wood is close-grained and used in turnery.

Excluded species

The distribution of *Clausena excavata* Burm.f. (*Fl. Indica*: 87, t. 29, f. 2. 1768) in S. India was reported by Sundararaj and Nagarajan (*J. Bombay Nat.*

Hist. Soc. 66: 657-659. 1970) based on an imperfect specimen, *V. Narayanaswami s.n.* (MH), from Arambha, Travancore. This, in fact, represents *C. anisata*.

7. GLYCOSMIS Corrêa, nom. cons.

Shrubs or small trees, unarmed; branches densely ferruginous-tomentose when young, glabrescent soon. Leaves alternate, rarely opposite, 1-foliolate or imparipinnate; leaflets alternate or opposite, entire or crenate; petiolules often jointed at base. Inflorescences axillary or terminal panicles. Flowers bisexual, fragrant or not. Sepals 4 or 5, distinct or connate at base, imbricate. Petals 4 or 5, imbricate, often glandular, greenish to creamy white. Stamens 8-10, free, unequal, inserted around disc; filaments linear, flat, glabrous, rarely pubescent; anthers ovoid, glandular. Disc minute, annular, fleshy. Ovary ovoid-cylindric, glabrous or rusty-puberulent, seated on disc, 2-5-loculed; ovules 1 or 2 in each locule; style short, cylindric, glabrous or rusty-puberulent; stigma subcapitate. Fruit a dry or pulpy berry, subglobose, creamy white or purplish black when ripe, 1-3-seeded; seeds globose, usually depressed, greenish.

Indomalesia, 43 species, 7 in India and 4 in Kerala.

Literature: Brizicky, G.K. 1962. Taxonomic and nomenclatural notes on *Xanthoxylum* and *Glycosmis* (Rutaceae). *J. Arnold Arbor.* 43: 80-93. Mitra, R.L. & Subramanyam, K. 1969. *Glycosmis pentaphylla* (Rutaceae) and related Indian taxa. *J. Arnold Arbor.* 50: 153-157. Narayanaswami, V. 1941. A revision of the Indo-Malayan species of *Glycosmis*. *Rec. Bot. Surv. India* 14: 1-72.

Key to species

- | | | |
|-----|---|---------------------------|
| 1a. | Ovary glabrous | 2 |
| b. | Ovary rusty-puberulent above | 3. <i>G. mauritiana</i> |
| 2a. | Ovary 3-loculed | 1. <i>G. angustifolia</i> |
| b. | Ovary 5-loculed | 3 |
| 3a. | Inflorescences usually from uppermost leaf axils, paniced cymes | 2. <i>G. macrocarpa</i> |
| b. | Inflorescences axillary and terminal panicles | 4. <i>G. pentaphylla</i> |

1. ***Glycosmis angustifolia*** Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 93. 1834, quoad Wall., Numer. List No. 6378-H B. Heyne, excl. spec. Wight

315; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 333. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 140. 2002. *G. pentaphylla* var. 2. subvar. *angustifolia* Hook.f., Fl. Brit. India 1: 500. 1875. *G. triphylla* Wight var. *angustifolia* (Wall. ex Wight & Arn.) Kurz in J. Bot. 14: 37. 1876.

Shrub, to 3 m high; branchlets cylindrical, ferruginous-tomentose when young, glabrate soon; bark shining, smooth or fissured, brownish on drying. Leaves pinnate, to 10 cm long; leaflets 3 - 5, alternate or subopposite, short-petioluled, oblanceolate or elliptic-lanceolate, cuneate at base, entire at margin, obtusely acute or acuminate at apex, 5.5 - 7 x 1.5 - 2 cm, coriaceous, glabrous; lateral nerves 7 - 9 pairs, slender, faint above, prominent beneath, finely reticulate. Inflorescences axillary short condensed paniced cymes, to 1.5 cm long, puberulous to ferruginous-pubescent; pedicels ca 0.5 mm long, glabrous or nearly so. Sepals 5, ovate, acute, ca 1 mm long, puberulent, ciliolate at margin. Petals 5, oblong, obtusely acuminate, ca 4.5 x 1.5 mm, glandular, glabrous. Stamens 10; filaments, strap-shaped, ca 3.5 mm long, flat below, with a central ridge near apex on inner surface, glabrous; anthers ellipsoid, apiculate, ca 0.5 mm long. Ovary ovoid-cylindrical, glabrous, 3-loculed; ovule 1 in each locule; style indistinct; stigma obtuse. Berries globose or subglobose, ca 10 mm across, cream-coloured, becoming pink when ripe, usually 1-seeded; rind glandular.

Fl.: May - Sept. *Fr.*: March - April.

Habitat: Semievergreen forests, to 800 m.

Distrib.: Thiruvananthapuram. Western Ghats of Tamil Nadu. Sri Lanka.

2. ***Glycosmis macrocarpa*** Wight, Ill. Ind. Bot. 1: 109. 1840; Subr. & A.N. Henry in Bull. Bot. Surv. India 12: 3. 1970; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 83. 1988; Ahmedul. & K.N. Nair in M.P. Nayar & Sastry, Red Data Book Indian Pl. 3: 239. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 82. 1996; Sivar. & P. Mathew, Fl. Nilambur: 123. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 338. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 142. 2002. *G. pentaphylla* var. *macrocarpa* (Wight) Hook.f., Fl. Brit. India 1: 500. 1875.

Shrub or small tree, 2 - 3 m high. Leaves pinnate, 13 - 26.5 cm long; rachises and petiolules glabrous or ferruginous-puberulous when young; leaflets 3 or 5, alternate, oblong-elliptic, cuneate at base, entire or nearly so at margin, acuminate at apex, 7.5 - 15 x 3 - 7 cm, coriaceous, glabrous; petiolules 5 - 10 mm

long; lateral nerves 5 - 7 pairs. Inflorescences terminal paniced cymes, to 3 cm long, grey-pubescent. Sepals 5, deltoid, less than 1 mm long, puberulous. Petals 5, oblong-elliptic, ca 2.5 x 1.5 mm, white. Stamens 10; filaments linear, flat, slightly ridged, to 2 mm long, glabrous; anthers oblong, less than 1 mm long. Disc lobuled, ca 0.5 mm long, glabrous. Ovary ovoid-cylindric, ca 1 mm long, glandular, glabrous, 5-loculed; ovule 1 in each locule; style indistinct; stigma small, depressed. Berries globose-depressed, ca 2 x 1.5 cm.

Fl.: Dec. May *Fr.*: Feb. June.

Habitat: Evergreen forests, 550 - 1800 m, occasional.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Southern W. Ghats. Endemic.

3. *Glycosmis mauritiana* (Lam.) Tanaka in Bot. Not. 1928: 159. 1928; Manilal, Fl. Silent Valley: 45. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 84. 1988; Vajr., Fl. Palghat: 104. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 103. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 143. 2002,

var. ***angustifolia*** Tanaka in J. Bot. 68: 226. 1930; B.C. Stone in Proc. Acad. Nat. Sci. Philadelphia 137: 14. 1985; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 341. 1997. *G. angustifolia* Wight & Arn., Prodr. Fl. Ind. Orient.: 93. 1834 p.p. *G. pentaphylla* sensu Hook.f., Fl. Brit. India 1: 499. 1875 p.p., non (Retz.) DC. 1824. *G. cochinchinensis* sensu Gamble, Fl. Madras: 153(109). 1915 p.p., non (Lour.) Pierre ex Engl. 1896.

Tree, to 10 m tall; branchlets cylindrical, glabrous or rusty-pubescent. Leaves imparipinnate, 3 - 5-foliolate, 6.5 - 15 cm long; petiolules slender, ca 2.5 cm long, glabrescent; leaflets alternate, narrow, linear-lanceolate, tapering at both ends, entire, ca 10 x 2 cm, coriaceous, glabrous; lateral nerves 6 - 16 pairs. Inflorescences axillary panicles, ca 8 cm long; peduncles greyish-puberulous; bracteoles deltoid, minute. Flowers ca 0.5 mm long; pedicels ca 1 mm long. Sepals 5, ca 0.5 mm long, ciliolate at margin. Petals elliptic-oblong, 2.5 - 4.5 x 1 - 2 mm, glandular, greenish white. Stamens 8; filaments subulate, 3 - 4 mm long; anthers ovoid, ca 1 mm long. Disc small, lobed. Ovary cylindrical, ca 2 mm long, pitted, rusty-puberulent, 5-loculed; ovule 1 in each locule; style absent; stigma truncate, persistent in fruit. Berries subglobose, 5 - 15 mm across, glandular, pinkish, 1-seeded.

Fl.: Sept. Feb. *Fr.*: March onwards.

Habitat: Evergreen forests, 300 - 660 m.

Distrib.: Kannur, Kollam, Palakkad, Pathanamthitta and Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic and rare.

4. *Glycosmis pentaphylla* (Retz.) DC., Prodr. 1: 538. 1824; Hook.f., Fl. Brit. India 1: 499. 1875 p.p.; Bourd., Forest Trees Travancore: 65. 1908; Rama Rao, Fl. Pl. Travancore: 65. 1914; Nicolson & al. in Regnum Veg. 119: 232. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 104. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 82. 1996; Sivar. & P. Mathew, Fl. Nilambur: 120. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 343. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 144. 2002. *Limonia pentaphylla* Retz., Obs. Bot. 5: 24. 1788. *L. arborea* Roxb., Pl. Coromandel 1: 60, t. 85. 1798. *Glycosmis arborea* (Roxb.) DC., Prodr. 1: 538. 1824; Manilal & Sivar., Fl. Calicut: 60. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 83. 1988; Vajr., Fl. Palghat: 104. 1990. *G. cochinchinensis* sensu Gamble, Fl. Madras: 153(109). 1915 p.p., non Pierre ex Engl. 1896.

Mal.: *Panchi, Panel*

Shrub or small tree, 3 - 4 m high; branchlets cylindrical, puberulous when young; bark lenticelled, greenish. Leaves pinnate; rachises angled or cylindrical, glabrous; leaflets 3 - 5, opposite, elliptic-oblong, cuneate or obtuse at base, finely serrate, rarely entire at margin, acute, obtuse, rounded or acuminate at apex, 8 - 20 x 3 - 6 cm, coriaceous, glabrous; lateral nerves 10 - 18 pairs, finely reticulate. Inflorescences axillary and terminal panicles; peduncles to 15 cm long, branches greyish- or rusty-puberulent; bracteoles 2, ovate, ciliolate at margin. Sepals 5, imbricate, deltoid, ca 1 mm long. Petals 5, imbricate, elliptic-obovate, 2.5 - 4.5 x 2 - 3 mm, glandular, glabrous, creamy white. Stamens 10, ca 3.5 mm long; filaments tapering above, glabrous; anthers oblong, ca 1 mm long, gland-tipped. Disc annular, ca 0.5 mm long, lobed, fleshy, white. Ovary ovoid, 1.5 - 2.5 mm long, glabrous, 5-loculed; ovule 1 in each locule; style indistinct; stigma truncate, obscurely lobed. Berries subglobose, 6 - 8 mm across, white turning dull pink, 1 - many-seeded; seeds planoconvex, green.

Fl. & Fr.: Almost throughout the year.

Habitat: Semievergreen forests, to 950 m, fairly common.

Distrib.: Throughout Kerala. Throughout India. Bangladesh, China, Myanmar,

Nepal, Philippines, Sri Lanka and Thailand.

Uses: Pounded root mixed with sugar is used in the treatment of fever. Ripe fruit is edible.

Excluded species

Glycosmis cymosa (Kurz) V. Naray. in *Rec. Bot. Surv. India* 14: 26, f. 8. 1941 (= *G. cyanocarpa* (Blume) Spreng. var. *cymosa* Kurz in *J. Bot.* 14: 34. 1876) was included by Mohanan and Henry (*l.c.*). It is not distributed in S. India (*vide* Nair & Nayar, *l.c.*).

8. LIMONIA L.

Shrubs or small trees, often armed; branchlets densely tomentose; spines axillary, straight. Leaves alternate, 3-foliolate or imparipinnate; rachises and petiolules winged; leaflets usually opposite. Flowers in fascicles, racemes or panicles. Calyx 4- or 5-lobed or -partite. Petals 4 or 5, imbricate. Stamens 8–10, free, subequal, inserted around disc; filaments subulate; anthers cordate or linear-oblong. Disc minute. Ovary oblong, 4- or 5-loculed; ovules 1 or 2 in each locule; style short, jointed; stigma obtuse or capitate. Berries globose, 1–4-loculed, 1–4-seeded; seeds ovoid or flat, embedded in mucilage.

India to Indonesia, unispecific.

Limonia acidissima L., *Sp. Pl.* ed. 2, : 554. 1762; Airy Shaw in *Bull. Misc. Inform.* 1939: 293. 1939; B.C. Stone & Nicolson in *Taxon* 27: 551. 1978; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 294. 1997. *Feronia elephantum* Corrêa in *Trans. Linn. Soc. London* 5: 225. 1800; Hook.f., *Fl. Brit. India* 1: 516. 1875; Bourd., *Forest Trees Travancore*: 71. 1908; Rama Rao, *Fl. Pl. Travancore*: 66. 1914; Gamble, *Fl. Madras*: 160(114). 1915.

Mal.: *Vila*, *Vlatti*

Tree, 3–8 m high, armed; branchlets glabrous; spines axillary, ca 3.5 cm long, sharp; bark greyish. Leaves alternate, 5–10 cm long; rachises narrowly winged; leaflets 5, obovate, cuneate at base, entire or crenulate at margin, obtuse and emarginate at apex, ca 3 x 2 cm, gland-dotted, glabrous; lateral nerves 2–4 pairs, finely reticulate beneath. Inflorescences axillary and terminal panicles, many-flowered, 4–5 cm long; pedicels ca 3–5 mm long, glabrescent. Flowers

bisexual, pale yellowish. Calyx 5-toothed; teeth small, ciliate near tip, caducous. Petals 4 or 5, oblong, ca 6.5 x 3 mm, glandular, glabrous, white or pale yellowish. Stamens 8 - 10, free, inserted around disc; filaments subequal, to 3.5 mm long, pubescent on inner face, glabrous above; anthers linear-oblong, ca 4 mm long. Disc minute. Ovary oblong-obovoid, to 2 mm long, 4-loculed; ovules many in each locule, many-seriate; style to 2 mm long, thick, fleshy; stigma capitate. Berries globose, 5 - 7 cm, woody; seeds ovoid, ca 5 x 3 mm.

Fl.: Feb. - April *Fr.*: Aug. - Dec.

Habitat: Dry and moist deciduous forests at lower elevations.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*) and Kottayam. Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh and W. Bengal. Myanmar, Sri Lanka, Thailand and Vietnam. Cultivated in many other countries.

Uses: Fruit pulp is edible and consumed in the form of sherbet. Leaf yields an essential oil. It is useful in diarrhoea, vomiting, bronchitis, cough and cardiac debility. Ripe fruit is useful in diarrhoea, dysentery and vomiting. Wood is hard and used for house-building and agricultural implements.

9. LUVUNGA Buch.-Ham. ex Wight & Arn.

Climbing shrubs; spines axillary. Leaves alternate, digitately 3-foliolate; rachises jointed at both ends; leaflets short-petioluled, entire, coriaceous, glandular. Inflorescences axillary, racemose or paniced. Flowers 4- or 5-merous, oblong or subglobose in bud. Calyx cupular, entire or obscurely 4 - 6-lobed. Petals 4 or 5, free, imbricate, linear-oblong, thick, fleshy. Stamens 8 - 10, inserted around disc, free or connate; filaments linear, equal or not; anthers linear or linear-oblong, dorsifixed. Disc elevated, annular or cupular. Ovary oblong-ovoid, 2 - 4-loculed; ovules 2 in each locule, collateral; style stout, jointed, caducous; stigma capitate. Berries ellipsoid, 1 - 3-seeded; seeds ovoid, light greenish.

Indomalesia, 12 species, 2 in India and 1 in Kerala.

Luvunga eleutherandra Dalzell in Hooker's J. Bot. Kew Gard. Misc. 2: 258. 1850; Hook.f., Fl. Brit. India 1: 509. 1875; Rama Rao, Fl. Pl. Travancore: 64. 1914; Gamble, Fl. Madras: 157(112). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 84. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 83. 1996; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 296. 1997. *L. sarmentosa* auct. non (Blume)

Kurz 1870: Gandhi in C.J. Saldanha & Nicolson, Fl. Hassan: 386. 1976; Manilal, Fl. Silent Valley: 45. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 104. 1994; Sivar. & P. Mathew, Fl. Nilambur: 124. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 144. 2002.

Climbing shrub; branches cylindrical, glabrous; spines axillary, ca 2.5 cm long, deflexed, stout, sharp; bark lenticelled, yellowish white. Leaves 3-foliolate; rachises divaricate, 3 - 6 cm long; leaflets short-petioluled, elliptic-oblong or obovate, acute at base, entire at margin, short-acuminate at apex, 6.5 - 16 x 3 - 6 cm, coriaceous, gland-dotted, glabrous; lateral nerves 5 - 8 pairs. Inflorescences paniced, 2 - 3 cm long; pedicels ca 4 - 5 mm long, puberulent. Flowers 5 - 10 mm long. Calyx cupular, entire or 4-lobed, 1.5 - 2.5 mm long, puberulent. Petals oblong, ca 4 x 2 mm, glabrous, fleshy, white. Disc annular, ca 0.5 x 1.5 mm, glabrous. Stamens 8, free; filaments linear, glabrous; anthers apiculate, ca 2 mm long. Ovary ovoid, ca 1 mm long, 3-loculed; ovules 2 in each locule; style ca 1.5 mm long; stigma capitate. Berries oblong, ca 20 x 10 mm, tubercled, yellowish when ripe, 3-loculed. *Fl.*: Dec. - Jan. *Fr.*: Feb. - July.

Habitat: Evergreen forests, to 900 m, rare.

Distrib.: Idukki, Kannur, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats. Endemic.

Uses: Stem, bark and leaf are used in aches and rheumatism.

10. MELICOPE J.R. Forst. & G Forst.

Shrubs or trees, unarmed. Leaves opposite, 1 - 3-foliolate, pellucid-punctate. Inflorescences axillary, rarely terminal, cymose or paniced, sometimes flower solitary. Flowers bi- or functionally unisexual. Sepals 4, valvate or imbricate. Petals 4, valvate or imbricate. Stamens 8, inserted at base of disc, free; filaments subulate or flat; anthers oblong or cordate. Ovary deeply 4-lobed, 4-loculed with 1 or 2 collateral ovules in each; style apical or subapical; stigma capitate, peltate or 4-lobed. Fruits basally connate follicles, 1- or 2-seeded; seeds oblong, shining, black or brownish; cotyledons oblong.

Indomalesia to Australia and New Zealand and Hawaii, 150 species, 4 in India and 1 in Kerala.

Literature: Nair, K.N. & NAYAR, M.P. 1989. A revision of the genus *Fuodia* J.R. & G

Forst. (*Rutaceae*) in India. *J. Econ. Tax. Bot.* 13: 193 - 203.

Melicope lunuankenda (Gaertn.) T.G. Hartley in Sandakania 4: 61. 1994; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 369. 1997. *Fagara lunuankenda* Gaertn., *Fruct. Sem. Pl.*: 334, t. 68, f. 9. 1778. *Zanthoxylum roxburghianum* Cham. in *Linnaea* 5: 58. 1830. *Z. triphyllum* Wight, *Icon. Pl. Ind. Orient.*: t. 204. 1839. *Euodia roxburghiana* (Cham.) Benth., *Fl. Hongk.*: 59. 1861; Hook.f., *Fl. Brit. India* 1: 487. 1875; Bourd., *Forest Trees Travancore*: 63. 1908; Rama Rao, *Fl. Pl. Travancore*: 61. 1914. *E. lunuankenda* (Gaertn.) Merr. in *Philipp. J. Sci.* 7: 378. 1912; Gamble, *Fl. Madras*: 148(105). 1915; Manilal, *Fl. Silent Valley*: 44. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 83. 1988; Vajr., *Fl. Palghat*: 104. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 103. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 82. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 122. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 140. 2002, incl. var. *tirunelvelica* A.N. Henry & Chandrab. 1973.

Mal.: *Kaneli*

Tree, 10 - 20 m tall; branches cylindrical; bark lenticelled, greyish brown. Leaves 3-foliolate, ca 20 cm long; rachises 4.5 - 10 cm long, grooved, glabrous; leaflets elliptic-oblong, cuneate at base, entire at margin, obtuse at apex, coriaceous; lateral nerves 15 - 20 pairs, parallel, indistinct at margin. Inflorescences umbelled cymes, 10 - 20 cm long, spreading, puberulous; peduncles brachiate; pedicels ca 2 mm long, pubescent. Flowers functionally unisexual. Male flowers ca 3 mm long; sepals 4, ovate-orbicular, ca 0.5 mm long, greenish; petals 4, 2 - 3 mm long, glabrous, white; stamens 4; filaments to 3 mm long, glabrous; anthers oblong, ca 0.7 mm long; disc annular, 4-lobed, ca 1 mm long, pubescent. Female flowers: Sepals and petals as in male ones; disc ca 0.5 mm long; staminodes 4, ca 1 mm long; ovary subglobose, 4-lobed, 4-loculed; style short; stigma capitate, 4-grooved; follicles 2 - 4, globose, to 8 mm, pale green; seed 1 in each follicle, globose, 4 - 5 mm, shining, black.

Fl.: July - Aug. *Fr.*: Oct. - Dec.

Habitat: Evergreen forests, to 2000 m, fairly common.

Distrib.: Almost throughout Kerala, Andhra Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Orissa, Sikkim and Tamil Nadu. South and SE. Asia.

Uses: Leaf juice is applied in treating fever. Wood is used for making match

sticks. Leaf is said to be used for flavouring curries.

11. MURRAYA J. König ex L., nom. & orth. cons.

Shrubs or small trees, unarmed. Leaves alternate, oblique, cuneate at base. Inflorescences axillary or terminal panicles, few-flowered. Calyx 5-lobed, connate at base, glandular. Petals 5, imbricate, linear, glandular, white. Stamens 10, free, unequal; filaments linear-subulate, sometimes dilated below; anthers small, ovoid. Disc annular, cylindric, short. Ovary 2-5-loculed with 2, rarely 1 ovule in each; style elongate, jointed, caducous; stigma capitate. Berries ovoid-ellipsoid, 1 few-seeded; testa woolly or glabrous.

Indomalesia to the Pacific, 4 species and 2 in India.

Key to species

- 1a. Leaflets 15 - 27, asymmetric; inflorescences terminal, many-flowered; berries subglobose, purplish black when ripe **1. M. königii**
- b. Leaflets 3 - 5, symmetric; inflorescences terminal or axillary, few-flowered; berries ovoid-ellipsoid, reddish when ripe **2. M. paniculata**

1. *Murraya königii* (L.) Spreng., Syst. Veg. 2: 315. 1825; Hook.f., Fl. Brit. India 1: 503. 1875; Bourd., Forest Trees Travancore: 66. 1908; Rama Rao, Fl. Pl. Travancore: 63. 1914; Gamble, Fl. Madras: 156(111). 1915; Manilal & Sivar., Fl. Calicut: 60. 1982; Nicolson & al. in Regnum Veg. 119: 233. 1988; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 351. 1997. *Bergera königii* L., Mant. Pl.: 563. 1771; Wight, Icon. Pl. Ind. Orient.: t. 13. 1838.

Mal.: *Karivepu, Kurriveppila*

Tree, to 6 m high; branchlets cylindric, glabrous; bark dark grey. Leaves pinnate, to 30 cm long; rachises terete, pubescent; leaflets alternate, 15 - 27, asymmetric, obliquely ovate or oblong-lanceolate, irregularly crenate-dentate at margin, tapering at apex, 2.5 - 8 x 1.5 - 3 cm, membranous to chartaceous; lateral nerves 4 - 10 pairs; petiolules 2 - 3 mm long. Inflorescences terminal corymbose panicles, many-flowered, to 6.5 x 8 cm; pedicels slender, ca 3.5 mm long. Flowers fragrant. Calyx patelliform; lobes 5, connate at base, ca 1 mm long, caducous. Petals 5, valvate, 6.5 - 8 x 1 - 1.5 mm, glandular, glabrous, greenish white. Stamens 10; filaments subulate, 5.5 - 7 mm long, glabrous; anthers ellipsoid, ca 1 mm

long, dorsifixed. Disc annular, conic, ca 0.5 mm long, 5-lobed. Ovary oblong-ovoid, ca 1 mm long, 2-loculed with 1, rarely 2 ovules in each; style slender, ca 2.5 mm long; stigma capitate, glandular. Berries subglobose, 8 - 10 mm long, purplish black, 2-seeded; seeds ovoid-oblong, green.

Fl.: Feb. - April *Fr.*: May - Aug.

Habitat: Usually in moist deciduous forests.

Distrib.: Idukki, Kollam, Kottayam, Kozhikode, Malappuram and Wynad. Usually cultivated for the aromatic leaves. Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Karnataka, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and W. Bengal. Cambodia, China, Laos, Myanmar, Sri Lanka and Vietnam.

Uses: Fresh leaf is used as an ingredient in curries and chutneys; yields an essential oil which is used as a fixative for soap perfume. Fruit is edible. Wood is used for making agricultural implements. Root, bark and leaf are useful in burning sensation, skin diseases, diarrhoea, dysentery, vomiting and foul-ulcers.

2. *Murraya paniculata* (L.) Jack in Malayan Misc. 1: 31. 1820; Manilal & Sivar., Fl. Calicut: 60. 1982; Vajr., Fl. Palghat: 105. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 105. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 83. 1996; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 352. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 145. 2002. *Chalcas paniculata* L., Mant. Pl.: 68. 1767. *Murraya exotica* L., Mant. Pl.: 563. 1771 (as *Murraea*); Wight, Icon. Pl. Ind. Orient.: t. 96. 1838; Hook.f., Fl. Brit. India 1: 502. 1875; Bourd., Forest Trees Travancore: 66. 1908; Rama Rao, Fl. Pl. Travancore: 63. 1914; Gamble, Fl. Madras: 155(111). 1915.

Mal.: *Kattumulla*

Tree, to 8 m high; branchlets cylindrical; bark smooth, lenticelled, yellowish white. Leaves imparipinnate, to 20 cm long; rachises slender, cylindrical, glabrous; leaflets alternate, 3 - 5, variable, ovate or ovate-elliptic, cuneate at base, entire or obscurely crenate at margin, obtuse at apex, 3.5 - 7.5 x 2.5 - 3.5 cm; petiolules ca 7 mm long, glabrous; lateral nerves 4 - 7 pairs, distinctly reticulate. Inflorescences terminal or axillary panicles, few-flowered; pedicels slender, 5 - 10 mm long, glandular. Flowers to 13 mm long, fragrant. Calyx 5-lobed; lobes oblong, obtuse, to 1 mm long, glabrous. Petals 5, oblong-lanceolate, narrow at base, obtuse at apex,

1.3 - 2 cm long, glabrous, white. Stamens 10; filaments linear, flat, tapering, to 10 mm long, white; anthers ellipsoid-oblong, ca 1 mm long, yellowish. Disc annular, lobed, ca 1 x 1.5 mm, glabrous. Ovary ovoid, to 3 mm long, 2-loculed with 1 ovule in each; style cylindrical, to 10 mm long; stigma capitate, 2-lobed. Berries ovoid-ellipsoid, 1.3 - 2 cm long, tapering, red when ripe, 1 - 2-seeded; seeds ellipsoid, ca 1 cm long.

Fl.: March - April *Fr.*: May - Dec.

Habitat: Evergreen and moist deciduous forests, to 2000 m.

Distrib.: Idukki, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Almost throughout India. South-east Asia to Australia.

Uses: Leaf is medicinal and used in the treatment of diarrhoea and dysentery; yields an essential oil. Flower yields a glucoside, 'murrayin'

12. NARINGI Adans.

Erect shrubs or small trees; spines axillary, stout. Leaves alternate, imparipinnate; leaflets opposite, sessile, crenulate, chartaceous; rachises and petioles distinctly winged. Inflorescences axillary few-flowered racemes or fascicles on old wood. Sepals free. Petals elliptic. Stamens 8; filaments free. Disc pulvinate. Ovary oblong, 4- or 5-loculed with 1 ovule in each; style short, thick; stigma capitate. Berries globose; seeds 1 - 4.

Indomalaysia, unispecific.

Naringi crenulata (Roxb.) Nicolson in C.J. Saldanha & Nicolson, *Fl. Hassan*: 387. 1976; Manilal & Sivar., *Fl. Calicut*: 58. 1982; Nicolson & al. in *Regnum Veg.* 119: 234. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 84. 1988; Vajr., *Fl. Palghat*: 105. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 84. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 125. 1997; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 303. 1997. *Limonia crenulata* Roxb., *Pl. Coromandel* 1: 60, t. 86. 1798; Gamble, *Fl. Madras*: 157(112). 1915. *Hesperuthusa crenulata* (Roxb.) M. Roem., *Fam. Nat. Syn. Monogr.* 1: 38. 1846. *Limonia acidissima* auct. non L. 1762: Hook.f., *Fl. Brit. India* 1: 507. 1875; Rama Rao, *Fl. Pl. Travancore*: 64. 1914.

Mal.: *Cheriakattunaregam*, *Kattunaregam*

Tree, 3 - 8 m high; branchlets cylindrical, glabrous; spines axillary, solitary or

in pairs, 1 - 2 cm long; bark rugose, brownish. Leaves alternate, imparipinnate, 5 - 10 cm long; rachises narrowly winged, to 3 cm long; leaflets 5, opposite, sessile, ovate-elliptic, acute at base, crenulate at margin, obtuse at apex, 2 - 7 x 1 - 3 cm, membranous to thin-coriaceous, villous on nerves above, glabrous beneath; glands dimorphic; lateral nerves 3 - 8 pairs, finely reticulate. Inflorescences axillary racemes; peduncles to 2 cm long, short-pubescent; pedicels filiform, 8 - 12 mm long, glabrous or pubescent. Flowers to 1 cm across, bisexual. Sepals 4, ovate-orbicular, glabrous or puberulous. Petals 4 or 5, oblong, ca 7 mm long, glabrous, white. Stamens 8 - 10, free, 4 - 6 mm long, inserted around disc; filaments subequal, linear; anthers oblong, ca 1.5 mm long, yellowish. Disc annular, glabrous. Ovary oblong-obovoid, to 2 mm long, 4-loculed with 1 ovule in each; style ca 2 mm long, inserted in depression of ovary lobes, gradually dilated above with a ring of glands; stigma capitate. Berries globose, to 1 cm, bluish black, 4-seeded; seeds ovoid, ca 5 x 3.5 mm, brownish.

Fl.: March - April *Fr.*: May - Sept.

Habitat: Moist deciduous forests, to 1200 m.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*), Kannur, Kozhikode, Malappuram, Palakkad and Thrissur. Central, E. and S. India. South and SE. Asia.

Uses: Root is a purgative, sudorific and used in colic and cardialgia.

13. PARAMIGNYA Wight

Climbing shrubs; spines axillary, retrorse. Leaves alternate, 1-foliolate, entire, subcoriaceous; petioles twisted. Flowers axillary, fascicled or solitary, fragrant. Calyx cupular, 4- or 5-lobed, persistent. Petals 4 or 5, free, imbricate, white. Stamens 8 - 10, free; filaments linear, equal or not, inserted around disc, subulate; anthers linear-oblong. Disc columnar. Ovary 3 - 5-loculed with 1 or 2 ovules in each; style elongate, jointed; stigma capitate, globose. Berries subglobose or ellipsoid, apiculate or obtuse at apex, 1 - 5-seeded; seeds oblong, compressed; testa membranous; cotyledons fleshy, equal.

Indomalesia, 12 species, 5 in India and 2 in Kerala.

Key to species

1a. Pedicels shorter than or as long as flower; berries subglobose or obovoid, downy-pubescent

2. *P. monophylla*

b. Pedicels much longer than flower; berries globose or pyriform, glabrous **I. P. beddomei**

1. Paramignya beddomei Tanaka in J. Bot. 68: 230. 1930; C.E.C. Fisch. in Gamble, Fl. Madras, Add.: 1872(1295). 1936; Sivar. & P. Mathew, Fl. Nilambur: 126. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 309. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 146. 2002. *P. armata* auct. non (Thwaites) Oliv. 1861: Bedd., Icon. Pl. Ind. Orient.: t. 275. 1868-1874, excl. descr.; Hook.f., Fl. Brit. India 1: 510. 1875; Gamble, Fl. Madras: 158(113). 1915; Manilal, Fl. Silent Valley: 46. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 85. 1988; Vajr., Fl. Palghat: 106. 1990.

Woody climber; spines axillary, retrorse; branchlets often zigzag, densely puberulent; bark lenticelled, green. Petioles slender, 10 - 20 mm long, puberulent; blade ovate-lanceolate, obtuse at base, entire at margin, acuminate at apex, 4 - 9.5 x 2 - 4.5 cm, chartaceous, glabrous; lateral nerves 5 - 10 pairs, reticulate. Bracteoles 2, oblong, minute; pedicels slender, 15 - 17 mm long, glabrous. Flowers axillary, solitary, rarely paired, ca 12 mm long. Calyx cupular, 1.5 - 2 mm, glandular; lobes 5, auricled, ca 0.5 mm long, glabrous. Petals 5, oblong, ca 11.5 x 3.5 mm, glabrous, glandular, white. Stamens 10, subequal; filaments linear, 4 - 6 mm long, densely pubescent; anthers linear, obtuse, 5 - 6 mm long. Ovary subglobose, ca 2 x 1.5 mm, 5-lobed, glabrous, 5-loculed with 1 ovule in each; style cylindrical, ca 6.5 mm long; stigma 5-lobed. Berries globose or pyriform, ca 2 cm, glandular, pinkish; seeds 3 - 5, compressed.

Fl.: June - Oct. *Fr.*: Dec. - May.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Kannur, Malappuram, Palakkad, Thiruvananthapuram and Wynad. Western Ghats of Tamil Nadu. Sri Lanka.

2. Paramignya monophylla Wight, Ill. Ind. Bot. 1: 108, t. 42. 1840; Hook.f., Fl. Brit. India 1: 510. 1875; Gamble, Fl. Madras: 158(113). 1915; Manilal, Fl. Silent Valley: 46. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 84. 1996; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 312. 1997.

Climbing shrub; spines axillary, recurved, sharp. Leaves simple, elliptic to elliptic-oblong, rounded at base, entire at margin, acuminate at apex, 6.5 - 13.5 x 2.5 - 6 cm, coriaceous, glabrous; lateral nerves 10 - 20 pairs, finely reticulate; petioles 6 - 12 mm long, twisted; pedicels 6 - 8 mm long, pubescent. Flowers in

axillary cymes, sometimes solitary, to 2.5 cm across, fragrant. Calyx cupular, ca 5 mm long; lobes 5, rounded, obtuse, ca 2 mm long, persistent. Petals 4, oblong, ca 13.5 x 4.5 mm, fleshy, white. Stamens 8 or 10; filaments linear, 8 - 12.5 mm long, pilose or glabrous; anthers linear, obtuse, ca 3.5 mm long. Ovary ovoid, ca 2 x 1.5 mm, tawny-pubescent, 3 - 5-loculed with 2 collateral ovules in each; style cylindrical, 6 - 12 mm long; stigma capitate. Berries subglobose or obovoid, ca 2.5 cm across, grooved above, downy-pubescent, orange; seeds 3 - 5, flat.

Fl.: March - May *Fr.*: Aug. - Dec.

Habitat: Evergreen forests, to 1500 m, occasional.

Distrib.: Kasaragod, Palakkad and Thrissur. Arunachal Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Mizoram, Sikkim and Tamil Nadu. Eastern, NE. and S. India. Bhutan, Myanmar, Nepal and Sri Lanka.

Uses: Root is used as a tonic and diuretic and also given to cattle in haematuria and other bloody fluxes from the abdomen. Bruised leaf is applied to wounds in snake-bite.

14. RUTA L.

Perennial, woody herbs. Leaves alternate, 2- or 3-pinnatisect, strongly aromatic. Inflorescences terminal corymbose cymes. Flowers bisexual, fragrant. Sepals 4, persistent. Petals 4, imbricate, concave, dentate, ciliate. Stamens twice as many as petals, unequal. Disc thick, lobuled, glandular, often pitted. Ovary 4-lobed, 4-loculed with 2 - many ovules in each; style ventral; stigma capitate. Fruit a 4- or 5-lobed capsule, dehiscent at apex; seeds angled or reniform, pitted, endospermous; embryo curved.

Macaronesia, Mediterranean to SW. Asia, 7 species and 1 in India, usually cultivated.

Ruta chalepensis L., Mant. Pl.: 69. 1767; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 363. 1997. *R. graveolens* L. var. *angustifolia* Hook.f., Fl. Brit. India 1: 485. 1875, non *R. angustifolia* Pers. 1805. *R. graveolens* sensu Manilal & Sivar., Fl. Calicut: 60. 1982, non L. 1753.

Mal.: *Nagadhali*

Erect herb, to 70 cm high, strong-smelling; stem more or less angled. Leaves pyramidal or oblong, 3 - 8 cm long; leaflets subsessile, obovate or elliptic,

entire or obscurely crenate at margin, obtuse at apex, 4.5 - 14.5 x 2 - 3 mm. Inflorescences dichasial, 6 - 12 cm across; bracts leafy, lanceolate, narrow at base, entire or crenate, acuminate, 5 - 7.5 x 2 - 2.5 mm; pedicels ca 8 - 10 mm long, glabrous. Flowers 8 - 10 mm across. Sepals 4, ovate, entire or crenate, ca 4 x 2 mm, green. Petals 4, spatulate, fimbriate, hooded at apex, ca 6 x 4 mm, yellow. Stamens 8 or 10; filaments linear, 5.5 - 7 mm long, glabrous; anthers ovoid, ca 1.5 - 2 mm long, dorsifixed. Disc 8 - 10-lobed, ca 1 x 4 mm. Ovary subglobose; carpels 4 or 5, free to middle; ovules 2 or 3 in each locule, collateral; style ca 3.5 mm long; stigma capitate, lobed. Capsules 4- or 5-lobed, 6 - 8 mm across, 1- or 2-seeded; seeds ca 2 mm long, angled, pitted, brown.

Fl. & Fr.: Most part of the year.

Native to the Mediterranean region; cultivated in India.

Uses: Plant yields an essential oil with properties similar to that of 'garden rue oil' which acts as a stimulant in uterine and nervous systems. Decoction of leaf is used in fever.

15. TODDALIA Juss., nom. cons.

Scandent shrubs, usually prickly. Leaves alternate, digitately 3-foliolate; leaflets sessile, obovate, coriaceous, gland-dotted. Inflorescences axillary or terminal cymes or panicles. Flowers unisexual, 2 - 5-merous. Calyx campanulate, 5-lobed. Petals 5 or 6, imbricate or valvate, oblong. Male flowers: Stamens as many as petals; filaments slender; anthers oblong with a small gland on back, introrse; ovary rudimentary with a columnar style. Female flowers: Stamens reduced to staminodes; anthers rudimentary; ovary oblong or globose, 5- or 6-loculed with 2 ovules in each, superposed; style short or absent; stigma capitate; fruits subglobose, fleshy; seed 1 in each locule, reniform, angled.

Old World tropics, unispecific.

Toddalia asiatica (L.) Lam., Tabl. Encycl. 2: 116. 1797; Gamble, Fl. Madras: 150(107). 1915, incl. vars.; Manilal & Sivar., Fl. Calicut: 59. 1982; Nicolson & al. in Regnum Veg. 119: 234. 1988; Manilal, Fl. Silent Valley: 46. 1988, incl. vars.; Sasidh. & Sivar., Fl. Pl. Thrissur: 85. 1996, incl. vars.; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 403. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 146. 2002, incl. var. *obtusifolia* Gamble 1915. *Paullinia asiatica* L., Sp. Pl.: 365. 1753. *Scopalia aculeata* Sm., Pl. Icon. Ined. 2: t. 34. 1790, nom. illeg. *Toddalia*

aculeata (Sm.) Pers., Syn. Pl. 1: 249. 1805; Wight, Ill. Ind. Bot. 1: t. 66. 1840; Hook.f., Fl. Brit. India 1: 497. 1875; Rama Rao, Fl. Pl. Travancore: 62. 1914. *T. asiatica* (L.) Lam. var. *floribunda* (Wall.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 44: 130. 1875; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 85. 1988; Vajr., Fl. Palghat: 106. 1990; Sivar. & P. Mathew, Fl. Nilambur: 126. 1997.

Mal.: *Kakkatodali*

Scandent shrub, to 3 m high; branchlets glandular-tomentose, prickly or not; prickles scattered, 3 - 5 mm long, recurved. Leaves alternate, digitately 3-foliolate, ca 7 cm long; rachises 2 - 3.5 cm long, prickly or not; leaflets sessile, variable, obovate, cuneate or acute at base, entire or faintly crenulate at margin, obtuse or acuminate at apex, 1.5 - 9.5 x 0.5 - 4 cm, membranous to chartaceous; lateral nerves 10 - 20 pairs. Inflorescences axillary or terminal panicles or racemes, 2 - 10.5 cm long. Male flowers: Calyx campanulate; lobes 5, deltoid, ca 0.5 mm long, glandular, short-pubescent outside; petals 5, broadly oblong, hooded at apex, 2 - 6 x 0.8 - 1.5 mm, glabrous, glandular; stamens 5, longer than petals; filaments 2 - 5 mm long, white; anthers oblong, ca 1 mm long with a pellucid gland on dorsal side, yellow; disc 5-lobed, 0.6 - 0.8 x ca 1 mm. Female flowers: Sepals and petals as in male ones; staminodes ca 1.5 mm long; ovary oblong, entire, 2 - 3 x ca 1.5 mm, 5-loculed with 2 ovules in each; style short or absent; stigma 5-lobed, sessile, capitate; drupes subglobose, fleshy, 5- or 6-lobed, orange when ripe; seed 1 in each locule, reniform, ca 1 mm across, shining, brownish.

Fl.: Sept. - Jan. *Fr.*: Feb. - Aug.

Habitat: Fringes of evergreen forests, to 2500 m, fairly common.

Distrib.: Idukki, Kannur, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Throughout India except arid regions. Africa, S. and SE. Asia.

Uses: Fresh leaf is eaten in stomach pain. Ripe fruit is pickled. Fresh root bark is administered for the cure of hill fever. Flower is useful as an external application in wasp sting.

16. TRIPHASIA Lour.

Shrubs or small trees; spines axillary. Leaves alternate, simple or 3-foliolate, petioled; leaflets ovate, obtuse, usually crenate, profusely gland-dotted. Flowers solitary or in axillary 2- or 3-flowered cymes, fragrant. Calyx 3-lobed. Petals 3,

free, imbricate, oblong, white. Stamens twice as many as petals, free, inserted around disc; filaments free, subequal, linear-subulate; anthers linear-oblong. Disc annular, fleshy. Ovary ovoid-oblong, 3 - 5-loculed with 1 or 2 ovules in each. Fruit an ovoid fleshy berry, reddish orange when ripe, glandular; seeds 1 - 3, ovoid-oblong, embedded in mucilage.

Southeast Asia, 3 species and 1 in India.

Triphasia trifolia (Burm.f.) P. Wilson in *Torreya* 9: 33. 1909; K.N. Nair & M.P. Nayar in Hajra & al., *Fl. India* 4: 319. 1997. *Limonia trifolia* Burm.f., *Fl. Indica*: 103. 1768. *L. trifoliolata* L., *Mant. Pl.*: 273. 1771. *Triphasia aurantiola* Lour., *Fl. Cochinch.*: 152. 1790; Gamble, *Fl. Madras*: 156(111). 1915. *T. trifoliolata* (L.) DC., *Prodr.* 1: 536. 1824; Hook.f., *Fl. Brit. India* 1: 507. 1875.

Erect or straggling, evergreen shrub; spines axillary, paired, slender, straight; branches terete. Leaves 3-foliolate; petioles 3 - 5 mm long; leaflets thick and soft, terminal one 2 - 5 x 1.5 - 2 cm, short-petioled; lateral ones ovate-elliptic, cuneate at base, crenulate at margin, emarginate at apex, 1 - 2 x 0.5 - 1 cm, glabrous. Flowers axillary, solitary or in 2- or 3-flowered short-peduncled cymes, white, fragrant. Sepals 3, ovate, ciliolate, green. Petals 3, free, linear-oblong, rounded at tip, 8 - 12 x ca 4 mm, glabrous. Stamens 6, free, subequal; filaments linear, 7 - 9 mm long, glabrous; anthers linear-oblong, ca 2 mm long. Disc annular, fleshy. Ovary seated on disc, ovoid, ca 2 mm long, glabrous, 3-loculed with 1 ovule in each; style slender, caducous; stigma capitate, 3-lobed, glandular. Berries ovoid-ellipsoid, apiculate, ca 1 cm long, fleshy, gland-dotted, reddish orange when ripe; seeds 1 - 3, oblong, green, embedded in mucilage.

Fl. & Fr.: Jan. - May.

Distrib.: Ernakulam (Cochin, Gamble, *l.c.*) and Kannur.

Probably native to SE. Asia. Introduced and runs wild in India (*vide* Nair & Nayar, *l.c.*).

17. VEPRIS Comm. ex A. Juss.

Shrubs or trees. Leaves alternate, 1- or 3-foliolate; leaflets usually petioluled, gland-dotted. Inflorescences terminal or axillary panicles or racemes. Flowers functionally uni- or bisexual. Calyx patelliform, 2- or more-lobed. Petals 2 - 4, imbricate, lanceolate or ovate. Stamens 6 - 8; filaments slender; anthers ovoid,

reduced to minute staminodes in female flowers. Ovary globose, 2-4-loculed with 1 or 2 ovules in each; style absent; stigma capitate. Fruits drupaceous, oblong, fleshy; seeds oblong, flat.

Tropics and S. Africa to Mascarenes, 15 species and 1 in India.

Vepris bilocularis (Wight & Arn.) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 178. 1896; Gamble, Fl. Madras: 151(108). 1915; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 105. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 85. 1996; Sivar. & P. Mathew, Fl. Nilambur: 127. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 405. 1997. *Toddalia bilocularis* Wight & Arn., Prodr. Fl. Ind. Orient.: 149. 1834; Hook.f., Fl. Brit. India 1: 497. 1875; Bourd., Forest Trees Travancore: 64. 1908; Rama Rao, Fl. Pl. Travancore: 62. 1914.

Mal.: *Karagil*

Tree, 20 - 30 m high; bark lenticelled, grey. Leaves digitately 3-foliolate, 17 - 25 cm long; rachises to 7.5 cm long, grooved almost to middle; leaflets elliptic-oblong, oblique at base, entire at margin, acuminate at apex, 9 - 20.5 x 4.5 - 8 cm, coriaceous; lateral nerves to 40 pairs; petiolules ca 10 mm long. Inflorescences terminal or from uppermost leaf axils, paniced, to 10 cm long; pedicels 1 - 2 mm long, pubescent. Flowers in clusters, unisexual. Calyx patelliform, 2- or 3-lobed. Petals 2, orbicular, ca 2.5 mm, yellowish, distinctly nerved. Stamens 6, exserted; filaments to 3 mm long; anthers oblong, ca 1 mm long. Ovary globose, 2-4-loculed; style absent; stigma capitate. Drupes oblong, ca 1 x 2 cm, fleshy, 2-loculed with 1 seed in each; seeds oblong, flat, brown.

Fl.: Jan. - April *Fr.*: June.

Habitat: Evergreen and semievergreen forests, to 1500 m.

Distrib.: Kollam, Malappuram, Pathanamthitta, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Uses: Plant yields a high quality timber used for making shelves, cart-wheels and spokes. Oil boiled with decoction of wood is useful in eye and ear diseases, rheumatism and asthma. A decoction of the root is given in biliousness.

18. ZANTHOXYLUM L.

Erect or climbing shrubs or trees, evergreen or deciduous, armed or not. Leaves alternate, 3-foliolate or imparipinnate; leaflets opposite or alternate,

subsessile to short-petiololed, often asymmetric, entire or crenate, pellucid-punctate. Inflorescences axillary or terminal panicles or cymes. Flowers often unisexual. Sepals and petals 5 each. Stamens 3 - 5, hypogynous, reduced to staminodes in female flowers. Disc flat or obscure. Carpels 1 - 4, distinct or partially connate, rudimentary in male flowers. Ovary 1-loculed with 2 collateral ovules in each; styles free or connate above; stigma capitate, distinct. Follicles 1 - 4, distinct or partially connate, red or black, 1-seeded; endocarp horny; seeds ovoid or subglobose, often hanging out.

Africa, America, Asia and Australia, ca 250 species, 12 in India and 2 in Kerala.

Literature: Babu, C.R. 1977. The genus *Zanthoxylum* Linn. (*Rutaceae*) in India. *Bull. Bot. Surv. India* 16: 48 - 71. Hartley, T.G. 1966. A revision of the Malesian species of *Zanthoxylum* (*Rutaceae*). *J. Arnold Arbor.* 47: 171 - 211.

Key to species

- 1a. Erect shrub or small tree, unarmed or armed with straight or incurved prickles; leaves 1 - 5-foliolate
1. *Z. ovalifolium*
- b. Medium-sized to large tree, armed with conic prickles; leaves pinnate
2. *Z. rhetsa*

1. *Zanthoxylum ovalifolium* Wight, Ill. Ind. Bot. 1: 169. 1840; Hook.f., Fl. Brit. India 1: 492. 1875; Rama Rao, Fl. Pl. Travancore: 61. 1914; Gamble, Fl. Madras: 150(107). 1915; Vajr., Fl. Palghat: 106. 1990; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 384. 1997. *Z. separium* Wight, Ill. Ind. Bot. 1: 169. 1840. *Z. ovalifolium* Wight var. *separium* (Wight) Hook.f., Fl. Brit. India 1: 492. 1875.

Shrub or tree, to 8 m high; branchlets glabrous, prickly or not; prickles 3 - 6 mm long, straight or incurved, reddish brown; bark reddish or greyish brown. Leaves digitately 1 - 5-foliolate, to 30 cm long; rachises stout, 5.5 - 10.5 cm long, flat; leaflets elliptic-oblong or obovate, acute to cuneate at base, crenulate at margin, abruptly acuminate or retusely subobtuse at apex, 4.5 - 20 x 2 - 7 cm, coriaceous, usually pellucid-dotted, glabrous; lateral nerves 8 - 20 pairs; petiolules ca 5 mm long. Inflorescences in lax terminal and axillary panicles, to 12.5 cm long; buds globose or obovoid; pedicels as long as buds. Male flowers ca 3 mm long;

sepals 4, ovate-triangled, acute, ca 1 mm long; petals 4, elliptic-oblong, subobtuse, 2 - 3 mm long, whitish; stamens 4, rarely 3, 2 - 3 mm long, alternating with petals; filaments linear, flat; anthers oblong, ca 1 mm long, white; disc pulvinate, ca 0.8 mm long. Female flowers 3 - 4 mm long; sepals and petals as in male ones; disc pulvinate, ca 0.5 mm long; staminodes 4, filiform; ovary ovoid; style ca 0.5 mm long; stigma globose; follicles subglobose with persistent style, 6.5 - 9 mm across; seeds globose, 5 - 6 mm, smooth, black.

Fl.: May - June *Fr.*: Sept. Oct.

Habitat: Evergreen forests, to 1300 m, common.

Distrib.: Idukki, Kollam, Kottayam, Palakkad and Pathanamthitta. Andaman & Nicobar Islands, Andhra Pradesh, Assam, Karnataka, Meghalaya, Nagaland, Sikkim, Tamil Nadu and W. Bengal. Indonesia, Lesser Sunda Islands, Myanmar and New Guinea.

Use: Wood is used for making tool handles and in cabinet work.

2. *Zanthoxylum rhetsa* (Roxb.) DC., Prodr. 1: 728. 1824; Hook.f., Fl. Brit. India 1: 495. 1875; Bourd., Forest Trees Travancore: 63. 1908; Rama Rao, Fl. Pl. Travancore: 61. 1914; Gamble, Fl. Madras: 150(107). 1915; Manilal & Sivar., Fl. Calicut: 59. 1982; Nicolson & al. in Regnum Veg. 119: 234. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 85. 1996; Sivar. & P. Mathew, Fl. Nilambur: 127. 1997; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 387. 1997. *Fagara rhetsa* Roxb., Fl. Ind. 1: 438. 1820.

Mal.: *Mullilavu*

Tree, 30 - 35 m tall; branchlets terete, woody; prickles conic, ca 5 mm long. Leaves crowded towards ends of branchlets, 30 - 40 cm long; petioles grooved when young, cylindric when mature, prickly. Leaflets 7 - 33, opposite, ovate, oblique at base, entire or crenate-serrate at margin, caudate-acuminate at apex, 7.5 - 19 x 3.5 - 6.5 cm, coriaceous, glabrous; petiolules 2.5 - 7 mm long. Inflorescences in terminal and axillary corymbose panicles, 12 - 25 cm long, often prickly. Male flowers to 2.5 mm long; sepals 4, ovate-triangled, subentire or fimbriate at margin, ca 0.5 mm long, green; petals 4, elliptic-oblong, ca 2.5 mm long, white; stamens 4, ca 3 mm long; filaments linear; anthers oblong, ca 1 mm long, yellowish; disc pulvinate, lobed, ca 0.3 mm long. Female flowers ca 2.5 mm long; sepals and petals as in male ones; staminodes absent; disc pulvinate; carpel 1, rugose,

red; style eccentric; stigma capitate; follicles globose, apiculate with persistent stylar base, 5.5 - 7 mm across; seeds globose, 4.5 - 6 mm, bluish black.

Fl.: June - Nov. *Fr.*: Oct. - Jan.

Habitat: Evergreen and moist deciduous forests, to 600 m.

Distrib.: Kannur, Kollam, Kozhikode, Malappuram and Thrissur. Andaman Islands, Andhra Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu and W. Bengal. South and SE. Asia.

Use: Root bark is diuretic and used in Ayurvedic medicines.

SIMAROUBACEAE

(E. VAJRAVELU)

Trees or shrubs, usually with bitter substances; twigs hairy or glandular, pithy. Leaves alternate to spiral, usually pinnate, rarely simple with pitted concave or flat glands; stipules caducous or absent. Inflorescences axillary, rarely terminal, usually compound racemes or corymbose panicles, pubescent. Flowers many few, small, 3 - 5-merous, regular, uni- or bisexual. Sepals 3 - 5, partly connate or free. Petals 3 - 5, free, greenish to variously coloured. Disc annular or elongate, lobed or not. Stamens as many or twice as many as petals, rarely numerous, free; filaments slender, often with a scale at base; anthers oblong, dehiscing longitudinally. Carpels 4, 5 or less, sessile, free or connate; ovary 1 - 5-loculed with 1 ovule in each; styles 1 - 5, free or connate; stigmas free or connate. Fruit a drupe, nut, samara or schizocarp; seed 1, with a membranous or coriaceous testa.

Tropics, 13 genera and 110 species, 5 and 11 in India and, 3 and 4 in Kerala.

Literature: Basak, R.K. 1980. *Simaroubaceae & Balanitaceae. Fusc. Fl. India* 4: 1 - 24.

Key to genera

- | | | |
|-----|---|---------------------|
| 1a. | Leaves simple; fruit a drupe | 3. <i>Samadera</i> |
| b. | Leaves compound; fruit a samara or nut | 2 |
| 2a. | Stamens twice as many as petals; fruit a samara | 1. <i>Ailanthus</i> |
| b. | Stamens as many as petals; fruit a nut | 2. <i>Brucea</i> |

1. AILANTHUS Desf., nom. cons.

Lofty trees, fast-growing, sometimes deciduous; young parts brownish-hairy; branches thick, pithy. Leaves large, impari- or paripinnate, crowded at ends of branches; leaflets opposite to subopposite, petioluled, oblique, entire or toothed, acuminate, usually glandular beneath. Flowers in axillary or terminal branched panicles, usually unisexual; male flowers foetid during anthesis. Calyx small, 5-lobed. Petals 5, oblong, concave, longer than calyx. Disc thick, 10-lobed, flat. Stamens 10 in male flowers; filaments subulate, reduced or absent in female flowers. Carpels 2 - 5, free, flat, rudimentary or absent in male flowers; styles free or connate; stigma peltate. Fruits 1 - 5, linear or oblong-lanceolate 1-seeded samaras; wings membranous; seeds orbicular or obovate, flat.

Asia to Australia, 5 species, 4 in India and 2 in Kerala.

Key to species

- | | | |
|-----|---|-----------------------|
| 1a. | Leaflets coarsely toothed or lobed; samaras twisted | 1. <i>A. excelsa</i> |
| b. | Leaflets entire or wavy; samaras not twisted | 2. <i>A. triphysa</i> |

1. *Ailanthus excelsa* Roxb., Pl. Coromandel 1: 24, t. 23. 1795; Wight, Ill. Ind. Bot. 1: 170, t. 67. 1840; A.W. Benn. in Hook.f., Fl. Brit. India 1: 518. 1875; Rama Rao, Fl. Pl. Travancore: 68. 1914; Gamble, Fl. Madras: 163(116). 1915; R.K. Basak in Hajra & al., Fl. India 4: 410. 1997. *Pongelion wightii* Tiegh. in Ann. Sci. Nat. Bot. 9, 4: 277. 1906.

Mal.: *Matti-pongilyam*

Tree, 15 - 25 m tall, deciduous; branches with large leaf scars. Leaves equally or unequally pinnate, usually 20 - 40 cm long, rarely to 90 cm or more; rachises tomentose; leaflets 8 - 14 pairs, alternate or subopposite, variable in shape, unequal at base, coarsely and irregularly toothed or sublobate, acute or acuminate at apex, 4 - 16 x 3 - 8 cm, tomentose when young; lateral nerves 12 - 20 pairs; petiolules usually with 2 hairy glands near base. Flowers large, lax in much branched panicles, greenish yellow; pedicels slender. Calyx lobes ovate-triangular, ca 2 mm long. Petals ovate-lanceolate, reflexed, 3 - 4 x ca 2 mm, glabrous. Stamens 10 in male flowers; filaments glabrous; anthers ca 1 mm long. Ovary sparsely hairy; styles free or connate; stigma curling outward. Samaras linear or oblong to fan-

ceolate, acute at both ends, 4 - 7.5 x 1 - 1.5 cm, strongly reticulate, once or twice twisted at base, reddish brown.

Fl. & Fr.: Dec. - April.

Habitat: Usually planted, but found in scrub forests and forest slopes on hills.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*) and Pathanamthitta. Most states in India. Pakistan and Sri Lanka.

Uses: Timber is used for making paper, match sticks, packing cases, boats, toys and other articles. Bark is used as a febrifuge and tonic.

2. *Ailanthus triphysa* (Dennst.) Alston, Handb. Fl. Ceylon 6 (Suppl.): 41. 1931; Nooteboom in Steenis, Fl. Males. 1, 6: 219. 1962; Manilal & Sivar., Fl. Calicut: 61. 1982; Nicolson & al. in Regnum Veg. 119: 245. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 86. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 105. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 86. 1996; Sivar. & P. Mathew, Fl. Nilambur: 128. 1997; R.K. Basak in Hajra & al., Fl. India 4: 413. 1997. *Adenantha triphysa* Dennst., Schlüssel Hortus Malab.: 18, 32. 1818. *Ailanthus malabarica* DC., Prodr. 2: 89. 1825 (as *malabaricus*), nom. illeg. incl. type of *Adenantha triphysa* Dennst. 1818; Wight, Icon. Pl. Ind. Orient.: t. 1604. 1850; A.W. Benn. in Hook.f., Fl. Brit. India 1: 518. 1875; Rama Rao, Fl. Pl. Travancore: 68. 1914; Gamble, Fl. Madras: 163(116). 1915. *A. kurzii* Prain in Indian Forester 28: 133, t. 3b. 1902.

Mal.: *Mattipal, Pongilyam*

Tree, 30 - 45 m tall, deciduous; bark rough, grey. Leaves crowded, mostly paripinnate, 20 - 70 cm long; leaflets 6 - 10 pairs, opposite, alternate or subopposite, obliquely ovate-oblong or oblong-lanceolate, falcate, tapering, unequal at base, entire or wavy at margin, acute or acuminate at apex, 9 - 14 x 2.5 - 5.5 cm, glabrous, glaucous beneath; petiolules 5 - 10 mm long. Flowers in dense axillary branched pubescent 20 - 50 cm long panicles; bracts small, caducous; pedicels ca 3 mm long. Calyx lobes ca 1 mm long, 3-angled, acute, pubescent. Petals oblong-lanceolate, 3 - 5 x 1 - 1.5 mm, glabrous, white. Stamens 3 - 4 mm long in male flowers; filaments tortuous-folded in bud, filiform with spreading hairs; anthers ovate-cordate. Ovary 2 - 2.5 x 1 - 1.5 mm, glabrous; styles free at base, connate above; stigma 3- or 4-lobed, peltate. Samaras linear-oblong, rounded at both ends, not twisted, 5 - 9.5 cm, reddish brown.

Fl. & Fr.: Jan. - May.

Habitat: Lowlands to 600 m in wet evergreen forests, also planted.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Thiruvananthapuram and Thrissur. Andaman Islands and S. India. South and SE. Asia to Australia.

Uses: Wood is used for making paper, match sticks, packing cases, toys and match boxes. Bark being bitter is used as a febrifuge. Resin is used for making incense sticks and as a substitute for turpentine. It is also used medicinally in dysentery. Fruit is used in eyesores.

2. BRUCEA J.F. Mill., nom. cons.

Shrubs or small trees; young parts pubescent. Leaves exstipulate, very large, imparipinnate, pubescent; leaflets 3 - 11 (15), opposite, oblique, ovate to lanceolate, entire or toothed with flat spot-like glands at margin beneath, acuminate. Flowers uni- or bisexual, in long usually unbranched axillary panicles. Sepals 4, ovate-elongate or 3-angled, pubescent, imbricate in bud. Petals 4, free, ovate-oblong, oblong or linear, pubescent outside. Disc cupular, thick, 4-lobed, glabrous. Stamens 4, inserted below disc; filaments short; anthers ovate-cordate. Ovary of 4 free ovoid carpels; styles free or connate at base, bent outward over ovary; stigma thick or clavate. Fruits of 1 - 4 free dry nuts, ovoid or ellipsoid with 2 ribs; seed 1, ovoid.

Old World tropics, 8 species, 2 in India and 1 in Kerala.

Brucea javanica (L.) Merr. in J. Arnold Arb. 9: 3. 1928; R.K. Basak in Hajra & al., Fl. India 4: 414. 1997. *Rhus javanica* L., Sp. Pl.: 265. 1753. *Brucea sumatrana* Roxb., Fl. Ind. 1: 449. 1832; A.W. Benn. in Hook.f., Fl. Brit. India 1: 521. 1875. *B. amarissima* sensu N.C. Nair in J. Bombay Nat. Hist. Soc. 57: 237. 1960, non (Lour.) Merr. 1935.

Shrub or small tree, evergreen, 1 - 6 m high, often epiphytic, foetid; branchlets stout, tomentose. Leaves 25 - 50 cm long; rachises 6 - 15 cm long; leaflets usually 5 - 11, rarely more, ovate-oblong to lanceolate, acute or obtuse at base, acuminate at apex, 4 - 14 x 2 - 5.5 cm, densely yellowish-pubescent beneath, sparsely hairy above, rarely glabrous; petiolules slender. Flowers in axillary pubescent panicles of cymes, reddish, greenish or purplish. Panicles 15 - 30 cm

long; bracts minute, deltoid. Male flowers with slender pedicels; sepals 1 - 2 mm long, pubescent; petals linear, spatulate, rarely toothed, 1 - 2 mm long, sparsely pubescent or glabrous; filaments subulate. Female flowers with to 2.5 mm long pedicels; sepals and petals as in male ones; stigma free, ca 1 mm long, nuts 1 - 4 together, ovoid, somewhat compressed, ridged, 4 - 5 x 2 - 3.5 mm, glabrous, black; stone reticulate.

Fl.: Jan. - July *Fr.*: July - Nov.

Habitat: Sandy soil and rocky slopes in open secondary forests and forest edges, to 900 m.

Distrib.: Alappuzha, Kollam, Kottayam and Pathanamthitta. Andaman Islands, Arunachal Pradesh, Assam, Meghalaya and Nagaland. East, NE. and SE. Asia to Australia.

Uses: Bitter root and fruit are used in dysentery and fever. Leaf is used in ring-worm, boils, centipede bite etc.

3. SAMADERA Gaertn., nom. cons.

Small trees. Leaves alternate, simple, petioled, oblong, entire, coriaceous, shining, with 2 glands at base. Flowers in axillary or terminal pseudoumbels, bisexual. Calyx 3 - 5-lobed, imbricate, glandular. Petals 3 - 5, free, imbricate, elongate, coriaceous. Disc large, obconic. Stamens 6 - 10, included with basal scales and slender filaments; anthers lanceolate. Ovary of 4 or 5 free carpels; styles free at base, more or less connate above; stigma acute. Fruits of 1 - 5 large compressed drupes, rigid, winged, 1-seeded.

South and SE. Asia and Madagascar, 2 species and 1 in India.

Note: Nootboom (in Steenis, *Fl. Males.* 1, 6: 199, 1962) reduced this genus to a section under *Quassia* L. but the genus *Samadera* with simple leaves is treated here as distinct from the compound-leaved *Quassia*.

Samadera indica Gaertn., *Fruct. Sem. Pl.* 2: 352, t. 156, f. 3. 1791; A.W. Benn. in Hook.f., *Fl. Brit. India* 1: 519. 1875; Rama Rao, *Fl. Pl. Travancore*: 68. 1914; Gamble, *Fl. Madras*: 163(117). 1915; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 86. 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 106. 1994; R.K. Basak in Hajra & al., *Fl. India* 4: 420. 1997. *Niotia lucida* Wall., *Pl. Asiat. Rar.* 2: 54, t. 168. 1831. *Samadera lucida* (Wall.) Planch. in Hooker's *J. Bot. Kew Gard. Misc.* 5: 562. 1854; A.W. Benn. in Hook.f., *Fl. Brit. India* 1: 519. 1875.

Quassia indica (Gaertn.) Nootboom in Steenis, Fl. Males. 1, 6: 199. 1962; Manilal & Sivari., Fl. Calicut: 61. 1982; Nicolson & al. in Regnum Veg. 119: 245. 1988.

Mal.: *Karingotta, Karinjotta*

Evergreen tree or shrub, to 10 m high. Leaves elliptic-oblong, subacute-rounded at base, acute to acuminate at apex, 9 - 30 x 3.5 - 11 cm, coriaceous, glabrous, shining, reticulately nerved; petioles 1 - 2 cm long, stout. Flowers 20 or more in umbelliform glabrous or puberulous inflorescences; peduncles 7 - 30 cm long, stout, flat, thick above; pedicels 1 - 1.5 cm long, to 3 cm in fruit, jointed at base; bracts minute. Calyx 2 - 3 cm long, 4-lobed; lobes semiorbicular, thick, puberulous outside. Petals 4, free, oblong-ob lanceolate, obtuse, 1 - 2 x ca 0.5 cm, dorsally pubescent, white, pale yellow or purplish. Stamens 8, 8 - 12 mm long, pubescent; anthers oblong-lanceolate, 2 - 3 mm long; filaments puberulous. Ovary ca 2 mm across, puberulous; styles to 2 cm long, glabrous. Drupes 1 - 4 together, 4 - 6 x 2.5 - 4 cm, flat, smooth, glandular, reticulate.

Fl. & Fr.: March - Dec.

Habitat: Evergreen forests and along backwaters.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Andaman Islands and S. India. Myanmar and Sri Lanka.

Uses: It is the source of the niepa bark of commerce; wood is used for turnery articles, packing cases, cheap and light furniture and in match industry. Most of the parts are of medicinal value. Seed yields an oil.

Quassia amara L., Surinam quassia wood, native to Brazil, an ornamental plant, is rarely cultivated for its foliage and red showy flower.

OCHNACEAE

(E. VAJRAVELU)

Shrubs or small trees, with watery juice. Leaves simple, alternate, stipuled, glabrous, pinnately nerved. Inflorescences terminal or axillary racemes, cymes or thyrsoid panicles. Flowers 1 or 2 - many, bisexual, regular; pedicels jointed. Sepals (4 or)5, free or basally connate, imbricate, persistent. Petals 5(4 - 10), free, contorted or imbricate, caducous. Stamens 4 - many in 1 - 5 whorls, inserted at base or on disc; filaments filiform, usually persistent; anthers linear, basifixed, dehiscing

by apical pores or longitudinally. Carpels 2-5 (10); ovary superior, 2-5 (10)-loculed, sometimes surrounded by an annular basal disc; ovules 1-many in each locule, axile or parietal, 2-tegmic, ana- or campylotropous; style simple, subulate, straight or incurved; stigma apical, simple. Fruits of several drupaceous fruitlets on an enlarged red fleshy receptacle, berries or septicidal capsules; seeds 1-many; embryo straight, large, nonendospermous; cotyledons planoconvex.

Tropics especially Brazil, 28 genera and 370 species, 3 and 7 in India and, 2 and 4 in Kerala.

Literature: Kanis, A. 1968. A revision of the *Ochnaceae* of the Indo-Pacific area. *Blumea* 16: 1-82. Kanis, A. 1971. *Ochnaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* I, 7: 97-119.

Key to genera

- | | | |
|-----|---|-------------------|
| 1a. | Leaves with a distinct intramarginal nerve; stamens 10 | 1. Gomphia |
| b. | Leaves without an intramarginal nerve; stamens more than 10 | 2. Ochna |

1. GOMPHIA Schreb.

Trees or shrubs with spreading branches. Leaves simple, alternate, coriaceous, shining; nerves close, parallel, curved upwards near margin; nervules reticulate; stipules intrapetiolarly connate, caducous. Inflorescences axillary or terminal thyrses. Flowers with a short 5-ribbed gynophore enlarging in fruit; pedicels filiform, jointed at base. Sepals 5, pinkish, accrescent in fruit. Petals 5, yellow, creamy or white. Stamens 10; filaments terete, short; anthers opening by 2 apical pores. Ovary obovoid, 5-lobed; lobes 1-loculed; styles connate; stigma simple. Fruits 1-2 (-5), yellowish turning dark purple or blue black when ripe; seed 1.

Old World tropics, E. to Celebes, 30-35 species and 1 in India.

Gomphia serrata (Gaertn.) Kanis in *Taxon* 16: 422. 1967; Manilal & Sivar., *Fl. Calicut*: 62. 1982; Nicolson & al. in *Regnum Veg.* 119: 199. 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 106. 1994; Safui & M.P. Nayar in Hajra & al., *Fl. India* 4: 425. 1997. *Meesia serrata* Gaertn., *Fruct. Sem. Pl.* 1: 344, t. 70, f. 6. 1788. *Gomphia angustifolia* Vahl, *Symb. Bot.* 2: 49. 1791; A.W. Benn. in Hook.f., *Fl. Brit. India* 1: 525. 1875; Rama Rao, *Fl. Pl. Travancore*: 69. 1914. *G. malabarica* DC., *Prodr.* 1: 736. 1824. *Ouratea angustifolia* (Vahl) Baill. ex Laness., *Pl. Util. Col. Franc.*: 607. 1886; Gamble, *Fl. Madras*: 167(119).

1915. *Campylospermum malabaricum* (DC.) Tiegh. in Bull. Mus. Hist. Nat. (Paris) 9: 77. 1903.

Mal.: *Anaivilavu, Aneperala, Chavakampu, Chokatti, Puachetti*

Shrub or tree, to 25 m tall. Leaves ovate to obovate-lanceolate, acute or tapering at base, serrate at margin, acute to acuminate at apex, 6-20 x 2-5 cm, glabrous; petioles 2-6 mm long; stipules 3-6 mm long. Inflorescences many-flowered terminal or axillary cymes. Flowers 8-16 mm across; pedicels to 1 cm long, longer in fruit. Sepals free, ovate to elliptic, 4-6 x 2.5-3.5 mm, accrescent in fruit. Petals obliquely obovate to broadly spatulate, 4.5-7 x 2.5-5 mm, yellow, creamy or white, caducous. Receptacle ca 1 mm across, accrescent in fruit. Stamens subsessile. Ovary deeply 4- or 5-lobed, glabrous; style 3-5 mm long, elongate in fruit; stigma minute. Fruits ca 8 x 6 mm, smooth, shining.

Fl. & Fr.: Almost throughout the year.

Habitat: Sandy loam or rocky soil in primary and secondary forests, in open scrub forests or on slopes and ridges, 1200-1500 m.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Pathanamthitta, Thiruvananthapuram and Wynad. Southern India. Indomalaysia.

Uses: Wood is used as poles or planks for construction of houses. Decoction of root and leaf, being bitter, is used as a stomachic and antiemetic; young twig is used against toothache.

2. OCHNA L.

Shrubs or small trees with spreading branches. Leaves alternate, shining, many-nerved; stipules 2, caducous. Inflorescences simple cymes, lateral or terminal thyrses or panicles; peduncles sometimes branching once or twice after flowering. Flowers conspicuous, bracteate; pedicels filiform. Sepals 5, imbricate, persistent and turning red in fruit. Petals 5 (10) in 1 or 2 whorls, yellow. Stamens many in 2 or more whorls; filaments subterete; anthers opening by 2 apical pores. Ovary 5-10(-15)-lobed; lobes 1-loculed; styles free or connate; stigma simple or capitate. Fruits 1-5, greenish turning black when ripe.

Old World tropics, 86 species, 5 in India and 2 in Kerala.

Key to species

- 1a. Petals 5 - 10 x 2 - 5 mm, as long as sepals 1. *O. lanceolata*
 b. Petals 15 - 25 x 7 - 15 mm, longer than sepals 2. *O. obtusata*

1. ***Ochna lanceolata*** Spreng., Syst. Veg. 2: 597. 1825; Safui & M.P. Nayar in Hajra & al., Fl. India 4: 428. 1997, excl. syn. *O. wightiana* Wall. ex Wight & Arn. 1834. *O. heyneana* Wight & Arn., Prodr. Fl. Ind. Orient.: 152. 1834; Gamble, Fl. Madras: 166(119). 1915.

Shrub or small tree, much branched; branchlets lenticelled. Leaves elliptic, ovate or oblong-lanceolate, acute at both ends or subcordate at base and obtuse at apex, crenate or subentire towards base, 1.5 - 8 x 1 - 2.8 cm, subcoriaceous; petioles 1 - 3 mm long; stipules slender, 4 - 12 mm long. Inflorescences simple, 1 - 3 (rarely 5)-flowered. Flowers 1 - 2 cm across with filiform 1 - 2.5 cm long pedicels. Sepals 5, ovate-oblong, 7 - 10 x 3 - 5 cm. Petals 5, ovate-oblong, caducous. Stamens 20 - 50; filaments 2 - 4 mm long; anthers 2 - 5 mm long. Ovaries 5 - 7; styles free at apex or not, 5 - 7.5 cm long, elongate in fruit; stigma shortly branched at apex. Fruits 1 - 3, to 8 mm long with usually persistent style.

Key to varieties

- 1a. Leaves oblong-lanceolate, acute at both ends with spaced nerves, to 8 cm long; styles free at apex 1.1. var. ***lanceolata***
 b. Leaves elliptic or ovate, subcordate at base, obtuse at apex with close nerves, to 5 cm long; styles not free at apex 1.2. var. ***wightiana***

1.1. var. *lanceolata*

Fl. & Fr.: June - Sept.

Habitat: Drier lowlands and on ridges, to 1200 m.

Distrib.: Travancore (Gamble, *l.c.*). Southern India. Sri Lanka.

Use: Stems are used for making walking sticks.

1.2. var. *wightiana* (Wall. ex Wight & Arn.) Vajr., stat. & comb. nov.

O. wightiana Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 152. 1834; Wight, Ill. Ind. Bot. 1: 172. 1840 & Icon. Pl. Ind. Orient.: t. 223. 1839, quoad descr. excl. stigma; A.W. Benn. in Hook.f., Fl. Brit. India 1: 524. 1875, p.p; Bourd., Forest Trees Travancore: 75. 1908; Rama Rao, Fl. Pl. Travancore: 69. 1914; Gamble,

Fl. Madras: 166(119). 1915.

Fl. & Fr.: March - Sept.

Habitat: Drier lowlands and slopes in evergreen forests, to 1200 m.

Distrib.: Travancore (Gamble, *l.c.*). Southern India. Sri Lanka.

Use: Stems are used for making walking sticks.

2. *Ochna obtusata* DC. in Ann. Mus. Natl. Hist. Nat. 17: 411. 1811; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 107. 1994; Safui & M.P. Nayar in Hajra & al., Fl. India 4: 429. 1997. *O. squarrosa* auct. non L. 1753; A.W. Benn. in Hook.f., Fl. Brit. India 1: 523. 1875; Bourd., Forest Trees Travancore: 75. 1908; Rama Rao, Fl. Pl. Travancore: 69. 1914; Gamble, Fl. Madras: 165(118). 1915.

Shrub or small tree, to 8 m high with slender branches. Leaves very variable, elliptic, ovate, obovate, oblong or lanceolate, acute or cuneate at base, serrate, denticulate or aculeate at margin, mostly acute to short-acuminate at apex, 5 - 16 x 3 - 7 cm, chartaceous, shining; lateral nerves many, subparallel, distinct above; petioles to 5 mm long; stipules 3 - 5 mm long. Inflorescences many-flowered thyrses or umbels; peduncles 0.5 - 3 cm long. Flowers 3 - 4.5 cm across. Sepals ovate or ovate-oblong, 10 - 18 x 5 - 10 mm, green turning pale pinkish red in fruit. Petals obovate to oblanceolate, cuneate at base, rounded at apex, 9 - 10 x 4 - 6 mm, yellow, caducous. Receptacle subglobose. Stamens 30 - 75; filaments to 4 mm long; anthers 4 - 10 mm long. Ovaries 5 - 10; style twisted, 8 - 12 mm long, elongate in fruit. Drupes 3 - 5, on a swollen receptacle, oblong, obtuse, 8 - 12 x 5 - 7 mm.

Fl.: Jan. - March *Fr.*: May - Dec.

Habitat: Hill slopes, to 1200 m.

Distrib.: Kasaragod, Kollam, Kottayam and Thiruvananthapuram. Assam, Bihar, Madhya Pradesh, Maharashtra, S. India, Tripura, Uttar Pradesh and W. Bengal. Bangladesh, Nepal and Sri Lanka.

Uses: Root is used as an antidote in snake bite; decoction of root is given in certain menstrual complaints, consumption and asthma. Stem is used as walking stick.

Note: Specimens from Kottayam and Thiruvananthapuram at MH differ much in leaf and inflorescence characters. Further studies are required on fresh material.

Gamble (*l.c.*) mentioned Quilon (Travancore) as the distribution of *Ochna gamblei* King ex Prain which has been treated as a variety under *O. obtusata* by Kanis (*l.c.*). But there is no specimen at MH. Kanis (*l.c.*) stated, "Wight K.D. 392 from Quilon at K was named *O. gamblei* King by Brandis according to Gamble (*l.c.*). I admit that the specimen concerned has a superficial resemblance to other collections under that name. However, the duplicates of this collection at L and S are much more suggestive of *O. obtusata* DC. var. *obtusata*. Besides, all the leaves are rather thin and not waxy. Occurrence of the more succulent var. *gamblei* in Travancore is not very probable because of the rather moist climate there" Therefore var. *gamblei* is excluded.

BURSERACEAE

(A.N. HENRY & V. CHITHRA)

Trees or shrubs, secreting resin or oil. Leaves alternate, spiral, more or less crowded at ends of branchlets, imparipinnate, rarely 1-foliolate. Inflorescences axillary or terminal racemes or panicles, often crowded at ends of branchlets; bracts and bracteoles usually deltoid to subulate. Flowers uni- or bisexual, actinomorphic, 3-6-merous, greenish to cream-coloured. Sepals variously connate, imbricate or valvate. Petals free or variously connate, imbricate or valvate. Disc annular or cupular, free or adnate to calyx, intrastaminal, crenate, rarely pilose. Stamens twice as many as petals, slightly reduced in female flowers; filaments free or more or less connate, inserted below or on disc, sometimes pubescent; anthers 2-loculed, dorsifixed. Ovary superior, 2-5-loculed with 2 ovules in each on axile placenta usually pendulous; style simple; stigma capitate or slightly lobed; pistil reduced to a pistillode or absent in male flowers. Fruits drupaceous, indehiscent with 2-5 pyrenes or dehiscent and pseudocapsular; seed 1, nonendospermous.

Tropics especially America and NE. Africa, 17 genera and 540 species, 7 and 19 in India and, 4 and 8 in Kerala.

Literature: Engler, H.G.A. 1931. *Burseraceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2, 19a: 405 - 456.

Key to genera

1a. Fruits dehiscent

1. *Boswellia*

- | | | |
|-----|----------------------|----------------------|
| b. | Fruits indehiscent | 2 |
| 2a. | Flowers 3-merous | 2. Canarium |
| b. | Flowers 4 - 6-merous | 3 |
| 3a. | Disc adnate to calyx | 4. Garuga |
| b. | Disc free from calyx | 3. Commiphora |

1. BOSWELLIA Roxb. ex Colebr.

Trees; bark greenish or ash-coloured, papery, peeling off in thin flakes. Leaves alternate, exstipulate, imparipinnate; leaflets opposite or subopposite. Racemes axillary, usually paniced. Flowers bisexual, white or pink. Calyx 5-lobed, persistent. Petals 5, imbricate. Disc annular, crenate. Stamens 10, alternately long and short, inserted on or at base of disc. Ovary sessile, 3-loculed; ovules 2 in each locule, pendulous; style short, grooved; stigma 3-lobed. Drupes 3-gonous, septi-cidal; pyrenes 3, cordate with a long apex, surrounded by a broad membranous wing, bony, 1-seeded; seed compressed; cotyledons multifid.

Old World tropics, ca 20 species, 2 in India and 1 in Kerala.

Boswellia serrata Roxb. ex Colebr. in *Asiat. Res.* 9: 379, t. 5. 1807; A.W. Benn. in *Hook.f., Fl. Brit. India* 1: 528. 1875; Rama Rao, *Fl. Pl. Travancore*: 69. 1914; Gamble, *Fl. Madras*: 168(120). 1915; Chithra & A.N. Henry in *Hajra & al., Fl. India* 4: 432. 1997. *B. glabra* Roxb., *Pl. Coromandel* 3: 5, t. 207. 1811; Gamble, *Fl. Madras*: 168(120). 1915.

Mal.: *Vella-kundirukkam*

Tree, 6 - 20 m tall; branchlets with annular swellings at intervals. Leaves 15.5 - 44 cm long; leaflets 8 - 23, variable in size, shape and degree of pubescence (sometimes the lowermost pair much smaller than others), ovate-lanceolate, oblong-ovate or elliptic, oblique, cuneate to rounded at base, crenate-serrate sometimes entire or repand at margin, acute, obtuse or retuse and mucronate at apex, 0.8 - 9.4 x 0.4 - 3.5 cm. Panicles to 21 cm long; bracts subulate, pubescent, caducous. Flowers pinkish, fragrant. Calyx broadly campanulate, 1.5 - 3 x 2.5 - 3 mm; lobes triangled-ovate, pubescent, persistent. Petals ovate-oblong, short-clawed, obtuse, inflexed at apex, 5 - 7 x 2.5 - 4 mm, pink or white, pubescent outside except margin. Stamens 2.5 - 5 mm long, glabrous, pubescent or puberulous; anther lobes oblong; connectives produced beyond anther lobes. Pistil ca 4 mm

long; stigma capitate. Drupes 3-gonous, 1.2 - 2.4 x 1 - 1.4 cm.

Fl. & Fr.: Jan. - Sept.

Habitat: Gravelley soil in dry hills and on slopes, 275 - 900 m.

Distrib.: Malabar (Engler, 1883) and Idukki (Anjanad, Rama Rao, *l.c.*). Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and W. Bengal. Endemic.

Uses: The oleo-gum-resin, known as Indian olibanum, is used as an incense; also used in medicine for rheumatism, nervous diseases, urinary disorders and skin diseases, and as an ingredient in certain ointments. Boswellia oil is used in paint making.

2. CANARIUM L.

Tall trees, rarely shrubs. Leaves spiral, alternate, stipuled or not, imparipinnate; leaflets slightly oblique at base, entire to dentate or serrate at margin, acuminate at apex; the lowest leaflets often stipuliform. Inflorescences axillary or terminal, sometimes pseudoterminal branched panicles, thyrsoid. Flowers bracteate, 3-merous, uni- or bisexual. Calyx cupular or urceolate; lobes deltoid, persistent. Petals oblong or obovate with a small inflexed apiculum. Stamens 6, rarely 3; filaments free or connate at base; anthers oblong-lanceolate, dorsifixed, sterile in female flowers. Disc intrastaminal, 6-lobed. Ovary ovoid or ellipsoid, 3-loculed with 2 ovules in each; style cylindrical; stigma capitate, faintly 3-lobed; pistil in male flowers reduced to a pistillode or absent, sometimes united with disc to form an 'ovario disc'. Drupes ovoid or ellipsoid, often 3-gonous, usually blue-black when ripe; pericarp fleshy, rarely fibrous; pyrenes stony; locules 3, 1 or 2 sterile; seed 1 in each locule, brown.

Old World tropics, ca 75 species, 6 in India and 2 (1 cultivated) in Kerala.

Literature: Leenhouts, P.W. 1959. Revision of the *Burseraceae* of the Malaysian area in a wider sense X a. - *Canarium*. *Blumea* 9: 275 - 471.

Key to species

- | | | |
|-----|--|-----------------------|
| 1a. | Stipules absent; leaflets ferruginous-tomentose beneath; indigenous | 1. <i>C. strictum</i> |
| b. | Stipules present; leaflets glabrous or pulverulent beneath; cultivated | 2. <i>C. vulgare</i> |

1. *Canarium strictum* Roxb., Fl. Ind. 3: 138. 1832; A.W. Benn. in Hook.f., Fl. Brit. India 1: 534. 1875; Bourd., Forest Trees Travancore: 76. 1908; Rama Rao, Fl. Pl. Travancore: 70. 1914; Gamble, Fl. Madras: 172(123). 1915; Manilal, Fl. Silent Valley: 47. 1988; Vajr., Fl. Palghat: 107. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 108. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 86. 1996; Sivar. & P. Mathew, Fl. Nilambur: 129. 1997; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 440. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 147. 2002.

Mal.: *Karuttukungiliyam, Kunthirikka-payin, Pantappayan, Thelli*

Large tree, buttressed; branchlets ferruginous-wooly. Leaves 20 - 56 cm long, 3 - 5(7)-jugate, variable in shape and degree of pubescence; rachises tomentose; leaflets ovate-elliptic, oblong-obovate, lanceolate or oblanceolate, oblique, obtuse, subcordate, rounded to broadly cuneate and slightly decurrent at base, serrulate, crenulate, irregularly and obscurely crenate or finely undulate at margin, short-acuminate at apex, 7 - 22 x 4 - 10 cm, coriaceous, ferruginous-tomentose beneath. Inflorescences axillary or pseudoterminal, paniced, thrysoid. Flowers uni- or bisexual, yellow, dull white or pale green with mangiferous odour. Male flowers: Calyx campanulate, 4 - 5.5 x 3 - 4 mm; lobes 3-angled, ferruginous-pubescent outside; petals oblong-lanceolate, 6.5 - 8.5 x 2.5 - 4.5 mm, concave, subglabrous to densely pubescent; stamens 6 - 8 mm long, connate into a tube; anthers acuminate; disc apically pilose; pistillode absent. Female inflorescences few-flowered; calyx tube urceolate, 5 - 6 x 4 - 5 mm, pubescent outside; petals oblong-oblanceolate, 7 - 8 x 3 - 4 mm, pubescent outside; stamens 3.5 - 4.5 mm long, connate; anthers reduced; disc obscurely lobed, pilose; pistil ca 6.5 mm long, flask-shaped; ovary and style hairy; style thick; stigma capitate; drupes oblong-ellipsoid or obovoid, 3.5 - 5 x 1.5 - 2 cm, dark blue.

Fl. & Fr.: Jan. - March & Nov. - Dec.

Habitat: Evergreen forests.

Distrib.: Idukki, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Assam, Karnataka, Meghalaya, Orissa, Sikkim and Tamil Nadu. Myanmar.

Uses: The resin, the black dammar of commerce, is used in the manufacture of varnishes, bottling wax and as a substitute for Burgundy pitch in plasters. Well-seasoned timber is used for making boards, ceiling, flooring and partitions.

Decoction or powder of resin is used in treating rheumatism, cough, fever and asthma.

2. *Canarium vulgare* Leenh. in Bernice P. Bishop Mus. Bull. 216: 31, f. 13. 1955 & Steenis, Fl. Males. I, 5: 263. 1956; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 441. 1997. *C. commune* L., Mant. Pl.: 127. 1767 p.p., excl. type; A.W. Benn. in Hook.f., Fl. Brit. India 1: 531. 1875; Rama Rao, Fl. Pl. Travancore: 71. 1914; Gamble, Fl. Madras: 172(123). 1915.

Mal.: *Karaiccingari*

Tree, to 45 m tall, buttressed. Leaves 23–32 cm long; stipules oblong, elliptic or rotundate, auricled, caducous; leaflets lanceolate or ovate-oblong (terminal leaflet often smaller and elliptic), slightly oblique at base, cuneate, dilated and jointed at point where lamina joins petiolule, entire or slightly wavy at margin, long-acuminate at apex, 4.5–16 x 2–7 cm, glabrous or pulverulent. Inflorescences terminal, thyrsoïd; bracts ovate-orbicular, concave, obtuse-rounded at apex. Flowers tomentose; male flowers sessile or subsessile; female ones pedicelled. Calyx cupular, ca 3.5 x 4.5 mm; lobes ovate, obtuse, densely pubescent. Petals ovate, obtuse, ca 4.5 x 3 mm. Stamens 6, free, ca 3 mm long. Disc in male flowers solid, sometimes with a style-like appendix; in female ones adnate to receptacle except rim. Ovary glabrous. Pistillode absent in male flowers. Drupes ovoid with persistent calyx.

Fl. & Fr.: March–June.

Malabar (Drury, *Handb. Indian Fl.* 1: 247. 1864) and Travancore (Malayattur, Rama Rao, *l.c.*). Native to Malaysia, elsewhere cultivated (*Wealth of India* 2: 53. 1950).

Uses: Seed is a substitute for almond and seed oil is used as a substitute for coconut oil. Emulsion of seed is used as a baby food. The oleo-resin called “nauli gum” is applied in the form of an ointment to indolent ulcers. Timber is useful.

3. COMMIPHORA Jacq., nom. cons.

Shrubs or small trees, deciduous; branchlets often spinescent. Leaves alternate or fascicled, exstipulate, imparipinnate, 3–7-foliolate; leaflets entire, crenate or serrate; lateral ones often shorter than terminal one. Flowers solitary, in fascicles or paniced dichasial cymes, crowded at ends of branches, sessile or

subsessile, bi- or unisexual. Calyx campanulate, cupular or tubular, 4- , rarely 5- or 6-lobed, persistent. Petals 4, rarely 5 or 6, inserted on margin of disc, linear-oblong, oblong or oblanceolate, apiculate, reflexed at apex, valvate. Disc cupular, free from calyx. Stamens 8 in 2 rows, alternately long and short; filaments flat or filiform; anthers oblong, basifixed. Ovary ovoid or oblong, sessile, 2 - 4-loculed with 2 ovules in each; style short; stigma 2- rarely 3- or 4-lobed. Drupes ovoid, globose or subglobose, apiculate, crustaceous or woody.

Africa and Madagascar, Arabia to Sri Lanka, Mexico and S. America, ca 190 species, 6 in India and 3 (1 cultivated) in Kerala.

Key to species

- | | | |
|-----|------------------------------------|----------------------|
| 1a. | Branchlets ending in a spine | 2 |
| b. | Branchlets not ending in a spine | 2. <i>C. caudata</i> |
| 2a. | Leaves 3-foliolate; indigenous | 1. <i>C. berryi</i> |
| b. | Leaves 5 - 7-foliolate; cultivated | 3. <i>C. myrrha</i> |

1. ***Commiphora berryi*** (Arn.) Engl. in A. & C. DC., Monogr. Phan. 4: 17. 1883; Gamble, Fl. Madras: 170(122). 1915; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 443. 1997. *Balsamodendron berryi* Arn. in Ann. Nat. Hist. 3: 86. 1839; A.W. Benn. in Hook.f., Fl. Brit. India 1: 529. 1875; Rama Rao, Fl. Pl. Travancore: 70. 1914.

Shrub or small tree, 3 - 6 (- 10) m high; branchlets ending in sharp spines. Leaves alternate or fascicled, 3-foliolate; leaflets sessile, obovate to ovate-suborbicular, terminal leaflet larger than lateral ones, cuneate or subacute at base, entire to crenate at margin, obtuse or rotund at apex, 0.3 - 2 x 0.3 - 1.5 cm, chartaceous, glabrous, shining above. Flowers solitary or fascicled, axillary. Calyx narrowly campanulate, 4-lobed; lobes 3-angled or deltoid. Petals 4, oblanceolate; apiculate, deep red, pink or cream-coloured. Stamens 8, free, alternately long and short, larger in male flowers. Disc small, 6 - 8-lobed. Drupes oblong or ovoid-subglobose, 0.8 - 1.2 x 0.6 - 0.9 cm, beaked; seeds 2.

Fl.: Feb. - March *Fr.*: June - Dec.

Habitat: Dry areas.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*), Andhra Pradesh, Karnataka and Tamil Nadu. Endemic.

Uses: Grown as a hedge plant in S. India; yields a fragrant gum-resin.

2. *Commiphora caudata* (Wight & Arn.) Engl. in A. & C. DC., Monogr. Phan. 4: 27. 1883; Gamble, Fl. Madras: 171(122). 1915; Manilal & Sivar., Fl. Calicut: 62. 1982; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 443. 1997. *Protium caudatum* Wight & Arn., Prodr. Fl. Ind. Orient.: 176. 1834; A.W. Benn. in Hook.f., Fl. Brit. India 1: 530. 1875; Bourd., Forest Trees Travancore: 76. 1908; Rama Rao, Fl. Pl. Travancore: 70. 1914.

Mal.: *Kilimaram*

Tree, 5 - 15 m high with short thorns on old wood, glabrous. Leaves alternate; leaflets 3 - 7, terminal one larger, ovate-oblong, lanceolate or elliptic, cuneate or attenuate at base, entire at margin, long-acuminate or caudate at apex, 2.7 - 10.5 x 1.3 - 5 cm, chartaceous, glabrous, shining above. Panicles terminal or axillary; bracts linear; bracteoles short. Flowers uni- or bisexual, fragrant. Calyx 4-lobed; lobes ovate or deltoid, 2 - 4 mm long, as long as broad, persistent. Petals 4, linear-oblong or oblanceolate, apiculate at apex, 4 - 6 mm long, pale green to red. Disc intrastaminal. Stamens 8, 1 - 3.5 mm long; filaments dilated at base. Pistillode short. Ovary in bisexual and female flowers ovoid or oblong, 2-loculed; ovules pendulous; style short; stigma 2-lobed. Drupes ellipsoid or globose, 0.7 - 1.7 x 0.8 - 1.5 cm, black; pyrenes 1 or 2; seeds ca 2 mm long with 4 radiating wings.

Fl. & Fr.: March - Oct.

Habitat: Dry forests.

Distrib.: Idukki (Cardamom hills, Bourdillon, *l.c.*; Rama Rao, *l.c.*) and Kozhikode. Andhra Pradesh, Karnataka and Tamil Nadu. Sri Lanka.

Uses: Planted as an avenue tree. Oleo-gum-resin, obtained from bark and leaf, is used in medicine, as incense and for embalming. Fruit is pickled and eaten.

3. *Commiphora myrrha* (T. Nees) Engl. in A. & C. DC., Monogr. Phan. 4: 10. 1883; Dutt in Indian Oil & Soap J. 26: 233. 1961; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 445. 1997. *Balsamodendron myrrha* T. Nees in Weyhe, Pl. Medicin.: t. 182. 1828.

Small, deciduous tree; branchlets spiny. Leaflets 5 - 7, ovate-oblong or oblanceolate. Flowers small in numerous branched, 7 - 20 cm long clusters, ap-

pearing before leaves. Fruits broadly ovoid or ellipsoid.

Native to Arabia; cultivated in dry hilly regions of Malabar.

Uses: The gum obtained from the tree is used in Ayurvedic and Unani medicines; occasionally used as an incense in religious worship.

Whole plant aromatic like green mangoes ... Dutt (*l.c.*).

4. GARUGA Roxb.

Deciduous trees; branchlets pubescent. Leaves alternate, imparipinnate, clustered at ends of branches; stipules caducous; leaflets opposite or subopposite, subsessile, crenate-serrate; stipels often present. Panicles axillary, much branched, in clusters at ends of branchlets. Flowers bi- or unisexual, 5-merous. Calyx broadly or narrowly campanulate, tomentose; lobes ovate. Petals inserted on calyx. Disc cupular, crenate, adnate to receptacle. Stamens 10, free, equal or alternately long and short, inserted in notches of disc; filaments subulate, pubescent; anthers oblong. Ovary ovoid, pubescent or glabrous, 4- or 5-loculed with 2 ovules in each; style grooved, pubescent; stigma capitate, 4- or 5-lobed. Drupes globose; pericarp fleshy; pyrenes 1 - 5, bony, rugose, 1-seeded.

Himalayas, Indomalaysia to the W. Pacific, 4 species and 2 in India.

Key to species

- 1a. Leaves glabrous; calyx tube less than 2 mm long, persistent in fruit; drupes 8 - 10 mm across, obtuse 1. *G. floribunda* var. *gamblei*
- b. Leaves pubescent; calyx tube more than 3 mm long, caducous; drupes 15 - 20 mm across, horned 2. *G. pinnata*

1. *Garuga floribunda* Decne. var. *gamblei* (King ex W.W. Sm.) Kalkman in *Blumea* 7: 466. 1953; Chithra & A.N. Henry in Hajra & al., *Fl. India* 4: 448. 1997. *G. gamblei* King ex W.W. Sm. in *Rec. Bot. Surv. India* 4: 262. 1911; Gamble, *Fl. Madras*: 169(121). 1915.

Tall tree, often buttressed; bark smooth, ash-grey; young parts puberulous. Leaves to 45 cm long; stipules oblong, caducous; leaflets ovate-oblong to oblong-lanceolate, oblique, cuneate at base, crenate-serrate at margin, acuminate at apex, 3.6 - 15 x 1.5 - 4 cm, chartaceous. Panicles to 20 cm long, pubescent or glabrescent; bracts linear. Flowers fragrant. Calyx narrowly campanulate, ca 1.5

mm long; lobes 3-angled, minutely tomentose or puberulous outside. Petals oblong or ovate, acuminate at apex, 3 - 4 x 1 - 1.5 mm, pubescent, white or pale yellow. Stamens ca 2 mm long; filaments puberulous. Disc crenate. Ovary sparsely puberulous; style pubescent; stigma lobed. Drupes globose, 8 - 10 mm, 4-lobed; pyrenes 4, 1-seeded.

Fl. & Fr.: Feb. - June.

Habitat: Deciduous forests.

Distrib.: Kasaragod and Malabar (Gamble, *l.c.*). Assam, E. Himalayas, Sikkim and W. Ghats. Bangladesh and China.

Use: Wood is used for expensive furniture.

2. *Garuga pinnata* Roxb., Pl. Coromandel 3: 5, t. 208. 1811; A.W. Benn. in Hook.f., Fl. Brit. India 1: 528. 1875; Rama Rao, Fl. Pl. Travancore: 70. 1914; Gamble, Fl. Madras: 169(121). 1915; Manilal & Sivar., Fl. Calicut: 63. 1982; Nicolson & al. in Regnum Veg. 119: 75. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 86. 1988; Vajr., Fl. Palghat: 107. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 87. 1996; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 448. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 148. 2002.

Mal.: *Kareyam, Karuvembu, Kattukalasan, Kosaramba*

Tall tree; bark white, grey or brown; branchlets pubescent. Leaves to 42 cm long; stipules falcate; leaflets 11 - 17, variable in size, ovate-obovate, elliptic or oblong-lanceolate, oblique at base, subentire or serrate-crenate at margin, acute to acuminate at apex, 2.8 - 14.2 x 1.5 - 5.9 cm, chartaceous, pubescent. Panicles 7 - 30 cm long, tomentose; bracts linear. Calyx 3 - 8 mm long; lobes 5, ovate-oblong, densely tomentose. Petals 5, oblong-lanceolate, 5 - 8 x 1.5 - 2 mm, tomentose, cream-coloured or pale yellow. Stamens 3 - 3.5 mm long, inserted on calyx; filaments pubescent. Disc crenate, yellow. Ovary globose, pilose; style pilose; stigma 5-lobed. Drupes oblong or irregularly globose, 1.5 - 2 cm across, fleshy; pyrenes 2 or 3; seeds with a membranous wing.

Fl.: Feb. - May *Fr.*: May - Nov.

Habitat: Deciduous forests, 150 - 900 m.

Distrib.: Kannur, Kasaragod, Kottayam, Kozhikode, Palakkad, Thiruvananthapuram and Thrissur. Throughout India. South and SE. Asia.

Uses: Fruit is edible, used in preparing pickles. Bark and galls are used for tan-

ning. Leaf juice is used in asthma. Timber is used for planking, canoes, boxes, drums, cabinet work, house-building etc. Tree is valuable in afforestation.

MELIACEAE

(N.C. NAIR & N.P. BALAKRISHNAN)

Trees, shrubs or undershrubs. Leaves alternate, rarely opposite, exstipulate, 3- or more-foliolate, rarely 1-foliolate by reduction, mostly 1-pinnate, 2-pinnate; leaflets alternate or opposite, entire or dentate, rarely glandular-punctate. Inflorescences axillary or terminal panicles, racemes, thyrses or umbels, sometimes cauliflorous. Flowers pedicelled or not, bisexual, sometimes polygamous, rarely dioecious or polygamo-regular, 3 - 6-merous, hypogynous, ebracteolate. Sepals 3 - 6, connate at base or free, imbricate, rarely valvate. Petals 5(3 - 14), free, rarely shortly connate, mostly imbricate, rarely valvate or contorted, sometimes adnate to staminal tube at base. Stamens 8 or 10(3 - 25), as many or twice as many as petals, connate into a tube (free in *Toona*); tube cupular, globose or urceolate, apically lobed or free; lobes 2-fid or -toothed; anthers attached to staminal tube inside, opposite or alternate with tube lobes, exserted or not, 2-loculed, dorsi- or basifixed, introrse, usually sessile. Disc tubular, annular, fleshy or indistinct. Ovary superior, sometimes adnate to or within disc, 2 - 5- , rarely 1-loculed; locules 2 (- many)-ovuled; ovules collateral or superposed, 2-tegmic, crassinucellar, ana-ortho- or campylotropous; style simple, sometimes absent; stigma usually capitate or lobed, sometimes sessile. Fruits capsular, baccate or drupaceous; seeds winged or not, arillate or not; raphe ventral; embryo large, straight; cotyledons usually fleshy, sometimes thin; endosperm moderate or absent.

Tropics and subtropics, 51 genera and 565 species, 19 and 70 in India and, 17 and 32 in Kerala.

Note: The genus *Toona* (Endl.) M. Roem. is sometimes considered congeneric with the New World genus *Cedrela* P. Browne. Due to the presence of free stamens some authors treat this genus in *Flindersiaceae* along with *Chloroxylon* DC. and *Cedrela*.

Literature: Chang, K.T. & Wang, F.H. 1956. Morphology of pollen grains of *Meliaceae*. *Acta Bot. Sin.* 5: 253 - 265. Choudhuri, A.B. 1965. A study of *Meliaceae* of India with special

reference to West Bengal. *Indian Forester* 91: 454 - 461. Chowdhuri, A.B. 1967. Studies on *Meliaceae* of India and neighbouring countries. *Bull. Bot. Soc. Bengal* 21: 1 - 24. Datta, P.C. & Samanta, P. 1977. Cytotaxonomy of *Meliaceae*. *Cytologia* 42: 197 - 208. Harms, H. 1940. *Meliaceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2, 19b: 1 - 172. Juliano, J.B. 1934. Studies on the morphology of the *Meliaceae*. *Philipp. J. Agric.* 23: 253 - 266. Khosla, P.K. & Styles, B.T. 1975. Karyological studies and chromosomal evolution in *Meliaceae*. *Silvae Genet.* 24: 73 - 83. Kribs, D.A. 1930. Comparative anatomy of the woods of *Meliaceae*. *Amer. J. Bot.* 17: 724 - 738. Miller, N.G. 1990. The genera of *Meliaceae* in the Southeastern United States. *J. Arnold Arbor.* 71: 453 - 486. Nair, N.C. 1962. Studies on *Meliaceae* V. Morphology and anatomy of the flower of tribes Melieae, Trichilieae and Swietenieae. *J. Indian Bot. Soc.* 41: 226 - 249. Nair, N.C. 1963. Studies on *Meliaceae* VI. Morphology and anatomy of the flower of the tribe Cedreleae and a discussion on the floral anatomy of the family. *J. Indian Bot. Soc.* 42: 177 - 189. Paetow, W. 1931. Embryologische untersuchungen an *Taccaceen*, *Meliaceen* und *Dilleniaceen*. *Planta* 14: 441 - 470. Pennington, T.D. & Styles, B.T. 1975. A generic monograph of the *Meliaceae*. *Blumea* 22: 419 - 540. Styles, B.T. & Vosa, C.G. 1971. Chromosome numbers in the *Meliaceae*. *Taxon* 20: 485 - 499.

Key to genera

1a. Stamens 5, free	13. <i>Toona</i>
b. Stamens 8 - 10, connate	2
2a. Ovary locules with 1 or 2 ovules	3
b. Ovary locules with more than 2 ovules	16
3a. Undershrubs; petioles winged; staminal tube usually inflated at top	9. <i>Naregamia</i>
b. Shrubs or trees; petioles not winged; staminal tube not inflated at top	4
4a. Filaments connate below only	5
b. Filaments connate throughout	7
5a. Leaves 3 - 5-foliolate	16. <i>Walsura</i>
b. Leaves 5- or more-foliolate	6
6a. Leaflets toothed at margin	5. <i>Cipadessa</i>
b. Leaflets entire at margin	14. <i>Trichilia</i>
7a. Petals 3	2. <i>Aphanamixis</i>
b. Petals 4 or 5 (- 6)	8
8a. Staminal tube apically entire or 5-toothed	1. <i>Aglaia</i>
b. Staminal tube apically lobed	9
9a. Leaves simple	15. <i>Turraea</i>
b. Leaves not simple	10

10a.	Leaflets regularly toothed at margin	11
b.	Leaflets entire or coarsely toothed at margin	12
11a.	Leaves 2- or 3-pinnate	7. <i>Melia</i>
b.	Leaves 1-pinnate	3. <i>Azadirachta</i>
12a.	Anthers in 2 rows	10. <i>Reinwardtiadendron</i>
b.	Anthers in 1 row	13
13a.	Disc tubular and enclosing ovary	14
b.	Disc annular, fleshy and flat, or absent	15
14a.	Leaflets opposite, entire or coarsely toothed	8. <i>Munronia</i>
b.	Leaflets subopposite or alternate, entire	6. <i>Dysoxylum</i>
15a.	Disc absent	4. <i>Chukrasia</i>
b.	Disc present, flat or annular	11. <i>Soymida</i>
16a.	Ovary 5-loculed with many ovules in each	12. <i>Swietenia</i>
b.	Ovary 4-loculed with 2 - 12 ovules in each	17. <i>Xylocarpus</i>

1. *AGLAIA* Lour., nom. cons.

Evergreen trees or shrubs; branches glabrous, stellate-pubescent or scurfy-scaly. Leaves alternate, pinnate or 1-foliolate; leaflets opposite or subopposite, entire. Flowers in axillary branched panicles, polygamodioecious, globose, 4- or 5-merous. Sepals imbricate. Petals free or shortly adnate to staminal tube, imbricate, concave. Staminal tube subglobose or globose, entire or 5-toothed at apex; anthers 5 or 10, erect, included or partly or fully exerted. Disc absent or inconspicuous. Ovary ovoid, 1- or 2-, rarely 3-loculed with 1 or 2 ovules in each; style very short; stigma simple or lobed. Fruits 1 - 5-loculed berries with a coriaceous fleshy or corky pericarp, or a capsule; aril fleshy or absent; cotyledons thick, superposed, enclosing minutely villous or glabrous embryo; endosperm absent.

Indomalesia and the W. Pacific, 105 species, 23 in India and 9 in Kerala.

Literature: Kostermans, A.J.G.H. 1966. A monograph of *Aglaia* Sect. *Lansium* Kosterm. (*Meliaceae*). *Reinwardtia* 7: 221 - 282.

Key to species

1a.	Leaves 1-foliolate	10. <i>A. simplicifolia</i>
b.	Leaves 3 - 11-foliolate	2

2a.	Inflorescences and leaves rufous-scaly beneath	3
b.	Inflorescences and leaves not rufous-scaly beneath, either glabrous, stellate-tomentose or pubescent	4
3a.	Leaves 10 - 15 x 2 - 10 cm; ovary 2-loculed	3. <i>A. elaeagnoidea</i>
b.	Leaves 27 - 36 x 21 - 38 cm; ovary 3-loculed	8. <i>A. malabarica</i>
4a.	Leaflets more than 7	5
b.	Leaflets less than 7	7
5a.	Stamens exserted from staminal tube	9. <i>A. minutiflora</i>
b.	Stamens included in staminal tube	6
6a.	Leaflets unequal at base, black when dry; flowers pedicelled, black when dry	7. <i>A. maiae</i>
b.	Leaflets obtusely acute or rounded at base, olive brown when dry; flowers sessile, brown when dry	2. <i>A. canarensis</i>
7a.	Seeds arillate	8
b.	Seeds exarillate	9
8a.	Fruits baccate	1. <i>A. barberi</i>
b.	Fruits capsular	4. <i>A. indica</i>
9a.	Leaves lepidote	5. <i>A. jainii</i>
b.	Leaves not lepidote	6. <i>A. jawii</i>

1. *Aglaia barberi* Gamble in Bull. Misc. Inform. 1915: 346. 1915 & Fl. Madras: 180(129). 1915; Sasidh. & Sivar., Fl. Pl. Thrissur: 88. 1996; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 457. 1997.

Tree, to 10 m high; branches lepidote when young, reddish brown. Leaves alternate, imparipinnate, to 10 cm long; leaflets 7, subopposite, lanceolate or elliptic, acutely oblique at base, long-acuminate at apex, 6 - 12 x 2 - 4 cm; lateral nerves ca 12, nearly at right angles to midnerve, lepidote; reticulations obscure; petiolules 3 - 7 mm long. Inflorescences axillary, paniced with cymose branching, to 15 cm long, lepidote; bracts minute. Flowers close together. Sepals shortly ciliate. Petals oblong-ovate, glabrous. Staminal tube globose, undulate at apex, not contracted at base; stamens as long as tube; anthers ovoid, included in tube. Ovary villous; style short; stigma capitate. Berries globose to obovoid, depressed at apex, 1 - 1.5 cm across, reddish brown; seeds arillate.

Fl.: Nov. - Feb. *Fr.*: March - April.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Idukki, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu (Coimbatore and Tirunelveli). Endemic.

2. *Aglaia canarensis* Gamble in Bull. Misc. Inform. 1915: 374. 1915 & Fl. Madras: 180(129). 1915; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 459. 1997.

Tree or shrub; young branches lepidote. Leaves alternate, to 40 cm long; leaflets 13, opposite or subopposite, obtusely acute or rounded at base, acuminate at apex, 13 - 17 x ca 5 cm; lateral nerves 12 - 15, nearly at right angles to midnerve, puberulous; reticulations obscure; petiolules ca 1 cm long. Inflorescences axillary, paniced with ultimate spicate branches, to 40 cm long; peduncles to 16 cm long, lepidote; bracteoles acute. Flowers distant, sessile, lepidote. Calyx campanulate, pubescent; lobes obtuse, ciliate. Petals oblong, 1 - 2 mm long, glabrous. Staminal tube subglobose, glabrous; anthers acute, included in staminal tube. Ovary conic; style short. Fruit not known.

Fl.: Nov. - April.

Habitat: Evergreen and semievergreen forests, to 1000 m, very rare.

Distrib.: Kollam, Pathanamthitta and Wynad. Western Ghats of Karnataka. Endemic.

3. *Aglaia elaeagnoidea* (A. Juss.) Benth., Fl. Austral. 1: 383. 1863; Backer & Bakh.f., Fl. Java 2: 128. 1965; Manilal & Sivar., Fl. Calicut: 63. 1982; Nicolson & al. in Regnum Veg. 119: 177. 1988. *Nemadra elaeagnoidea* A. Juss. in Mem. Mus. Hist. Nat. 19: 259, t. 14. 1830. *Milnea roxburghiana* Wight & Arn., Prodr. Fl. Ind. Orient.: 119. 1834. *Aglaia roxburghiana* (Wight & Arn.) Miq., Ann. Mus. Lugd.-Bat. 4: 41. 1868; Bedd., Fl. Sylv. S. India: t. 130. 1871; Hiern in Hook.f., Fl. Brit. India 1: 555. 1875; Bourd., Forest Trees Travancore: 84. 1908; Rama Rao, Fl. Pl. Travancore: 74. 1914; Gamble, Fl. Madras: 180(128). 1915.

Tree, to 15 m tall. Leaflets 3 - 7, petioluled or not, elliptic, oblong, oblong-lanceolate, narrowly lanceolate or oblanceolate, 10 - 15 x 2 - 10 cm, glabrous above, pubescent beneath, scaly beneath or not, drying brown or grey beneath; lateral nerves nearly at right angles to midnerve or prominently oblique. Panicles close, to 15 cm long, rufous-scaly; branches of female panicles spicate, those of male ones cymose. Flowers polygamodioecious, pedicelled or not, 5-merous, pale yellow. Calyx scaly or not, tomentose or not; lobes rounded or

acute. Petals obovate or oblong, apically hooded, to 1.7 mm long, imbricate. Staminal tube urceolate or globose, shorter than petals; anthers 5, included in staminal tube or slightly exerted. Disc obscure. Ovary globose, ca 1 mm, pubescent, 2-loculed with 1 or 2 ovules in each; stigma sessile, almost as broad as ovary, obscurely 2-lobed. Berries globose, subglobose or ovoid, to 1.5 cm long, ferruginous-velvety-tomentose; seed 1, ellipsoid, exarillate.

Key to varieties

- 1a. Lateral nerves in leaflets nearly at right angles to midnerve; anthers included in staminal tube 2
- b. Lateral nerves in leaflets oblique; anthers exerted from staminal tube 3.2. var. *bourdillonii*
- 2a. Leaflets oblong or elliptic-lanceolate, to 15 x 5 cm, drying brownish red 3.4. var. *elaegnoidea*
- b. Leaflets narrowly lanceolate or ovate to oblanceolate, to 10 x 2.5 cm, drying greyish 3
- 3a. Leaflets usually 5, ovate to oblanceolate 3.3. var. *courtallensis*
- b. Leaflets usually 7, narrowly lanceolate 3.1. var. *beddomei*

3.1. var. *beddomei* (Gamble) K.K.N. Nair in J. Bombay Nat. Hist. Soc. 78: 426. 1981; Vajr., Fl. Palghat: 109. 1990; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 462. 1997. *Aglaia roxburghiana* (Wight & Arn.) Miq. var. *beddomei* Gamble, Fl. Madras: 180(128). 1915. *A. roxburghiana* sensu Bedd., Fl. Sylv. S. India: t. 130A. 1871 p.p., non (Wight & Arn.) Miq. 1868.

Mal.: *Punyava*

Fl. & Fr.: Nov. - Feb.

Habitat: Semievergreen forests, to 1000 m.

Distrib.: Idukki, Kannur, Kottayam, Palakkad, Pathanamthitta and Thiruvananthapuram. Eastern and W. Ghats of Andhra Pradesh, Orissa and Tamil Nadu. Endemic.

3.2. var. *bourdillonii* (Gamble) K.K.N. Nair in J. Bombay Nat. Hist. Soc. 78: 426. 1981; Manilal, Fl. Silent Valley: 48. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 109. 1994; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 462. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 149. 2002. *Aglaia bourdillonii* Gamble in Bull. Misc. Inform. 1915: 346. 1915 & Fl. Madras:

180(129). 1915. *A. roxburghiana* sensu Bedd., Fl. Sylv. S. India: t. 130B. 1871 p.p., non (Wight & Arn.) Miq. 1868.

Fl. & Fr.: Nov. - April.

Habitat: Forests above 1000 m.

Distrib.: Palakkad and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

3.3. var. *courtallensis* (Gamble) K.K.N. Nair in J. Bombay Nat. Hist. Soc. 78: 426. 1981; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 109. 1994; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 465. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 149. 2002. *Aglaia roxburghiana* (Wight & Arn.) Miq. var. *courtallensis* Gamble, Fl. Madras: 180(129). 1915.

Fl. & Fr.: Nov. - April.

Habitat: Evergreen forests.

Distrib.: Idukki, Kollam, Pathanamthitta and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

3.4. var. *elaegnoidea*

Mal.: *Njazhel*

Fl.: Feb. May *Fr.*: Aug. Oct.

Habitat: Semievergreen forests at lower elevations.

Distrib.: Alappuzha, Idukki, Kasaragod, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta and Wynad. Bihar, Goa, Karnataka, Maharashtra, Orissa and Tamil Nadu. Malesia.

Uses: Fruit is edible, sweet, cooling and astringent. Wood, dark red, smooth and very strong, is used for ornamental furniture, axe handles and spokes of wheels. Ash is medicinal.

4. *Aglaia indica* (Hook.f.) Harms in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19b1: 146. 1940; N.C. Nair & Rajan in N.C. Nair & A.N. Henry, Fl. Tamil Nadu 1: 66. 1983; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 87. 1988; Sivar. & P. Mathew, Fl. Nilambur: 130. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 468. 1997. *Beddomea indica* Hook.f. in Benth. & Hook.f., Gen. Pl. 1: 336. 1862; Hiern in Hook.f., Fl. Brit. India 1: 566. 1875; Gamble, Fl. Madras: 184(132). 1915.

Shrub, to 3 m high. Leaves to 35 cm long; leaflets 3-5, opposite or subopposite, elliptic, cuneate at base, entire at margin, obtuse at apex, to 18 x 8 cm, pubescent, lepidote; petiolules to 2.5 cm long. Panicles lax, axillary. Flowers bisexual, 4-6-merous, to 6.5 mm across. Calyx lobes ovate, spreading, imbricate in bud. Petals orbicular, concave, imbricate in bud. Staminal tube globose, crenulate at small mouth, thick; anthers 4-6, included in staminal tube; connectives thick, adnate to staminal tube on their back. Ovary within inconspicuous disc, shortly hairy, 3-loculed; ovules 2 in each locule, collateral; style short, thick; stigma 3-lobed. Capsules obovoid, beaked, furrowed, coriaceous, stellate-pubescent, dehiscing into 2 or 3 valves; seeds 3-5, more or less angled, exarillate.

Fl. & Fr.: Nov. - April.

Habitat: Undergrowth in evergreen forests, to 1000 m.

Distrib.: Kannur, Malappuram, Palakkad and Wynad. Western Ghats of Tamil Nadu (Nilgiris). Endemic.

5. *Aglaia jainii* M.V. Viswan. & K. Ramach. in Bull. Bot. Surv. India 24: 212. 1983; Sivar. & P. Mathew, Fl. Nilambur: 131. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 469. 1997. *Oraoma canarana* Turcz. in Bull. Soc. Imp. Naturalistes Moscou 1: 411. 1858. *Amoora canarana* (Turcz.) Hiern in Hook.f., Fl. Brit. India 1: 560. 1875, non *Aglaia canarensis* Gamble 1915; Bourd., Forest Trees Travancore: 77. 1908; Rama Rao, Fl. Pl. Travancore: 75. 1914; Gamble, Fl. Madras: 182(129). 1915. *Aglaia tamilnadensis* N.C. Nair & Rajan in N.C. Nair & A.N. Henry, Fl. Tamil Nadu 1: 66. 1983; Manilal, Fl. Silent Valley: 48. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 88. 1988.

Mal.: *Karagil*

Tree, 10-20 m tall, densely foliaceous; young parts lepidote. Leaves pinnate, 12-40 x 5-20 cm; leaflets 4-8, subsessile, alternate or subalternate, narrowly elliptic or oblong, narrow at oblique base, entire or often undulate at margin, to 22 x 8 cm, thin-coriaceous, glabrate above, lepidote beneath; petiolules to 10 mm long. Flowers polygamodioecious, short-pedicelled, ca 5 mm across, yellowish, fragrant, male flowers in pyramidal axillary panicles, female ones in branched racemes, shorter than leaves. Calyx cupular, 4- or 5-lobed; lobes 3-angled, lepidote. Petals 4 or 5, imbricate, concave, glabrous, greenish yellow. Staminal tube campanulate, apically crenate; anthers 6-10, included or very slightly

exserted. Ovary ovoid, ribbed, lepidote, 3-loculed; ovules 1 or 2 in each locule; style absent; stigma discoid, 3-toothed. Capsules crowded on erect branches, subglobose or ovoid, to 3 cm long, coriaceous, lepidote, grey to greenish, 3-valved; seeds surrounded by fleshy aril with ventral hilum and coriaceous testa.

Fl.: Oct. - March *Fr.*: May - Aug.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Ernakulam, Idukki, Kannur, Malappuram and Palakkad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

6. *Aglaia lawii* (Wight) C.J. Saldanha in C.J. Saldanha & Nicolson, *Fl. Hassan*: 392. 1976; Vajr., *Fl. Palghat*: 109. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 88. 1996; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 471. 1997. *Nimmonia lawii* Wight in *Calcutta J. Nat. Hist.* 7: 13. 1847. *Amoora lawii* (Wight) Bedd., *Fl. Sylv. S. India*: t. 133. 1871; Hiern in *Hook.f., Fl. Brit. India* 1: 561. 1875; Rama Rao, *Fl. Pl. Travancore*: 75. 1914; Gamble, *Fl. Madras*: 182(130). 1915.

Tree, to 15 m tall; young parts lepidote; scales yellowish brown. Leaves imparipinnate, to 30 cm long; leaflets 3 - 5, sometimes alternate, ovate-lanceolate, oblique, entire at margin, 11 - 16 x 4 - 6 cm, thin. Inflorescences lepidote; male flowers in panicles of racemes, female ones in short spikes. Flowers polygamodioecious, 4-merous. Calyx almost truncate, lepidote. Petals 4, oblong, ca 4 x 3 mm, white. Staminal tube almost globose, crenulate at mouth; anthers 8 - 10. Ovary lepidote, 3-loculed; ovule 1 in each locule; style absent; stigma 3-lobed. Fruits pyriform, ca 2.5 cm long.

Fl. & Fr.: Jan. - March.

Habitat: Semievergreen forests at low elevations, rare.

Distrib.: Idukki, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

7. *Aglaia maiae* Bourd. in *J. Bombay Nat. Hist. Soc.* 12: 349. 1899 & *Forest Trees Travancore*: 75. 1908; Rama Rao, *Fl. Pl. Travancore*: 74. 1914; Gamble, *Fl. Madras*: 180(129). 1915; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 473. 1997.

Slender, handsome tree, to 25 m tall; bark smooth, reddish brown, flaking off. Leaves 50 - 65 cm long; leaflets usually 11 - 13, oblong-elliptic or lanceolate, oblique at base, rounded at apex, 10 - 16 x 5.5 - 6 cm, coriaceous, glabrous be-

neath, shining, pale when young, dark green when mature, black on drying; lateral nerves nearly at right angles to midnerve; petiolules ca 1.25 cm long. Panicles to 35 cm long, lax, drying black; flowers glabrous, yellow, black when dry. Calyx lobes acute. Petals 5, free, concave. Staminal tube globose, entire; anthers 5 - 7, included. Ovary hairy, 2-loculed; ovules 2 in each locule, collateral. Fruits ovoid, ca 2.5 cm long, pubescent; seeds exarillate.

Fl.: March *May Fr.*: Aug. Oct.

Habitat: Evergreen forests, to 450 m.

Distrib.: Ernakulam, Idukki, Kollam and Pathanamthitta. Western Ghats of Karnataka (Hassan). Endemic.

Use: Wood is fragrant like sandalwood and useful for furniture and decoration works.

8. *Aglaia malabarica* Sasidh. in Kew Bull. 16(Add. Ser.): 369, f. 113. 1992.

Mal.: *Churranakil*

Tree, 20 - 25 m tall; bark smooth, brown, reddish brown inside; twigs longitudinally ridged, peltate-scaly, brown or greyish brown. Leaves imparipinnate, 27 - 36 x 21 - 38 cm; petioles 4.5 - 8.5 cm long; rachises, petioles and petiolules peltate-scaly; leaflets 7 - 11, alternate, ovate or oblong, slightly asymmetric, rounded at base, acuminate at apex with acute or obtuse 10 - 20 mm long acumen, 6 - 21 x 2.2 - 8 cm, pitted and peltate-scaly above, peltate-scaly beneath; lateral nerves 10 - 19 pairs, ascending and curved upwards near margin; petiolules 10 - 25 mm long. Male inflorescences ca 20 x 15 cm, peltate-scaly; flowers 2.5 - 3 mm long; pedicels 1 - 1.5 mm long; calyx ca 0.5 mm long, cupular, 5-lobed; lobes rounded; petals 5(-7), quincuncial, yellow; staminal tube ca 2 x 1.6 - 2 mm, entire; anthers ovoid, included; ovary globose-depressed, 3-loculed with 1 ovule in each; stigma subglobose, depressed at apex. Female inflorescences ca 5.5 x 4 cm; flowers larger than male ones otherwise similar; fruits obovoid, depressed at apex, 3.5 - 4.5 x 2.7 - 4 cm, indehiscent; pericarp ridged and peltate-scaly; seeds 1.7 - 2.5 x ca 1.5 cm, surrounded by a thin translucent pink aril.

Fl. & Fr.: Dec. July.

Habitat: Evergreen forests, to 500 m, fairly common.

Distrib.: Thrissur.

9. *Aglaia minutiflora* Bedd., Icon. Pl. Ind. Orient.: t. 193. 1868-1874; Bourd., Forest Trees Travancore: 85. 1908; Rama Rao, Fl. Pl. Travancore: 74. 1914; Gamble, Fl. Madras: 181(129). 1915; Vajr., Fl. Palghat: 109. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 109. 1994. *A. minutiflora* Bedd. var. *travancorica* Hiern in Hook.f., Fl. Brit. India 1: 557. 1875. *A. travancorica* (Hiern) Bourd., Forest Trees Travancore: 85. 1908.

Mal.: *Nirmulei*

Slender tree, to 16 m tall; young parts ferruginous or rufous-stellate-tomentose; bark rough. Leaves to 65 cm long; leaflets to 15, opposite or subopposite, narrowly elliptic to oblong-lanceolate, subcordate at base, acuminate at apex, 5 - 7 x 2 - 6 cm, glabrescent above except midnerve, densely stellate-hairy beneath; lateral nerves conspicuous, not very oblique. Panicles to 50 cm long, spreading, divaricately branched, stellate-tomentose. Flowers ca 2 mm across. Calyx lobes acute to rounded. Petals subglabrescent. Anthers exerted from staminal tube. Disc inconspicuous. Ovary tomentose, 2-loculed; ovules 1 or 2 in each locule; style very short; stigma 2-lobed. Fruit a subglobose berry, 1- or 2-seeded.

Fl.: Oct. - Dec. *Fr.*: April - May.

Habitat: Evergreen forests, 500 - 1000 m.

Distrib.: Idukki, Palakkad, Pathanamthitta and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

Uses: A handsome tree, can be introduced into gardens. Wood is reddish pink and fragrant.

Note: *Aglaia minutiflora* Bedd. var. *griffithii* Hiern from NE. India and Malesia is *Aglaia exstipulata* (Griff.) Theob.

10. *Aglaia simplicifolia* (Bedd.) Harms in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19bI: 146. 1940; N.C. Nair & Rajan in N.C. Nair & A.N. Henry, Fl. Tamil Nadu 1: 66. 1983; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 87. 1988; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 474. 1997. *Beddomea simplicifolia* Bedd., Fl. Sylv. S. India: t. 135. 1871; Hiern in Hook.f., Fl. Brit. India 1: 566. 1875, incl. vars.; Bourd., Forest Trees Travancore: 79. 1908; Rama Rao, Fl. Pl. Travancore: 76. 1914; Gamble, Fl. Madras: 184(132). 1915.

Small tree, 3 - 6 m high; young parts scurfy or rufous-tomentose. Leaves petioled, 1-foliolate, elliptic or narrowly so, obtuse or cuneate at base, entire at

margin, subacuminate at apex, to 20 x 10 cm, glabrescent; petioles to 2.5 cm long, thickened and jointed near apex. Panicles or racemes varied, shorter than to much longer than leaves. Flowers variable in size, to 5 mm across, 4 - 6-merous. Sepals large and enclosing petals, imbricate in bud. Petals free, concave, imbricate in bud. Staminal tube globose, thin, crenulate at mouth; anthers 4 - 6, small, inserted near top of staminal tube, partly exerted; connectives thick, broadly attached on their back. Disc inconspicuous. Ovary villous, 3-loculed; ovules 2 in each locule, collateral; style short; stigma 3-lobed. Capsules ellipsoid or ovoid to oblong, ca 4 cm long, stellate-pubescent, dehiscing into 3 valves; seeds 3 - 6, exarillate.

Fl.: July - Aug. *Fr.*: Sept. - Dec.

Habitat: Evergreen forests, 600 - 1300 m.

Distrib.: Idukki, Kannur, Thiruvananthapuram and Wynad. Western Ghats of Karnataka (Coorg) and Tamil Nadu (Coimbatore, Madurai and Tirunelveli). Endemic.

2. APHANAMIXIS Blume

Evergreen trees. Leaves usually unequally pinnate, to 1 m long; leaflets usually oblique at base, entire. Inflorescences axillary spikes or racemes, often branched. Flowers subsessile, polygamous. Sepals usually 5. Petals 3, imbricate. Staminal tube subglobose or campanulate, toothed at apex; anthers 3 - 6 (8). Pistillode small. Ovary 3-loculed; ovules usually 2 in each locule, superposed; stigma subsessile, 3-lobed. Capsules subfleshy; seed 1 in each locule, fully or partially enclosed by orange, red or yellow aril.

Indomalesia to the Solomon Islands, 3 species and 1 in India.

Aphanamixis polystachya (Wall.) R. Parker in *Indian Forester* 57: 486. 1931; Manilal & Sivar., *Fl. Calicut*: 63. 1982; Manilal, *Fl. Silent Valley*: 48. 1988; Vajr., *Fl. Palghat*: 110. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 109. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 94. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 131. 1997; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 477. 1997; N. Mohanan & Sivad., *Fl. Agasthyamala*: 150. 2002. *Aglaia polystachya* Wall. in Roxb., *Fl. Ind.* 2: 429. 1824. *Andersonia rohituka* Roxb., *Fl. Ind.* 2: 213. 1832. *Amoora rohituka* (Roxb.) Wight & Arn., *Prodr. Fl. Ind. Orient.*: 119. 1834; Bedd., *Fl. Sylv. S. India*: t. 132. 1871; Hiern in Hook.f., *Fl. Brit. India* 1: 559. 1875; Bourd., *Forest Trees Travancore*: 76. 1908; Rama Rao, *Fl. Pl. Travancore*: 75. 1914; Gamble, *Fl.*

Madras: 181(130). 1915.

Mal.: *Chemmaram*

Tree, to 40 m tall; trunk to 4 m across; branches sericeous. Leaves imparipinnate, to 50 cm long, crowded at ends of branches; leaflets 7–11, opposite, ovate-oblong or -lanceolate, asymmetric, obliquely acute at base, undulate at margin, caudate-acuminate at apex, 6.5–17 x 3.5–6 cm, thick-coriaceous, glabrous above, tomentose beneath; lateral nerves to 17 pairs; petioles to 9 cm long; petiolules to 8 mm long. Inflorescences as long as or longer than leaves. Flowers pedicelled or not, ca 5 mm across, dull white, polygamodioecious. Calyx cupular, to 4 mm long; lobes 5, short. Petals 3, orbicular, to 4 mm, white. Staminal tube as long as petals; anthers 6, at base of tube, ca 2 mm long. Ovary ovoid, ca 2 mm long, villous, 3-loculed; ovules 1 or 2 in each locule; stigma sessile, top-shaped, 3-lobed. Capsules globose or obovoid, ca 3.5 x 3 cm, coriaceous, smooth, grey to yellowish, 3-valved; seeds 2 or 3, oblong, red; aril fleshy, yellow.

Fl.: Sept.–Oct., Feb.–March *Fr.*: Dec.–April.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Idukki, Kasaragod, Kollam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Almost throughout India. Indomalasia.

Uses: A hard timber tree, used for canoe-making. Seed yields a medicinal oil. Bark is used as an astringent.

3. AZADIRACHTA A. Juss.

Trees. Leaves alternate, imparipinnate; leaflets subopposite, very oblique at base, serrate. Inflorescences axillary panicles. Flowers bisexual, 5-merous, fragrant. Calyx 5-lobed. Petals 5, free, imbricate, much longer than calyx. Staminal tube cylindrical, shorter than petals, widening above, 10-lobed at apex; lobes truncate, slightly toothed; anthers 10, within tube, opposite and shorter than lobes. Disc absent. Ovary 3-loculed; ovules 2 in each locule, collateral; style elongate, slender; stigma cylindrical. Fruit a drupe; endocarp woody; seed 1, sometimes polyembryonic; endosperm absent.

Indomalasia, 2 species and 1 in India.

Literature: Ahmed, B. & Grainage, M. 1986. Potential of neem tree (*Azadirachta indica*)

for pest control and rural development. *Econ. Bot.* 40: 201 - 209. Deshmukh, N.Y. 1957. Chromosome number in neem. *Indian Oilseeds J.* 3: 45. Mukherjee, S.K. 1952. Meiosis in *Azadirachta indica* A. Juss. *Curr. Sci.* 2: 287. Nair, N.C. 1956. Placentation in *Melia azadirachta* L. (*Azadirachta indica* Juss.). *Curr. Sci.* 25: 264 - 265. Nair, N.C. & Kusumkanta, K. 1961. Studies in *Meliaceae* IV. Floral morphology and embryology of *Azadirachta indica* A. Juss. - A reinvestigation. *J. Indian Bot. Soc.* 40: 382 - 396.

Azadirachta indica A. Juss. in Mem. Mus. Hist. Nat. 19: 221, t. 2, f. 5. 1830; Wight, Icon. Pl. Ind. Orient.: t. 17. 1838; Gamble, Fl. Madras: 177(127). 1915; Manilal & Sivar., Fl. Calicut: 64. 1982; Nicolson & al. in Regnum Veg. 119: 178. 1988; Vajr., Fl. Palghat: 113. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 110. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 100. 1996; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 478. 1997. *Melia azadirachta* L., Sp. Pl.: 385. 1753; Hiern in Hook.f., Fl. Brit. India 1: 544. 1875; Rama Rao, Fl. Pl. Travancore: 72. 1914.

Mal.: *Arya-vaepu*

Semievergreen tree, to 25 m tall; branches glaucous. Leaves to 20 x 9 cm; rachises to 5 cm long; leaflets ca 7 pairs, oblong-lanceolate, falcate, cuneate at base, acuminate at apex, 4 - 7.5 x 1.5 - 2.5 cm, subcoriaceous; petiolules ca 2 mm long. Panicles to 15 x 5 cm; peduncles to 5 cm long; bracteoles scaly; pedicels ca 5 mm long. Calyx lobes connate at base, ovate, ca 0.7 mm long, ciliolate. Petals oblong-obovate, attenuate at base, ca 5 x 1.5 mm, tomentose, white. Staminal tube ca 4 mm long, glabrous; anthers sessile, apiculate. Ovary glabrous; style ca 3 mm long; stigma 3-lobed. Drupes oblong-ovoid, ca 1.5 x 0.5 cm; seeds ellipsoid, glabrous; cotyledon thick, cordate at base, fleshy.

New foliage: Feb. *March Fl.:* Feb. *April Fr.:* June.

Habitat: Coasts to 1000 m.

Distrib.: Throughout Kerala. Cultivated and self-sown. Native to India and China; elsewhere cultivated or naturalized.

Uses: The margosa tree is grown as an avenue tree and near temples. Wood is close-grained and resembles mahogany. Leaf, flower, seed and the oil they yield are medicinal. Fruit pulp is edible. Margosa or neem cake is used as a manure. Oil is used for making soap.

4. CHUKRASIA A. Juss.

Trees. Leaves alternate, pinnate or 2-pinnate; leaflets alternate or subopposite, oblique at base, entire, acuminate at apex, pubescent. Panicles terminal. Flowers bisexual, 4- or 5-merous. Calyx tube short, dentate. Petals oblong, free, contorted. Staminal tube cylindrical, 10-toothed; anthers 10, inserted within crenatures. Disc absent. Ovary short-stipitate, 3-loculed; ovules many in each locule, 2-seriate; style stout; stigma capitate. Capsules 3-loculed, septifragally 3-valved; seeds many, flat, winged at base, exarillate.

South China to Indomalesia, unispecific.

Literature: Livera, E.J. 1925. The genus *Chukrasia*. *Ann. Roy. Bot. Gard. (Peradeniya)* 9: 307-308.

Chukrasia tabularis A. Juss. in *Mem. Mus. Hist. Nat.* 23: 251, t. 22. 1830; Wight, *Ill. Ind. Bot.* 1: t. 56. 1840; Bedd., *Fl. Sylv. S. India*: t. 9. 1869; Hiern in Hook.f., *Fl. Brit. India* 1: 568. 1875 (as *Chikrassia*); Bourd., *Forest Trees Travancore*: 80. 1908; Rama Rao, *Fl. Pl. Travancore*: 77. 1914; Gamble, *Fl. Madras*: 186(133). 1915; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 88. 1988; Vajr., *Fl. Palghat*: 110. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 94. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 132. 1997; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 481. 1997.

Mal.: *Chuvanna-akil, Malavaeppu, Pabba*

Tree, to 35 m tall with an extensive crown, densely foliaceous; trunk to 5 m across; bark reddish brown; branches lenticelled; latex blackish. Leaves ca 30 x 18 cm; leaflets 5 - 8 pairs, subopposite, ovate-lanceolate, oblique at base, acuminate at apex, to 15 x 7 cm, coriaceous, glabrous above, rusty-pubescent beneath; petioles to 5 cm long; petiolules to 1 cm long. Panicles shorter than leaves, to 15 x 10 cm. Flowers 1.5 - 2 cm across, fragrant. Calyx lobes ovate, pubescent. Petals oblong, ovate or spatulate, ca 1.5 x 0.5 cm, pubescent, cream-coloured. Staminal tube to 1.5 cm long, glabrous; anthers exerted, linear, to 2 mm long; stigma capitate. Capsules ovoid or globose, ca 5 x 4 cm, glabrous, persistent; valves 2-lamellate, separating from 3-winged axis and often forked at apex; seeds ca 2 x 0.5 cm, thin.

Fl.: April - June (Sept.) *Fr.*: Dehiscing by next Feb.

Habitat: Semievergreen forests, to 1000 m.

Distrib.: Idukki, Kannur, Kasaragod, Malappuram, Palakkad, Thrissur and Wynad. Andaman & Nicobar Islands, E. & NE. India and E. & W. Ghats.

Uses: Wood, yellowish brown to reddish brown resembling mahogany, is excellent for furniture, also useful for paper pulp. Flower yields a yellow or red dye. Tree yields a gum. Bark is astringent.

5. CIPADESSA Blume

Shrubs or small trees. Leaves alternate or subopposite, imparipinnate. Flowers in axillary panicles, bisexual, 5-merous. Calyx cupular. Petals free, valvate, oblong, spreading. Staminal tube 10-lobed; lobes forked above; anthers sessile, inserted between teeth. Disc cupular, adnate to staminal tube at base. Ovary 5-loculed with locules alternating with calyx lobes; ovules 2 in each locule, collateral; style short; stigma clavate-capitate. Drupes 5-ribbed, 5-loculed, slightly fleshy; locules 1- or 2-seeded; seeds angled, exarillate; endosperm fleshy; cotyledons subfoliaceous.

Indomalesia, unispecific.

Cipadessa baccifera (Roth) Miq., Ann. Mus. Lugd.-Bat. 4: 6. 1868; Gamble, Fl. Madras: 176(126). 1915; Manilal & Sivar., Fl. Calicut: 64. 1982; Manilal, Fl. Silent Valley: 49. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 88. 1988; Vajr., Fl. Palghat: 110. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 110. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 95. 1996; Sivar. & P. Mathew, Fl. Nilambur: 133. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 482. 1997. *Melia baccifera* Roth, Nov. Pl. Sp.: 215. 1821. *Cipadessa fruticosa* Blume, Bijdr.: 162. 1825; Hiern in Hook.f., Fl. Brit. India 1: 545. 1875; Bourd., Forest Trees Travancore: 81. 1908; Rama Rao, Fl. Pl. Travancore: 73. 1914.

Much branched shrub, to 5 m high; young branches tomentose. Leaves alternate, to 15 x 11 cm; leaflets 9 (11), opposite; basal ones smaller than the terminal, oblong-lanceolate, acute at base, distally serrate at margin, acute, rarely acuminate at apex, to 12.5 x 3.8 cm, thin-coriaceous, hairy on nerves beneath otherwise glabrous; petiolules to 3 mm long. Panicles axillary, corymbose, to 30 cm long; peduncles to 7 cm long, hairy; pedicels ca 2 mm long. Flowers ca 8 mm

across. Calyx tube deeply 5-lobed, pubescent; lobes 3-angled. Petals valvate, lanceolate, ca 4 x 1.5 mm, pubescent outside, white. Staminal tube ca 3 mm long, 2-fid at tip, pubescent; anthers 10, between teeth. Disc cupular, adnate to staminal tube at base. Ovary obovoid, glabrous, 5-loculed; style short, subulate, swollen above; stigma top-shaped. Drupes globose or ellipsoid, ca 5 mm across, smooth with very thin flesh showing the 5 divisions, red when ripe; seeds 5, ovoid, ca 4 mm long.

Fl.: Jan. - March, July - Aug. *Fr.*: Nov. - Feb.

Habitat: Undergrowth in semievergreen forests above 750 m, common.

Distrib.: Almost throughout Kerala. Southern India. South and SE. Asia.

Use: Good firewood.

6. DYSOXYLUM Blume

Trees. Leaves alternate, rarely opposite, imparipinnate or abruptly pinnate; leaflets opposite, subopposite or alternate, oblique at base, entire, acuminate at apex, coriaceous. Flowers in panicles, bisexual, 4- or 5-merous. Calyx subentire or 4- or 5-lobed. Petals 4 or 5, valvate or slightly imbricate, oblong, spreading. Staminal tube cylindric, dentate or crenulate at mouth; anthers 8 - 10, included or half-exserted, inserted below apex of staminal tube. Disc tubular or cupular, as long as or longer than ovary which it surrounds, crenulate or entire at mouth. Ovary 2 - 5-loculed; ovules usually 2 in each locule, superposed or collateral; style as long as staminal tube; stigma capitate. Capsules globose or pyriform; valves coriaceous; seeds arillate or not, nonendospermous; cotyledons thick, fleshy; plumule often hirsute.

Indomalesia to New Zealand and Tonga, 80 species, 16 in India and 4 in Kerala.

Key to species

- 1a. Calyx urceolate or cupular, subentire, about half as long as petals; disc tubular, acutely lobed; ovary 3 - 5-loculed; capsules reddish 2. *D. binectariferum*
- b. Calyx neither urceolate nor cupular, shortly or deeply 4-lobed; disc tubular or cupular, not acutely lobed, slightly toothed or entire at apex; ovary 2 - 4-loculed; capsules yellow or purple

- 2a. Ovary 2-loculed; capsules rough, ribbed 1. **D. beddomei**
 b. Ovary more than 2-loculed; capsules smooth or furrowed 3
 3a. Calyx very shortly 4-lobed; disc tubular, slightly toothed at apex; capsules smooth, purple 3. **D. ficiforme**
 b. Calyx deeply 4-lobed; disc cupular, entire; capsules furrowed, yellow 4. **D. malabaricum**

1. *Dysoxylum beddomei* Hiern in Hook.f., Fl. Brit. India 1: 548. 1875; Bourd., Forest Trees Travancore: 74. 1908; Rama Rao, Fl. Pl. Travancore: 73. 1914; Gamble, Fl. Madras: 178(127). 1915; Sasidh. & Sivar., Fl. Pl. Thrissur: 95. 1996; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 485. 1997.

Tree, to 20 m tall; young parts pubescent. Leaves 30 - 45 cm long; leaflets usually 9, alternate, ovate-elliptic to oblong, oblique or cuneate at base, narrowly and obtusely acuminate, 10 - 16 x 3.5 - 5 cm, glabrous, pale green; nerves pale, not prominently reticulate beneath; petiolules 5 - 7 mm long. Inflorescences axillary, spicate, sometimes branched near base, to 15 cm long. Flowers ca 8 mm across, 4-merous, pubescent, greenish yellow. Calyx very short, short-toothed. Disc tubular, longer than ovary, short-toothed, glabrous. Ovary hirsute, 2-loculed; ovules collateral. Capsules to 2.5 cm across, ribbed, rough, yellow, 1 - 3-seeded; testa coriaceous.

Fl. & Fr.: Nov. - Dec.

Habitat: Evergreen forests, to 1300 m.

Distrib.: Idukki, Thiruvananthapuram and Thrissur. Endemic.

Use: The fragrant wood is suitable for furniture.

2. *Dysoxylum binectariferum* (Roxb.) Hook. f. ex Bedd. in Trans. Linn. Soc. London 25: 212. 1866; Hiern in Hook.f., Fl. Brit. India 1: 546. 1875; Bourd., Forest Trees Travancore: 73. 1908; Rama Rao, Fl. Pl. Travancore: 73. 1914; Gamble, Fl. Madras: 178(127). 1915; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 486. 1997. *Guarea binectarifera* Roxb., Fl. Ind. 2: 240. 1832 (as *binertarifera*).

Mal.: *Akil*

Tree, to 15 m tall. Leaves 23 - 48 cm long; leaflets 5 - 9, alternate, elliptic to obliquely ovate-oblong, cuneate at base, obscurely dentate at margin, acuminate at apex, 6 - 18 x 2.5 - 7 cm, glabrous; lateral nerves 5 - 10 pairs; petiolules ca 2 cm

long. Inflorescences racemiform panicles, 20 - 30 cm long, much shorter than leaves, nearly glabrous. Flowers ca 1 cm across, 4- or 5-merous, pale green or white. Calyx urceolate or cupular, subentire, nearly half as long as flower. Petals valvate, spreading, mucronate. Staminal tube mealy on both sides. Disc tubular, twice as long as ovary, slightly toothed at apex, glabrous inside scarcely so outside. Ovary shortly hairy, 3 - 5-loculed; ovules 2 in each locule, collateral; style shortly hairy. Fruit a woody capsule, obovoid, somewhat pyriform or subglobose, narrow at base, 6 - 8 x ca 5 cm, nearly glabrous or puberulous, reddish, 4- or 5-loculed, 4- or 5-seeded; seeds shining, dark purple, exarillate with a yellow hilum.

Fl.: March - April *Fr.*: July - Aug.

Habitat: Semievergreen forests.

Distrib.: Idukki. Southern W. Ghats and NE. India. Bangladesh and Sri Lanka.

Use: Wood is reddish grey, rough, hard and close-grained.

3. *Dysoxylum ficiforme* (Wight) Gamble, Fl. Madras: 178(127). 1915; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 487. 1997. *Amoora ficiformis* Wight, Ill. Ind. Bot. 1: 47. 1840. *Dysoxylum purpureum* Bourd. in J. Bombay Nat. Hist. Soc. 12: 349, t. 2. 1899 & Forest Trees Travancore: 83. 1908; Rama Rao, Fl. Pl. Travancore: 74. 1914.

Evergreen tree, to 30 m tall; bark smooth, pale. Leaves ca 45 cm long; leaflets 7 - 11, subopposite or alternate, elliptic-lanceolate, oblique at base, entire at margin, acute at apex, 12 - 20 x 4 - 8 cm, shining; lateral nerves 9 or 10 pairs, conspicuous beneath; petioles to 6 mm long. Flowers in axillary or terminal panicles or spikes, ca 8 mm long, buff; pedicels 2 - 4 mm long. Calyx very shortly 4-lobed, fleshy. Petals 4, fleshy. Staminal tube crenulate at mouth; anthers 8, included. Disc tubular, toothed at apex. Ovary hairy, 4-loculed; style stout, almost as long as staminal tube; stigma capitate with a ring at base, slightly exserted. Capsules rounded, 5 - 7.5 cm, smooth, purple, 3- or 4-seeded.

Fl. & Fr.: Feb. - Oct.

Habitat: Evergreen forests, rare.

Distrib.: Kollam. Western Ghats of Tamil Nadu. Endemic.

4. *Dysoxylum malabaricum* Bedd. ex Hiern in Hook.f., Fl. Brit. India 1: 548. 1875; Bourd., Forest Trees Travancore: 81. 1908; Rama Rao, Fl. Pl.

Travancore: 73. 1914; Gamble, Fl. Madras: 178(128). 1915; Sasidh. & Sivar., Fl. Pl. Thrissur: 95. 1996; Sivar. & P. Mathew, Fl. Nilambur: 133. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 489. 1997. *D. glandulosum* Talbot, Syst. List Trees Bombay: 39. 1894.

Tree, 30 - 40 m tall, ca 1.5 m across; bark grey with white warts. Leaves 30 - 35 cm long; leaflets 4 or 5 pairs, elliptic-oblong, 5 - 23 x 4 - 8 cm, pale green, puberulous when young; lateral nerves 10 - 20 pairs, prominent beneath; petiolules 6 - 12 mm long. Panicles axillary, 10 - 20 cm long, crowded near ends of branches. Flowers ca 6 mm long, white, fragrant; pedicels 3 - 6 mm long. Calyx deeply 4-lobed; lobes more or less obtuse. Petals 4, imbricate, linear-oblong, subacute, pubescent outside. Staminal tube tubular or urceolate, more or less 4-angled with 8 deep emarginate crenatures; anthers 8, included. Disc cupular, truncate, as long or half as long as ovary, crenulate and ciliate at margin, pubescent inside. Ovary white-tomentose, 4-loculed with 2 collateral ovules in each; style as long as staminal tube; stigma capitate. Capsules pyriform, 5 - 6.5 cm across, verrucose, bright yellow with 4 longitudinal furrows; seeds 3 or 4, bluntly 3-gonous; testa reddish brown.

Fl. & Fr.: Feb. - June.

Habitat: Evergreen forests, above 600 m, common.

Distrib.: Idukki, Kollam, Malappuram, Pathanamthitta and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

7. MELIA L.

Small to large-sized deciduous trees with an indumentum of simple and tufted stellate hairs. Leaves alternate, 2- or 3-pinnate; leaflets serrate or entire. Panicles axillary, many-flowered; bisexual and male flowers in same plant. Calyx 5-lobed to near base; lobes sometimes imbricate. Petals usually 5, free, imbricate, much longer than calyx lobes. Staminal tube a little shorter than petals, cylindrical, dilated at mouth, 10- or 12-ribbed, terminating in as many or twice as many as anthers, sometimes appendages 2 - 4-lobed; anthers apiculate or acute, hairy or glabrous, inserted at margin or just below within staminal tube, alternating with or opposite appendages. Disc small, annular or cupular, free around base of ovary. Ovary 4 - 8-loculed; ovules 2 in each locule, superposed; style cylindrical, elongate; stigma capitate, sometimes 3 - 8-lobed. Fruit a 3 - 8-loculed drupe; locules 1- or 2-

seeded; seeds oblong, laterally compressed, nonendospermous.

Old World tropics, 3 species and 2 in India.

Key to species

- | | |
|---|------------------------|
| 1a. Flowers lilac, honey-scented; drupes to 2 cm long | 1. <i>M. azedarach</i> |
| b. Flowers white, inodorous; drupes 2.5 - 4 cm long | 2. <i>M. dubia</i> |

1. *Melia azedarach* L., Sp. Pl.: 384. 1753; Wight, Icon. Pl. Ind. Orient.: t. 160. 1839; Hiern in Hook.f., Fl. Brit. India 1: 544. 1875; Rama Rao, Fl. Pl. Travancore: 72. 1914; Gamble, Fl. Madras: 176(126). 1915; Sivar. & P. Mathew, Fl. Nilambur: 134. 1997, excl. syns.; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 494. 1997.

Small or medium-sized tree; young parts scurfy-tomentose, glabrous when mature. Leaves 2-, rarely 3-pinnate, 30 - 90 cm long; pinnae 5 - 9, usually opposite; leaflets 3 - 7 in each pinna, opposite or subopposite, lanceolate, oblanceolate, ovate-lanceolate or elliptic-, oblique at base, toothed or lobed at margin, acuminate at apex, 2.5 - 5 x 1 - 2.5 cm; lateral nerves 8 - 15 pairs; petiolules to 5 mm long. Panicles lax; pedicels slender, to 7 mm long. Calyx 5-lobed to base, pubescent outside. Petals 5, linear-oblong or oblanceolate, deflexed, ca 7 mm long, pubescent outside when young. Staminal tube 0.5 - 1 cm long, cylindric, 20 - 30-toothed, purple; anthers at mouth of tube, apiculate. Ovary glabrous; style clavate; stigma 10-lobed. Drupes ellipsoid or globose, fleshy, yellow when ripe.

Fl. & Fr.: May - Dec.

Asia to Australia; cultivated almost throughout India.

2. *Melia dubia* Cav., Diss. 7: 364. 1789; Hiern in Hook.f., Fl. Brit. India 1: 545. 1875; Bourd., Forest Trees Travancore: 80. 1908; Rama Rao, Fl. Pl. Travancore: 73. 1914; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 89. 1988; Vajr., Fl. Palghat: 111. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 97. 1996; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 495. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 151. 2002. *M. composita* Willd., Sp. Pl. 2: 559. 1799; Bedd., Fl. Sylv. S. India: t. 12. 1869; Gamble, Fl. Madras: 176(126). 1915.

Tree, to 25 m tall; young parts scurfy-tomentose, glabrous when mature. Leaves to 1 m long; pinnae 3 - 8 pairs; leaflets 3 - 13, ovate-lanceolate to -rotund,

more or less oblique at base, serrulate or entire at margin, acuminate at apex, 3-12 x 1.5-4 cm; lateral nerves 6-16 pairs; petiolules to 5 mm long, longer in terminal leaflets. Panicles 12-20 cm long. Calyx 5-lobed; lobes ovate-oblong, tomentose. Petals linear-spatulate, concave, ca 5 mm long, pubescent outside, puberulous inside. Staminal tube gibbous at base, slightly expanded at apex with 10, 2-fid appendages, nearly glabrous or puberulous inside, white; anthers exserted, pubescent. Ovary glabrous; style a little longer than staminal tube; stigma cylindrical, 5-toothed. Drupes ovoid or ellipsoid, 2.5-4 x 2-2.5 cm, pulpy, yellowish, 1-6-seeded.

Fl. & Fr.: March - Feb.

Habitat: Deciduous forests, common.

Distrib.: Kannur, Kollam, Palakkad, Thiruvananthapuram and Thrissur. Throughout India. Bangladesh, Bhutan, Myanmar, Nepal, Pakistan and Sri Lanka.

8. MUNRONIA Wight

Shrubs or undershrubs. Leaves alternate, imparipinnate; leaflets opposite, entire or coarsely toothed. Flowers in few-flowered axillary cymes, bisexual. Calyx tube usually elongate, 5-partite; lobes foliaceous, persistent. Petals 5, elongate, free or partly connate, spreading above. Disc tubular, membranous, sheathing ovary and base of style. Staminal tube cylindrical, sometimes adnate to corolla, 10-toothed at apex; anthers 10, terminal, apiculate, alternating with teeth. Ovary 5-loculed; ovules 2 in each locule, superposed; style elongate, slender; stigma capitate. Fruit a loculicidal capsule, globose-depressed, 5-lobed; valves separating from 5-winged axis; seeds winged; endosperm thin; cotyledons flat, foliaceous; radicle short.

Indomalaysia, ca 10 species and 1 in India.

Literature: Harms, H. 1917. Über die Asiatische *Meliaceen* gattung *Munronia* Wight und eine verwandte sud Africanische gattung. *Ber. Deutsch. Bot. Ges.* 35: 74-82.

Munronia pinnata (Wall.) Theob. in Mason, *Burmah* ed. 4, 2: 581. 1883; Mabb. in *Taxon* 34: 155. 1985; Manilal, *Fl. Silent Valley*: 49. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 89. 1988; Vajr., *Fl. Palghat*: 111. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 97. 1996; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 497. 1997. *Turraea pinnata* Wall., *Pl. Asiat. Rar.* 2: 21, t. 119. 1829. *Munronia*

wallichii Wight, Ill. Ind. Bot. 1: 147. 1840; Hiern in Hook.f., Fl. Brit. India 1: 543. 1875; Gamble, Fl. Madras: 175(125). 1915. *M. neelgherrica* Wight, Ill. Ind. Bot. 1: 147, t. 54. 1840.

Undershrub, to 1 m high. Leaves mainly confined to ends of branches, to 30 cm long; petioles 5 - 10 cm long; leaflets 5 - 9, usually 7, opposite or subopposite, lanceolate, ovate or ovate-elliptic, obliquely rounded or cuneate at base, crenate at margin, acuminate at apex, 6 - 12 x 3 - 4.5 cm, hairy on nerves beneath. Peduncles axillary, hairy, bent down after flowering. Flowers bisexual, to 4 cm long, pink or white. Sepals obovate or elliptic, hairy, green. Petals elongate, linear-spatulate, to 4 x 1 cm, pubescent. Staminal tube with short subulate teeth. Ovary locules opposite sepals. Capsules to 2.3 cm across, pubescent; seeds planoconvex with ventral hollow hilum, fringed with incurved laciniae at margin.

Fl. & Fr.: Sept. May.

Habitat: Evergreen forests, fairly common.

Distrib.: Kannur, Palakkad and Thrissur. East, NE. and S. India. Bhutan.

Note: The combination *M. pinnata* is to be attributed to Theobald (*vide* Mabberley, *l.c.*) unlike what is followed in most Indian works.

9. NAREGAMIA Wight & Arn., nom. cons.

Small, branched undershrubs, glabrous. Leaves alternate, 3-foliolate; petioles winged. Flowers 1 or 2 together, axillary. Calyx 5-cleft. Petals 5, elongate. Staminal tube elongate, slender, cylindric below, inflated near top and sometimes cleft into 2, obscurely 10-crenate at mouth; anthers 10, inserted in crenatures of mouth, apiculate, exserted. Disc annular. Ovary 3-loculed; style filiform; stigma capitate. Capsules ovoid-globose, loculicidally 3-valved; valves separating from 3-winged axis; seeds pendulous, curved, truncate at both ends, muricate with short double membrane on axial side; endosperm fleshy; cotyledons flat, foliaceous.

Southwest tropical Africa and India, 2 species and 1 in India.

Literature: Nair, N.C. 1959. Studies on *Meliaceae* I. Floral morphology and embryology of *Naregamia alata* W. & A. *J. Indian Bot. Soc.* 38: 353 - 366.

Naregamia alata Wight & Arn., Prodr. Fl. Ind. Orient.: 117. 1834; Hiern in Hook.f., Fl. Brit. India 1: 542. 1875; Rama Rao, Fl. Pl. Travancore: 71. 1914;

Gamble, Fl. Madras: 175(125). 1915; Manilal & Sivar., Fl. Calicut: 64. 1982; Nicolson & al. in Regnum Veg. 119: 178. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 90. 1988; Vajr., Fl. Palghat: 111. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 110. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 98. 1996; Sivar. & P. Mathew, Fl. Nilambur: 135. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 498. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 151. 2002.

Mal.: *Nelannaragam*

Erect or decumbent undershrub, to 50 cm high. Leaves to 10 cm long; leaflets sessile, to 3 x 1.2 cm, the terminal larger than lateral ones and almost as long as winged petiole, elliptic or obovate, cuneate at base, entire at margin, glabrous, shining. Flowers to 4.5 cm long, white. Calyx campanulate; lobes imbricate, caducous. Petals linear-spatulate, spreading later, imbricate in bud. Staminal tube white. Ovary glabrous; ovules 2 in each locule, pendulous, collateral. Capsules ca 7 mm across; seeds curved, truncate at both ends, muricate with a short double membrane (aril) along side next to axis.

Fl. & Fr.: Almost throughout the year, profusely in July - Nov.

Habitat: Lateritic slopes and forest undergrowth, to 900 m.

Distrib.: Throughout Kerala. Western Ghats. Endemic.

Use: Entire plant medicinal.

10. REINWARDTIODENDRON Koord.

Trees or shrubs. Leaves imparipinnate; leaflets alternate or subopposite, entire. Flowers polygamodioecious, 3-merous, male ones in panicles, female ones in spikes or racemes. Sepals imbricate, rounded. Petals imbricate, rounded, connivent. Staminal tube globose, crenulate; anthers 10 in 2 rows, shorter ones included. Disc obsolete. Ovary 3-5-loculed with 1 or 2 ovules in each; style short, thick; stigma 3-5-lobed. Fruits 1-5-loculed berries; seeds surrounded by pulpy aril; endosperm absent; cotyledons transverse; radicle superior.

Indomalesia, 7 species and 1 in India.

Reinwardtiodendron anamallaiense (Bedd.) Mabb. in Malayan For-
ester 45: 452. 1982 (as *anamalaiense*) & Blumea 31: 144. 1985; S.S. Jain & Bennet
in Hajra & al., Fl. India 4: 498. 1997. *Lansium anaimalaiense* Bedd. in Madras J.
Lit. Sci. 3, 1: 40. 1864. *L. anamalanum* Bedd. in Trans. Linn. Soc. London 25:

212. 1865, nom. superf.; Fl. Sylv. S. India: t. 131. 1871 (as *anamallayanum*) & Icon. Pl. Ind. Orient.: t. 104. 1868-1874 (as *anamallayanum*); Hiern in Hook.f., Fl. Brit. India 1: 558. 1875; Bourd., Forest Trees Travancore: 816. 1908; Rama Rao, Fl. Pl. Travancore: 75. 1914; Gamble, Fl. Madras: 182(130). 1915 (as *anamallayanum*). *Aglaia anamallayana* (Bedd.) Kosterm. in Reinwardtia 7: 257, f. 10. 1966 (as *anamallayana*); Vajr., Fl. Palghat: 109. 1990 (as *anamallayana*). *Reinwardtiadendron anamallayanum* C.J. Saldanha in C.J. Saldanha & Nicolson, Fl. Hassan: 392. 1976 (as *anamallayanum*), nom. invalid.; Manilal, Fl. Silent Valley: 50. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 90. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 98. 1996; Sivar. & P. Mathew, Fl. Nilambur: 133. 1997.

Mal.: *Vandakamin*

Evergreen tree, to 20 m tall; bark grey with small lenticels. Leaves to 25 cm long; leaflets 3 - 7, alternate, elliptic-lanceolate, subequal and cuneate at base, acuminate at apex, ca 14 x 4.5 cm, glabrous, occasionally hairy with glandular domatia in axils of primary nerves beneath; petiolules to 2 cm long. Panicles axillary. Flowers ca 2 mm long, white; bisexual ones sessile, others short-pedicelled. Sepals 5, short-ciliate. Petals 5, concave. Outer anthers partly exerted. Ovary 3-lobed, pubescent or villous, 3-loculed with 2 ovules in each. Fruits oblong, 1- or 2-seeded, ca 1.5 x 0.7 cm, scaly, white; seeds with ventral hilum; radicle pubescent. *Fl.*: March - April *Fr.*: July - Aug.

Habitat: Evergreen forests, 450 - 1000 m.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thrissur and Wynad. Western Ghats. Endemic.

Uses: Fruit is edible. Wood, pink, fragrant and insect-resistant, is valuable.

11. SOYMIDA A. Juss.

Trees. Leaves alternate, paripinnate; leaflets opposite, entire or crenate-serrate when young, obtuse and unequal at base. Panicles axillary and terminal. Flowers bisexual, 5-merous, greenish white. Sepals imbricate. Petals imbricate, spreading, obovate, unguiculate. Staminal tube cupular, 10-cleft with lobes 2-fid again; anthers 10, between teeth, sessile or subsessile. Disc flat. Ovary 5-loculed; locules alternating with sepals; ovules many in each locule, 2-seriate; style short; stigma discoid, 5-angled. Fruits woody, septifragally 5-valved; valves with 2 plates separating from 5-winged axis; seeds many, flat, winged at both ends; endosperm

fleshy; cotyledons foliaceous.

Tropical Asia, unispecific.

Soymida febrifuga (Roxb.) A. Juss. in Mem. Mus. Hist. Nat. 19: 251, t. 11, f. 26. 1830; Bedd., Fl. Sylv. S. India: t. 8. 1869; Hiern in Hook. f., Fl. Brit. India 1: 567. 1875; Bourd., Forest Trees Travancore: 90. 1908; Rama Rao, Fl. Pl. Travancore: 76. 1914; Gamble, Fl. Madras: 185(133). 1915; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 501. 1997. *Sweitenia febrifuga* Roxb., Pl. Coromandel 1: 18, t. 17. 1795 & Fl. Ind. 2: 398. 1832.

Mal.: *Somi*

Evergreen tree, to 15 m tall; branches divaricate, glabrous, with persistent leaf scars; bark bluish, grey or brown. Leaves to 40 x 15 cm, greyish green; leaflets 3 - 6 pairs, sessile, ovate-oblong, obliquely rounded-obtuse at base, entire at margin, obtuse at apex, to 9.5 x 5 cm, thick-coriaceous, glabrous; petioles to 6 cm long. Panicles ca 15 x 11 cm; peduncles ca 2.5 cm long; bracts ovate-deltoid. Flowers ca 1 cm across. Calyx 5-lobed; lobes ovate, ca 2 mm long, pubescent. Petals ca 5 mm long, pubescent outside, greenish white. Staminal tube short. Ovary ovoid; ovules pendulous, 2-seriate; stigma sessile, 5-angled. Capsules obovoid, smooth, black when ripe, 5-valved, opening from apex; valves 2.5 - 6.5 cm long, 2-lamellate; seeds oblong, 2-aucled at base.

Fl.: Feb. - April *Fr.*: Dehiscing by July.

Habitat: Lateritic soil, in exposed sunny situations, rare.

Distrib.: South Travancore and Idukki (Anjanad Valley, Rama Rao, *l.c.*). Andhra Pradesh, Karnataka, Orissa, NW. India and Tamil Nadu.

Uses: Bark yields a strong red fibre for ropes, also used for tanning and dyeing. Wood red and very hard, called Indian red wood, is one of the most durable. Bark bitter and is used in diarrhoea and dysentery.

12. SWIETENIA Jacq.

Trees. Leaves paripinnate; leaflets subopposite. Panicles axillary. Flowers 5-merous, bi- or unisexual. Calyx tube 5-lobed; lobes suborbicular or ovate, imbricate. Petals twisted. Staminal tube urceolate, apically 10-lobed; anthers 10, between lobes, included, medifixed. Disc annular. Ovary 5-loculed; ovules many in each locule; style narrow, tapering; stigma peltate. Capsules oblong-globose,

woody, 5-loculed, septifragally 5-valved, dehiscing from base leaving a thick 5-angled central column basally 5-winged; valves thick, woody; seeds many with an elongate wing.

Tropical America, 3 species, now widely cultivated in tropics and 2 in Kerala.

Literature: Lee, H.Y. 1967. Studies on *Swietenia* (Meliaceae). Observations on the sexuality of flowers. *J. Arnold Arbor.* 48: 101-104.

Key to species

- 1a. Leaflets more than 3 cm wide, glabrous beneath 1. *S. macrophylla*
 b. Leaflets less than 3 cm wide, puberulous beneath 2. *S. mahagoni*

1. *Swietenia macrophylla* King in Hooker's Icon. Pl.: t. 1550. 1886; Rama Rao, Fl. Pl. Travancore: 78. 1914; Styles, Fl. Neotrop. 28: 395, f. 80. 1981; Sasidh. & Sivar., Fl. Pl. Thrissur: 100. 1996; Sivar. & P. Mathew, Fl. Nilambur: 136. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 526. 1997.

Tree, to 30 m tall, densely foliaceous; trunk to 2.5 m across. Leaves ca 25 cm long; leaflets 3 or 4 pairs, subopposite, ovate-lanceolate, falcate, oblique at base, entire at margin, acuminate or abruptly acute at apex, 5-12 x ca 5 cm, coriaceous, glabrous, shining above, dull beneath; petioles to 7.5 cm long; petiolules to 1 cm long. Panicles axillary, to 10 cm long; peduncles to 5 cm long. Flowers ca 8 mm across; pedicels to 4 mm long. Calyx lobes suborbicular, ca 0.5 mm long. Petals oblong, ca 4 mm long, cream-yellow. Staminal tube ca 4 mm long. Ovary glabrous; style ca 1.5 mm long; stigma faintly 5-lobed. Capsules subglobose, ca 8.5 x 6.5 cm, rusty outside; seeds numerous, ca 6 cm long, winged.

Leaf fall: Jan. - Feb. *New leaves* (reddish): March - April.

Fl.: April - May *Fr.:* Dehiscing with an explosive sound during Dec. - Jan.

Native to Honduras, now widely cultivated in gardens and avenues in tropics; planted in Kollam as forest plantations (Bourdillon, *l.c.*; Rama Rao, *l.c.*). Naturalized in Nilambur (Sivarajan & Mathew, *l.c.*).

Use: Wood is valuable for making furniture.

2. *Swietenia mahagoni* (L.) Jacq., Enum. Pl. Carib.: 20. 1760; Rama Rao, Fl. Pl. Travancore: 78. 1914; Gamble, Fl. Madras: 187(134). 1915; Vajr., Fl.

Palghat: 113. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 112. 1994; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 525. 1997. *Cedrus mahagoni* L., Syst. Nat. ed. 10, 2: 940. 1759.

Mal.: *Mahogani*

Tree, to 25 m tall; trunk to 4 m across; bark deeply fissured. Leaves to 18 cm long; leaflets ca 5 pairs, oblong-lanceolate, falcate, oblique at base, entire at margin, acuminate at apex, to 7 x 2.5 cm, coriaceous, glabrous above, puberulous beneath; petioles to 3 cm long; petiolules 5 - 6 mm long. Panicles to 10 cm long; peduncles to 4 cm long. Flowers ca 7 mm across. Calyx lobes 5, ovate, ca 2 mm long, pubescent. Petals 5, obovate, hooded, ca 5 x 2 mm, spreading, pubescent outside, cream-yellow. Staminal tube cupular, ca 3 mm long, glabrous, 10-lobed; anthers 10, included, alternating with lobes. Ovary 5-loculed; style narrow, tapering, to 2 mm long. Capsules oblong, ca 7 x 5.5 cm; seeds ca 6 x 1.5 cm, winged. *Fl.*: April - May *Fr.*: Oct. Dec.

Widely planted in gardens, avenues, house compounds and on roadsides. Native to tropical America and the West Indies, now widely cultivated in tropics.

Use: Wood is very valuable and is excellent for furniture.

13. TOONA (Endl.) M. Roem.

Deciduous or semievergreen, large trees. Leaves alternate, usually paripinnate; leaflets 10 - 20, entire or serrate, acuminate, glabrous. Panicles terminal and axillary, often pendulous, well branched, shorter or longer than leaves. Flowers 5- or 6-merous, fragrant. Calyx 5-parted. Petals adnate to conspicuously fleshy crenulate disc at base. Stamens free, shorter than petals, broad below, narrow in upper half, often alternating with staminodes. Ovary within disc, glabrous or hairy, 5- or 6-loculed; ovules 8 - 10 in each locule; style elongate; stigma globose. Capsules woody, septifragally 5-valved, with a thick central 5-angled column; seeds winged above or at both ends.

Indomalesia to Australia, 6 species, 5 in India and 1 in Kerala.

Literature: Bahadur, K.N. 1988. *Monograph on the genus Toona (Meliaceae)*, 1 - 251. Candolle, A.C.P. de 1908. A revision of the Indo-Malayan species of *Cedrela*. *Rec. Bot. Surv. India* 3: 357 - 376. Singh, B. 1951. Chromosome numbers of some flowering plants. *Curr. Sci.* 20: 105. Smith, C.E. 1960. A revision of *Cedrela*. *Fieldiana, Bot.* 29: 295 - 341.

Toona ciliata M. Roem., Fam. Nat. Syn. Monogr. 1: 139. 1846; Manilal, Fl. Silent Valley: 50. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 90. 1988; Vajr., Fl. Palghat: 112. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 111. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 98. 1996; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 504. 1997. *Cedrela toona* Roxb. ex Rottler in Ges. Naturf. Freunde Berlin Neu Schriften 4: 198. 1803; Roxb., Pl. Coromandel 3: 34, t. 238. 1815; Wight, Icon. Pl. Ind. Orient.: t. 161. 1839; Bedd., Fl. Sylv. S. India: t. 10. 1869; Hiern in Hook.f., Fl. Brit. India 1: 568. 1875; Bourd., Forest Trees Travancore: 81. 1908; Rama Rao, Fl. Pl. Travancore: 77. 1914; Gamble, Fl. Madras: 186(133). 1915.

Mal.: *Akil, Mathagiri-vembu, Mela-veppu, Vedi-vembu*

Tree, to 25 m tall, densely foliaceous with a spreading crown, deciduous; trunk 4 - 5 m across; branches tomentose; bark thin, rough, rusty brown, scaling off in large flakes. Leaves to 30 x 15 cm; leaflets 6 - 9 pairs, subopposite, oblong-lanceolate, obliquely cuneate at base, entire or subundulate at margin, acuminate at apex, 8 - 9 x 2 - 3 cm, thin-coriaceous, glabrous; petioles to 5 cm long; petiolules ca 7 mm long. Panicles as long as or longer than leaves, usually ca 25 x 10 cm; peduncles to 3 cm long. Flowers ca 8 mm across, bisexual. Calyx lobes 5, ovate, ca 1 mm long, ciliate. Petals imbricate, oblong, attenuate at base, ca 5 x 3 mm, keeled at point of insertion with disc, ciliate, white. Stamens 5; filaments subulate, ca 1 mm long; anthers oblong, versatile. Disc thick, 5-lobed, pubescent. Ovary ovoid, ca 2 mm long, pubescent or sparsely hairy; ovules pendulous, 2-seriate; style short, ca 1 mm long; stigma globose or discoid. Capsules oblong, ca 3 x 1.5 cm, lenticelled or not, blackish when dry; seeds ca 1.5 cm long, winged at both ends.

Leaf fall: Dec. - Jan. *New foliage* (red soon turning green): Feb. - March.

Fl. (along with new leaves): Feb. - March *Fr.:* Ripening in Aug. - Oct.

Habitat: Semievergreen forests, to 1200 m.

Distrib.: Idukki, Kannur, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Almost throughout India. Indomalesia to Australia.

Uses: Timber, red, soft and fragrant, is useful for making furniture, door panels, tea boxes etc. Being an ornamental, the tree is suitable for avenues and gardens. Yields a medicinal resinous gum. Leaf is a good fodder. Flower yields a red dye.

14. TRICHILIA P. Browne, nom. cons.

Trees, rarely large shrubs. Leaves imparipinnate; leaflets 5 - 11, opposite, entire at margin, petioluled. Panicles terminal and axillary, corymbose, long-peduncled. Flowers bisexual, 4- or 5-merous. Calyx 4- or 5-lobed; lobes imbricate. Petals free, imbricate, suberect. Stamens 10, united for 1/2, forking at tip with anthers between lobes. Disc cupular, fleshy, surrounding ovary. Ovary more or less within disc, 2- or 3-loculed; style elongate; stigma peltate. Capsules glabrous, 2-valved, usually 1-seeded; seed covered with white aril, nonendospermous; cotyledons hemispheric, planoconvex; radicle superior.

Tropics, 84 species and 1 in India.

Trichilia connaroides (Wight & Arn.) Benth. in Acta Bot. Neerl. 11: 13. 1962; Manilal, Fl. Silent Valley: 51. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 91. 1988; Vajr., Fl. Palghat: 112. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 111. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 99. 1996; Sivar. & P. Mathew, Fl. Nilambur: 137. 1997; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 515. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 152. 2002. *Zanthoxylum connaroides* Wight & Arn., Prodr. Fl. Ind. Orient.: 148. 1834 (as *Xanthoxylon*). *Heynea trijuga* Roxb. ex Sims in Curtis, Bot. Mag. 41: t. 1738. 1815, non *Trichilia trijuga* Vell. 1825; Roxb., Pl. Coromandel 3: 56, t. 260. 1820; Hiern in Hook. f., Fl. Brit. India 1: 565. 1875; Bourd., Forest Trees Travancore: 78. 1908; Rama Rao, Fl. Pl. Travancore: 76. 1914; Gamble, Fl. Madras: 183(131). 1915. *Heynea affinis* A. Juss. in Mem. Mus. Hist. Nat. 19: 235, 275. 1830, non *Trichilia affinis* A. Juss. 1829; Bedd., Fl. Sylv. S. India: t. 134. 1871.

Mal.: *Korakkadi*

Tree, to 20 m tall; branchlets lenticelled, reddish; bark thin, rough, warty. Leaves ca 20 x 10 cm, 7 - 9-foliolate; rachises angled; leaflets opposite, ovate-lanceolate or oblong, unequally acute at base, entire at margin, acuminate at apex, 6 - 14 x 3 - 6 cm, thin-coriaceous, glabrous above, glaucous beneath; lateral nerves 10 - 13 pairs; petioles to 6 cm long; petiolules to 1 cm long. Panicles with corymbose cymes, to 20 cm long, sometimes longer. Flowers ca 8 mm across; pedicels 1 - 2 mm long, jointed. Calyx lobes imbricate, ovate, pubescent to ciliate. Petals subvalvate or imbricate, oblong, ca 4 mm long, suberect, ciliolate, white or

cream-coloured. Staminal tube deeply 10-lobed, pubescent; lobes with 2 linear tooth-like appendages; anthers 10, between appendages. Disc thick, surrounding ovary. Ovary globose, glabrous, 2-loculed; ovules 2 in each locule, collateral; style ca 1 mm long; stigma capitate, 2-lobed or -dentate. Capsules globose to oblong-subglobose, to 1.5 cm long, 1-loculed, 2-valved, conspicuously red or brownish red; seed 1, ovoid, yellow-brown; aril fleshy, thin, white, brown when dry; testa membranous.

Fl.: Jan. - May *Fr.*: July - Aug., Dec. - Feb.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Idukki, Kannur, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. North, NE. and Peninsular India. Indomalaysia.

Uses: Cultivated as an ornamental in gardens. Wood is grey and moderately hard. Bark and leaf are a bitter tonic.

15. TURRAEA L.

Trees or shrubs. Leaves alternate, simple, entire or obtusely lobed. Flowers in axillary clusters or short racemes, bisexual. Calyx campanulate, 4- or 5-fid. Petals 4 or 5, free, elongate, linear-spatulate, imbricate in bud. Staminal tube elongate, cylindrical, toothed at apex; anthers 8 - 10, inserted just within mouth of tube, alternating with teeth. Disc annular or obsolete. Ovary 4- or more-loculed; ovules 2 in each locule, superposed; style elongate, exserted; stigma urceolate or capitate. Capsules 4- or more-loculed, loculicidal; valves woody or coriaceous, separating from winged axis; seeds oblong with a broad ventral hilum; endosperm fleshy; cotyledons foliaceous; radicle superior.

Tropical Asia to Australia and tropical S. Africa, ca 60 species and 1 in India.

Turraea villosa A.W. Benn., *Fl. Jav. Rar.* 1: 182. 1840; Wight, *Icon. Pl. Ind. Orient.*: t. 1593. 1850; Hiern in *Hook.f., Fl. Brit. India* 1: 542. 1875; Rama Rao, *Fl. Pl. Travancore*: 71. 1914; Gamble, *Fl. Madras*: 174(124). 1915; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 91. 1988; Vajr., *Fl. Palghat*: 112. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 99. 1996; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 515. 1997.

Evergreen shrub or small tree; young branches more or less pubescent with

short hairs. Leaves elliptic or ovate, obtuse or cuneate at base, entire, short-acuminate at apex, 5 - 10 x 3 - 5 cm, membranous, glabrous. Flowers 4 - 7 cm long, 3 - 6 in axillary clusters or short racemes, white, fragrant; bracts lanceolate; pedicels to 1 cm long, glabrescent. Calyx to 1 cm long, 5-fid, pubescent. Petals glabrous. Staminal tube to 4 cm long with short teeth, glabrous. Ovary 5-loculed; style far exserted. Capsules subglobose, ca 1.25 cm long, glabrescent; seeds oblong, elongate.

Fl. & Fr.: Jan. - Nov.

Habitat: Evergreen forests, to 600 m.

Distrib.: Idukki, Kannur, Palakkad and Thrissur. Southern India. Malesia.

Use: Medicinal.

16. WALSURA Roxb.

Trees. Leaves exstipulate, imparipinnate, 3 - 5-foliolate; laeaflets usually opposite, entire, pale beneath. Panicles axillary and terminal. Flowers bisexual, 4- or 5-merous. Calyx 4- or 5-partite; lobes imbricate. Petals imbricate or subvalvate. Stamens 8 - 10, shortly connate below; filaments forked at tip with anthers in notch. Disc annular, fleshy. Ovary within disc, 1- or 2- , or falsely 4-loculed; style dilated above, short; stigma turbinate, capitate, 2- or 3-dentate. Berries leathery, tomentose, 1 - 4-loculed enclosing as many seeds; pericarp thin; seeds with fleshy white aril, nonendospermous; cotyledons thick, planoconvex; radicle superior.

Indomalesia, 16 species, 7 in India and 1 in Kerala.

Literature: Ghosh, R.B. 1961. Chromosome numbers of some flowering plants. *Curr. Sci.* 30: 73. Ghosh, R.B. 1968. Studies on the morphology of somatic chromosomes in *Walsura piscidia* Roxb. *Caryologia* 21: 111 - 114.

Walsura trifoliata (A. Juss.) Harms in Engl. & Prantl, *Nat. Pflanzenfam.* ed. 2, 1961: 119, 177. 1940 (as *trifolia*); M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 111. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 99. 1996; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 522. 1997. *Heynea trifoliata* A. Juss. in *Mem. Mus. Hist. Nat.* 19: 235. 1830. *Walsura piscidia* Roxb., *Fl. Ind.* 2: 384. 1832; Wight, *Ill. Ind. Bot.* 1: 55. 1840; Hiern in Hook.f., *Fl. Brit. India* 1: 564. 1875; Bourd., *Forest Trees Travancore*: 78. 1908; Rama Rao, *Fl. Pl. Travancore*: 75. 1914; Gamble, *Fl. Madras*: 183(131). 1915.

Mal.: *Kanjimaram, Paerilla-pacha*

Tree, to 15 m tall, densely foliaceous; branchlets densely tomentose; bark rough, thin, dark. Leaves 3-foliolate, to 12 x 9 cm, thick-coriaceous, glabrous, shining above, glaucous beneath; petioles to 4.5 cm long; petiolules to 1 cm long. Panicles corymbose, to 16 cm long; peduncles to 9 cm long. Flowers ca 8 mm across, 5-merous. Calyx lobes 3-angled, pubescent to ciliate. Petals imbricate, lanceolate, ca 3 mm long, pubescent outside, cream-coloured. Staminal tube cupular, ca 1.5 mm long, deeply 10-lobed, pubescent; lobes 2-fid; anthers 10, exserted. Ovary globose, ca 2 mm, pubescent, 2-loculed; ovules 2 in each locule, collateral; style to 1 mm long, dilated above; stigma turbinate, 2-dentate. Berries globose or ellipsoid, ca 2 x 1.5 cm, velvety-brown-tomentose; seed 1, ovoid, ca 7 x 5 mm.

Fl.: Nov. - April *Fr.*: April - Aug.

Habitat: Coasts to ca 200 m.

Distrib.: Kollam, Pathanamthitta, Thiruvananthapuram and Thrissur. Peninsular India. Sri Lanka.

Uses: Wood is hard, dark red and black-streaked. Bark is medicinal and used as a hair wash to kill lice and vermin. Bark and fruit pulp are also used as a fish poison.

17. XYLOCARPUS J. König

Littoral, evergreen trees. Leaves alternate, paripinnate; leaflets opposite, entire. Panicles axillary and terminal, few-flowered. Flowers bisexual, 4-merous. Petals reflexed, contorted. Staminal tube urceolate-globose, 8-dentate; teeth 2-partite; anthers 8, just included in tube, alternating with teeth. Disc cupular, fleshy, adnate to ovary. Ovary 4-grooved, 4-loculed; locules 2 12-ovuled; style short; stigma discoid. Capsules irregularly globose, 6 12-seeded; pericarp fleshy, dehiscent by 4 valves; seeds thick, angled, nonendospermous; testa hard, spongy, exarillate; hilum ventral; cotyledons superposed; radicle dorsal, in one corner.

Coasts of tropical Old World, 3 species and 1 in Kerala.

Xylocarpus granatum J. König in *Naturforscher* (Halle) 20: 2. 1784; C.E. Parkinson in *Indian Forester* 60: 138. 1934; S.S. Jain & Bennet in Hajra & al., *Fl. India* 4: 518. 1997. *Carapa obovata* Blume, *Bijdr.*: 179. 1825; Bourd., *Forest Trees Travancore*: 79. 1908. *Xylocarpus obovatus* (Blume) A. Juss. in *Mem. Mus. Hist. Nat.* 19: 244, t. 9, f. 22. 1830; Gamble, *Fl. Madras*: 185(132).

1915. *Carapa moluccensis* auct. non Lam. 1784: Bedd., Fl. Sylv. S. India: t. 136. 1871; Hiern in Hook.f., Fl. Brit. India 1: 567. 1875; Rama Rao, Fl. Pl. Travancore: 76. 1914.

Mal.: *Somunthiri*

Evergreen tree, to 8 m high; bark grey; branchlets sparsely lepidote. Leaves paripinnate, to 9 cm long; leaflets 2 or 3 pairs, opposite, obovate, cuneate at base, entire at margin, obtuse or rounded at apex, to 6 x 3.5 cm, thick-coriaceous, puberulous, shining above; petioles to 6 cm long, red; petiolules to 2 mm long, red. Panicles cymose, to 10 cm long; peduncles to 2.5 cm long. Flowers ca 1 cm across; pedicels to 4 mm long, red. Calyx lobes to 1 mm long. Petals oblong, ca 6 x 3 mm, glabrous, white, pinkish or yellowish white. Staminal tube to 4 mm long, glabrous. Ovary ca 1 mm long. Capsules ca 6 x 4.5 cm, brown; seeds arranged radially from remains of axis outwards, convex on back, pink.

Fl.: Sept. Dec. Fr.: Oct.

Habitat: A mangrove species in swampy seacoasts.

Distrib.: Thiruvananthapuram. Andaman & Nicobar Islands, Andhra Pradesh, Gujarat, Goa, Karnataka, Tamil Nadu, Maharashtra, Orissa and W. Bengal. Africa, Australia, Malesia and Sri Lanka.

Uses: The valuable hard and dark red wood is used for buildings and furniture. Seed yields an oil.

Sandoricum koetjape (Burm.f.) Merr. in Philipp. J. Sci. 7: 237. 1912. *Melia koetjape* Burm.f., Fl. Indica: 101. 1768. *Sandoricum indicum* Cav., Diss. 7: 359, t. 202 & 203. 1789; Hiern in Hook.f., Fl. Brit. India 1: 553. 1875.

Tree. Leaves to 45 cm long, 3-foliolate; leaflets elliptic or ovate, obtuse, short-acuminate at apex, 7 - 20 x 3.75 - 12.5 cm, coriaceous. Flowers in clustered axillary subsessile panicles, yellowish, fragrant. Calyx cupular with short imbricate lobes. Petals spreading. Staminal tube tubular, toothed at apex, nearly as long as petals. Disc cupular. Ovary 5-loculed. Berries globose, ca 7.5 cm, fleshy with acrid pulp.

Native to Malesia; sometimes grown in gardens for its handsome foliage and edible fruit.

DICHAPETALACEAE

(N.C. NAIR)

Trees, shrubs or lianas. Leaves simple, alternate, spiral, often seemingly distichous, entire, short-petioled, almost always with circular flat glands near base, pinnately nerved; stipules 3-angled or subulate, often early caducous. Inflorescences axillary or sometimes epiphyllous dichotomously branched umbels, glomerules, corymbs or fascicles; lower forkings often with bractlets; pedicels jointed near apex. Flowers 5-merous, rarely 4-merous, bi- or unisexual, hypo-epi- or perigynous, actino- or zygomorphic. Sepals slightly connate at base, imbricate. Petals free or connate at base, equal or not, spatulate, 2-fid or notched, often inflexed at apex, creamy white, drying black. Stamens in a whorl of 5 or 4, subperigynous, all or 3 fertile, antisepalous, free or adnate to petals at base; filaments long or short; anthers introrse, dehiscing by longitudinal slits; connectives much thick on dorsal side. Disc of 5 antisepalous glands or scales, or 5-glandular or -lobed cup, intrastaminal. Ovary superior or semi-inferior, pubescent or hispid, 2- or 3-loculed; ovules 2 in each locule, 1 developing into seed, pendulous, anatropous, 1-tegmic; styles 2 or 3, free or connate. Fruit a drupe or capsule, oblong or didymous, compressed, hispid or pubescent, 1- or 2-loculed; seeds sometimes caruncled, nonendospermous; testa membranous; embryo large; cotyledons thick; radicle superior.

Tropics, 3 genera and ca 160 species, 1 and 3 in India and, 1 and 1 in Kerala.

Literature: Lecnhouts, P.W. 1957. *Dichapetalaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males*. 1, 5: 305 - 316. & 1972. 6: 941 - 943.

Note: The most striking morphological feature of the family is the frequent conrescence of the petiole and peduncle which then apparently seems to arise from the base of the leaf blade.

DICHAPETALUM Thouars

Trees, shrubs or lianas, mono- or dioecious. Leaves apparently distichous, usually thickened at margin by a nerve; stipules caducous. Inflorescences axillary or seemingly terminal on leafless shoots or epiphyllous, umbels or reduced to 1 or 2 flowers. Flowers 5-merous, bi- or unisexual, hypo- or slightly epigynous. Sepals

ovate, slightly connate at base, pubescent. Petals free, 2-partite or -fid, clawed, white. Stamens 5, antisepalous. Disc of 5 glands, intrastaminal. Ovary 2- or 3-loculed; styles free or connate at base; stigmas apical. Fruit a drupe or dehiscent exposing orange to scarlet thin mesocarp, lobed or not, usually tomentose or glabrescent, orange-brown, greyish or yellowish, with or without sutures; endocarp crustaceous; stones 1 - 3, slightly united, 1-seeded; cotyledons planoconvex.

Tropics, 124 species, 3 in India and 1 in Kerala.

Dichapetalum gelonioides (Roxb.) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 4: 348. 1896; Gamble, Fl. Madras: 188(134). 1915; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 92. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 112. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 100. 1996; N.C. Nair in Hajra & al., Fl. India 4: 528. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 153. 2002. *Moacura gelonioides* Roxb., Fl. Ind. 2: 69. 1832. *Chailletia gelonioides* (Roxb.) Hook.f. in Benth. & Hook.f., Gen. Pl. 1: 341. 1862; Bedd., Fl. Sylv. S. India: t. 9, f. 1. 1870; Hook.f., Fl. Brit. India 1: 570. 1875.

Dioecious tree, to 10 m tall, liana or woody creeper; young branches scattered-pubescent, becoming glabrous. Leaves elliptic-lanceolate or obovate, acute at base, usually undulate at margin, acuminate or obtuse at apex, to 16 x 7 cm, herbaceous, glabrous or nearly so; glands few near acute base below; lateral nerves 5 - 10 pairs, interarching near margin. Inflorescences in axillary clusters, 7 - 10-flowered. Flowers 2 - 3 mm across. Disc lobes quadrate, round or cordate. Ovary in female flowers velvety-pubescent, in male ones pubescent to woolly, 2- or 3-loculed. Fruits oblong or compressed-obcordate, ca 1 x 1.5 cm, 1- or 2-lobed, grey- or yellowish-tawny-tomentose, smooth; sutures clearly discernible.

Fl.: March - June *Fr.*: Aug. - Dec.

Habitat: Wet evergreen forests, to 1500 m.

Distrib.: Ernakulam, Idukki, Kannur, Kasaragod, Kollam, Kottayam, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Assam, Karnataka, Meghalaya and Tamil Nadu. South and SE. Asia.

OLACACEAE

(N.P. BALAKRISHNAN)

Usually evergreen root-parasites, trees, shrubs, stragglers, lianas or tendrilled climbers. Leaves alternate, rarely distichous, exstipulate, petioled, simple, entire, pinnately or palmately nerved. Inflorescences axillary, small, rarely on old wood, cymose, thyrsoid or short racemes and panicles, or elongate spikes, often fascicled or glomeruled, sometimes reduced to a solitary flower. Flowers generally bi-, rarely unisexual, actinomorphic, 3 - 7-merous, rarely heterostylous. Calyx often very shortly 3 - 7-lobed or dentate-crenate, cup-like base free or adnate to disc and/or ovary, sometimes accrescent and then either free from or connate with fruit. Petals 3 - 7, free or slightly connate at base, mostly valvate, caducous. Disc, if present, annular, of free glands or cup-like, rarely accrescent and covering fruit almost to apex. Stamens hypogynous, 3 - 20 in 1 - 3 series, antipetalous and epipetalous or partly episealous, rarely partly staminodal; anthers basi- or medifixed, 2-, rarely 1-loculed, dehiscing longitudinally or by short slits. Ovary superior, rarely semi-inferior when within disc, basally 2 - 5- and apically 1-loculed with 1 pendulous ovule in each; ovules generally anatropous, 1- or 2-tegmic, or ategmic; style, if any, simple, conic, columnar or filiform; stigma small, sessile, 3 - 5-partite. Fruit a drupe or nut, bearing calyx scar at apex with a thin or fleshy exocarp and a crustaceous to woody endocarp, often with accrescent calyx or disc; seed 1 with thin testa; endosperm copious, starchy and/or oily bearing a minute to medium-sized embryo at apex; cotyledons 2, 3 or 4.

Tropics, 29 genera and ca 200 species, 6 and 16 in India and, 5 and 5 in Kerala.

Literature: Sleumer, H. 1980. A taxonomic account of the *Olacaceae* of Asia, Malesia and the adjacent areas. *Blumea* 26: 145 - 168. Sleumer, H. 1984. *Olacaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* I, 10: 1 - 29.

Key to genera

- 1a. Climbing shrubs, usually with axillary tendrils; leaves 3 - 5-nerved and subpeltate at base
2. Erythralium
- b. Shrubs, trees or stragglers, never climbing by tendrils; leaves pinnately nerved, never peltate at base

- 2a. Calyx accrescent and enveloping fruit almost completely; staminodes present 3. *Olex*
 b. Calyx not accrescent, if accrescent connate with fruit only at its lower part; staminodes absent 3
- 3a. Branchlets usually with axillary spines and/or thorns; leaves usually mucronulate at apex, deciduous in dry season; stamens alternately epipetalous and episepalous 5. *Ximenesia*
 b. Branchlets usually without spines or thorns; leaves not mucronulate at apex, persistent; stamens all epipetalous 4
- 4a. Calyx accrescent and much enlarged in fruit; disc not accrescent in fruit; petals entirely free
 4. *Strombosia*
 b. Calyx not accrescent in fruit; disc accrescent in fruit; petals connate in lower half

1. *Anacolosia*

1. ANACOLOSA (Blume) Blume

Trees or erect shrubs. Leaves alternate, sometimes subdistichous, simple, petioled, entire, pinnately nerved. Flowers bisexual, in sessile axillary cymes or fascicles, often from bracteoid woody warts or short axes, rarely from trunk or main branches. Calyx cupular, very shortly 5-7-lobed or subtruncate, not accrescent, subpersistent in mature fruit at base. Petals 5-7, free, connate at base, valvate, inserted at margin of cupular disc, fleshy, concave below and stamens there within, with a bearded keel above cavity. Stamens 5-7, opposite petals; filaments short, flat; anthers broadly ovoid, generally hairy at tip; locules distant and embedded in thick connective, dehiscing longitudinally. Disc hypogynous, cupular, 6-denticulate or -furrowed, adnate to ovary, much accrescent in fruit. Ovary within disc basally and for most part, incompletely 2- (or 3)-loculed below and 1-loculed above; ovules 2 or 3, pendent from apex of basal free central placenta, 1-axile; style slightly dilated at base; stigma shortly lobed. Drupes enclosed by accrescent disc almost to top and tipped by remains of style at apex, subtended by persistent calyx; pericarp thin-fleshy; endocarp thin, crustaceous; seed 1; endosperm fleshy; embryo minute; radicle superior, thicker than cotyledons.

Old World tropics, 16 species, 4 in India and 1 in Kerala.

Anacolosia densiflora Bedd. in Madras J. Lit. Sci. 3, 1: 38. 1864; Mast. in Hook. f., Fl. Brit. India 1: 580. 1875; Rama Rao, Fl. Pl. Travancore: 79. 1914; Gamble, Fl. Madras: 192(137). 1915; Uniyal in N.P. Singh & al., Fl. India 5: 2.

2000; Augustine in Indian J. Forest. 25: 338. 2002.

Mal.: *Kal-manikkam*

Tree, 10 - 15 m tall, straight-boled; wood reddish brown, moderately hard; branches terete. Leaves oblong to elliptic-lanceolate, acute to obtuse at base, entire at margin, acute to short-acuminate at apex, 10 - 15 x 2.5 - 5.5 cm, coriaceous, glabrous; midnerve often grooved above, ridged beneath; lateral nerves 4 or 5 pairs, faint above, distinct and raised beneath; petioles 5 - 10 mm long, channelled above. Flowers in dense axillary glomerules or condensed cymes, 4 - 5 mm long and as much across, pale yellow to white, fragrant. Calyx cupular or patelliform with 6 minute teeth at margin, ca 2 mm across, glabrous. Petals linear-lanceolate to ovate-, broad and slightly connate at base, narrow and recurved towards tip, 5 - 6 x 1 - 2 mm, glabrous outside, densely villous-hairy inside in upper part. Stamens 6, opposite petals and enclosed in gibbous and glabrous basal cavities, ca 1 mm long; anthers oblong. Ovary within annular disc with wavy or dentate margin, 3-loculed; style erect, thick, ca 1 mm long with 3-lobed stigma. Drupes oblong-obovoid, truncate at apex, 8 - 12 mm long, within accrescent disc except apex with persistent conic styler base; stone crustaceous, 1-seeded.

Fl.: Sept. - Dec. *Fr.*: April - June.

Habitat: Evergreen forests, to 700 m, rare.

Distrib.: Idukki, Kollam and Travancore (*Bourdillon* 457 MH). Western Ghats of Tamil Nadu. Endemic.

2. ERYTHROPALUM Blume

Climbing shrubs or lianas, with axillary woody tendrils. Leaves alternate or subdistichous, subpeltate at base, entire, 3 - 5-nerved at base, long-petioled. Flowers small, bisexual or androdioecious on loose slender peduncles and repeatedly dichotomous many-flowered cymes; bracts minute; pedicels filiform. Calyx cupular, with 4 or 5 short broad subimbricate teeth with basal part accrescent and covering fruit. Petals 5, valvate, oblong or ovate-triangular, recurved, connate at base. Stamens 5, inserted at base of petals, with 2 lateral scales (or staminodes) each; filaments very short; anthers ovate, introrse, dehiscing longitudinally; connectives thick. Disc cupular, 5-crenate. Ovary rudimentary in male flowers, half within disc, tapering to a short conic style with a minutely 3-lobed stigma, (2- or) 3-loculed below, 1-loculed above; ovules 1 - 3, pendulous from free central

apical placenta, 1-tegmic. Fruits drupaceous, oblong or ellipsoid, crowned by persistent calyx lobes and remains of disc; pericarp thin-fleshy; endocarp crustaceous to woody, splitting into 3 - 6 segments; seed 1; embryo minute; endosperm copious, fleshy, oily.

Indomalaysia, unispecific.

Erythropalum scandens Blume, Bijdr.: 922. 1826; Mast. in Hook.f., Fl. Brit. India 1: 578. 1875; Sasidh. & Sivar., Fl. Pl. Thrissur: 100. 1996; Sivar. & P. Mathew, Fl. Nilambur: 138. 1997; Uniyal in N.P. Singh & al., Fl. India 5: 5. 2000. *Mackaya populifolia* Arn. in Ann. Mag. Nat. Hist. 2: 350. 1838. *Modeccopsis vaga* Griff., Not. Pl. Asiat. 4: 633. 1854. *Erythropalum populifolium* (Arn.) Mast. in Hook.f., Fl. Brit. India 1: 578. 1875; Gamble, Fl. Madras: 191(137). 1915; Manilal, Fl. Silent Valley: 51. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 92. 1988; Vajr., Fl. Palghat: 113. 1990; N. Mohanan & Sivad., Fl. Agasthyamala: 153. 2002. *E. vagum* (Griff.) Mast. in Hook.f., Fl. Brit. India 1: 1578. 1875.

Scandent shrub or liana, 3 - 10 m long; stem flexible; branches slender, striate; tendrils simple, rarely 2-fid, woody, thick above; bark yellowish brown, dotted with lenticels. Leaves variable in shape and size, ovate-triangular to oblong-lanceolate, broadly attenuate-truncate or rarely subcordate and mostly subpeltate at base, acute or acuminate at apex, 5 - 16(- 22) x 6 - 12(- 16) cm, membranous to subcoriaceous or chartaceous, foetid when bruised, deep green above, glaucous beneath when fresh, yellowish green when dry; basal nerves 1 or 2 pairs, widely divergent, ascending, 3 - 7 upper pairs spreading, prominent beneath; reticulations usually distinct when dry; petioles swollen and wrinkled at both ends, (2 -)3 - 5(- 10) cm long. Inflorescences lax, slender, repeatedly dichotomous and many-flowered cymes, to 15 x 2 - 6 cm; peduncles slender, 4 - 8 cm long; bracts ovate-triangular, to 1 mm long; pedicels filiform, 4 - 5 mm long. Calyx cupular, 5-toothed, ca 1 mm long. Petals oblong, ovate or 3-angled, 1 - 1.5 mm long. Stamens with a tuft of hairs on either side; filaments very short; anthers ovate-cordate. Disc 5-angled, flat, ca 1.5 mm across, fleshy, elevated in middle forming a stout conic style with 3 small stigmas. Drupes pendulous, subglobose to ellipsoid or obovoid-pyriform, 1.5 - 2(- 2.5) x 1.5 - 2 cm, crowned by persistent calyx lobes and remains of disc; pericarp thin-fleshy, yellow to reddish brown, rarely whitish; endocarp crustaceous, splitting downwards into 3 - 6 recurved

segments, red inside; seed indigo blue, foetid.

Fl.: Nov. - May *Fr.*: Jan. - July.

Habitat: Tropical and subtropical forests, to 1200 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Andamans, E., NE. and S. India and Sikkim. South and SE. Asia.

3. OLAX L.

Trees or shrubs, sometimes straggling or climbing, occasionally thorny. Leaves distichous or subdistichous, pinnately nerved, petioled. Flowers in erect racemes, panicles or spikes, rarely solitary, minutely bracteate. Calyx cupular, truncate or obscurely toothed, accrescent in fruit. Petals 3, entire or, all or in part 2-partite and thus seemingly 6 (rarely 5), inserted at conic disc, free or connate in pairs. Stamens 8 or 9, opposite petals and partly attached at base, 3 fertile ones alternating with 5 or 6, 2-fid staminodes; filaments flat; anthers oblong, dehiscing longitudinally. Ovary superior, surrounded by shallow hypogynous disc, 1- or 3-loculed in lower part only with 3 anatropous 1- or ategmic ovules pendulous from apex of a free central short placenta; style short or elongate; stigma capitellate, 3-lobed. Fruit a drupe, oblong or ovoid to subglobose, covered halfway or almost to top by accrescent firmly membranous calyx though not strictly connate with it; pericarp parenchymatous; endocarp stony, crustaceous, 1-loculed; seed mostly 1, inverse; endosperm copious, oily; embryo minute.

Old World tropics, ca 25 species, 6 in India and 1 in Kerala.

Olax imbricata Roxb., *Fl. Ind.* 1: 169. 1820; Mast. in Hook.f., *Fl. Brit. India* 1: 575. 1875; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 101. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 138. 1997; Uniyal in N.P. Singh & al., *Fl. India* 5: 7. 2000. *O. wightiana* Wall. ex Wight & Arn., *Prodr. Fl. Ind. Orient.*: 89. 1834; Mast. in Hook.f., *Fl. Brit. India* 1: 575. 1875; Rama Rao, *Fl. Pl. Travancore*: 78. 1914; Gamble, *Fl. Madras*: 190(136). 1915; Uniyal in N.P. Singh & al., *Fl. India* 5: 11. 2000. *O. wightiana* Wall. ex Wight & Arn. var. *nigrescens* Gamble, *Fl. Madras*: 190(136). 1915.

Shrub, usually scandent; branchlets unarmed, striate, pale, lenticelled, somewhat pubescent initially, glabrous later, becoming reddish brown when dry. Leaves

ovate to elliptic-oblong, cuneate or rounded at base, subacuminate, acute or blunt at apex, 4 - 15(- 18) x 2 - 7 cm, subcoriaceous, glabrous on both surfaces, shining above; lateral nerves 6 - 9 pairs, curved-ascending towards margin, slightly raised beneath; petioles 5 - 9 mm long, wrinkled. Racemes axillary, 1 - 3(- 5) cm long, branched from base, many-flowered; rachises puberulous; bracts ovate, concave, 2 - 3 mm long, imbricate in 2 rows when young, puberulous, caducous; pedicels 3 - 4 mm long, glabrous. Calyx cup truncate, 1 - 1.5 mm long, glabrous, few-ciliate at margin. Petals 3, linear-oblong, 9 - 12 mm long, glabrous, pinkish white. Stamens 3; staminodes 5 or 6, 2-fid, pinkish white. Ovary ovoid, suborbicular, ca 1.5 mm long; style simple, erect, ca 4 mm long; stigma capitate. Drupes subglobose, rarely oblong or obovoid, 17 - 24 cm long, almost completely covered by thin accrescent orange calyx.

Fl. & Fr.: May - Aug.

Habitat: Primary evergreen forests, 500 - 1200 m.

Distrib.: Idukki, Malappuram and Thrissur. Andaman & Nicobar Islands, NE. and W. Peninsular India. South and SE. Asia.

Note: Nayar and Giri (*Bull. Bot. Surv. India* 27: 257 - 259, 1985) and Uniyal (*l.c.*) considered *O. wightiana* distinct from *O. imbricata*. The only specimen, *V.S. Raju & C.N. Mohanan* 73132, collected in Idukki, Kerala, was studied in detail with reference to the long list of differences listed by the former. It is seen that in some respects it agrees with *O. wightiana* while in others with *O. imbricata* indicating that the differences are not constant.

4. STROMBOSIA Blume

Evergreen shrubs or trees, glabrous; young twigs distinctly zigzag. Leaves alternate, rarely almost distichous, simple, coriaceous, pinnately nerved. Flowers bisexual, in axillary sessile fascicles or short-peduncled cymes. Calyx cupular, more or less 5-lobed, subperi- or perigynous, finally epigynous, accrescent, adnate to tip in mature fruit. Petals (4 or) 5, free, valvate, often reflexed at anthesis, hairy inside. Stamens (4 or) 5, opposite petals; filaments flat, hairy, uppermost part adnate to petals; anthers didymous, dorsifixed, introrse. Ovary superior, finally half-inferior, imperfectly 3 - 5(- 6)-loculed below, 1-loculed above, surrounded by a lobed disc; ovules 3 - 5(- 6), pendulous from apex of a free central placenta, 1-tegmatic, anatropous; style short to filiform-elongate; stigma subglobose, obscurely lobed. Drupes with remains of persistent calyx and stylar base at apex; pericarp

thin, fleshy; mesocarp crustaceous or woody; seed 1; endosperm copious, fleshy; embryo minute.

Old World tropics, ca 12 species and 1 in India.

Strombosia ceylanica Gardner in *Calcutta J. Nat. Hist.* 6: 350. 1845; Mast. in Hook.f., *Fl. Brit. India* 1: 579. 1875; Gamble, *Fl. Madras*: 191(137). 1915; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 101. 1996; Uniyal in N.P. Singh & al., *Fl. India* 5: 14. 2000.

Mal.: *Kal-manikkam*

Tree, sometimes shrub, (5 -)10 - 20 m tall; trunk straight, sometimes buttressed, closely branched; branches pendulous with a compact crown. Leaves elliptic, ovate-oblong to oblong-lanceolate, sometimes ovate or suborbicular, cuneate, rounded and subequal at base, short-acuminate with an acute or blunt tip, 8 - 16 x 3 - 8 cm, subcoriaceous, glabrous, shining above, densely pellucid-punctate; lateral nerves 5 - 8 pairs, ascending, arched; petioles slightly swollen at apex, 4 - 12 mm long. Flowers from small woody warts, 3 - 8(- 15) in each fascicle, white, fragrant; bracts and bracteoles several, minute, rounded, scale-like, reddish; pedicels 1 - 2 mm long. Calyx 5-lobed; lobes ovate, obtuse, ciliate. Petals 5, oblong, recurved at tip, glabrous outside, hairy inside, greenish white. Ovary half-inferior, on conic disc; style filiform, 2 - 4 mm long. Drupes sessile, pyriform when young, ellipsoid to subglobose with shortly attenuate base with remnants of calyx at apex, 1.5 - 2.5 cm long; pericarp thin, fleshy, rugose or tubercled, pink to purple; endocarp thin, woody; seed 1, ca 1.2 cm long.

Fl.: Dec. - Feb. *Fr.*: April - June.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Palakkad (Silent Valley), Pathanamthitta and Thrissur. Western Ghats of Karnataka (S. Canara and Coorg) and Tamil Nadu (Anamalais). South and SE. Asia.

5. XIMENIA L.

Shrubs or small trees, root-parasites; branches usually armed with axillary spines; brachyblasts (short branches) often ending in thorns. Leaves simple, short-petioled, spiral, sometimes fascicled or in brachyblasts, entire, pinnately nerved. Inflorescences axillary or at ends of brachyblasts, in few-flowered umbel-like

cymes, rarely flower solitary. Flowers usually bisexual, reflexed. Calyx small, cupular, 4(or 5)-dentate, persistent, usually accrescent in fruit. Petals 4 or 5, free, linear-oblong, finally revolute. Stamens 8 or twice as many as petals, hypogynous, alternately epipetalous and episealous; filaments filiform; anthers linear, erect, 2-loculed, basifixed, dehiscent in opposite longitudinal clefts. Staminodes absent. Ovary superior, sessile, 3- or 4-loculed; ovule 1 in each locule, pendulous, anatropous; style columnar; stigma simple. Fruits drupaceous, ovoid, fleshy, 1-loculed; pericarp pulpy; endocarp crustaceous, woody; seed 1; endosperm copious, oily; embryo very small.

Tropics, 8 species and 1 in India.

Ximenia americana L., Sp. Pl.: 1193. 1753; Mast. in Hook.f., Fl. Brit India 1: 574. 1875; Rama Rao, Fl. Pl. Travancore: 78. 1914; Gamble, Fl. Madras 189(135). 1915; Uniyal in N.P. Singh & al., Fl. India 5: 15. 2000.

Sprawling shrub or low-branching tree; branchlets pubescent with axillary spines. Leaves often close on short lateral twigs, deciduous in dry season, variable in shape and size, narrowly to broadly lanceolate, ovate, obovate or elliptic, sometimes suborbicular, generally obtuse at both ends, entire at margin, apiculate or mucronulate and sometimes emarginate at apex, 1.5 - 4 x 1 - 3 cm, thin-coriaceous, yellowish green turning brownish and brittle on drying; lateral nerves 3 - 5(- 7) pairs, rather faint; petioles 3 - 7 mm long. Inflorescences axillary or near ends of short lateral branchlets, subumbelled racemes or cymes, 3 - 9-flowered, to 2.5 cm long; peduncles to 1.5 cm long; bracteoles 2 - 4, scaly, ca 1 mm long; pedicels 3 - 7 mm long. Flowers white to greenish, fragrant. Calyx cupular, subacutely 4(or 5)-toothed, 0.5 - 1.5 mm long, ciliate, persistent. Petals linear-oblong to lanceolate, acute to rather obtuse and apiculate at apex, finally recurved, frilled, 8 - 10 x 1.5 - 2 mm, densely white-pilose to villous inside. Filaments 1.5 - 3 mm long, sigmoid near apex; anthers 3 - 4 mm long. Ovule 1 in each locule, pendulous. Drupes plum-like, subglobose to ellipsoid, rarely ovoid, apiculate, 1.5 - 2.5 x 1.5 - 3 cm, yellow to bright orange or scarlet; pericarp pulpy, green; endocarp bony; seed 1, 1 - 2.5 x 1 - 2 cm.

Fl.: March - April *Fr.*: June - July.

Habitat: Coastal scrub and dry inland forests.

Distrib.: Idukki (Chinnar, Rama Rao, *l.c.*) and Palakkad (Walayar). Scattered in

India. Almost throughout tropics.

OPILIACEAE

(N.P. BALAKRISHNAN)

Usually evergreen root-parasitic trees and shrubs, sometimes lianoid. Leaves alternate, simple, exstipulate, entire, pinnately nerved, tubercled by cystoliths when dry. Inflorescences axillary racemes, spikes, umbels or panicles, sometimes cauliflorous; bracts scab-like, peltate, often caducous. Flowers bi- or unisexual, dioecious, (3-4 or 5(6)-merous. Calyx obsolete, rarely minute and obscurely 4- or 5-lobed. Petals 4 or 5, valvate, free or connate, or absent. Stamens 4 or 5, antipetalous, rarely antisepalous; filaments short or filiform, free or epipetalous; anthers basifixed, introrse, dehiscing longitudinally. Disc entire, annular or glandular-lobed, alternating with stamens, sometimes cupular, fleshy. Ovary superior or semi-inferior, 1-loculed; ovule 1, basal or pendulous, 1- or ategmic, ana- or orthotropous; style simple, short with apical punctate stigma. Fruit a drupe with thin pericarp and fleshy and juicy or woody endocarp; seed without testa, with a basal hilum; embryo small, linear, straight; cotyledons broad; endosperm copious; radicle superior.

Tropics, 10 genera and 32 species, 4 and 4 in India and, 2 and 2 in Kerala.

Literature: Heipko, P. 1978. A revision of *Opiliaceae* 1. Genera of the eastern Old World, excluding *Opilia*. *Willdenowia* 8: 13 - 56. Heipko, P. 1982. A revision of *Opiliaceae* 2. *Opilia* Roxb. *Willdenowia* 12: 161 - 182. Heipko, P. 1984. *Opiliaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males*, I, 10(1): 31 - 52.

Key to genera

- 1a. Flowers in spikes; bracts 1-flowered; tepals connate, urceolate; stamens shorter than tepals
1. Cansjera
- b. Flowers in racemes; bracts 3-flowered; tepals free, recurved; stamens longer than tepals
2. Opilia

1. CANSJERA Juss., nom. cons.

Climbing or erect shrubs; branches usually zigzag, sometimes armed; twigs covered with upcurved hairs. Leaves entire, herbaceous to thin-fleshy or

coriaceous, glabrous or hairy. Flowers bisexual, in short axillary spikes, each flower in axil of a small persistent bract; peduncles hairy. Perianth urceolate or campanulate; lobes 4 (or 5), small, recurved. Stamens 4 or 5, shorter than perianth tube; filaments filiform. Disc of 4 or 5, 3-angled fleshy glandular scales alternating with stamens. Ovary superior, ovoid to cylindrical; style short, hardly longer than perianth tube or not; stigma capitate, somewhat 4-lobed. Drupes 1 or 2 in each infructescence, ellipsoid, sessile, on lacerated perianth; mesocarp fleshy and juicy; endocarp thin, brittle; seed 1, erect; cotyledons 3 or 4; radicle superior.

Indomalaysia to Australia, 3 species and 1 in India.

Cansjera rheedei J.F. Gmel., Syst. Nat. 2: 280. 1791 (as *Cansiera rheedii*); Mast. in Hook.f., Fl. Brit. India 1: 582. 1875 (as *rheedii*); Gamble, Fl. Madras: 193(138). 1915 (as *rheedii*). *C. scandens* Roxb., Pl. Coromandel 2: 2, t. 103. 1799; Manilal & Sivar., Fl. Calicut: 64. 1982 (as *rheedii*); Nicolson & al. in Regnum Veg. 119: 203. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 92. 1988 (as *rheedii*); M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 112. 1994 (as *rheedii*); R. Mathur in N.P. Singh & al., Fl. India 5: 40. 2000 (as *rheedii*).

Mal.: *Cheriavallikanjiram*

Liana or climbing shrub, 8 - 10 m with hanging branches, rarely an erect shrub; branches shining, brown, lenticelled, often with curved thorns. Leaves ovate to lanceolate or elliptic, shortly attenuate to rounded at base, subacuminate at apex, (3 -)5 - 9(- 13) x 1.5 - 4(- 5) cm, dull, glabrous, thin-coriaceous and brittle when dry; lateral nerves 6 or 7 pairs; petioles 3 - 5 mm long, densely hairy. Spikes 1 - 3(- 5) in a leaf axil, 1.5 - 2.5(- 4) cm long; bracts ovate to 3-angled, acute, ca 1 mm long. Perianth urceolate, greenish yellow; tube 2.5 - 3 mm long; lobes recurved, ca 0.5 mm. Filaments ca 2 mm long; anthers broadly ovate, reaching as far as throat of perianth tube. Disc scales ovate, acute, irregularly toothed, slightly fleshy. Ovary subcylindrical, ca 1 mm long; style ca 1 mm long, persistent; stigma 4-lobed. Drupes oblong-ovoid, 10 - 13(- 15) x 7 - 9(- 12) mm, smooth, orange-red when ripe; seed with a deeply sunk hilum.

Fl.: Sept. - Nov. Fr.: Dec. - Feb.

Habitat: Evergreen and semideciduous forests, to 1000 m.

Distrib.: Idukki, Kannur, Kasaragod, Kozhikode, Palakkad, Thiruvananthapuram and Wynad. Andhra Pradesh, Karnataka, Maharashtra, Orissa and Tamil Nadu.

Indomalesia to Australia.

2. OPILIA Roxb.

Climbing shrubs, low trees or erect shrubs; young branchlets glabrous or puberulous. Leaves alternate, entire, coriaceous, pinnately nerved. Inflorescences racemose, axillary, cone-like in bud; peduncles and pedicels densely covered with brownish or yellowish hairs. Flowers bisexual, 3 together in axils of peltate bracts. Calyx, if present, minute, annular or obscurely 4- or 5-lobed. Petals 5 or 4, free, valvate, oblong, recurved. Disc of 4 or 5 fleshy cupular glands alternating with petals. Stamens 5, antipetalous; filaments slender, longer than petals; anthers 2-loculed. Ovary superior, ellipsoid to oblong; ovule 1, pendulous; style short. Drupes ellipsoid, puberulous with a fleshy pericarp and thin woody endocarp; seed large; embryo as long as seed; endosperm copious, fleshy; cotyledons 3, joined together; radicle superior, extremely small.

Old World tropics, 2 species and 1 in India.

Opilia amentacea Roxb., Pl. Coromandel 2: 31, t. 158. 1802; Mast. in Hook.f., Fl. Brit. India 1: 583. 1875; Rama Rao, Fl. Pl. Travancore: 79. 1914; Gamble, Fl. Madras: 192(138). 1915; R. Mathur in N.P. Singh & al., Fl. India 5: 44. 2000.

Climbing shrub or weak liana, to 10 m or erect shrub; bark smooth or slightly fissured, pale to dark grey; branches glabrous or glabrescent, pale brown. Leaves ovate, oblong or lanceolate, attenuate or rounded at base, acute to acuminate or obtuse at apex, 5 - 14(- 16) x 2 - 5 cm, glabrous; lateral nerves (6 -)7 - 9(- 11) pairs; petioles 3 - 7(- 10) mm long. Racemes 1 - 5 in a leaf axil, 1.5 - 3.5 cm long; bracts imbricate, peltate, 2 - 3 mm broad, ciliate at margin, caducous; pedicels 1.5 - 2 mm long. Flowers fragrant. Petals oblong with short inflexed tip, ca 1.5 mm long, shortly pubescent outside. Filaments filiform, ca 1.5 mm long; anthers ovoid. Disc lobes subclavate, ca 0.5 mm long, green. Ovary ca 1 mm long. Drupes oblong, 1.5 - 3 x 1.25 - 1.75 cm, glaucous green to orange-yellow when ripe with 5 - 7 mm long swollen pedicel.

Fl.: Feb. May *Fr.*: June Sept.

Habitat: Scrub and deciduous forests, to 1200 m.

Distrib.: Palakkad, Travancore (Chemunji, Rama Rao, *l.c.*) and Wynad. Andhra

Pradesh, Bihar, Madhya Pradesh, Orissa and Tamil Nadu. Tropical Africa, S. and SE. Asia to Australia.

Use: The fleshy mesocarp is edible.

ICACINACEAE

(N.P. BALAKRISHNAN)

Trees, erect or climbing shrubs, lianas or rarely herbs. Leaves mostly spiral, rarely opposite, simple, exstipulate, entire, rarely lobed or toothed, pinnately or palmately nerved. Inflorescences mostly axillary, leaf-opposed or from old wood, usually cymose or thyrsoid, sometimes racemose, rarely few-flowered fascicles or solitary flower, sometimes spicate or paniced. Flowers usually bi-, rarely uni-sexual, (4-5)(5-6)-merous, cyclic, actinomorphic; pedicels, if any, jointed with calyx. Calyx small, 5(4 or 6)-lobed, sometimes absent; lobes imbricate or valvate. Petals 5, rarely 4 or 6, free or connate below; lobes valvate, rarely subimbricate, inflexed at tip, mostly caducous. Stamens as many as sepals and petals, alternating with petals, episepalous, basally inserted, sometimes in upper part of calyx tube; filaments subulate, often flat or filiform, fleshy; anthers 2-loculed, often divergent below, basifixed, lat- or introrse; staminodes present in female flowers. Disc cupular or 5-lobed, often absent. Pistil with 3 (2-5) carpels; ovary superior, 1-, rarely 2-5-loculed; ovules usually 2 in each locule, collateral, subapical, 1-tegmic, crassi- or tenuinucellar, anatropous; style simple, usually short; stigma apical, sometimes capitate. Fruits usually drupaceous, rarely a samara, ellipsoid to globose, often laterally compressed; epicarp thin, fleshy; endocarp thin, crustaceous, sometimes spongy or fibrous, often nerved or longitudinally ribbed; seed 1, pendulous; embryo small, straight or arcuate; cotyledons sometimes foliaceous or folded, rarely thick; endosperm sometimes copious, rarely absent; radicle superior.

Tropics, a few temperate, 52 genera and ca 300 species, 11 and 16 in India and, 6 and 6 in Kerala.

Literature: Howard, R.A. 1940. Studies in the *Icacinaceae*. Preliminary taxonomic notes. *J. Arnold Arbor.* 21: 461-488. Sleumer, H. 1969. Materials towards the knowledge of the *Icacinaceae* of Asia, Malesia and adjacent areas. *Blumea* 17: 179-264. Sleumer, H. 1972. *Icacinaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 7: 1-87.

Key to genera

- | | | |
|-----|--|-----------------|
| 1a. | Erect shrubs or small trees | 2 |
| b. | Climbing shrubs | 4 |
| 2a. | Flowers unisexual or functionally so; filaments hairy at apex | 2. Gomphandra |
| b. | Flowers bisexual; filaments glabrous | 3 |
| 3a. | Petals glabrous; disc absent; ovary with a lateral swelling developing into a succulent appendage in fruit | 1. Apodytes |
| b. | Petals villous; disc present; ovary without an appendage | 4. Nothapodytes |
| 4a. | Leaves palmately 3-nerved at base | 3. Miquelia |
| b. | Leaves pinnately nerved | 5 |
| 5a. | Leaves coarsely toothed and glandular at margin; calyx absent | 5. Pyrenacantha |
| b. | Leaves entire at margin; calyx 4 - 6-toothed | 6. Sarcostigma |

1. APODYTES E. Meyer ex Arn.

Trees or shrubs. Leaves entire, pinnately nerved, usually turning black when dry. Flowers bisexual, in terminal or axillary corymbose cymes, cylindrical in bud, jointed, on short pedicel. Calyx cupular, (4 - or)5-toothed, persistent. Petals (4 or)5, free or a little connate at base, valvate in bud, finally spreading, linear, obscurely keeled on inner side with inflexed apex, glabrous. Stamens 5, almost as long as petals; filaments subulate, dilated, glabrous; anthers linear-oblong, 2-partite-sagittate below, 2-loculed, medifixed, introrse, dehiscing by lateral longitudinal slits. Disc absent. Ovary oblique, laterally gibbous at base, 1-loculed; ovules 2, pendulous, superposed; styles slender, eccentric, ending in a small slightly oblique stigma. Drupes obliquely ellipsoid or ovoid, slightly compressed with lateral appendage; stone crustaceous; seed 1, ovoid-reniform, slightly compressed with thin testa.

Africa, S. and SE. Asia to N. Australia, 2 species and 1 in India.

Apodytes dimidiata E. Meyer ex Arn. in Hooker's J. Bot. Kew Gard. Misc. 3: 155. 1851; Manilal, Fl. Silent Valley: 52. 1988; Vajr., Fl. Palghat: 113. 1990; R. Mathur in N.P. Singh & al., Fl. India 5: 18. 2000. *A. benthamiana* Wight, Icon. Pl. Ind. Orient.: t. 1153. 1846; Bedd., Fl. Sylv. S. India: t. 140. 1871; Mast. in Hook.f., Fl. Brit. India 1: 588. 1875; Gamble, Fl. Madras: 195(140). 1915. *A. beddomei* Mast. in Hook.f., Fl. Brit. India 1: 588. 1875; Gamble, Fl. Madras:

195(140). 1915.

Tree, 10 - 20(- 25) m tall; trunk 20 - 50(- 70) cm across; bark rough, dark grey to brown; branchlets sparsely lenticelled. Leaves oblong, ovate-elliptic or broadly ovate, acute or obtuse-rounded at base, entire with flat or slightly revolute margin, acute to short-acuminate or rarely obtuse at apex, 6 - 12 x 3 - 6 cm, membranous to thin-coriaceous, glabrous, rarely with scattered yellow hairs on midnerve and petiole, dark green and shining above when fresh, brownish black when dry; midnerve slightly grooved above, distinct beneath; lateral nerves 6 - 10 pairs, spreading; petioles 1 - 2 cm long. Flowers in many-flowered 3 - 8 cm long terminal corymbs, white to yellowish, fragrant; peduncles 1 - 3 cm long; branches almost at right angles; pedicels pilose; flower buds oblong-cylindric. Calyx cupular, ca 0.75 mm long, short-dentate, pubescent outside, glabrous inside. Petals oblong, 4 - 6 mm long, glabrous. Filaments ca 1.5 mm long; anthers oblong, ca 3.5 mm long, yellow. Ovary narrowly ovoid, densely pubescent or glabrescent; style ca 2.5 mm long, white. Drupes ovoid or obliquely ellipsoid, rounded at apex, laterally compressed, ca 5 x 9 mm, nerved, dark purple, becoming shining black; lateral appendage juicy, green, becoming scarlet-red.

Fl.: April - May *Fr.*: June - Dec.

Habitat: Evergreen forests, 800 - 1200 m.

Distrib.: Kannur, Palakkad and Wynad. Assam, Karnataka, Meghalaya and Tamil Nadu. Africa, S. and SE. Asia.

Use: The tree yields a good timber.

2. GOMPHANDRA Wall. ex Lindl.

Trees or shrubs, dioecious. Leaves entire, chartaceous to coriaceous, dark green above, pale beneath, pinnately nerved, rarely 3-nerved; midnerve a little grooved above; petioles often somewhat decurrent on branchlets. Flowers functionally unisexual, polygamodioecious, jointed, on short pedicel, arranged in loose or capitate di- or trichotomously branched axillary or lateral cymes. Calyx cupular, minute, 4- or 5-toothed to almost entire, subsistent. Petals 4 or 5, valvate in bud, more or less connate into a campanulate tube with free inflexed-hooked tips. Male flowers: Stamens 4 or 5, hypogynous, free, often exserted, alternating with petals; filaments thick, dilated above, flat, fleshy, bearing clavate hairs at apex below locules in front and on back of connectives; anthers pendulous

from inner apex of filaments, ovoid-ellipsoid, basifixed, dehiscing longitudinally; disc annular with a sunken pistillode in centre. Female flowers: Staminodes present or not; filaments linear with shorter hairs; locules devoid of pollen; disc hypogynous, annular, thick or absent; ovary cylindrical, 1-loculed with conic style and small thick discoid stigma; drupes oblongoid or ellipsoid, asymmetrically swollen at base, sometimes shortly attenuate-beaked or crowned by persistent stigma; pericarp thin, smooth, fleshy; endocarp leathery or hard, smooth or longitudinally 8 - 10-ribbed; seed 1, pendulous, longitudinally surrounded by raphe; embryo minute.

Southeast Asia to the Solomon Islands, 33 species, 3 in India and 1 in Kerala.

Gomphandra tetrandra (Wall.) Sleumer in Notizbl. Bot. Gart. Berlin-Dahlem 15: 238. 1940; Manilal, Fl. Silent Valley: 52. 1988; V.S. Ramach. & V.I. Nair, Fl. Cannanore: 93. 1988; Vajr., Fl. Palghat: 114. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 113. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 102. 1996; Sivar. & P. Mathew, Fl. Nilambur: 140. 1997; R. Mathur in N.P. Singh & al., Fl. India 5: 25. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 155. 2002. *Lasianthera tetrandra* Wall. in Roxb., Fl. Ind. 2: 328. 1824; Bedd., Fl. Sylv. S. India: t. 61. 1870. *Gomphandra polymorpha* Wight, Ill. Ind. Bot. 1: 103. 1840; Gamble, Fl. Madras: 195(139). 1915. *G. coriacea* Wight, Ill. Ind. Bot. 1: 103. 1840; Gamble, Fl. Madras: 195(140). 1915; Manilal, Fl. Silent Valley: 52. 1988; Vajr., Fl. Palghat: 114. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 112. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 102. 1996; Sivar. & P. Mathew, Fl. Nilambur: 139. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 154. 2002. *G. axillaris* Wall. ex Voigt, Hort. Suburb. Calcutt.: 31. 1845; Mast. in Hook.f., Fl. Brit. India 1: 586. 1875; Bourd., Forest Trees Travancore: 95: 1908; Rama Rao, Fl. Pl. Travancore: 79. 1914.

Large shrub or small tree. Leaves oblong-ovate, elliptic-ovate, elliptic-lanceolate to linear- cuneate or obliquely cuneate at base, acuminate, acute to rarely obtuse at apex, 7 - 13 x 2 - 6 cm, membranous or coriaceous to chartaceous, scattered-hairy when young, glabrous when mature; lateral nerves 4 - 6 pairs; reticulations indistinct above. Flowers in sessile, axillary or leaf-opposed peduncled cymes, pale yellow, polygamodioecious. Calyx 5-toothed, tomentose outside. Petals connate at base into a tube. Filaments subglabrous or often with a tuft of hairs

above. Ovary oblong, glabrous with a discoid stigma. Drupes oblong-ovoid to subglobose, rounded, rarely swollen at base, gradually narrowing or rounded at apex, 12 - 15 x 5 - 8 mm, smooth, white or yellow, 1-seeded.

Fl.: Dec. *March* *Fr.*: May - Aug.

Habitat: Evergreen forests, to 1800 m.

Distrib.: Almost throughout Kerala. Western Ghats from Concan southwards. Arunachal Pradesh, Assam and Meghalaya. South and SE. Asia.

Note: A very variable species. *G. coriacea* is considered only a montane form with coriaceous to subcoriaceous leaves. The glabrous or hairy filaments do intergrade and cannot stand as a distinguishing character.

3. MIQUELIA Meisn., nom. cons.

Climbing or twining shrubs, dioecious. Leaves simple, entire or coarsely lobed, membranous, palmately nerved at base. Flowers sessile, in heads or umbels, on elongate supra-axillary peduncles often arranged in racemes or panicles. Male flowers: Calyx minute, deeply 4- or 5-lobed or absent; petals connate into a tube with free lobes; lobes 4 or 5, valvate, a little inflexed at tip, patent or reflexed; stamens 4 or 5, alternating with corolla lobes; filaments short, linear; anthers linear-oblong to subsagittate, dorsifixed, introrse; pistillode minute. Female flowers: Calyx and corolla lobes either distant from each other by elongate floral axis or close together; staminodes flat, short; ovary sessile, thick-cylindric, hairy, 1-loculed; ovules 2, pendulous from above; stigma sessile or on short style, patelliform or cupular; drupes stalked or not, oblongoid to subovoid or ellipsoid, compressed, often narrow at base into a stalk; mesocarp thin; endocarp crustaceous, rugose or shallowly lacunose with warts causing small pits; seeds surrounded by juicy pulp; testa thin; endosperm fleshy, rugulose; cotyledons elliptic, leafy.

Indomalesia, 8 species, 2 in India and 1 in Kerala.

Miquelia dentata Bedd. in Madras J. Lit. Sci. 3, 1: 38. 1864 & Trans. Linn. Soc. London 25: 211, t. 23. 1865; Mast. in Hook.f., Fl. Brit. India 1: 593. 1875; Gamble, Fl. Madras: 197(141). 1915; Manilal, Fl. Silent Valley: 53. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 93. 1988; Vajr., Fl. Palghat: 114. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 102. 1996; Sivar. & P. Mathew, Fl. Nilambur: 140. 1997; R. Mathur in N.P. Singh & al., Fl. India 5: 29. 2000.

Climbing shrub. Leaves variable in size and shape, oblong to elliptic-lanceolate, narrowly rounded to cuneate, rarely truncate or subcordate at base, irregularly and coarsely dentate at margin, caudate-acuminate at apex with to 2.5 cm long acumen, 8 - 20 x 4 - 12 cm, membranous, glabrous on both surfaces, 3-nerved at base; nerves ridged beneath; lateral nerves 4 - 6 pairs; reticulations distinct beneath; petioles 3 - 8 cm long. Flowers 4-merous, in capitate or subcapitate, on supra-axillary slender 3 - 10 cm long peduncles often arranged in short supra-axillary panicles; bracts many, clustered at apex of peduncle, subulate, to 1 mm long; pedicels 1 - 10 mm long, slender. Calyx indistinct in male flowers. Petals connate in male flowers, free in female ones, linear-oblong to lanceolate, obtuse, 2.5 - 3.5 x ca 1 mm, persistent in fruit. Stamens 4; anthers oblong, sagittate. Drupes to 6 in heads on long peduncle, ellipsoid to oblogoid, somewhat compressed, 16 - 20 x 8 - 11 mm, reticulate-pitted when dry; seeds oblong, slightly compressed, 8 - 10 mm long, pitted-foveolate, light brown.

Fl.: April - Sept. *Fr.*: Oct.

Habitat: Moist secondary forests, to 1200 m.

Distrib.: Ernakulam, Idukki, Kannur, Kasaragod, Kollam, Malappuram, Palakkad, Pathanamthitta, Thrissur and Wynad. Western Ghats of Tamil Nadu. Endemic.

4. NOTHAPODYTES Blume

Trees or large shrubs; branches angled with large leaf scars. Leaves alternate, sometimes subopposite, entire, very finely pellucid-punctate when seen against strong light, pinnately nerved. Flowers bisexual, in terminal or rarely axillary cymes collected in corymbs; pedicels short, jointed above, without a bract; flower buds oblong-ellipsoid. Calyx cupular, 5-lobed or sinuate-dentate, persistent. Petals 5, linear-oblong, slightly connate at base, usually inflexed at apex. Stamens 5, free; filaments more or less flat below, glabrous, fleshy; anthers oblong-ellipsoid; locules divergent often with reflexed appendage at base cohering to filament, introrse. Disc cupular, shallowly 5- or 10-crenulate, fleshy to foliaceous, glabrous outside, with a few hairs inside. Ovary ovoid or subconic, tapering above to a short stout or slender hairy or glabrous style; stigma capitate, truncate or mostly oblique. Drupes ellipsoid with thin juicy exocarp and thin crustaceous smooth or rugose endocarp; seed 1, endospermous; embryo large.

East Asia and Malesia, 5 species and 1 in India.

Nothapodytes nimmoniana (J. Graham) Mabb. in Manilal, Bot. Hist. Hort. Malab.: 88. 1980; Manilal & Sivar., Fl. Calicut: 65. 1982; Manilal, Fl. Silent Valley: 53. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 94. 1988; Vajr., Fl. Palghat: 115. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 113. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 104. 1996; Sivar. & P. Mathew, Fl. Nilambur: 141. 1997; R. Mathur in N.P. Singh & al., Fl. India 5: 31. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 156. 2002. *Premna nimmoniana* J. Graham, Cat. Pl. Bombay: 153. 1839. *Stemonurus foetidus* Wight, Icon. Pl. Ind. Orient.: t. 955. 1845. *Mappia foetida* (Wight) Miers in Ann. Mag. Nat. Hist. 2, 9: 395. 1852; Mast. in Hook.f., Fl. Brit. India 1: 589. 1875; Bourd., Forest Trees Travancore: 97: 1908; Rama Rao, Fl. Pl. Travancore: 80. 1914; Gamble, Fl. Madras: 196(141). 1915. *M. ovata* Miers in Ann. Mag. Nat. Hist. 2, 9: 396. 1852; Mast. in Hook.f., Fl. Brit. India 1: 589. 1875; Gamble, Fl. Madras: 196(141). 1915. *M. oblonga* Miers in Ann. Mag. Nat. Hist. 2, 9: 396. 1852; Mast. in Hook.f., Fl. Brit. India 1: 589. 1875; Gamble, Fl. Madras: 196(141). 1915. *M. wightiana* Miers in Ann. Mag. Nat. Hist. 2, 9: 397. 1852; Gamble, Fl. Madras: 197(141). 1915. *M. tomentosa* Miers in Ann. Mag. Nat. Hist. 2, 9: 397. 1852; Mast. in Hook.f., Fl. Brit. India 1: 589. 1875; Gamble, Fl. Madras: 196(141). 1915. *Nothapodytes foetida* (Wight) Sleumer in Notizbl. Bot. Gart. Berlin-Dahlem 15: 247. 1940.

Tree or shrub, (4 - 6 - 10(- 15) m high; trunk 10 - 20 cm across; bark smooth with white patches, greenish grey; branchlets angled with corky bark and large leaf scars; young parts densely appressed-hairy. Leaves variable, elliptic-ovate to oblong- or oblong-lanceolate, broadly cuneate to rounded and asymmetric at base, acute to short-acuminate at apex, 9 - 22 x 4 - 11 cm, membranous to subcoriaceous, often appressed-soft-hairy beneath; lateral nerves 6 - 10 pairs, curved-ascendent, raised beneath; reticulations obscure; petioles 2 - 6 cm long. Cymes terminal, corymbosely arranged, many-flowered, long-peduncled, 5 - 10 cm across; peduncles and branches flat or angled, crisp-hairy; pedicels 1 - 2 mm long. Flowers greenish white or cream-white, foetid. Calyx ca 1.5 mm long, toothed. Petals spreading, linear-oblong, subacuminate, 4 - 6 x ca 1.5 mm, densely to sparsely hairy inside. Disc cupular. Filaments (2 -)3 - 4 mm; anthers ca 1 mm long. Ovary ovoid, hirsute, narrowing to 3 mm long style with thick green stigma. Drupes oblong-ovoid or ellipsoid, compressed, 1 - 2 x 0.8 - 1 cm, smooth, sparsely short-pubescent, half yellow, half red, finally black; endocarp thin, woody, shallowly

rugose to reticulate-pitted; seed 1; endosperm foetid.

Fl. & Fr.: Feb. Oct.

Habitat: Primary and secondary evergreen to scrub forests, to 2000 m, common.

Distrib.: Almost throughout Kerala. Assam, Karnataka, Maharashtra, Sikkim, Tamil Nadu and W. Bengal. South and SE. Asia.

Uses: Camptothecin, a proven antitumour alkaloid, is found in the plant and much exploited therefor. Root contains more of this alkaloid. Seed oil has antimicrobial and antifungal activity (*vide* Agarwal, J.S. & Rostogi, R.P. 1973. Chemical constituents of *Mappia foetida* Miers. *Indian J. Chemistry* 11: 969. Govindachari, T.R. & Viswanathan, N. 1972. Alkaloids of *Mappia foetida*. *Phytochemistry* 11: 352. Joshi, R., Jain, N.K. & Garg, B.D. 1978. Antimicrobial activity of the oil and its unsaponifiable matter from the seeds of *Mappia foetida*. *Indian Drugs* 16: 18).

5. PYRENACANTHA Wight, nom. cons.

Woody climbers, dioecious. Leaves simple, alternate, repand or coarsely toothed and glandular at margin, pinnately nerved. Flowers in axillary or supra-axillary filiform spikes and heads. Calyx absent. Petals 4, oblong, connate below. Male flowers: Stamens 4; pistillode rudimentary, villous. Female flowers: Staminode present or not; ovary oblong; stigma sessile, rounded or truncate; drupes flat, fleshy; endocarp hard, warty outside, verrucose inside; seed 1 with ruminant endosperm and foliaceous cotyledons.

Old World tropics, ca 20 species and 1 in India.

Pyrenacantha volubilis Wight in Bot. Misc. 2: 107, tt. 9 & 10. 1830; Rama Rao, Fl. Pl. Travancore: 80. 1914; Gamble, Fl. Madras: 198(142). 1915; R. Mathur in N.P. Singh & al., Fl. India 5: 34. 2002; E.S.S. Kumar & al. in J. Econ. Tax. Bot. 25: 729, f. 1. 2001; N. Mohanan & Sivad., Fl. Agasthyamala: 156. 2002.

Much branched climber. Leaves rhomboid-lanceolate, obtuse at base, coarsely 3- or 4-toothed at margin, retuse or mucronate at apex, to 12 x 3.5 cm, subcoriaceous, scabrid beneath with a pair of glands at base; petioles ca 1 cm long. Male flowers in spikes and female ones in heads. Male flowers: Calyx absent; petals 4, connate at base, valvate, oblong, inflexed at apex, pubescent outside; stamens 4; pistillode minute, villous. Female flowers: Staminode minute; ovary ellipsoid, pubescent, 1-loculed with 2 pendulous, collateral ovules; stigma sessile

with radiating branches; drupes ovoid, laterally compressed, ca 1.5 x 1 cm, orange to red, fleshy; endocarp thin, punctate outside, papillose inside projecting into ruminant endosperm.

Fl. & Fr.: Sept. Oct.

Habitat: Evergreen forests, rare.

Distrib.: Thiruvananthapuram. Western Ghats. South and SE. Asia.

6. SARCOSTIGMA Wight & Arn.

Climbing shrubs, dioecious. Leaves simple, entire, pinnately nerved, strongly reticulate; petioles curved or twisted, longitudinally striate and transversely wrinkled. Flowers (4 -) 5(- 6)-merous, sessile, sometimes female ones short-pedicelled, in distinct fascicles or solitary on long lateral pendulous interrupted or spike-like racemes combined into panicles or simple. Calyx cupular, shortly 4 - 6-dentate, persistent. Petals 4 - 6, free or shortly connate at base, reflexed, persistent in female flowers. Male flowers: Stamens 4 - 6, hypogynous, alternating with petals, exerted; filaments linear; anthers ellipsoid, versatile; locules slightly divergent below; pistillode conic, hirsute. Female flowers: Staminodes subulate-filiform, sometimes absent; ovary oblong-ovoid, hirsute, 1-loculed; ovules 2, pendulous from above; stigma subsessile, thick; drupes oblongoid, somewhat flat; exocarp thin, coriaceous; endocarp thin, woody, smooth or slightly verrucose and covered with a white membrane inside, sometimes a little reticulate-foveolate outside; seed 1, nonendospermous; testa thin; cotyledons fleshy, connate.

Indomalaysia, 2 species and 1 in India.

Sarcostigma kleinii Wight & Arn. in Edinburgh New Philos. J. 14: 299. 1833; Wight, Icon. Pl. Ind. Orient.: t. 1854. 1852; Mast. in Hook.f., Fl. Brit. India 1: 594. 1875; Rama Rao, Fl. Pl. Travancore: 80. 1914; Gamble, Fl. Madras: 199(142). 1915; Manilal & Sivar., Fl. Calicut: 65. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 94. 1988; Vajr., Fl. Palghat: 115. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 114. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 104. 1996; Sivar. & P. Mathew, Fl. Nilambur: 141. 1997; R. Mathur in N.P. Singh & al., Fl. India 5: 35. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 157. 2002.

Climbing shrub, to 8 m; stems to 6 cm across; branches slender, puberulous. Leaves oblong-lanceolate, -obovate or -elliptic, broadly cuneate to rounded at

base, abruptly and bluntly acuminate or obtuse at apex, 10 - 25 x 4 - 8 cm, subcoriaceous to coriaceous, glabrous on both surfaces, rarely scattered-hairy, yellowish when dry; lateral nerves 6 - 8 pairs, curved, ascendent and arching near margin; reticulations dense and prominent on both surfaces; petioles 1 - 1.5 cm long. Spikes 1 - 3(- 5)-fascicled, slightly supra-axillary from partly defoliated branches or from old wood, densely short-brown-hairy; male spikes 15 - 25 cm long; female ones to 40 cm long. Flowers many in clusters, generally sessile. Calyx obtusely lobed halfway, 1 - 1.5 mm long, hairy below. Petals linear-oblong, subacute, 3 - 4 mm long, densely brown-hairy outside, glabrous inside, greenish yellow. Filaments strap-shaped, ca 5 mm long, glabrous; staminodes present or not in female flowers. Ovary ellipsoid or obovoid, hirsute; stigma subconic or flat. Pistillode elongate-conic, hirsute in male flowers. Drupes unequally subovoid-ellipsoid or oblongoid, laterally compressed, contracted at base, 2.5 - 3.5 x 1.7 - 2 cm, crowned by thick stigma, orange or deep yellow; exocarp thin with numerous vertical lines, brownish-hirsute, bright orange-red or yellow; endocarp thin, hard, reticulate-lacunose outside; seed with an edible sweet pulp.

Fl. & Fr.: Nov. - June.

Habitat: Evergreen forests, to 1800 m.

Distrib.: Almost throughout Kerala. Andaman & Nicobar Islands and W. Ghats. Southeast Asia.

Uses: Fruit is edible. Seed oil is used in rheumatism

AQUIFOLIACEAE

(M. REEMA KUMARI, W. ARISDASON & P. DANIEL)

Small trees or shrubs, evergreen or deciduous, mono- or dioecious. Leaves simple, alternate, rarely opposite, entire or serrate, coriaceous or chartaceous; stipules minute, persistent or not, or absent. Flowers solitary or fascicled in axillary cymes, racemes or pseudoumbels, uni- or bisexual, actinomorphic, usually 4- , rarely 8 - 16-merous. Sepals connate at base, rarely free, imbricate, persistent or not, absent in female flowers. Petals rotate, white, united at base in male flowers, free in female ones. Stamens alternating and adnate to petals at base; filaments slender; anthers 2-loculed, dorsifixed, dehiscing by longitudinal slits. Disc absent. Ovary superior, 3 - 8- rarely many-loculed; ovules 1 or 2 in each locule, pendulous, in axile placentation; style very short or absent; stigma lobed, capitate or discoid.

Fruit a drupe with as many pyrenes as locules, 1-seeded.

Almost cosmopolitan, 4 genera and 420 species, 1 and 26 in India and, 1 and 4 in Kerala.

Literature: Hu, S.Y. 1949. The genus *Ilex* in China. *J. Arnold Arbor.* 30: 233 - 344, 348-387. Loesener, T. 1901. Monographia Aquifoliacearum. *Nova Acta Acad. Cæs. Leop.-Carol. German. Nat. Cur.* 78: 1 - 599.

ILEX L.

Trees or shrubs, evergreen or deciduous, dioecious. Leaves alternate, entire, serrate or spinose at margin; stipules minute, persistent or not; midnerve channelled above. Inflorescences cymose, branched or not, solitary, axillary or fascicled. Flowers uni-, rarely bisexual, actinomorphic. Male flowers peduncled; calyx patelliform, 4 - 6-lobed; petals 4 - 8, connate at base; stamens as long as or longer than petals, epipetalous; anthers oblong-ovoid; ovary rudimentary, subglobose with a beak, glabrous or puberulous. Female flowers 4 - 8- sometimes to 18-merous; calyx 4 - 8-lobed, persistent; petals free or connate at base; staminodes epipetalous; sterile anthers cordate or sagittate; ovary ovoid, glabrous or pubescent, 4 - 8- rarely 1 - 10-loculed; style indistinct; stigma discoid, capitate; fruit a drupe, globose; exocarp membranous or chartaceous; mesocarp fleshy; endocarp stony; pyrenes 4 - 12 (rarely - 18), smooth, striate or rugose, pitted, 1-seeded.

Cosmopolitan especially tropical and temperate America and Asia, ca 400 species, 26 in India and 4 in Kerala.

Key to species

- | | | |
|-----|--|---------------------------------|
| 1a. | Drupes with persistent calyx, style and/or stigma | 2 |
| b. | Drupes without persistent calyx, style and stigma | 3 |
| 2a. | Leaves serrate at margin; flowers 4-merous; drupes 6 - 8 mm, crowned with stigma | 1. <i>I. denticulata</i> |
| b. | Leaves entire at margin; flowers 6-merous; drupes 3 - 4 mm, crowned with distinct style and stigma | 2. <i>I. malabarica</i> |
| 3a. | Leaves entire and recurved at margin; corolla lobes orbicular or ovate | 3. <i>I. walkeri</i> |
| b. | Leaves serrulate at margin; corolla lobes oblong | 4. <i>I. wightiana</i> |

1. **Ilex denticulata** Wall. ex Wight, Ill. Ind. Bot. 2: t. 149. 1850; Hook.f., Fl. Brit. India 1: 600. 1875; Gamble, Fl. Madras: 200(144). 1918; D. Basu in N.P. Singh & al., Fl. India 5: 53. 2000.

Evergreen tree, to 15 m tall; branchlets subterete, smooth, glabrous. Leaves ovate-elliptic, elliptic or oblong, obtuse, cuneate or decurrent at base, serrate at margin, shortly and abruptly acuminate or acute to obtuse at apex, 5 - 10(- 10.5) x 2.5 - 3(5) cm, coriaceous, olivaceous or cinerous-olivaceous; midnerve channelled above, raised beneath; lateral nerves (3 -)6 - 9 pairs; petioles (0.7 -)1 - 1.3(1.5) cm long; stipules absent or very minute. Male inflorescences sessile or subsessile cymes; flowers 4-merous; calyx patelliform, ca 2.5 mm across, 4-lobed; lobes broadly ovate or deltoid, irregular or entire at margin, obtuse or subacute, rarely apiculate, ca 0.5 x 1 mm, glabrous; petals oblong-rhomboid, connate at base, reflexed, ca 3 x 2.5 mm; stamens as long as petals; filaments to 2 mm long; anthers ovoid, 0.75 - 1.25 mm long; ovary rudimentary, globose. Female inflorescences fascicled; flowers 4-merous; calyx patelliform; lobes obscure; petals 4, free, oblong-orbicular, truncate at base, entire at margin, rounded at apex, ca 4 x 2.5 - 3.5 mm; stamens 4, rudimentary; ovary oblong, ca 3 x 2 mm; stigma sessile, 4-lobed; drupes globose, 6 - 8 mm, smooth, brown, with persistent calyx and stigma; pyrenes 4, oblong-elliptic, 3-gonous, 4 - 5 x ca 3 mm, striate or rugose.

Fl.: Dec. - April *Fr.*: March - Nov.
Habitat: Evergreen forests, to 2200 m.
Distrib.: Idukki and Kottayam. Western Ghats of Tamil Nadu. South Asia.

Fl.: Dec. - April *Fr.*: March - Nov.

Habitat: Evergreen forests, to 2200 m.

Distrib.: Idukki and Kottayam. Western Ghats of Tamil Nadu. South Asia.

2. **Ilex malabarica** Bedd., Fl. Sylv. S. India: t. 143. 1872; Hook.f., Fl. Brit. India 1: 600. 1875; Gamble, Fl. Madras: 200(143). 1918; D. Basu in N.P. Singh & al., Fl. India 5: 63. 2000.

Tree, to 10 m high; branchlets glabrous or minutely pubescent, lenticelled. Leaves elliptic-oblong, ovate, ovate-elliptic or obovate, acute, cuneate, rounded or upcurved at base, entire at margin, acute, short-acuminate, mucronate or rarely retuse at apex, 3 - 8(10) x 1.5 - 3.5 cm, subcoriaceous, dark green, shining above, pale beneath; midnerve channelled above, raised beneath; lateral nerves faint; petioles 0.5 - 1.5 cm long. Male inflorescences paniced cymes; peduncles and pedicels (3 -)6 - 8 mm long, slender, puberulous; flowers 6-merous; calyx 6-lobed; lobes broadly 3-angled, ovate, ciliate at margin, acute to obtuse at apex, ca

1 x 0.9 mm, puberulous; petals 3-6, connate at base, oblong, entire at margin, obtuse or rounded at apex, ca 2 x 1 mm; stamens 6, shorter than petals; filaments 0.75-1 mm long; anthers oblong-ovoid, ca 0.5 mm long, dorsifixed; ovary rudimentary, puberulent; stigma 4-6. Female inflorescences solitary or fascicled; pedicels 6-8 mm long; stigmas 6; drupes globose, 3-4 mm, red, crowned with a distinct style and stigma.

Fl. & Fr.: Feb. - July.

Habitat: Forests, to 1600 m.

Distrib.: Kottayam and Wynad. Western Ghats. Endemic.

Use: Wood is used for making planks, bowls, packing cases and cabinets.

3. *Ilex walkeri* Wight & Gardner ex Thwaites, Enum. Pl. Zeyl.: 184. 1858; Hook.f., Fl. Brit. India 1: 600. 1875; Manilal, Fl. Silent Valley: 54. 1988; D. Basu in N.P. Singh & al., Fl. India 5: 72. 2002. *I. thwaitesii* Locs. ex Gamble, Fl. Madras: 200(143). 1918.

Shrub or small tree; branchlets glabrous. Leaves elliptic-obovate, cuneate to obtuse at base, subentire and recurved at margin, mucronate or retuse at apex, 1.25-3 x 1.5-2.5 cm, coriaceous or membranous, glabrous; lateral nerves 2 or 3(4) pairs; petioles ca 2.5 mm long; stipules subulate-deltoid, to 7.5 mm long, subpersistent. Inflorescences umbels; peduncles and pedicels short in both sexes. Flowers 4- or 5(-6)-merous. Calyx 4-lobed; lobes subulate, deltoid, ca 0.75 x 0.75-1.25 mm, glabrous. Petals 4 or 5, connate at base, orbicular or ovate, ca 2.5 x 1.25-4.7 mm. Stamens 4 or 5, included. Stigma lobed. Drupes globose, ca 4 mm, red; pyrenes 4 or 5, 3-gonous, hard.

Fl. & Fr.: Feb. - May.

Habitat: Evergreen forests, to 2000 m.

Distrib.: Palakkad. Western Ghats of Maharashtra and Tamil Nadu. Sri Lanka.

4. *Ilex wightiana* Wall. ex Wight, Icon. Pl. Ind. Orient.: t. 1216. 1848; Hook.f., Fl. Brit. India 1: 603. 1875, incl. vars.; Bourd., Forest Trees Travancore: 98. 1908; Rama Rao, Fl. Pl. Travancore: 81. 1914; Gamble, Fl. Madras: 200(143). 1918; Manilal, Fl. Silent Valley: 4. 1988; D. Basu in N.P. Singh & al., Fl. India 5: 73. 2000, incl. vars.

Tree, to 15 m tall; branchlets glabrous. Leaves elliptic, ovate, oblong or oblanceolate, acute or rounded at base, subentire or serrulate at margin, acute to

acuminate, mucronate-apiculate or rarely obtuse at apex, 2.5 - 7 x 1.2 - 4 cm, glabrescent; lateral nerves distinct or not; petioles to 1.4 cm long. Inflorescences in umbellules; peduncles of male inflorescences 0.8 - 1.25 cm long; flowers 5-merous, 5 - 6 mm across; calyx cupular, 1 - 2 x 2 - 2.5 mm; lobes 5 or 6, oblong-ovate, ovate or oblong, acute-apiculate, sometimes obtuse at apex, ciliate at margin, 0.75 - 1 x 0.5 - 0.75 mm, puberulous; petals 5 or 6, connate below, white; tube ca 1 mm long; lobes oblong, oblong-obovate or ovate-elliptic, entire at margin, obtuse at apex, 2 - 2.5 x 1.5 - 2 mm; stamens 5 or 6, shorter than petals, epipetalous; filaments ca 1 mm long; anthers oblong, 0.8 - 0.9 mm long, dorsifixed; ovary rudimentary, puberulent; stigma 4 - 6-lobed. Female umbels lax; peduncles ca 1.2 cm long; calyx and petals as in male flowers; ovary globose, ca 2 mm, 6-loculed; ovules 1 or 2 in each locule, pendulous; style ca 0.5 mm long; stigma capitate; drupes globose, ca 6 mm, apiculate, smooth, dark red or blue; pyrenes 5 or 6, 3-gonous.

Fl. & Fr.: March - Sept.

Habitat: Along streams in sholas, to 2225 m.

Distrib.: Idukki, Kottayam and Palakkad. Western Ghats of Tamil Nadu. Endemic.

CELASTRACEAE

(incl. Hippocrateaceae)

(K. RAMAMURTHY & P. VENU)

Trees or, erect or climbing shrubs; stems sometimes producing rootlets, thorny and buttressed at base. Leaves simple, alternate, spiral, opposite or decussate, crenate or entire at margin; stipules caducous. Flowers bi- or unisexual, axillary and/or terminal, sometimes extra-axillary, cymose, thyrsoid, paniced, racemose, fascicled or solitary. Calyx 4- or 5-lobed; lobes imbricate or valvate. Petals 4 or 5, contorted, valvate; stamens 3 - 5; filaments inserted at or within disc, or below it. Disc cupular or saucer-shaped, entire, fleshy or membranous. Ovary partly or entirely within disc; styles short, distinct; stigmas simple or lobed; ovules usually 2 in each locule. Fruits capsular, baccate or drupaceous; seeds arillate or not, sometimes winged.

Tropical and temperate regions, 94 genera and ca 1300 species, 15 and 114 in India and, 12 and 35 in Kerala.

Literature: Ding Hou, 1962. *Celastraceae* I. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* I, 6: 227 - 291. Ding Hou 1964. *Celastraceae* II. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* I, 6: 389 - 421. Siddiqi, M.A. 1977. *Celastraceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan.* 119: 1 - 15. Smith, A.C. 1941. Notes on Old World *Hippocrateaceae*. *Amer. J. Bot.* 28: 438 - 443. Smith, A.C. 1945. Notes on *Hippocrateaceae* in South Eastern Asia. *J. Arnold Arbor.* 26: 169 - 179.

Key to genera

- 1a. Stamens 3, rarely 2 2
 b. Stamens 5 or 4 4
- 2a. Flowers in axillary fascicles; fruits drupaceous, indehiscent; seeds wingless 12. *Salacia*
 b. Flowers in axillary cymes, terminal thyrses or panicles; fruits capsular, dehiscent; seeds winged 3
- 3a. Disc conspicuous; inflorescences without supplementary branches 6. *Loeseneriella*
 b. Disc usually not conspicuous; inflorescences with short supplementary branches 11. *Reissantia*
- 4a. Leaves spiral or alternate 5
 b. Leaves decussate or opposite 7
- 5a. Leaves with distinct cross-bar nervation; petioles swollen at apex beneath 1. *Bhesa*
 b. Leaves with reticulate nervation; petioles not swollen at apex beneath 6
- 6a. Scandent shrubs; ovary free from disc; seeds completely enveloped by aril 3. *Celastrus*
 b. Erect shrubs or small trees; ovary usually partly within disc; seeds partly enveloped by aril 8. *Maytenus*
- 7a. Petals connate at base; disc inconspicuous; fruits splitting laterally, 1-seeded 9. *Microtropis*
 b. Petals free; disc conspicuous; fruits splitting loculicidally, 3 - many-seeded 8
- 8a. Ovary 2- or 1-loculed by abortion (in *Pleurostyliia*); ovules 2 in each locule; fruits drupaceous, indehiscent 9
 b. Ovary 3 - 5-loculed; ovules 1 - 18 in each locule; fruits capsular, dehiscent 10
- 9a. Disc not cupular; anthers subglobose or deltoid; connectives inconspicuous; fruits with persistent terminal style or its scar 2. *Cassine*
 b. Disc cupular; anthers ovoid; connectives usually conspicuous; fruits with persistent lateral style 10. *Pleurostyliia*
- 10a. Ovary 3-loculed; ovules 8 - 18 in each locule; fruits 3-angled, -lobed or -winged; seeds winged 7. *Lophopetalum*

- b. Ovary 4- or 5-loculed; ovules 1 or 2 in each locule; fruits 4- or 5-angled or -lobed; seeds not winged 11
- 11a. Ovules 2 in each locule; axis in fruits splitting completely together with valves; seeds 2 in each locule valve 4. *Euonymus*
- b. Ovule 1 in each locule; axis in fruits splitting or not but remains free from valves; seed 1 in each locule valve 5. *Glyptopetalum*

1. BHESA Buch.-Ham. ex Arn.

Trees. Leaves simple, spiral, entire, coriaceous; nerves prominent with cross-bar nervation; petioles swollen at apex; stipules convolute in bud, finely and longitudinally nerved, caducous. Flowers solitary or paired in paniced spikes or racemes, bisexual, 5-merous, white to greenish, fragrant; bracts caducous. Calyx deeply 5-lobed; lobes imbricate. Petals 5, contorted. Stamens 5, inserted at disc or just beneath its outer margin; anthers int-, lat- or extrorse, dehiscing longitudinally. Disc subentire or lobed, glabrous or puberulous, fleshy. Ovary 2-loculed; ovules 2 in each locule, erect; styles 2, filiform. Fruits capsular, entire or 2-lobed, dehiscing longitudinally by 2 valves; seeds 1 or 2, arillate.

Indomalesia, 5 species, 3 in India and 1 in Kerala.

Bhesa indica (Bedd.) Ding Hou in *Blumea* 4(Suppl.): 152. 1958; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 105. 1996; Ramam. in N.P. Singh & al., *Fl. India* 5: 77. 2000. *Trochisandra indica* Bedd., *Fl. Sylv. S. India*: t. 120. 1871. *Kurrimia bipartita* M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 622. 1875; Bourd., *Forest Trees Travancore*: 103. 1908; Rama Rao, *Fl. Pl. Travancore*: 84. 1914. *K. indica* (Bedd.) Gamble, *Fl. Madras*: 207(149). 1918.

Tree, to 20 m tall. Leaves oblong or ovate to lanceolate, rounded at base, acute to short-acuminate at apex, to 20 x 10 cm; lateral nerves 16 - 21 pairs; petioles to 10 cm long. Flowers in axillary panicles. Calyx 5-lobed; lobes elliptic-oblong, obtuse, ca 1 mm long. Petals obovate-oblong. Stamens 5; filaments inserted at margin of disc and continuous with it; anthers introrse. Disc flat, subentire. Ovary subglobose, ca 1 x 2 mm, more or less glabrous; styles almost divided to base. Fruits 2-lobed, 1 lobe sometimes abortive, 2.5 - 3.5 cm long; seeds more or less ellipsoid, ca 2.5 x 1.5 cm, partly arillate.

Fl.: Oct. - March *Fr.*: March - June.

Habitat: Evergreen forests, to 2500 m, common.

Distrib.: Idukki, Kollam, Kottayam and Thrissur. Western Ghats of Tamil Nadu. Southeast Asia.

Uses: Fruit is edible; wood is useful.

Excluded species

Rama Rao (*l.c.*) recorded *Kurrimia paniculata* (Wall. ex Arn.) Arn. (**Bhesa paniculata** Arn.) from Idukki (Peermade). But then, there is no specimen from Kerala nor is it found in any recent flora therefrom.

2. CASSINE L.

Trees or shrubs. Leaves opposite or subopposite, entire or crenulate, coriaceous. Flowers bisexual, 4- or 5-merous. Sepals lobed, imbricate. Petals imbricate, spreading. Stamens inserted at or slightly under outer margin of disc; filaments subulate; anthers subglobose or deltoid, versatile, introrse, with indistinct connective. Disc orbicular or lobed, flat, fleshy. Ovary short, conic or more or less flask-shaped, slightly adnate to disc at base or partly within it, 2-loculed; ovules 2 in each locule, erect; styles very short; stigmas obscure or slightly 2-lobed. Fruits drupaceous, indehiscent, with persistent terminal style on its scar, 1- or 2-loculed; exocarp thin or fleshy; endocarp leathery or mostly stony; seeds 1 or 2, exarillate.

Pantropical, ca 80 species, 4 in India and 3 in Kerala.

Key to species

- | | | |
|-----|---|--------------------------|
| 1a. | Fruits 2-seeded | 3. C. paniculata |
| b. | Fruits 1-seeded | 2 |
| 2a. | Leaves obtuse-rounded at apex; sepals orbicular; fruits ovoid or obovoid, 1.2 - 1.8 cm long | 1. C. albens |
| b. | Leaves caudate-acuminate at apex; sepals broadly ovate; fruits ellipsoid, 2.5 - 3 cm long | 2. C. kedarnathii |

1. **Cassine albens** (Retz.) Kosterm. in Gard. Bull. Straits Settlm. 39: 178. 1986; Ramam. in N.P. Singh & al., Fl. India 5: 80. 2000. *Schrebera albens* Retz., Obs. Bot. 6: 25, t. 3. 1791. *Elaeodendron roxburghii* Wight & Arn., Prodr. Fl. Ind. Orient.: 157. 1834; Bedd., Fl. Sylv. S. India: t. 148. 1871. *E. glaucum* auct. non Pers. 1805; M.A. Lawson in Hook.f., Fl. Brit. India 1: 623. 1875 p.p.;

Gamble, Fl. Madras: 211(152). 1918.

Tree; branchlets subterete. Leaves ovate to elliptic-oblong, obtusely cuneate or rounded at base, obtuse to rounded at apex, 5 - 15 x 2 - 6 cm; petioles to 3 cm long. Flowers in cymes in upper part of branchlets, 5-merous, greenish white; bracts small, ovate, acute. Sepals unequal, orbicular, membranous at margin. Petals orbicular, ca 4 mm, membranous at margin. Stamens on disc lobes, shorter than petals; filaments recurved; anthers attached to connectives. Disc thick, fleshy. Fruits drupaceous, ovoid or obovoid, apiculate, 12 - 18 mm long, yellowish green when mature; seed 1, crustaceous, arillate.

Fl.: March - Oct. *Fr.*: Oct. - Dec.

Distrib.: Malabar (precise locality not known) and West Coast (Gamble, *l.c.*). Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Uttar Pradesh and W. Bengal. Sri Lanka.

2. *Cassine kedarnathii* Sasidh. & Swarupan. in Reinwardtia 11: 30, ff. 1 - 10. 1992.

Tree, to 30 m tall; bark greyish brown, reddish inside. Leaves opposite, elliptic-oblong, acute at base, crenate at margin, caudate-acuminate at apex, 5 - 8 x 2 - 3.5 cm, coriaceous, glabrous; lateral nerves 5 - 9 pairs; petioles 2 - 2.5 cm long. Cymes dichasial, terminal and axillary, glabrous. Flowers ca 12 mm across, greenish yellow; pedicels 4 - 5 mm long. Sepals 5, imbricate, broadly ovate, obtuse, ca 1.5 x 3 mm, glabrous. Petals imbricate, oblong, obtuse, slightly revolute at margin, ca 5 x 2 - 2.5 mm. Stamens 5, inserted at margin of wavy annular disc; filaments ca 2 mm long. Ovary within disc, 2-loculed with 2 basal ovules in each; styles short; stigmas entire. Drupes ellipsoid, apiculate, 25 - 30 x 18 - 22 mm, green; epicarp thin, putamen slightly compressed, vertically grooved on both sides, 3 - 4 mm thick on one side, 5 - 7 mm on the other, shining, brown inside; seed 1, elliptic, planoconvex, ca 20 x 17 mm, shallowly grooved above, brown.

Fl.: March - June *Fr.*: Oct. - Nov.

Habitat: Evergreen forests.

Distrib.: Palakkad. Not collected elsewhere so far.

Note: It is allied to the Sri Lankan *C. congylos* Kosterm.

3. *Cassine paniculata* (Wight & Arn.) LoBr.-Callén in Bull. Mus. Hist. Nat. (Paris) B, Adansonia 2, 15: 220. 1975; Ramam. in N.P. Singh & al., Fl. India

5: 83. 2002. *Elaeodendron paniculatum* Wight & Arn., Prodr. Fl. Ind. Orient.: 157. 1834; Gamble, Fl. Madras: 212(152). 1918. *E. glaucum* sensu M.A. Lawson in Hook.f., Fl. Brit. India 1: 623. 1875 p.p., non Pers. 1805.

Large tree. Leaves ovate-lanceolate, rounded at base, bluntly crenate at margin, acute at apex, 7 - 8 x 2.5 - 3.5 cm, reddish brown on drying. Flowers in cymes often with a solitary flower at fork of inflorescence. Sepals orbicular. Petals spatulate, ca 5 x 3 mm, membranous at margin. Stamens arising from lobes of disc. Disc thick, fleshy. Fruits drupaceous, elliptic, apiculate, 2-seeded.

Fl.: Feb. - May *Fr.*: Nov.

Distrib.: Malabar (precise locality not known). Western Ghats of Karnataka and Tamil Nadu. South and SE. Asia.

3. CELASTRUS L.

Scandent shrubs or small trees. Leaves spiral, elliptic to orbicular, entire or crenate-dentate; petioles slender, not swollen at tip; stipules laciniate. Flowers in terminal, axillary or lateral racemes or cymes, uni- or bisexual, 5-merous. Calyx campanulate, 5-lobed; lobes valvate or imbricate. Petals and fertile stamens inserted under disc; anthers ovoid or oblong-ellipsoid, obtuse or apiculate, dorsifixed, lat- or introrse; sterile stamens smaller with ovate-oblong acute or acuminate anthers. Disc usually cupular, entire or 5-lobed, membranous, flat and fleshy. Ovary free from disc, 3-loculed with 2 or 1 ovule in each; style usually columnar; ovary in male flowers sterile, much smaller than fertile one. Fruits capsular, subglobose, dehiscent loculicidally, 3-valved; seeds 1 - 6, enveloped by fleshy aril; embryo erect; cotyledons thin, spatulate; endosperm copious.

Tropics and subtropics, 31 species, 7 in India and 1 in Kerala.

Literature: Ding Hou 1955. A revision of the genus *Celastrus*. *Ann. Missouri Bot. Gard.* 42: 215 - 302.

Celastrus paniculatus Willd., Sp. Pl. 1: 1125. 1797; M.A. Lawson in Hook.f., Fl. Brit. India 1: 617. 1875; Rama Rao, Fl. Pl. Travancore: 83. 1914; Gamble, Fl. Madras: 208(150). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 95. 1988; Vajr., Fl. Palghat: 117. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 105. 1996; Sivar. & P. Mathew, Fl. Nilambur: 142. 1997; Ramam. in N.P. Singh & al., Fl. India 5: 87. 2000.

Scandent shrub; branchlets terete, glabrescent, brown. Leaves elliptic to ovate-oblong, cuneate at base, crenulate at margin, acute at apex, 5 - 15 x 2 - 10 cm, glabrous, pubescent beneath; lateral nerves 5 - 8 pairs; petioles to 2 cm long. Flowers in terminal narrow panicles, 5 - 7 cm long. Male flowers: Calyx 5-lobed; lobes semi-orbicular, to 2 mm long, ciliate. Petals 5, oblong to obovate-oblong, to 3 mm long. Stamens 5. Disc cupular, obscurely lobed. Ovary columnar, sterile. Female flowers: Sepals, petals and disc as in male ones. Stamens sterile. Ovary globose, free from disc; style columnar; stigma 3-lobed. Fruits capsular, 3-lobed, subglobose, 7 - 10 x ca 8 mm on 5 - 7 mm long stalk, 3 - 6-seeded, bright yellow to orange; seeds ellipsoid, smooth, brownish, with fleshy scarlet aril.

Fl.: Feb. - June *Fr.*: March - Dec.

Habitat: Lower elevations in hills.

Distrib.: Almost throughout Kerala. Throughout India. Southeast Asia to Australia.

Use: Seed oil is used in certain stomach disorders.

4. EUONYMUS L., nom. & orth. cons.

Shrubs or small trees. Leaves opposite, alternate, rarely spiral. Flowers in axillary cymes or fascicles, bisexual, 5- or 4-merous. Sepals deeply lobed, imbricate. Petals spreading or reflexed, imbricate. Stamens inserted at disc; anthers dehiscing on top. Ovary within disc; ovules 2 in each locule. Fruits capsular; valves splitting and bearing no central axis when dehiscing; seeds 2 in each locule, arillate.

North temperate regions especially Asia and Australia, 177 species, 12 in India and 6 in Kerala.

Literature: Blakelock, R.A. 1951. A synopsis of the genus *Euonymus* L. *Bull. Misc. Inform.* 1951: 210 - 290. Sprague, T. 1928. The correct spelling of certain generic names 6. *Euonymus* or *Euonymous*. *Bull. Misc. Inform.* 1928: 294 - 296.

Editors' note: The generic name *Euonymus* is conserved using masculine gender and a proposal (*Taxon* 43: 473. 1998) to make it feminine was refused (*Taxon* 49: 270. 2002).

Key to species

- | | | |
|-----|---|--------------------------|
| 1a. | Capsules partite almost to base | 5. <i>E. lawsonii</i> |
| b. | Capsules not partite, if partite only halfway to base | 2 |
| 2a. | Cymes 7- or more-flowered | 3 |
| b. | Cymes less than 7-flowered | 5 |
| 3a. | Branchlets acutely 4-angled | 1. <i>E. angulatus</i> |
| b. | Branchlets terete | 4 |
| 4a. | Leaves oblong-lanceolate to ovate-lanceolate, entire, crenate or wavy | 3. <i>E. dichotomus</i> |
| b. | Leaves elliptic, crenate-serrate | 6. <i>E. paniculatus</i> |
| 5a. | Inflorescences dichotomous cymes | 2. <i>E. crenulatus</i> |
| b. | Inflorescences umbelled cymes | 4. <i>E. indicus</i> |

1. *Euonymus angulatus* Wight, Icon. Pl. Ind. Orient.: t. 1053. 1846; M.A. Lawson in Hook.f., Fl. Brit. India 1: 610. 1875; Gamble, Fl. Madras: 203(146). 1918; Ramam. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 115. 1987; Manilal, Fl. Silent Valley: 54. 1988; Vajr., Fl. Palghat: 117. 1990; Ramam. in N.P. Singh & al., Fl. India 5: 93. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 158. 2002.

Small tree; branchlets acutely 4-angled, glabrous. Leaves oblong-lanceolate to elliptic-, tapering at base, entire and thick at margin, acuminate at apex, 8 - 12 x 4 - 8 cm, coriaceous, glabrous, shining above, pale beneath; lateral nerves not conspicuous. Cymes lax, usually drooping, more than 7-flowered; peduncles slender. Sepals 5, entire or fimbriate at margin. Petals 5, free, orbicular, purplish. Stamens 5, alternating with petals, inserted at margin of disc. Disc 5-lobed, fleshy. Ovary within disc; styles short, thick. Fruits 5-loculed capsules, turbinate, attenuate below, obtusely winged above.

Fl.: Nov. - April *Fr.*: Oct.

Habitat: Evergreen forest slopes.

Distrib.: Palakkad and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic and endangered (Ramamurthy, 1987).

Editors' note: Lawson (*l.c.*) cited *E. acutangulus* Wight (*Ill. Ind. Bot.* 1: 178. 1840) as a synonym of *E. angulatus* Wight (1846). Based on Gough material from the Neilgherries *E. acutangulus* was validly published by Wight. Lawson (*l.c.*) perhaps assumed that Wight matured his concept and chose to correct his

earlier spelling *acutangulus* to *angulatus*. Since there is no provision in the Code for such a correction (Art. 60) the epithet *acutangulus* will replace *angulatus* as the correct name.

2. *Euonymus crenulatus* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 161. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 608. 1875; Bourd., Forest Trees Travancore: 99. 1908; Rama Rao, Fl. Pl. Travancore: 81. 1914; Gamble, Fl. Madras: 203(146). 1918; Ramam. in N.P. Singh & al., Fl. India 5: 97. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 159. 2002.

Tree; branchlets glabrous. Leaves elliptic-oblong to subovate, crenate-serate towards apex, 5 - 8 x 2.5 - 4 cm, coriaceous, convex and bullate above; petioles short. Cymes once or twice dichotomous, 1 - 3-flowered; peduncles stout. Calyx 5-lobed; lobes imbricate. Petals 5, orbicular. Stamens 5, very short; anthers dehiscing transversely. Ovary within disc; styles very short; stigma blunt. Fruits capsular, turbinate, lobed at apex, 5-loculed, red; seed 1 in each locule, exarillate. *Fl. & Fr.*: Oct. - March.

Habitat: Sholas, sometimes at lower elevations.

Distrib.: Idukki, Kottayam, Pathanamthitta and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

3. *Euonymus dichotomus* B. Heyne ex Wall. in Roxb., Fl. Ind. 2: 410. 1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 609. 1875; Gamble, Fl. Madras: 203(146). 1918; Vajr., Fl. Palghat: 117. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 115. 1994; Ramam. in N.P. Singh & al., Fl. India 5: 97. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 159. 2002.

Small tree; branchlets terete, very slender, 4-angled when young. Leaves oblong-lanceolate to ovate- tapering at base, entire, crenate or wavy at margin, acuminate at apex, 7 - 10 x 2 - 5 cm, thin-coriaceous. Cymes more than 7- flowered. Calyx 5-lobed. Petals 5, orbicular, entire, flat, greenish. Stamens 5, inserted at margin of disc. Disc lobed. Ovary within disc; stigma blunt. Fruits capsular, clavate, elongate, tapering below, ca 1.5 cm long; seeds oblong, glabrous, brownish, enclosed in a fleshy aril.

Fl.: March - May *Fr.*: April - Oct.

Habitat: Evergreen forests.

Distrib.: Idukki, Palakkad and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

Use: Used for wood work especially in engraving.

4. *Euonymus indicus* B. Heyne ex Wall. in Roxb., Fl. Ind. 2: 409. 1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 608. 1875; Rama Rao, Fl. Pl. Travancore: 81. 1914; Gamble, Fl. Madras: 202(146). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 95. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 115. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 106. 1996; Sivar. & P. Mathew, Fl. Nilambur: 143. 1997; Ramam. in N.P. Singh & al., Fl. India 5: 102. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 160. 2002. *E. goughii* Wight, Icon. Pl. Ind. Orient.: t. 215. 1839 & Ill. Ind. Bot. 1: 78. 1840.

Small tree; branchlets terete, slightly 4-angled at tip. Leaves lanceolate to ovate-attenuate at base, entire, sometimes obscurely serrate towards apex, acuminate at apex, 6-10 x 3-3.5 cm, glabrous, shining; nerves conspicuous; stipules linear-subulate, caducous. Flowers in axillary umbelled cymes. Calyx 5-lobed; lobes entire, erose at tip, glabrous, persistent, fleshy. Petals 5, ovate or orbicular-oblong, laciniate at apex. Stamens 5, inserted at disc near margin; filaments short, flat. Disc 5-angled, fleshy. Ovary within disc. Fruits capsular, obovate-clavate, lobed and angled, retuse at apex, ca 3.5 cm long; wings projected.

Fl. & Fr.: Throughout the year.

Habitat: Near streams on hills, ca 950 m

Distrib.: Kannur, Malappuram, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Andaman & Nicobar Islands, Karnataka, Maharashtra and Tamil Nadu.

5. *Euonymus lawsonii* C. B. Clarke ex Prain in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 73: 195. 1904; Ramam. in N.P. Singh & al., Fl. India 5: 105. 2000.

Small tree; branchlets terete, slender. Leaves elliptic or elliptic-oblong to lanceolate, cuneate at base, serrate at margin, acuminate at apex, 5-15 x 2.5-4 cm; lateral nerves 5-10 pairs, conspicuous. Flowers in lax, dichotomously branched cymes. Sepals 4, obtuse or rounded, concave, entire. Petals 4, orbicular, revolute at tip, finely nerved. Fruits capsular, 4-lobed to base, compressed; aril orange.

Fl.: Jan. May *Fr.:* Oct. Dec.

Distrib.: Malabar (precise locality not known). Arunachal Pradesh, Assam and

Meghalaya.

6. *Euonymus paniculatus* Wight ex M.A. Lawson in Hook.f., Fl. Brit. India 1: 609. 1875; Gamble, Fl. Madras: 203(146). 1918; Ramam. in N.P. Singh & al., Fl. India 5: 105. 2000.

Shrub; branchlets terete. Leaves elliptic, crenate-serrate, acute at apex, to 8.5 x 3.5 cm, membranous. Cymes more than 7-flowered; peduncles and pedicels slender. Calyx 4- or 5-lobed; lobes imbricate. Petals 4 or 5, orbicular, entire. Stamens 4 or 5, alternating with petals, inserted at disc; filaments short. Disc large, 4- or 5-lobed, fleshy. Ovary within disc, 2-loculed with 2 ovules in each; style short, thick; stigmas 3 - 5-lobed. Fruits capsular; seeds arillate.

Fl. & Fr.: April.

Distrib.: Malabar (precise locality not known). Western Ghats of Tamil Nadu. Endemic.

5. GLYPTOPETALUM Thwaites

Shrubs or small trees. Leaves opposite, entire or crenulate. Flowers in axillary or extra-axillary cymes, bisexual, 4-merous. Calyx lobes spreading. Petals fleshy. Stamens 4, inserted at disc; filaments very short; anthers divergent, dehiscing at top. Disc flat, 4-angled, fleshy. Ovary 4-loculed; ovule 1 in each locule; styles obscure. Fruits capsular, dehiscing loculicidally; seeds 4 or 3, globose, arillate.

Indomalesia, ca 20 species, 5 in India and 2 in Kerala.

Key to species

- | | |
|--|---------------------------|
| 1a. Leaves coriaceous; cymes 3-flowered | 1. <i>G. grandiflorum</i> |
| b. Leaves membranous; cymes 5 - 7-flowered | 2. <i>G. zeylanicum</i> |

1. *Glyptopetalum grandiflorum* Bedd., Icon. Pl. Ind. Orient.: t. 102. 1868 1874; M.A. Lawson in Hook.f., Fl. Brit. India 1: 613. 1875; Gamble, Fl. Madras: 204(147). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 96. 1988; Ramam. in N.P. Singh & al., Fl. India 5: 111. 2000.

Shrub; branchlets terete, angled when young. Leaves elliptic-oblong, rounded or cuneate at base, entire, rarely obscurely serrate towards apex, acute or acuminate at apex, 10 - 15.5 x 5 - 6.5 cm, coriaceous. Cymes 3-flowered;

peduncles filiform, slender, 10 - 16 cm long; pedicels ca 2.5 cm long, inserted with scale-like bracts. Sepals 4-lobed. Petals 4, obovate, 8 - 10 mm long, inconspicuously pitted or not, yellow. Stamens 4, sessile. Disc more or less rounded. Ovary within disc. Capsules globose, ca 2 cm, smooth, pale, 4-seeded; seeds ovate, 1.5 cm across, arillate.

Fl. & Fr.: Feb. - May.

Habitat: Evergreen forests, ca 800 m.

Distrib.: Kannur and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. *Glyptopetalum zeylanicum* Thwaites in Hooker's J. Bot. Kew Gard. Misc. 8: 268, t. 7B. 1856; M.A. Lawson in Hook.f., Fl. Brit. India 1: 612. 1875; Gamble, Fl. Madras: 204(147). 1918; Bourd., Forest Trees Travancore: 100. 1908; Rama Rao, Fl. Pl. Travancore: 82. 1914; Manilal, Fl. Silent Valley: 55. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 115. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 106. 1996; Sivar. & P. Mathew, Fl. Nilambur: 143. 1997; Ramam. in N.P. Singh & al., Fl. India 5: 114. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 160. 2002.

Shrub or small tree; branchlets terete, flat at tip. Leaves ovate-lanceolate, cuneate at base, sharply serrate at margin except at base, acute at apex, 10 - 15.5 x 3.5 - 6.5 cm, membranous, glabrous; lateral nerves conspicuous; petioles ca 8 mm long, channelled. Cymes axillary or supra-axillary, 5 - 7-flowered. Sepals 4, small. Petals 4, oblong, ca 5 mm long, with a pit near apex, yellow. Stamens 4, inserted at angles of disc; connectives enlarged. Ovary within disc, 4-lobed; styles conic. Capsules rounded, 1 - 4-loculed, 1 - 4-seeded; seeds ca 1.5 cm across; aril partially covering seed, red.

Fl.: July *Fr.*: July - Aug.

Habitat: Lower elevations on hills.

Distrib.: Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

6. *LOESENERIELLA* A.C. Sm.

Climbing or scandent shrubs. Leaves decussate; stipules interpetiolar, sometimes intrapetiolar. Cymes axillary, dichotomously branched. Calyx deeply 5-lobed. Petals 5, subvalvate, thick, subcoria- to coriaceous. Stamens 3, inserted

at base of free part of pistil; anthers dehiscing transversely. Disc conspicuous, extrastaminal, simple, fleshy. Ovary half within disc, 3-loculed; ovules 4–12 in each locule; styles distinct; stigmas obscure. Fruits capsular consisting of 3 separate divergent dorsiventrally flat follicles, each dehiscing into 2 navicular valves; seeds usually with basal membranous wings.

Old World tropics, 26 species, 8 in India and 3 in Kerala.

Key to species

- | | | |
|-----|---|---------------------------|
| 1a. | Petals orbicular | 1. <i>L. arnottiana</i> |
| b. | Petals 3-angled or lanceolate | 2 |
| 2a. | Leaves oblong, recurved at margin; petals lanceolate, mucronate | 2. <i>L. bourdillonii</i> |
| b. | Leaves not oblong, not recurved at margin; petals 3-angled, not mucronate | 3. <i>L. obtusifolia</i> |

1. *Loeseneriella arnottiana* (Wight) A.C. Sm. in J. Arnold Arbor. 16: 174. 1945; Manilal & Sivar., Fl. Calicut: 66. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 97. 1988; Vajr., Fl. Palghat: 118. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 117. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 108. 1996; Sivar. & P. Mathew, Fl. Nilambur: 145. 1997; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 140. 2000. *Hippocratea arnottiana* Wight, Ill. Ind. Bot. 1: 133, tt. 46 & 47. 1840; M.A. Lawson in Hook.f., Fl. Brit. India 1: 624. 1875; Rama Rao, Fl. Pl. Travancore: 85. 1914; Gamble, Fl. Madras: 213(153). 1918.

Climbing shrub; stems terete, glabrous. Leaves ovate or elliptic, obtuse at base, entire or faintly crenate at margin, acute at apex, 10–15 x 4–7.5 cm, coriaceous; nervation reticulate, conspicuous; petioles to 2 cm long. Flowers in axillary cymes. Calyx 5-lobed; lobes 3-angled, entire, glabrous. Petals 5, imbricate, orbicular with a narrow claw, glabrous. Stamens 3, inserted on top of disc. Ovary within disc, 3-loculed; styles short. Fruits oblanceolate, narrow, obtuse, ca 8 x 2.5 cm, striate; seeds compressed, thin, winged.

Fl. & Fr.: Almost throughout the year.

Habitat: Lower elevations on hills.

Distrib.: Kannur, Kasaragod, Kollam, Kozhikode, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

2. **Loeseneriella bourdillonii** (Gamble) Raju in J. Biol. 8: 56. 1965; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 97. 1988; Vajr., Fl. Palghat: 118. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 108. 1996; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 140. 2000. *Hippocratea bourdillonii* Gamble in Bull. Misc. Inform. 1916: 132. 1916 & Fl. Madras: 213(153). 1918.

Climbing shrub; stems 4-angled. Leaves oblong, rounded at base, recurved at margin, subacute at apex, 6 - 10 x 3 - 4 cm, coriaceous, glabrous; lateral nerves conspicuous, reticulate, arched at margin. Flowers in axillary ca 3 cm long cymes. Calyx lobes 5, ovate. Petals lanceolate, mucronate at apex, ca 5 mm long, puberulous inside. Disc conspicuous, subcylindric, puberulous at apex. Stamens 3, puberulous; anthers dehiscing transversely by 3 or 2 fissures. Ovary within disc; style subulate. Fruits oblong, obtuse, ca 6 x 3 cm.

Fl. & Fr.: Feb. May.

Habitat: Evergreen and semievergreen forests.

Distrib.: Kannur, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu. Endemic.

3. **Loeseneriella obtusifolia** (Roxb.) A.C. Sm. in Amer. J. Bot. 28: 440. 1941; Manilal, Fl. Silent Valley: 56. 1988; Vajr., Fl. Palghat: 118. 1990; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 141. 2000. *Hippocratea obtusifolia* Roxb., Fl. Ind. 1: 166. 1820; M.A. Lawson in Hook.f., Fl. Brit. India 1: 623. 1875; Rama Rao, Fl. Pl. Travancore: 84. 1914; Gamble, Fl. Madras: 213(153). 1918.

Straggling shrub; branches terete; branchlets 4-angled when young, pubescent. Leaves elliptic-ovate, ovate-lanceolate or obovate, attenuate or rounded at base, entire, crenate or serrate at margin, rounded, acute or acuminate at apex, 7 - 13 x 3 - 7 cm, subcoriaceous, glabrous; petioles to 3 cm long. Flowers ca 8 mm across, in axillary dichotomous cymes, green. Calyx lobes 5, ovate-triangular, puberulous. Petals 5, valvate, 3-angled, acute, subfleshy, glabrous inside. Stamens 3; filaments short, flat. Ovary within disc, 3-loculed; style short. Fruits oblong-obovoid, dorsiventrally compressed with conspicuous membranous wings.

Fl. & Fr.: Oct.

Habitat: Evergreen forests.

Distrib.: Kollam and Palakkad. Andhra Pradesh, Assam, Karnataka and Tamil Nadu. South and SE. Asia to Australia.

7. LOPHOPETALUM Wight & Arn.

Evergreen trees; branchlets terete, flat at nodes, dark. Leaves opposite, entire, short-petioled or sessile; stipules a tuft of hairs, caducous. Flowers in cymes, or thyrses often arranged in panicles, axillary, bisexual, 5-merous; bracts deltoid or lanceolate; pedicels fused at base. Calyx dish-shaped, 5-lobed. Petals imbricate, with cristate or fimbriate appendages on inner surface. Stamens inserted at disc; filaments filiform; anthers ellipsoid, versatile. Disc flat, fleshy. Ovary partly within disc, 3-loculed; ovules 8 - 18 in each locule, 2-seriate. Fruits capsular, 3-angled or winged, dehiscing loculicidally; seeds oblong, flat, winged.

Indomalaysia to tropical Australia, 18 species, 2 in India and 1 in Kerala.

Lophopetalum wightianum Arn. in Ann. Nat. Hist. 3: 151. 1839; Wight, Icon Pl. Ind. Orient.: t. 162. 1839; M.A. Lawson in Hook.f., Fl. Brit. India 1: 615. 1875; Bourd., Forest Trees Travancore: 101. 1908; Rama Rao, Fl. Pl. Travancore: 82. 1914; Gamble, Fl. Madras: 205(147). 1918; Manilal, Fl. Silent Valley: 55. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 96. 1988; Vajr., Fl. Palghat: 119. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 116. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 106. 1996; Ramam. in N.P. Singh & al., Fl. India 5: 116. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 161. 2002.

Mal.: *Venkotta*

Tree with smooth bark and terete branchlets. Leaves elliptic or elliptic to oblong, rounded or subacute at base, entire, acute or retuse at apex, 8 - 25 x 4 - 10 cm, coriaceous; lateral nerves 6 - 12 pairs. Flowers in axillary or terminal paniced cymes, yellow with pink tinge. Calyx lobes 3-angled, acute, short-ciliate. Petals 5, suborbicular, ca 3 mm long, inserted in middle of disc lobes, fimbriate-crested. Filaments ca 2.5 mm long; anthers oblong, apiculate. Disc cupular, 5-lobed, ca 5 mm across, red. Ovary 3-angled, depressed, narrowed to a conic style. Fruits capsular, 3-angled, 10 - 15 cm long, 3-loculed; seeds oblong, compressed, ca 6 x 1 cm, surrounded by a long linear wing, arillate.

Fl. & Fr.: March - May.

Habitat: Evergreen forests, to 900 m.

Distrib.: Almost throughout Kerala. Arunachal Pradesh, Assam, Karnataka, Meghalaya and Tamil Nadu. South and SE. Asia.

Use: Wood is ideal for making tea chests.

8. MAYTENUS Molina

(incl. *Gymnosporia* (Wight & Arn.) Benth. & Hook. f.)

Small trees or erect shrubs; branchlets glabrous; young parts sometimes pubescent; spines present or not. Leaves spiral or alternate, variable in shape and texture; stipules small, lanceolate, sparsely lacinate, caducous. Flowers in axillary or extra-axillary cymes, bisexual; pedicels jointed. Calyx 5(or 4)-lobed. Petals 5(or 4), patent or reflexed. Stamens inserted at margin of disc. Disc flat, rarely cupular, fleshy. Ovary partly or rarely entirely within disc with emergent part subglobose or 3-angled; ovules 2 in each locule; stigmas 3. Fruits capsular, subglobose or 3-angled, loculicidal, 2 - 6-seeded; seeds ellipsoid, arillate, remaining exposed in spreading valves after dehiscence.

Tropics and subtropics, ca 225 species, 18 in India and 3 in Kerala.

Key to species

- | | | |
|-----|--|-------------------------|
| 1a. | Spines leaf- and flower-bearing | 2 |
| b. | Spines not leaf- and flower-bearing | 2. <i>M. ovatus</i> |
| 2a. | Branchlets zigzag; stigma capitate; aril not fleshy, attached to base of seed | 3. <i>M. wallichii</i> |
| b. | Branchlets not zigzag; stigma not capitate; aril fleshy, covering base of seed | 1. <i>M. emarginata</i> |

1. *Maytenus emarginata* (Willd.) Ding Hou in Steenis, Fl. Males. I, 6: 241. 1962; Nicolson & al. in Regnum Veg. 119: 80. 1988; Ramam. in N.P. Singh & al., Fl. India 5: 120. 2000. *Celastrus emarginatus* Willd., Sp. Pl. 2: 1128. 1798. *C. montanus* Roth in Roem. & Schult., Syst. Veg. 5: 427. 1819. *Gymnosporia montana* (Roth) Benth., Fl. Austral. 1: 400. 1863; M.A. Lawson in Hook.f., Fl. Brit. India 1: 621. 1875; Rama Rao, Fl. Pl. Travancore: 84. 1914; Gamble, Fl. Madras: 210(151). 1918. *G. emarginata* (Willd.) Thwaites, Enum. Pl. Zeyl.: 409. 1864; M.A. Lawson in Hook.f., Fl. Brit. India 1: 621. 1875; Gamble, Fl. Madras: 210(151). 1918.

Shrub, to 4 m high, armed with axillary short straight spines or unarmed. Leaves obovate to spatulate or elliptic-oblong, attenuate at base, crenate to entire at margin, rounded or emarginate at apex, 3.5 - 14.5 x 2 - 9 cm, coriaceous to

chartaceous; lateral nerves 5 or 6 pairs; petioles 2 - 12 mm long. Flowers in axillary or extra-axillary cymes or borne at tips of spines, white; bracts deltoid, fimbriate. Petals oblong or ovate-oblong. Stamens inserted beneath disc. Disc rounded, fleshy. Ovary partly within disc, 3-loculed; stigmas 3, distinct. Fruits capsular, obovoid to subglobose, 10 - 12 x 8 - 9 mm; seeds ca 6, ellipsoid, ca 3 x 2.5 mm, red; aril covering base of seed, fleshy, white.

Fl.: Sept. - July *Fr.*: Nov. - Sept.

Distrib.: Idukki (Rama Rao, *l.c.*). Throughout India. South and SE. Asia to Australia.

2. *Maytenus ovatus* (Wall. ex Wight & Arn.) Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 140. 1942; Ramam. in N.P. Singh & al., Fl. India 5: 123. 2000. *Celastrus ovatus* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 159. 1834. *Gymnosporia ovata* (Wall. ex. Wight & Arn.) M.A. Lawson in Hook.f., Fl. Brit. India 1: 619. 1875; Rama Rao, Fl. Pl. Travancore: 83. 1914; Gamble, Fl. Madras: 210(151), 1918.

Thorny shrub. Leaves ovate or orbicular, subcordate or tapering at base, rounded at apex, 4.5 - 8 x 3 - 4.5 cm, coriaceous, glabrous. Flowers in cymes or fascicles. Sepals 5, obovate, fimbriate at margin. Petals 5, broadly ovate, membranous at margin, white. Stamens 5, interpetaloid, arising below margin of disc. Disc fleshy. Ovary within disc. Fruits capsular, obovoid, to 1.4 cm long, 3-loculed, 6-seeded; seeds obovate, 8 - 10 mm long, arillate.

Fl.: June - Dec. *Fr.*: Aug. - March.

Habitat: Deciduous forests, to 1500 m.

Distrib.: Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

3. *Maytenus wallichii* (G. Don) Bennet & K.C. Sahni in Indian Forester 103: 387. 1977; Ramam. in N.P. Singh & al., Fl. India 5: 128. 2000. *Catha wallichii* G. Don, Gen. Hist. 2: 10. 1832. *Celastrus rigidus* Wall. in Roxb., Fl. Ind. 2: 396. 1824, non Thunb. 1818. *C. wallichiana* Spreng. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 159. 1834. *Gymnosporia wallichiana* (Spreng. ex Wight & Arn.) M.A. Lawson in Hook.f., Fl. Brit. India 1: 621. 1875; Gamble, Fl. Madras 210(151). 1918. *Maytenus wallichiana* (Wight & Arn.) Raju & Babu in Bull. Bot. Surv. India 10: 348. 1968.

Shrub; branchlets zizzag, terete, thorny. Leaves obovate, cuneate at base, obtuse or emarginate at apex, 2.5-4 x 2-3 cm, coriaceous, glabrous; nerves distinct, reticulate. Flowers in cymes or fascicles, axillary or on spines. Sepals 5, 3-angled. Petals 5, oblong, thin. Stamens 5, interpetaloid, inserted below disc. Disc rounded, fleshy. Ovary within disc; stigmas capitate. Fruits capsular, slightly obcordate, ca 12 mm long, 3-loculed, 6-seeded; seeds flat, arillate; aril attached only to base of seed.

Fl.: March-Dec. *Fr.*: Nov.-March.

Distrib.: Malabar (precise locality not known). Karnataka, Tamil Nadu and W. Bengal. Bangladesh and Pakistan.

Editors' note: Ramamurthy (*l.c.*) included *Maytenus heyneana* (Roth) Raju & Babu. But then, there is no specimen from Kerala at MH nor does any recent flora therefrom mention it.

9. MICROTROPIS Wall. ex Meisn., nom. cons.

Shrubs or small trees. Leaves opposite, elliptic to obovate, entire; stipules minute, caducous. Flowers in peduncled cymes or sessile clusters, axillary or extra-axillary or terminal, bi-, sometimes unisexual, 5- or 4-merous. Calyx deeply lobed; lobes free, imbricate, persistent. Petals connate at base, imbricate, erect. Stamens dorsifixed; filaments subulate; anthers broadly ovoid. Ovary free, 2-loculed; ovules 2 in each locule, erect, collaterally attached to axis at base. Fruits capsular, short-apiculate, longitudinally striate, laterally split along one side bearing persistent calyx; seed 1; aril covering seed, wrinkled; testa smooth, red-brown.

Tropical amphipacific, ca 70 species, 6 in India and 5 in Kerala.

Literature: Merrill, E.D. & Freeman, F.L. 1940. The Old World species of the Celastraceous genus *Microtropis* Wallich. *Proc. Amer. Acad. Arts* 73: 271-310.

Key to species

- | | | |
|-----|---|--------------------------|
| 1a. | Flowers in peduncled cymes, axillary or terminal | 2. <i>M. microcarpa</i> |
| b. | Flowers in sessile fascicles, lateral, rarely terminal | 2 |
| 2a. | Leaves emarginate at apex | 3. <i>M. ramiflora</i> |
| b. | Leaves more or less acuminate or acute at apex | 3 |
| 3a. | Leaves 3 or more times broader or as long as broad; capsules ca 1 cm long | 5. <i>M. wallichiana</i> |

- b. Leaves mostly less than 3 times as long as broad; capsules ca 2 cm long 4
- 4a. Leaves acute; nerves distinct beneath; capsules oblong 4. *M. stocksii*
- b. Leaves acuminate; nerves obscure; capsules ellipsoid 1. *M. latifolia*

1. *Microtropis latifolia* Wight ex M.A. Lawson in Hook.f., Fl. Brit. India 1: 613. 1875; Rama Rao, Fl. Pl. Travancore: 82. 1914; Gamble, Fl. Madras: 206(148). 1918; Manilal, Fl. Silent Valley: 55. 1988; Vajr., Fl. Palghat: 119. 1990; K.K.N. Nair in J. Econ. Tax. Bot. 17: 271. 1993; Sivar. & P. Mathew, Fl. Nilambur: 144. 1997; Ramam. in N.P. Singh & al., Fl. India 5: 130. 2000.

Small tree. Leaves ovate-elliptic to oblong-lanceolate, attenuate at base, acuminate at apex, 7 - 15 x 2.5 - 6.5 cm, coriaceous, glabrous, rugulose above; lateral nerves obscure on both surfaces; petioles 6 - 7 mm long. Flowers sessile, clustered in axils of fallen leaves or solitary, yellowish white. Calyx 5-lobed, membranous at margin above, rugose outside. Petals obovate-cuneate, connate at base forming a ring. Stamens inserted at ring; filaments short. Ovary flask-shaped, furrowed. Capsules ellipsoid, narrow at base, 1.5 - 2 cm long, 1-seeded; seed oblong, rugose.

Fl.: April - Dec. *Fr.*: Dec. - Feb.

Habitat: Undergrowth in evergreen forests.

Distrib.: Idukki, Malappuram, Palakkad and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. *Microtropis microcarpa* Wight, Icon. Pl. Ind. Orient: t. 975. 1845; M.A. Lawson in Hook.f., Fl. Brit. India 1: 614. 1875; Rama Rao, Fl. Pl. Travancore: 82. 1914; Gamble, Fl. Madras: 207(149). 1918; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 116. 1994; Ramam. in N.P. Singh & al., Fl. India 5: 130. 2000. *M. ovalifolia* Wight, Icon. Pl. Ind. Orient.: t. 976. 1845; M.A. Lawson in Hook.f., Fl. Brit. India 1: 614. 1875.

Erect shrub. Leaves elliptic or oblong-lanceolate, attenuate at base, 3.5 - 5 x 2 - 2.5 cm, coriaceous, glabrous above, pale beneath; petioles ca 5 mm long. Flowers in cymes; peduncles shorter than leaves. Calyx 5-lobed, imbricate, thin and fleshy below, membranous above, persistent in fruit. Petals obovate, clawed, nerved. Stamens inserted at base of petals; filaments short; anthers large. Ovary ovoid-conic, ribbed; styles short. Fruits ellipsoid, pointed, rugose; seed 1, shining. *Fl.*: Sept. - Jan. *Fr.*: March - Nov.

Distrib.: Idukki and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

Editors' note: Ramamurthy (*l.c.*) included *Microtropis microcarpa* Wight var. *densiflora* (Wight) Merr. & Freem. However, there is no specimen from Kerala at MH nor does any recent flora therefrom mention it.

3. *Microtropis ramiflora* Wight, Icon. Pl. Ind. Orient.: t. 977. 1845; M.A. Lawson in Hook.f., Fl. Brit. India 1: 614. 1875; Rama Rao, Fl. Pl. Travancore: 82. 1914; Gamble, Fl. Madras: 207(149). 1918; Manilal, Fl. Silent Valley: 56. 1988; Sivar. & P. Matthew, Fl. Nilambur: 144. 1997; Ramam. in N.P. Singh & al., Fl. India 5: 131. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 161. 2002.

Small tree. Leaves broadly elliptic or obovate, subcordate or rounded at base, revolute at margin, emarginate at apex, 5 - 13 x 2.5 - 6.5 cm, slightly rugulose above; petioles ca 5 mm long. Flowers in sessile clusters. Sepals imbricate, often thick, unequal, scarious at margin. Petals obovate, 2 - 3 mm long, pale yellow. Stamens ca 1 mm long. Ovary conic; style cylindrical; stigma 2-lobed. Fruits ellipsoid or ovoid, 1.5 - 2 x 0.5 - 1 cm, white when mature.

Fl.: Nov. - March *Fr.:* Nov. - June.

Habitat: Sholas, to 2200 m.

Distrib.: Idukki, Kottayam, Malappuram, Palakkad and Thiruvananthapuram. Western Ghats of Tamil Nadu. Sri Lanka.

4. *Microtropis stocksii* Gamble in Bull. Misc. Inform. 1916: 132. 1916 & Fl. Madras: 206(148). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 96. 1988; Vajr., Fl. Palghat: 119. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 107. 1996; Sivar. & P. Mathew, Fl. Nilambur: 145. 1997; Ramam. in N.P. Singh & al., Fl. India 5: 131. 2000.

Small tree; branchlets glabrous, black. Leaves elliptic to oblanceolate, cuneate at base, reflexed at margin, acute at apex, 7.5 - 15 x 2.5 - 6.5 cm; lateral nerves reticulate, distinct beneath. Flowers sessile, in axillary clusters, greenish white. Sepals 5, imbricate, unequal, erose at tip; outer 3 larger. Petals 5, connate at base. Stamens 5, inserted at disc. Disc annular. Ovary conic, 2-loculed; styles short; stigmas 2 - 4-lobed. Capsules oblong, 1.5 - 2 cm long, smooth; seeds oblong, erect.

Fl. & Fr.: March - Dec.

Habitat: Evergreen forests at lower elevations.

Distrib.: Idukki, Kannur, Malappuram, Palakkad and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

5. *Microtropis wallichiana* Wight ex Thwaites, Enum. Pl. Zeyl.: 71. 1858; M.A. Lawson in Hook.f., Fl. Brit. India 1: 613. 1875; Bourd., Forest Trees Travancore: 100. 1908; Rama Rao, Fl. Pl. Travancore: 82. 1914; Gamble, Fl. Madras: 206(148). 1918; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 116. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 107. 1996; Ramam. in N.P. Singh & al., Fl. India 5: 131. 2000.

Shrub or small tree; branchlets terete or slightly 4-angled. Leaves elliptic or oblanceolate, cuneate or attenuate at base, acute at apex, 3.5 - 10 x 2.5 - 5 cm, subcoriaceous; lateral nerves 4 - 9 pairs; petioles to 15 mm long. Flowers in axillary clusters; bracteoles small, ovate. Sepals subreniform, fringed at margin, ca 2 mm long. Petals oblong-ovate, obtuse, ca 2 mm long. Stamens 2 - 3 mm long. Ovary short, conic. Capsules ellipsoid or oblong-obovoid with persistent style, ca 10 x 5 mm.

Fl.: Feb. - May *Fr.:* May - Sept.

Habitat: Sholas.

Distrib.: Idukki, Kollam, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. South and SE. Asia.

10. *PLEUROSTYLIA* Wight & Arn.

Shrubs or trees. Leaves opposite, nearly coriaceous; stipules caducous. Flowers in axillary cymes, bisexual, 5-merous. Sepals imbricate, lobed. Petals imbricate. Stamens inserted outside disc; anthers ovoid, thick; connectives dorsal, conspicuous. Disc cupular, crenate, fleshy. Ovary flask-shaped, 2-loculed, 1 abortive; styles short, slightly dilated at tip; stigmas capitate or peltate. Fruits slightly fleshy, with persistent lateral style; seed 1, exarillate.

Old World tropics, ca 6 species and 1 in India.

Pleurostylia opposita (Wall.) Alston, Handb. Fl. Ceylon 6(Suppl.): 48. 1931; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 117. 1994; Ramam. in N.P. Singh & al., Fl. India 5: 134. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 162. 2002. *Celastrus opposita* Wall. in Roxb., Fl. Ind. 2: 398. 1824. *Pleurostylia*

wightii Wight & Arn., Prodr. Fl. Ind. Orient.: 157. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 617. 1875; Bourd., Forest Trees Travancore: 102. 1908; Rama Rao, Fl. Pl. Travancore: 83. 1914; Gamble, Fl. Madras: 211(152). 1918.

Small tree; branchlets subterete. Leaves ovate to obovate-oblong, tapering at base, entire and slightly recurved at margin, obtuse to acute at apex, 3 - 8 x 1.5 - 5.5 cm; lateral nerves ca 6 pairs. Flowers in axillary cymes. Sepals rounded or subreniform. Petals elliptic to broadly ovate. Filaments subulate, attached just beneath margin of disc, to 2 mm long, fleshy; anthers ovoid. Disc cupular, fleshy. Ovary flask-shaped; styles short, stigmas capitate. Fruits drupaceous, ellipsoid, 5 x 4 - 5 mm.

Fl. & Fr.: June - Sept.

Habitat: Evergreen forests.

Distrib.: Idukki, Kollam and Thiruvananthapuram. Andaman Islands, Andhra Pradesh and Tamil Nadu. Madagascar, Mauritius, South and SE. Asia.

11. REISSANTIA N. Hallé

Scandent or erect shrubs. Leaves opposite. Flowers in axillary simple or compound cymes, sometimes crowded on short shoots or in panicles. Calyx lobes 5, imbricate. Petals 5, imbricate, erect or suberect. Stamens 3, inserted at base of ovary; anthers oblong, extrorse. Disc inconspicuous, extrastaminal, mostly united with ovary, uppermost part slightly extended outwards. Ovary 3-loculed; ovules usually 2, rarely 4 - 8 in each locule; styles short; stigmas obscure. Fruits capsular with 3 divergent separate follicles; seeds with a basal membranous wing.

Old World tropics, 7 species, 3 in India and 2 in Kerala.

Key to species

- | | |
|------------------------------------|-----------------------|
| 1a. Flowers in thrysiform panicles | 1. <i>R. grahamii</i> |
| b. Flowers in dichotomous cymes | 2. <i>R. indica</i> |

1. **Reissantia grahamii** (Wight) Ding Hou in Blumea 12: 33. 1963; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 117. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 108. 1996; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 147. 2000. *Hippocratea grahamii* Wight, Ill. Ind. Bot. 1: 134. 1840 & Icon. Pl. Ind. Orient: t. 380. 1840; M.A. Lawson in Hook.f., Fl. Brit. India 1: 624. 1875;

Rama Rao, Fl. Pl. Travancore: 85. 1914. *Arnicratea grahamii* (Wight) N. Hallé in Bull. Mus. Hist. Nat. (Paris) B, Adansonia 4, 6: 14. 1984; Vajr., Fl. Palghat: 116. 1990.

Shrub; branchlets scandent, woody. Leaves elliptic, broadly ovate-oblong to obovate, cuneate or rounded at base, entire, sometimes crenate at margin, acuminate at apex, (5 - 8 - 20 x 4 - 10) cm; lateral nerves 5 or 6 pairs. Flowers in thrysiform many-flowered axillary panicles. Sepals suborbicular, pectinate or ciliate at margin. Petals 5, oblanceolate to obovate-oblong, cucullate, short-clawed, inflexed at margin, membranous, white-creamy. Stamens 5; anthers sessile. Disc 5-angled with angles alternating with petals. Ovary 3-angled, within disc; style short, columnar. Fruits linear to obovate-oblong, 8 - 13 x 2.5 - 4.5 cm, striate, 4-seeded; seeds ovoid-oblong, ca 2.5 cm long; basal wings ca 4.5 x 2 cm, brown, with distinct funicle in middle.

Fl.: Feb. - April *Fr.*: April - July.

Habitat: Evergreen forests.

Distrib.: Palakkad, Thiruvananthapuram and Thrissur. Andaman Islands and W. Ghats. South and SE. Asia.

2. *Reissantia indica* (Willd.) N. Hallé in Mém. Inst. Franc. Afrique Noire 64: 85. 1962; Ding Hou in Blumea 12: 33. 1963; Manilal & Sivar., Fl. Calicut: 66. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 97. 1988; Sivar. & P. Mathew, Fl. Nilambur: 146. 1997; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 147. 2000. *Hippocratea indica* Willd., Sp. Pl. 1: 193. 1797; M.A. Lawson in Hook.f., Fl. Brit. India 1: 624. 1875; Gamble, Fl. Madras: 213(153). 1918. *Pristimera indica* (Willd.) A.C. Sm. in Amer. J. Bot. 28: 440. 1941.

Climbing shrub; branchlets woody. Leaves ovate to elliptic-oblong, cuneate at base, crenulate or serrate at margin, acuminate at apex, 3.5 - 14 x 2.5 - 5 cm; lateral nerves to 8 pairs; stipules 3-angled, 3-lobed, laciniate or fimbriate, ca 0.5 mm long; petioles 5 - 8 mm long. Flowers in axillary dichotomous cymes, pale yellow; peduncles to 3 cm long; bracts 3-angled, laciniate; pedicels ca 1 mm long. Sepals 3-angled, thin. Petals 5, oblong, papillose on both sides. Stamens 5; filaments longer than anthers. Disc cupular, thin, spreading. Ovary flask-shaped; ovules 2 in each locule. Fruits elliptic or obovate-oblong, 3 - 5.5 x 1 - 1.5 cm; pericarp leathery with marginal sutures spreading after dehiscence; seeds broadly

elliptic, 2.75 - 3.5 x ca 1 cm including wing.

Fl. & Fr.: Feb. - July.

Habitat: Evergreen forests.

Distrib.: Kannur, Kozhikode and Malappuram. Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Karnataka, Maharashtra, Orissa, Tamil Nadu and W. Bengal. South and SE. Asia.

12. SALACIA L., nom. cons.

Scandent or erect shrubs, small trees or lianas; branchlets terete, greyish brown. Leaves opposite, sometimes subopposite, rarely spiral. Flowers in fascicles, cymes, thyrses or panicles. Calyx deeply 5-lobed. Petals (4 or) 5. Stamens 3, inserted at base of ovary; filaments subulate, usually reflexed at anthesis; anthers laterally oblong. Disc intrastaminal, truncate, conic or flat, fleshy. Ovary partly or completely within disc, free part conic, gradually narrowing into an obscure style; ovules 2 - 8 in each locule. Fruits drupaceous, subglobose; pericarp coriaceous when dry; seeds 1 - many, embedded in mucilaginous pulp; cotyledons large, free or united.

Tropics, ca 150 species, 21 in India and 7 in Kerala.

Key to species

- | | | |
|-----|--|--------------------------|
| 1a. | Flowers in cymes; anthers dehiscing longitudinally | 2 |
| b. | Flowers in axillary fascicles on tubercles; anthers dehiscing transversely | 3 |
| 2a. | Flowers usually 3, on 5 mm long peduncles; seeds 8 | 6. <i>S. oblonga</i> |
| b. | Flowers more than 3, on elongate peduncles; seeds 3 | 3. <i>S. fruticosa</i> |
| 3a. | Flowers less than 6 in fascicles from axils; calyx lobes entire or slightly ciliate at margin | 4 |
| b. | Flowers more than 6 in fascicles from axils or extra-axillary tubercles; calyx lobes fringed at margin | 6 |
| 4a. | Branchlets angled; petals clawed | 2. <i>S. chinensis</i> |
| b. | Branchlets terete; petals not clawed | 5 |
| 5a. | Pedicels less than 6 mm long; petals thick | 7. <i>S. reticulata</i> |
| b. | Pedicels more than 6 mm long; petals thin at margin | 5. <i>S. malabarica</i> |
| 6a. | Lateral nerves in leaves regular; calyx lobes long-fimbriate at margin | 1. <i>S. beddomei</i> |
| b. | Lateral nerves in leaves irregular; calyx lobes short-fimbriate at margin | 4. <i>S. macrosperma</i> |

1. *Salacia beddomei* Gamble in Bull. Misc. Inform. 1916: 133. 1916 & Fl. Madras: 215(155). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 98. 1988; Vajr., Fl. Palghat: 120. 1990; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 151. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 163. 2002.

Climbing shrub. Leaves elliptic-oblong, somewhat rounded at base, undulate at margin, acute at apex, 12 - 14 x 5 - 7 cm, coriaceous, glabrous; lateral nerves ca 12 pairs, conspicuously reticulate; petioles 7 - 8 mm long. Flowers in axillary 4 - 12-flowered fascicles. Calyx minute, 5-lobed; lobes ovate, concave, long-fimbriate at margin. Petals obovate, 1 - 5 mm long, glabrous. Stamens intramarginal to disc. Ovary within disc; styles exserted. Berries globose or globose-depressed, 2.5 - 3.5 x 1.5 - 2.5 cm, tubercled, yellowish green to pale orange, reddish pink; seeds 3, ellipsoid, 1 - 1.5 x 0.5 - 1.2 cm.

Fl.: March - April *Fr.*: March - Dec.

Habitat: Lower elevations on hills.

Distrib.: Kannur, Palakkad, Thiruvananthapuram and Wynad. Western Ghats of Tamil Nadu. Endemic.

2. *Salacia chinensis* L., Mant. Pl.: 293. 1771; Nicolson & al. in Regnum Veg. 119: 150. 1988; Manilal, Fl. Silent Valley: 56. 1988; Vajr., Fl. Palghat: 120. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 118. 1994; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 152. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 164. 2002. *S. prinoides* DC., Prodr. 1: 579. 1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 626. 1875; Gamble, Fl. Madras: 215(154). 1918; Rama Rao, Fl. Pl. Travancore: 85. 1914.

Straggling or climbing shrub; branchlets angled, 1 - 5 mm thick, glabrous. Leaves oblong-lanceolate to elliptic-obovate, acute at base, entire or slightly crenulate at margin, short-acuminate at apex, 4.5 - 12 x 2.5 - 5 cm, thin-coriaceous, glabrous, often shining; lateral nerves 5 - 10 pairs; petioles 2 - 7 mm long. Flowers in axillary 3 - 6-flowered fascicles, yellowish white. Calyx lobes 3-angled, entire, slightly ciliate at margin. Petals 5, oblong or obovate, clawed at base. Stamens arising from inner margin of disc; filaments slender. Ovary conic, within disc. Berries globose, sometimes broadly ellipsoid, 6 - 12 mm across, smooth, bright red, blackish when dry, 1-loculed, 1- or 2-seeded; stalks slender, 5 - 10 mm long; seeds subglobose, ca 7 mm long, brownish.

Fl.: Feb. - July *Fr.*: Dec.

Habitat: Seashores, river banks and hills, to 500 m.

Distrib.: Kollam, Palakkad and Thiruvananthapuram. Andaman Islands, Arunachal Pradesh, Assam, Karnataka, Maharashtra, Meghalaya, Orissa, Tamil Nadu and W. Bengal. South and SE. Asia.

Use: Useful against diabetes.

Editors' note: Ramamurthy and Naithani (*l.c.*) cited *S. latifolia* Wall. (ex M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 629. 1875) as a synonym. Lawson (*l.c.*) mentioned it only under *Doubtful species* at the end of the genus and Wall., Numer. List No. 4222 is reportedly from Singapore.

3. *Salacia fruticosa* B. Heyne ex M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 628. 1875; Rama Rao, *Fl. Pl. Travancore*: 85. 1914; Gamble, *Fl. Madras*: 215(155). 1918; Manilal & Sivar., *Fl. Calicut*: 66. 1982; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 98. 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 118. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 108. 1996; Ramam. & B.D. Naithani in N.P. Singh & al., *Fl. India* 5: 153. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 164. 2002.

Climbing shrub; branchlets rough. Leaves ovate to elliptic-lanceolate, cunate at base, serrate at margin, acute at apex, 5 - 12 x 2.5 - 5 cm, chartaceous. Flowers in branched many-flowered cymes; peduncles elongated. Calyx lobes deltoid, minutely ciliate. Petals 5, orbicular, ca 2 mm, white at margin. Filaments recurved, inserted at inner margin of disc. Disc thick. Ovary conic, within disc, 3-loculed; styles very short; stigmas capitate. Berries globose or subglobose, 1.5 - 2.5 cm across, smooth with a coriaceous rind; seeds 3, angled, ca 1.5 x 1 cm.

Fl.: Feb. - July *Fr.*: Feb. - Nov.

Habitat: Semievergreen and evergreen forests.

Distrib.: Almost throughout Kerala. Western Ghats of Karnataka and Tamil Nadu. Endemic.

4. *Salacia macrosperma* Wight, *Icon. Pl. Ind. Orient.*: t. 962. 1845; M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 628. 1875; Gamble, *Fl. Madras*: 215(154). 1918; Manilal, *Fl. Silent Valley*: 57. 1988; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 109. 1996; Ramam. & B.D. Naithani in N.P. Singh & al., *Fl. India* 5: 157. 2000.

Scandent shrub; branchlets sometimes twisted around supports. Leaves

elliptic-oblong or obovate-elliptic, cuneate at base, entire at margin, acuminate to subobtusate at apex, to 13 x 6 cm, coriaceous, glabrous; lateral nerves irregular, oblique. Flowers in axillary fascicles or extra-axillary tubercles, greenish white. Calyx lobes oblong, much shorter than petals, short-fimbriate at margin with hairs. Stamens inserted close to ovary; filaments short, broad. Disc convex, slightly depressed in middle. Ovary within disc; styles very short. Berries globose, 1.5 - 2 cm, verrucose, fleshy, orange.

Fl.: Jan. *Fr.*: Feb.

Habitat: Semievergreen forests.

Distrib.: Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

5. *Salacia malabarica* Gamble in Bull. Misc. Inform. 1916: 138. 1916 & Fl. Madras: 215(154). 1918; Ramam. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 1: 119. 1987; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 158. 2000.

Scandent shrub; branchlets terete, purplish with distinct lenticels. Leaves opposite, sometimes subopposite or alternate at lower nodes, obtuse, obscurely or distinctly serrate at margin, 8 - 16 x 4 - 7 cm; lateral nerves 7 - 10 pairs, curved at margin, reticulate, indistinct; petioles ca 1 cm long. Flowers in axillary fascicles; pedicels 1 - 1.5 cm long, slender. Calyx lobes ovate, minute. Petals oblong, glabrous, hyaline at margin. Stamens arising between lobes of disc, recurved; filaments short. Ovary within thick disc; styles conic, minute. Fruit not seen.

Fl. & Fr.: Not known.

Habitat: Evergreen forests.

Distrib.: Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic and endangered.

6. *Salacia oblonga* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 106. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 628. 1875; Rama Rao, Fl. Pl. Travancore: 85. 1914; Gamble, Fl. Madras: 215(155). 1918; Sasidh. & Sivar., Fl. Pl. Thrissur: 109. 1996; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 160. 2000.

Shrub or small tree; branchlets terete, glabrous, lenticelled. Leaves elliptic-oblong to oblanceolate, obtuse at base, crenate-serrate at margin, rounded or

obtusely acuminate at apex, 7 - 15 x 3 - 5 cm, subcoriaceous, glabrous; petioles ca 6 mm long. Flowers in short usually to 5 mm long axillary peduncles, sometimes sessile. Calyx lobed nearly to base; lobes orbicular, ciliate. Petals oblong, rounded at apex, ca 3 mm long. Ovary half within disc, conic, tapering to a short style, 3-loculed; ovules 4 in each locule. Fruits globose, ca 5 cm, orange; seeds 8, angled, embedded in pulp.

Fl. & Fr.: Dec. March.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Thiruvananthapuram (Parathipalli, Rama Rao, *l.c.*) and Thrissur. Deccan Plateau and W. Ghats. Sri Lanka.

Use: Root bark is used in rheumatism, gonorrhoea and skin diseases.

7. **Salacia reticulata** Wight, Ill. Ind. Bot. 1: 134. 1840; M.A. Lawson in Hook.f., Fl. Brit. India 1: 627. 1875; Rama Rao, Fl. Pl. Travancore: 85. 1914; Gamble, Fl. Madras: 215(154). 1918; Ramam. & B.D. Naithani in N.P. Singh & al., Fl. India 5: 161. 2000.

Climbing shrub; branchlets terete, lenticelled. Leaves ovate to obovate-oblong, serrate, 6 - 9 x 3.5 - 5 cm, coriaceous, slightly shining above. Flowers in fascicles on axillary tubercles. Calyx lobes obtuse, not fringed. Petals 5, broad at base, thick. Stamens arising from margin of disc. Disc thick, broad. Ovary conic, within disc; styles short; stigmas capitate. Berries ca 5 cm across, tubercled; seeds angled.

Fl. & Fr.: June.

Habitat: Evergreen forests.

Distrib.: Kollam, (Palakkad ?) and Thiruvananthapuram. Western Ghats of Maharashtra and Tamil Nadu. Sri Lanka.

RHAMNACEAE

(P.V. SREEKUMAR & A.N. HENRY)

Trees, shrubs or lianas, armed or unarmed, rarely with tendrils. Leaves alternate, sometimes opposite, simple, palmately or pinnately nerved; stipules caducous or modified into persistent spines. Inflorescences axillary or terminal, cymose, rarely paniced or spiciform. Flowers bi- rarely unisexual or polygamodioecious, hypo-, peri- or epigynous. Calyx often persistent. Petals 4 or

5(6), free, rarely absent or reduced to claw-like structures. Intrastaminal disc cupular, lobed, nectariferous, sometimes produced beyond rim of cup. Stamens 4 or 5, antipetalous, inserted at edge of disc; filaments filiform or flat; anthers small, twice as long as wide, 2-loculed, rarely locules confluent. Carpels 2 or 3(1 - 4); ovule 1, anatropous; placentation basal; styles simple or divided into as many lobes as carpels; stigmas cupular or capitate. Fruits capsular or drupaceous, rarely samaroid; seed 1, ovoid, angled or compressed, rarely arillate; testa coria-, crusta- or chartaceous, shining; endosperm fleshy or horny, sometimes ruminant, rarely absent; embryo large, straight.

Cosmopolitan especially tropics and subtropics, 49 genera and 900 species, 12 and 57 in India and, 6 and 13 in Kerala.

Literature: Backer, C.A. & Bakhuizen, R.C. 1965. *Fl. Java* 2: 80 - 85. Tutin, T.G. 1968. *Rhamnaceae*. In: Tutin, T.G. & al. (ed.), *Fl. Europ.* 2: 243 - 245. Kornik, K.B. & Kornik, J.Z. 1977. *Rhamnaceae*. In: Reicheinger, K.H. (ed.), *Fl. Iran.* 125: 1 - 28. Bhandari, M.M. & Bhansali, A.K. 1990. *Rhamnaceae. Fasc. Fl. India* 20: 26 - 114.

Key to genera

- | | | |
|-----|---|---------------------|
| 1a. | Climbing shrubs with tendrils; disc lobed between stamens; fruits 3-winged | 2. <i>Gouania</i> |
| b. | Erect shrubs or trees, rarely climbing but then without tendrils; disc not lobed between stamens; fruits not 3-winged | 2 |
| 2a. | Leaves palmately 3 - 5-nerved | 6. <i>Ziziphus</i> |
| b. | Leaves pinnately nerved | 3 |
| 3a. | Fruits dehiscent, capsular | 1. <i>Colubrina</i> |
| b. | Fruits indehiscent, not capsular | 4 |
| 4a. | Leaves ovate or obovate, 1 - 5 cm long; spines recurved | 4. <i>Scutia</i> |
| b. | Leaves elliptic or ovate-lanceolate, 6 - 15 cm long; spines straight | 5 |
| 5a. | Fruits winged, samaroid, 1-seeded | 5. <i>Ventilago</i> |
| b. | Fruits not winged, drupaceous, 2 - 4-seeded | 3. <i>Sageretia</i> |

1. COLUBRINA Rich. ex Brongn., nom. cons.

Erect or scandent shrubs or trees, usually unarmed. Leaves petioled, palmately 3-nerved or pinnately nerved; stipules small, deciduous. Flowers protandrous, in axillary thyrsoid or cymose fascicles. Calyx lobes 5, valvate, deltoid. Petals 5,

obovate, cucullate, clawed. Stamens 5. Disc annular, fleshy. Carpels 3; ovary inferior; styles 3; stigmas truncate. Capsules globose, slightly 3-lobed, dehiscing into 3 cocci; seeds 3-angled, compressed; cotyledons flat; embryo flat.

Tropics and subtropics especially America, 31 species, 2 in India.

Key to species

- 1a. Young branches and pedicels glabrous; leaves ovate, 3 - 8 cm long; lateral nerves 2 or 3 pairs; flowers greenish yellow 1. *C. asiatica*
- b. Young branches and pedicels golden-hairy; leaves elliptic or lanceolate, 8 - 12 cm long; lateral nerves 4 - 6 pairs; flowers pink 2. *C. travancorica*

1. *Colubrina asiatica* (L.) Brongn., Mém. Fam. Rhamn.: 62. 1826 & in Ann. Sci. Nat. (Paris) 10: 369. 1827; Wight, Ill. Ind. Bot. 1: t. 74. 1840; M.A. Lawson in Hook.f., Fl. Brit. India 1: 642. 1875; Gamble, Fl. Madras: 224(161). 1918; Nicolson & al. in Regnum Veg. 119: 213. 1988; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 169. 2000. *Ceanothus asiaticus* L., Sp. Pl.: 196. 1753.

Unarmed shrub, 1 - 3 m high; branches zigzag. Leaves alternate, ovate, broadly rounded or shallowly cordate at base, crenate at margin, acuminate at apex, 3 - 8 x 2 - 4 cm, chartaceous; stipules ca 1 mm long. Flowers in cymes, greenish yellow, fragrant, lower ones bisexual, the upper sterile or staminate; peduncles 2 - 5 mm long; pedicels 2 - 5 mm long. Calyx lobes 2 - 3 mm long, glabrous. Petals emarginate, 1.5 - 2 mm long, yellow; claw slender. Stamens 1 - 1.5 mm long; anthers dorsifixed. Capsules globose, depressed at top, 8 - 10 mm; seeds 3, slightly emarginate at base, 4 - 5 mm, chocolate-brown.

Fl. & Fr.: Dec. - March.

Habitat: Coastal regions to 200 m.

Distrib.: Kozhikode and Malappuram. Andaman & Nicobar Islands, C. and S. India. Africa, Asia and Australia.

2. *Colubrina travancorica* Bedd., Icon. Pl. Ind. Orient.: t. 188. 1868 - 1874; M.A. Lawson in Hook.f., Fl. Brit. India 1: 653. 1875; Rama Rao, Fl. Pl. Travancore: 89. 1914; Gamble, Fl. Madras: 224(161). 1918; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 171. 2000.

Unarmed shrub. Leaves alternate or subopposite, elliptic to lanceolate, rounded at base, crenate at margin, acuminate at apex, 8 - 12 x 3 - 4 cm, densely pubescent beneath when young; petioles 5 - 8 mm long, pubescent. Inflorescences thyrsoid or dichasial; peduncles 3 - 8 mm long, silky-pubescent. Flowers 5 - 6 mm long, pinkish; pedicels 3 - 8 mm long, silky-pubescent. Calyx campanulate; lobes 2 - 2.5 mm long. Petals 1 - 2 mm long. Disc 10-lobed. Ovary glabrous; styles 3-partite. Capsules globose, 6 - 8 mm.

Fl. & Fr.: Sept. - Dec.

Habitat: Plains especially in coastal forests and hills, to 600 m.

Distrib.: Kollam, Pathanamthitta and Thrissur. Endemic.

2. GOUANIA Jacq.

Climbing shrubs with circinate tendrils. Leaves petioled; stipules caducous. Inflorescences terminal or axillary, racemose or paniced. Flowers bisexual, epigynous. Calyx lobes 5, valvate, glabrous or pubescent. Petals 5, cucullate, clawed. Stamens 5, enclosed by petals; anthers dehiscing longitudinally. Disc 5-lobed with lobes opposite calyx lobes. Ovary within disc, 3-loculed; styles 3-partite; stigma papillose. Capsules schizocarpic, 3-loculed, 3-winged; seeds 3, obovate; testa horny, shining; endosperm thin; cotyledons round; embryo erect.

Tropics and subtropics especially America, 50 - 70 species, 4 in India and 1 in Kerala.

1. *Gouania microcarpa* DC., Prodr. 2: 40. 1825; M.A. Lawson in Hook.f., Fl. Brit. India 1: 643. 1875; Rama Rao, Fl. Pl. Travancore: 89. 1914; Gamble, Fl. Madras: 225(161). 1918; Manilal, Fl. Silent Valley: 57. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 99. 1988; Vajr., Fl. Palghat: 120. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 109. 1996; Sivar. & P. Mathew, Fl. Nilambur: 147. 1997; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 176. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 165. 2002.

Climbing shrub; tendrils axillary or extra-axillary; branches and tendrils hairy. Leaves elliptic-ovate, rounded at base, serrate at margin, acute at apex, 2 - 10 x 1 - 5 cm; petioles 5 - 15 mm long, villous with brown hairs; stipules subulate, 3 - 5 x 0.5 - 1.5 mm, pubescent. Flowers in clusters of 4 - 8 in racemes, 4 - 5 mm long, white, foetid; bracteoles lanceolate, 2 - 3 mm long. Calyx lobes deltoid,

keeled, 1.5 - 2 x 1 - 1.5 mm, densely pubescent outside. Petals spatulate, 1 - 1.5 x 2 - 2.5 mm. Stamens ca 1 mm long. Disc patelliform, glabrous. Styles 3-partite. Capsules 3-lobed, 3-winged, 10 - 15 x 6 - 12 mm, crowned by persistent calyx, shining, green; seeds ovate, to 5 x 4 mm; cotyledons cordate at base, retuse.

Fl. & Fr.: Oct. - Feb.

Habitat: Coastal forests and hilly areas, to 900 m, fairly common.

Distrib.: Almost throughout Kerala. Gangetic Plains, Jammu & Kashmir and S. India. South and SE. Asia.

Use: Fruit is edible.

3. SAGERETIA Brongn.

Armed or unarmed trees or shrubs, rarely climbing. Leaves opposite or subopposite, serratures with glandular tips; stipules minute, caducous. Inflorescences axillary or terminal, paniced. Flowers bisexual, 5-merous. Calyx urceolate, keeled, persistent. Petals cucullate, clawed. Stamens enclosed by petals; anthers 2-loculed, dehiscing longitudinally. Disc patelliform, 5-lobed, fleshy. Ovary superior, within disc, 3-loculed; styles 3. Drupes globose, 3-loculed; seeds 3; testa crustaceous; embryo straight; cotyledons flat.

Tropical and subtropical America and SW. Asia to Taiwan, ca 35 species, 8 in India and 2 in Kerala.

Key to species

- 1a. Leaves elliptic-oblong, 10 - 14 cm long; lateral nerves 8 - 10 pairs; stamens longer than petals
1. *S. hamosa*
- b. Leaves ovate-lanceolate, 2.5 - 8 cm long; lateral nerves 6 pairs; stamens as long as or shorter than petals
2. *S. parviflora*

1. *Sageretia hamosa* (Wall.) Brongn., Mém. Fam. Rhamn.: 53. 1826 & in Ann. Sci. Nat. (Paris) 10: 360. 1827; M.A. Lawson in Hook.f., Fl. Brit. India 1: 641. 1875; Gamble, Fl. Madras: 223(160). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 99. 1988; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 200. 2000. *Ziziphus hamosa* Wall. in Roxb. Fl. Ind. 2: 3: 369. 1824.

Scandent shrub; lateral flower-bearing branches ending in thorns. Leaves subopposite, elliptic-oblong, rarely lanceolate, rounded at base, 10 - 14 x 4 - 6 cm,

furrowed, coriaceous. Panicles lax with alternate or subopposite racemes. Flowers sessile, 3 - 4.5 mm long, pubescent, green; bracts ovate, brownish. Calyx lobes deltoid, 1 - 2.5 x 1 - 1.5 mm, glabrescent. Petals obovate, emarginate at apex, ca 1.5 x 2 mm. Stamens ca 2.5 mm long; anthers dorsifixed. Disc slightly 5-lobed. Ovary urceolate; stigmas 3, convex. Drupes obovoid, ca 1 x 0.5 cm; seeds 3, 3 - 4 mm long, brownish black.

Fl. & Fr.: June - Aug.

Habitat: Hilly areas, to 600 m, occasional.

Distrib.: Kannur and Kottayam. Northeast and S. India. Nepal, Sri Lanka and Taiwan.

2. *Sageretia parviflora* (Roem. & Schult.) G. Don, Gen. Hist. 2: 29. 1832; Gamble, Fl. Madras: 223(160). 1918; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 202. 2000. *Rhamnus parviflora* Roem. & Schult., Syst. Veg. 5: 295. 1819. *Sageretia oppositifolia* Brongn., Mém. Fam. Rhamn.: 53. 1826 & in Ann. Sci. Nat. (Paris) 10: 360. 1827; M.A. Lawson in Hook.f., Fl. Brit. India 1: 641. 1875.

Large shrub or small tree, to 3 m high; branches climbing, armed. Leaves ovate-elliptic or lanceolate, rounded at base, serrulate at margin, acuminate at apex, 2.5 - 8 x 1 - 4 cm, subcoriaceous, hairy on nerves beneath; petioles 2 - 15 mm long, villous; stipules linear, 1.5 - 3 mm long, villous. Panicles with opposite racemes; bracts linear, 1 - 2 mm long, tomentose, caducous. Flowers sessile, ca 5 mm long. Calyx lobes deltoid, 1.5 - 2.5 mm long, villous outside. Petals obovate, emarginate at apex. Stamens 1 - 1.5 mm long. Disc flat. Ovary urceolate; stigmas capitate. Drupes turbinate, ca 10 x 5 mm, black when ripe; seeds 3 - 4 x 2 - 2.5 mm, black.

Fl. & Fr.: Oct. - Jan.

Habitat: Rocky places and scrub forests, to 400 m, very rare.

Distrib.: Kannur. Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kashmir, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and W. Bengal. Indonesia and Nepal.

Use: Fruit is edible.

4. SCUTIA (Comm. ex DC.) Brongn., nom. cons.

Small trees or shrubs, rarely scandent, armed or not. Leaves opposite or subopposite, petioled, ovate or obovate, obtuse at both ends, mucronate at apex; stipules 3-angled, caducous. Cymes condensed, axillary, solitary or in umbelled fascicles. Flowers bisexual, 5-merous. Calyx lobes deltoid, valvate in bud. Petals 2-lobed, cucullate or flat. Anthers ovate, dorsifixed, 2-loculed. Disc bordering calyx cup. Ovary within disc, 2- or 3-loculed; styles very short, slightly lobed. Drupes more or less globose; seeds 2 or 3, enclosed in free endocarpous stone.

South American and Old World tropics to S. Africa, 4 species and 1 in India.

Scutia myrtina (Burm.f.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 44: 168. 1875; Gamble, Fl. Madras: 223(160). 1918; Nicolson & al. in Regnum Veg. 119: 213. 1988; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 207. 2000. *Rhamnus myrtina* Burm.f., Fl. Indica: 60. 1768 (as *myrtinus*). *Scutia indica* Brongn., Mém. Fam. Rhamn.: 56, t. 4. 1826; M.A. Lawson in Hook.f., Fl. Brit. India 1: 640. 1875; Rama Rao, Fl. Pl. Travancore: 88. 1914.

Mal.: *Iutali*, *Veradaku*

Scandent shrub, rarely small tree, 2 - 5(- 8) m high, armed with subopposite recurved 2 - 6 mm long spines. Leaves ovate or obovate, to 5 x 4 cm, coriaceous, glabrous; stipules 2 - 5 mm long. Inflorescences cymose or fascicled, 2 - 12-flowered; peduncles 2 - 6 mm long; bracts ca 1 mm long, ciliate. Flowers ca 2 mm across, greenish yellow; pedicels 1 - 2 mm long. Calyx lobes deltoid, 1 - 2 mm long, keeled below. Petals emarginate or deeply 2-lobed, 0.5 - 1 mm long, yellow. Stamens 0.5 - 1 mm long; filaments slightly swollen at base. Disc glabrous. Ovary glabrous, 2-loculed; styles shortly 2-lobed. Drupes 5 - 6 mm long, glabrous, separating into 2 indehiscent stones; seeds 2, planoconvex, brownish.

Fl. & Fr.: July - Sept.

Habitat: Scrub forests, to 300 m, very rare.

Distrib.: Idukki (Anjanad, Rama Rao, *l.c.*) and Palakkad. Central and S. India. Mauritius, Myanmar and Sri Lanka.

Uses: Fruit is edible and used as an astringent. Plant is grown as a hedge.

5. VENTILAGO Gaertn.

Scandent shrubs; branches zigzag, striate. Leaves alternate, simple, chartaceous or coriaceous; lateral nerves converging prominently at margin; stipules minute. Inflorescences axillary or terminal, cymose, fascicled or paniced. Flowers pedicelled, bisexual. Calyx cupular or patelliform; lobes 5, keeled. Petals 5, cucullate, truncate, clawed, chartaceous. Stamens 5, enclosed by petals; anthers dorsifixed, introrse. Disc 5-lobed or -angled, fleshy, adnate to ovary. Ovary 2-loculed; styles hairy at base; stigmas 2. Samaras indehiscent, 1 wing prolonged, tip crowned by persistent styles, 1-seeded; seed globose or subglobose, nonendospermous; testa membranous; cotyledons thick, fleshy.

Old World tropics, 35 species, 4 in India and 3 in Kerala.

Key to species

- 1a. Flowers in axillary fascicles; calyx patelliform, adnate to fruit at base
1. *V. bombaiensis*
- b. Flowers in axillary or terminal panicles; calyx cupular, adnate to fruit in lower half 2
- 2a. Leaves to 15 cm long, oblique at base; panicles pubescent; ovary villous 2. *V. denticulata*
- b. Leaves to 8 cm long, obtuse at base; panicles golden-villous; ovary glabrous 3. *V. gamblei*

1. *Ventilago bombaiensis* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 36. 1851; M.A. Lawson in Hook.f., Fl. Brit. India 1: 631. 1875; Gamble, Fl. Madras: 218(157). 1918; Oza in J. Bombay Nat. Hist. Soc. 70: 591. 1974; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 99. 1988; Vajr., Fl. Palghat: 120. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 110. 1996. *Smythea bombaiensis* (Dalzell) S.P. Banerjee & P.K. Mukh. in Indian Forester 96: 214. 1970; Manilal, Fl. Silent Valley: 57. 1988; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 210. 2000.

Climbing, woody shrub, to 10 m high; branches fulvous-pubescent. Leaves ovate, ovate-elliptic or lanceolate, crenate at margin, acute at apex, 3 - 10 x 1 - 4 cm, subcoriaceous; lateral nerves 4 or 5 pairs; petioles 2 - 6 mm long; stipules subulate, 2 - 4 mm long. Inflorescences axillary, fascicled. Flowers 6 - 10 in each fascicle, 5 - 6 mm long, greenish yellow; pedicels 2 - 4 mm long, fulvous-pubescent. Calyx lobes deltoid, 2 - 3 mm long, densely fulvous-pubescent outside; tube obconic, persistent. Petals truncate, cuneate at base, 1 - 2 mm long. Stamens

1 2 mm long; anthers subglobose; connectives produced. Disc 5-lobed. Ovary hairy. Samaras winged, rounded or truncate at apex, black, 1-seeded.

Fl. & Fr.: March - May.

Habitat: Dry deciduous forests, to 700 m, frequent.

Distrib.: Idukki, Kannur, Palakkad, Pathanamthitta, Thrissur and Wynad. Southern India. Endemic.

Note: Banerjee and Mukherjee (*l.c.*) and, Bhandari and Bhansali (2000) placed this species in *Smythea* Seem. ex A. Gray based on its dehiscent fruits and axillary flowers. Examination of fruiting material reveals that the samaroid fruits are not dehiscent and the species is better placed in the genus *Ventilago* Gaertn. as opined by Oza (*l.c.*).

2. *Ventilago denticulata* Willd. in Ges. Naturf. Freunde Neue Schriften 3: 417. 1801; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 217. 2000. *V. calyculata* Tul. in Ann. Sci. Nat. Bot. 4: 124. 1857; M.A. Lawson in Hook.f., Fl. Brit. India 1: 631. 1875; Gamble, Fl. Madras: 218(157). 1918.

Liana; stem 10 - 25 cm across; branches pubescent; bark fissured, grey or dark brown, usually red in fissures. Leaves ovate-lanceolate, oblique at base, crenate-serrate at margin, obtuse or subacute at apex, 3 - 15 x 2 - 6 cm, subcoriaceous, pubescent; lateral nerves 5 - 8 pairs; petioles 3 - 10 mm long, furrowed, pubescent. Flowers greenish yellow, pungent; pedicels 1 - 4 mm long. Calyx lobes deltoid, 2 - 2.5 mm long, hairy. Petals spatulate, emarginate at apex, 1 - 1.5 mm long. Stamens 1 - 1.5 mm long; connectives prolonged. Disc 5-lobed. Ovary villos, 2-loculed; stigmas 2, divergent. Samaras pubescent.

Fl. & Fr.: Oct. - May.

Habitat: Dry forests, to 300 m, rare.

Distrib.: Palakkad. Andaman & Nicobar Islands, Jammu & Kashmir, C., NE. and S. India.

Uses: Bark is a source of a fibre. Bark is powdered and externally applied in sprains and extract of bark is applied to body to contain malarial fever. Oil from seed is often used as a cooking medium.

3. *Ventilago gamblei* Suess. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20d: 152. 1953; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 100. 1988; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 219. 2000. *V. lanceolata* Gamble in Bull.

Misc. Inform. 1916: 134. 1916 & Fl. Madras: 218(157). 1918, non Merr. 1915.

Climbing shrub; branches dark grey or brownish. Leaves elliptic or oblong-lanceolate, obtuse at base, crenate at margin, acuminate or mucronate at apex, 4 - 8 x 2 - 4 cm; lateral nerves 4 - 8 pairs; petioles 4 - 8 mm long, puberulous. Panicles axillary, very rarely terminal; bracts caducous; bracteoles linear. Flowers 4 - 5 mm long. Calyx lobes 3-angled, keeled at apex, 2 - 2.5 mm long. Petals spatulate, 1 - 1.5 mm long. Stamens 1 - 1.5 mm long; connectives apiculate, recurved. Ovary glabrous. Samaras mucronate at apex of wings, to 5 x 1.5 cm; seeds subglobose, 3 - 4 x 2 - 2.5 mm, black or brownish black.

Fl. & Fr.: Jan. - April.

Habitat: Evergreen forests, to 900 m, occasional.

Distrib.: Kannur. Southern India. Endemic.

6. ZIZIPHUS Mill.

Trees or shrubs, rarely straggling; branches often zigzag, spreading. Leaves alternate or opposite, entire or crenate, charta- or coriaceous, 3 - 5-nerved; stipules spinescent or not; spines curved or straight. Flowers in axillary or terminal cymes or fascicles, 5-merous, bi- unisexual or polygamous, perigynous. Calyx tube obconic; lobes keeled inside. Petals spatulate, cucullate, incurved or deflexed, rarely absent. Stamens inserted below disc. Disc flat or pitted, 5 - 10-lobed, rarely entire. Ovary within disc, 2 - 4-loculed; stigmas papillose. Drupes globose, oblong or elliptic; seeds 1 - 3, planoconvex; testa thin, smooth; endosperm scanty; cotyledons thick.

Tropics and subtropics, 86 species, 17 in India and 5 in Kerala.

Literature: Khoshoo, T.N. & Singh, N. 1963. Cytology of North-West Indian trees *Ziziphus*. *Silvae Genet.* 12: 158 - 165. Mehra, N.S. & Chauhan, K.S. 1985. A study on pollen morphology of the genus *Ziziphus*. In: Vargheese, T.M. (ed.), *Rec. Adv. Pollen Res.*: 203 - 213.

Key to species

- | | | |
|-----|---|---------------------|
| 1a. | Flowers in long-peduncled cymes or panicles; petals absent | 4. <i>Z. rugosa</i> |
| b. | Flowers in sessile or subsessile cymes, umbels or fascicles; petals present | 2 |
| 2a. | Straggling shrubs; disc pitted | 3 |
| b. | Erect shrubs or trees; disc not pitted | 4 |

- 3a. Spines in pairs, one straight and very sharp, the other shorter and hooked 2. *Z. nummularia*
 b. Spine solitary, recurved 3. *Z. oenoplia*
 4a. Styles 3, free; drupes woody, rugose 5. *Z. xylopyrus*
 b. Styles 2, connate; drupes fleshy, not rugose 1. *Z. mauritiana*

1. *Ziziphus mauritiana* Lam., Encycl. 3: 319. 1789; Manilal & Sivar., Fl. Calicut: 67. 1982; Nicolson & al. in Regnum Veg. 119: 214. 1988. *Rhamnus jujuba* L., Sp. Pl.: 194. 1753. *Ziziphus jujuba* (L.) Gaertn., Fruct. Sem. Pl. 1: 203. 1788, non Mill. 1786; M.A. Lawson in Hook.f., Fl. Brit. India 1: 632. 1875; Rama Rao, Fl. Pl. Travancore: 86. 1914; Gamble, Fl. Madras: 219(157). 1918.

Mal.: *Elantha*

Large shrubs or small trees; bark fissured, grey or black; younger parts rusty-tomentose; spines solitary or paired, straight or recurved. Leaves alternate, 3-nerved. Inflorescences axillary cymes or fascicles of 10 - 15 flowers. Flowers 4 - 5 mm across, greenish yellow, fragrant; pedicels 2 - 6 mm long. Calyx lobes 3-angled, 2 - 4 mm long. Petals spatulate, 1 - 1.5 mm long, white. Stamens as long as and enclosed by petals. Disc 10-grooved, fleshy. Ovary 2-loculed; styles 2; stigmas curved. Drupes ovoid or globose, 2- (or 1)-loculed; kernel irregularly wrinkled with a hard shell; seeds 1 or 2, compressed.

Key to varieties

- 1a. Low straggling shrub with thin bole and irregular canopy; drupes less than 1 cm across 1.1. var. **fructicosa**
 b. Erect shrub or small tree with thick bole and spreading round canopy; drupes more than 1 cm across 1.2. var. **mauritiana**

1.1. var. *fructicosa* (Haines) Sebastine & N.P. Balakr. in Indian Forester 89: 525. 1963; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 234. 2000. *Ziziphus jujuba* Lam. var. *fructicosa* Haines, Forest Fl. Chotanagpur: 270. 1910 & Bot. Bihar Orissa 2: 198. 1921; Gamble, Fl. Madras: 220(157). 1918.

Fl. & Fr.: Aug. - Dec.

Habitat: Fringes of forests, to 400 m, rare.

Distrib.: Kannur. Central and S. India. Endemic.

Use: Fruit is edible.

1.2. var. mauritiana

Fl. & Fr.: April - Oct.

Habitat: Scrub and coastal forests, to 600 m, fairly common.

Distrib.: Alappuzha, Idukki, Kannur, Kasaragod, Kottayam, Kozhikode, Malappuram, Palakkad and Pathanamthitta. Throughout India. Africa, Asia and Australia.

Uses: Fruit is edible and also used to cure chest complaints, and as an appetizer, blood purifier and cooling agent. Leaf is used as a fodder and bark for tanning. Decoction of fruit is used to stop vomiting and cough. Bark paste is applied on wounds and ulcers. Wood is used as fuel.

2. *Ziziphus nummularia* (Burm.f.) Wight & Arn., Prodr. Fl. Ind. Orient.: 162. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 633. 1875; Rama Rao, Fl. Pl. Travancore: 87. 1914; Gamble, Fl. Madras: 220(158). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 101. 1988. *Rhamnus nummularia* Burm.f., Fl. Indica: 61. 1768.

var. **nummularia**: Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 235. 2000.

Straggling shrub, 2 - 5 m high; branches divaricate, flexuous, tomentose when young; spines paired, one straight, very sharp, nearly as long as petiole, the other shorter, hooked. Leaves ovate, elliptic or orbicular, oblique or rounded at base, serrate at margin, acute or obtuse at apex, 1 - 2.5 x 0.5 - 1.8 cm, glabrous or tomentose above, tomentose to white-wooly beneath, 3-nerved at base. Inflorescences axillary 10 - 20-flowered cymes, short-peduncled or not. Flowers 4 - 5 mm across. Calyx lobes deltoid, acute, keeled nearly to base, 1.7 - 2.2 mm long. Petals obovate-spatulate, rounded or truncate at apex, 1 - 1.5 mm long. Stamens 0.8 - 1.2 mm long. Disc faintly 10-lobed. Ovary 2-loculed; style 2-cleft. Drupes globose, ca 0.8 cm, woody, glabrous, shining and black-red when ripe; seeds 1 or 2, compressed, black.

Fl. & Fr.: Aug. - Sept.

Habitat: Near villages in plains, occasional.

Distrib.: Idukki and Kannur. Andaman Islands, Gujarat, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. Afghanistan, Iran, Iraq and Pakistan.

3. *Ziziphus oenoplia* (L.) Mill., Gard. Dict. ed. 8, : 3. 1768; M.A. Lawson in Hook.f., Fl. Brit. India 1: 634. 1875; Rama Rao, Fl. Pl. Travancore: 87. 1914; Gamble, Fl. Madras: 220(158). 1918; Manilal & Sivar., Fl. Calicut: 67. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 101. 1988; Vajr., Fl. Palghat: 121. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 118. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 110. 1996; Sivar. & P. Mathew, Fl. Nilambur: 147. 1997; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 236. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 166. 2002. *Rhamnus oenoplia* L., Sp. Pl.: 194. 1753.

Mal.: Kottavalli, Mulli, Thuthalimullu, Todolimullu

Straggling or climbing shrub; branches spreading, densely rusty-tomentose. Leaves elliptic-lanceolate or elliptic, 3- or 4-nerved at base. Inflorescences axillary, cymose or fascicled. Flowers 2 - 4 mm across, greenish. Calyx lobes 3-angled, 1 - 2 mm long. Petals spatulate, emarginate, 0.5 - 1.5 mm long. Stamens 0.5 - 1 mm long. Disc 10-lobed, pitted or grooved. Ovary oblong; styles 2-fid; stigmas blunt at apex. Drupes ellipsoid or ovoid-ellipsoid, 0.5 - 1 cm long, purplish black when ripe; seeds 1 or 2, to 1 cm long.

Fl. & Fr.: Oct. - March.

Habitat: Plains and hills, to 1200 m, fairly common.

Distrib.: Throughout Kerala. Throughout India. South and SE. Asia to Australia.

Uses: Fruit is edible. Bark is used for tanning and decoction of it is applied to heal wounds. Plant extract is a very good astringent. Plant is used for fencing.

Note: Bhandari and Bhansali (*l.c.*) recognized 4 varieties under this species, of which var. *fasciculata* Bhandari & Bhansali, according to them, occurs in Kerala. But a critical scrutiny of specimens at MH and also fresh material from Kerala and Tamil Nadu revealed that the plant mentioned as var. *fasciculata* is only a diseased form and does not warrant a distinct taxonomic status.

4. *Ziziphus rugosa* Lam., Encycl. 3: 319. 1789; Wight, Icon. Pl. Ind. Orient.: t. 339. 1840; M.A. Lawson in Hook.f., Fl. Brit. India 1: 636. 1875; Bourd., Forest Trees Travancore: 106. 1908; Rama Rao, Fl. Pl. Travancore: 87. 1914; Gamble, Fl. Madras: 221(158). 1918; Manilal & Sivar., Fl. Calicut: 67. 1982; Manilal, Fl. Silent Valley: 58. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 101. 1988; Vajr., Fl. Palghat: 121. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 119. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 110. 1996; Sivar. & P. Mathew, Fl. Nilambur:

148. 1997; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 240. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 166. 2002.

Mal.: *Kara, Malan-tudali, Thodali*

Climbing shrub or tree, 3 - 5 m high; young branches tomentose; bark fissured, grey; spine solitary, recurved. Leaves ovate, ovate-oblong or elliptic, serrate at margin, 5 - 12.5 x 3 - 7 cm, dark green, 5-nerved at base; petioles 0.5 - 1 cm long, tomentose. Panicles terminal or axillary, to 20 cm long, tomentose. Flowers 5 - 6 mm across, yellowish green; pedicels 4 - 6 mm long, tomentose. Calyx lobes 3-angled, 1.5 - 2 mm long, pubescent outside. Stamens 1 - 2 mm long; anthers broadly ovate. Disc 5-lobed. Ovary 2-loculed; styles 2-partite. Drupes obovoid or globose, 5 - 10 mm long, fleshy; seeds 2(or 1), compressed, black.

Fl. & Fr.: Dec. - March.

Habitat: Dry deciduous forests, to 1000 m, fairly common.

Distrib.: Throughout Kerala. Jammu & Kashmir, C., NE. and S. India. South and SE. Asia.

Uses: Fruit is edible. Ripe fruit juice is used to cure rheumatic pain. Bark extract is used as an astringent to stop diarrhoea.

Note: Variety *glabrescens* Bhandari & Bhansali (*l.c.*) is a variable form of the species and does not warrant the status of a distinct variety.

5. *Ziziphus xylopyrus* (Retz.) Willd., Sp. Pl. 1: 1104. 1798; M.A. Lawson in Hook.f., Fl. Brit. India 1: 634. 1875; Rama Rao, Fl. Pl. Travancore: 87. 1914; Gamble, Fl. Madras: 220(158). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 101. 1988; Vajr., Fl. Palghat: 121. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 111. 1996; Sivar. & P. Mathew, Fl. Nilambur: 148. 1997; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 243. 2000. *Rhamnus xylopyrus* Retz., Obs. Bot. 2: 11. 1781.

Mal.: *Kotta, Mullu-kara*

Straggling shrub or small tree, 5 - 10 m high; young branches tomentose; spines in pairs. Leaves broadly elliptic, ovate or orbicular, subcordate at base, serrate at margin, obtuse and mucronate at apex, 2 - 6 x 1 - 5 cm, yellowish-hairy beneath, 3- or 4-nerved at base; petioles 2 - 5 mm long, tomentose. Inflorescences axillary or leaf-opposed cymes; peduncles 2 - 3 cm long. Flowers 3 - 6 mm across.

yellow or greenish yellow, fragrant; pedicels tomentose. Calyx lobes 3-angled, 2 - 2.5 mm long, pubescent outside. Petals spatulate, 1 - 2 mm long. Stamens 1 - 1.5 mm long, enclosed by petals. Ovary 3-loculed; styles 3. Drupes globose, 1.5 - 2.5 cm, woody, rugose; seeds 3, compressed, black.

Fl. & Fr.: June - Dec.

Habitat: Dry deciduous forests, to 1200 m, common.

Distrib.: Idukki, Kannur, Kottayam, Malappuram, Palakkad and Thrissur. Throughout except E. India. Nepal and Sri Lanka.

Uses: Leaf makes a good fodder. Fruit pulp and bark are used in tanning; kernel is edible.

Maesopsis eminii Engl., *Pflanzenw. Ost-Afrikas* 2/3 C: 255. 1895.
A densely foliaceous tree, native to Africa, is rarely cultivated.

VITACEAE

(B.V. SHETTY & P. SINGH)

Scandent shrubs (often lianas) or erect, sometimes herbaceous, rarely trees. Tendrils usually present, appearing leaf-opposed (and apparently extra-axillary), sometimes with adhesive discs at tips. Leaves alternate, simple, entire, palmately lobed, palmately or pinnately compound, stipuled. Inflorescences leaf-opposed, axillary or pseudoterminal, sometimes cirrhiferous, usually cymose or paniced. Flowers small, 4- or 5-merous, bi- or unisexual, regular, hypogynous. Calyx cupular or saucer-like, entire, dentate or lobed. Petals usually free, sometimes distally connate and calyptrately caducous, valvate, hooded at apex. Stamens opposite petals; filaments slender; anthers introrse. Disc annular or cupular, sometimes of 4 distinct glands. Pistil 2-carpelled, syn- or apocarpous; ovary superior, usually within disc; style short or absent; stigma small, simple or sometimes 2- or 4-fid. Fruit a berry, 1 - 4-seeded; seeds smooth or rugose, usually with 2 longitudinal grooves 1 on either side of linear raphe on adaxial surface and with a chalazal knot on abaxial surface; embryo small, straight; endosperm copious, rich in oil and protein; cotyledons small.

Tropics and subtropics, 14 genera and ca 850 species, 8 and 63 in India and, 6 and 27 in Kerala.

Key to genera

- 1a. Flowers 5-merous 2
- b. Flowers 4-merous 3
- 2a. Inflorescences tendril-bearing; tendrils without disc-like adhesive tips 1. *Ampelocissus*
- b. Inflorescences not tendril-bearing; tendrils with disc-like adhesive tips 5. *Parthenocissus*
- 3a. Flowers unisexual; stigma 4-lobed 6. *Tetrastigma*
- b. Flowers bisexual; stigma simple or 2-lobed 4
- 4a. Flower buds globose or oblong; nectariferous disc entire 5
- b. Flower buds flask-shaped; nectariferous disc of 4 free glands 4. *Cyphostemma*
- 5a. Inflorescences leaf-opposed; berries 1(or 2)-seeded; endosperm M- or ...-shaped in cross section 3. *Cissus*
- b. Inflorescences axillary; berries 2 - 4-seeded; endosperm T- or N-shaped in cross section 2. *Cayratia*

1. AMPELOCISSUS Planch., nom. cons.

Scandent shrubs. Leaves simple or, pedately or digitately 3 - 9-foliolate, densely hairy to glabrous, petioled. Flowers bisexual, in leaf-opposed peduncled cirrhiferous cymes, thyrses or paniced spikes. Calyx cupular or saucer-like, entire or obscurely lobed. Petals 5, free, oblong or ovate-oblong. Stamens 5; filaments short. Disc angled, often 5 - 10-grooved, adnate to ovary. Ovary usually 10-grooved; style short or absent; stigma minute or discoid. Berries 1 - 4-seeded; seeds obovate to elliptic-oblong or suborbicular in outline with adaxial surface flat or angled; raphe linear, somewhat ridged with a parallel wide shallow groove on either side, abaxial surface usually convex; chalazal knot somewhat spatulate in shallow depression; endosperm T-shaped in cross section.

Tropics, ca 100 species, 10 in India and 4 in Kerala.

Key to species

- 1a. Leaves ferruginous-hairy beneath; inflorescences cylindric, compact, umbelled-racemose; tendrils simple 2. *A. indica*
- b. Leaves glabrous to pubescent or if wooly beneath not ferruginous; inflorescences divaricate or dichotomous, umbelled-cymose; tendrils branched 2
- 2a. Wooly vine; calyx 4- or 5-lobed, wooly 4. *A. tomentosa*

- b. Glabrous vine, sometimes young parts and inflorescences pubescent; calyx entire, glabrous or puberulous 3
- 3a. Berries globose, 7 - 9 mm; seeds 6 - 7 x 4 - 5 mm, dark brown, abaxial surface with prominent transverse fissures 3. *A. latifolia*
- b. Berries cubiform, ca 10 mm across; seeds ca 11 x 9 mm, light brown, abaxial surface with fine transverse rays 1. *A. birii*

1. *Ampelocissus birii* P. Singh & B.V. Shetty, sp. nov.

A. latifolia (Roxb.) Planch. arte affinis, sed fructibus ubi seccis cubiformibus; seminibus magnioribus, complanatis, paginis adaxialibus manifeste carinatis et paginis abaxialibus non transversim fissuratis praecipue differt.

Type: India, Kerala, Palakkad Distr., Pathanthode, semievergreen forests, 850 m, 16.7.1969, E. Vajravelu 32146 (Holotype & Isotypes MH). Fig. 1

Scandent shrub; branches striate, glabrous. Leaves simple, 3-5-lobed, cordate at base, crenate-serrate at margin, acuminate at apex, 10-21 x 11-20 cm, pubescent beneath when young, glabrous when mature; petioles 4-10 cm long. Inflorescences thick, branched, paniced-cymose; primary branch 1.5-2 cm long; panicles 3-4 cm long; peduncles ca 7 cm long; tendrils branched. Flowers pink; pedicels ca 1 mm long, pubescent. Calyx saucer-like, entire, puberulous. Petals oblong, ca 1.7 mm long, puberulous. Disc covering about half of ovary, 5-furrowed. Ovary 10-ribbed. Berries cubiform when dry, ca 13 x 10 mm, usually 4-seeded; seeds elliptic-oblong in outline, mucronate at base, ca 11 x 9 mm, with a prominent longitudinal keel on adaxial surface and flat with a shallow groove and fine transverse rays on abaxial surface; margin fine-crenate.

Fl.: May - June *Fr.*: June - July.

Habitat: Semievergreen forests.

Distrib.: Palakkad.

Etymology: This species is named after Prof. S.S. Bir whose lectures during his post-graduate studies initiated P.S. into the world of botanical explorations.

2. *Ampelocissus indica* (L.) Planch. in *Vigne Amér. Vitic. Eur.* 8: 375. 1884; B.V. Shetty & P. Singh in *Taxon* 37: 169. 1988; Nicolson & al. in *Regnum Veg.* 119: 267. 1988; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 111. 1996; B.V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 254. 2000. *Vitis indica* L., *Sp. Pl.*: 202.

1753 & ed. 2, : 293. 1762; M.A. Lawson in Hook.f., Fl. Brit. India 1: 653. 1875; Rama Rao, Fl. Pl. Travancore: 91. 1914. *Ampelocissus arnottiana* Planch. in A. & C. DC., Monogr. Phan. 5: 379. 1887; Gamble, Fl. Madras: 231(165). 1918; M. Mohanan & al. in Bull. Bot. Surv. India 22: 106. 1982; Manilal & Sivar., Fl. Calicut: 69. 1982; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 119. 1994.

Mal.: *Chembravalli*

Scandent shrub; branches striate, ferruginous-wooly. Leaves simple, broadly ovate, sometimes angled, cordate at base, dentate-serrate at margin with teeth hardened at tip, acuminate at apex, 10 - 30 x 8 - 20 cm, coriaceous, glabrescent above, ferruginous-hairy beneath; petioles 2 - 8 cm long. Inflorescences dense racemes of umbels; primary branch ca 1 cm long; racemes 3 - 5 x ca 1 cm; peduncles to 5 cm long; tendrils simple, ca 10 cm long. Flowers reddish brown; pedicels ca 2 mm long. Calyx saucer-like, entire, glabrous. Petals oblong-ovate, ca 2 mm long, glabrous. Disc elongate, covering most of ovary, 5-furrowed. Berries globose, ca 1 cm; seeds suborbicular in outline, mucronate at base, ca 7 x 5.5 mm, with a longitudinal ridge and a broad groove on either side on adaxial surface and an elliptic chalazal knot and very fine fissures radiating towards margin on abaxial surface.

Fl.: June - Feb. *Fr.*: Aug. - Feb.

Habitat: Evergreen and semievergreen forests, to 400 m.

Distrib.: Ernakulam, Kollam, Kozhikode, Malappuram, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Goa, Karnataka and Tamil Nadu. Sri Lanka.

Uses: Root juice mixed with coconut kernel is employed as a laxative and blood purifier; it is also considered alterative and diuretic. Mixed with oil root juice is used in eye diseases and mixed with coconut milk is applied to ulcers.

Note: Shetty and Singh (1988) dealt with the nomenclature of this species.

3. *Ampelocissus latifolia* (Roxb.) Planch. in Vigne Amér. Vitic. Eur. 8: 374. 1884 & A. & C. DC., Monogr. Phan. 5: 370. 1887; Gamble, Fl. Madras: 230(165). 1918; Manilal & Sivar., Fl. Calicut: 68. 1982; B. V. Shetty & P. Singh in Taxon 37: 170. 1988; Nicolson & al. in Regnum Veg. 119: 267. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 102. 1988; Vajr., Fl. Palghat: 122. 1990; Sivar. & P. Mathew, Fl. Nilambur: 149. 1997; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 256. 2000. *Vitis latifolia* Roxb., Hort. Bengal.: 18. 1814 & Fl. Ind. 2: 474.

1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 652. 1875; Rama Rao, Fl. Pl. Travancore: 90. 1914.

Mal.: *Karantavalli, Valiyapirapitica*

Scandent shrub; branches striate, nearly glabrous, hollow. Leaves simple, often 5-gonal, sometimes 3-5-lobed, usually deeply cordate at base, serrate at margin, acute to acuminate at apex, 10-25 x 10-24 cm, glabrous; nerves prominent beneath; petioles 5-15 cm long, deeply grooved in upper half. Inflorescences pyramidal-thyrsoid; primary branch 1.5-5 cm long; thyrses 3-7 cm long; peduncles 5-10 cm long; tendrils branched, 10-15 cm long. Flowers reddish brown; pedicels ca 1 mm long, puberulous. Calyx saucer-like, entire, glabrous. Petals oblong, ca 1.5 x 0.8 mm, glabrous. Disc enclosing about half of ovary, 5-grooved. Berries globose, 7-9 mm, black when ripe, 2-4-seeded; seeds elliptic-oblong in outline, 6-7 x 4-5 mm, with a longitudinal, broad ridge and a groove on either side on adaxial surface and an oblong-elliptic chalazal knot and prominent fissures radiating towards margin on abaxial surface.

Fl.: May - Sept. Fr.: Aug. - Nov.

Habitat: Evergreen and deciduous forests, to 460 m.

Distrib.: Kannur, Kasaragod, Kottayam, Kozhikode, Malappuram, Palakkad and Thrissur. Almost throughout India. Bangladesh, Nepal and Pakistan.

Uses: Tender leaf juice is used in odontalgia as a detergent for ulcers and internally as an alterative. Root is astringent. Tender leaf is used as a vegetable.

4. *Ampelocissus tomentosa* (Roth) Planch. in Vigne Amér. Vitic. Eur. 8: 375. 1884 & A. & C. DC., Monogr. Phan. 5: 367. 1887; Gamble, Fl. Madras: 230(165). 1918; Vajr., Fl. Palghat: 122. 1990; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 261. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 167. 2002. *Vitis tomentosa* Roth in Roem & Schult., Syst. Veg. 5: 318. 1819 & Nov. Pl. Sp.: 157. 1821; Wight, Ill. Ind. Bot. 1: t. 57. 1840; M.A. Lawson in Hook.f., Fl. Brit. India 1: 650. 1875; Rama Rao, Fl. Pl. Travancore: 90. 1914.

Scandent shrub; branches angled, tomentose. Leaves simple, 3-5-angled or -lobed, rarely 3-5-partite, cordate at base, crenate-serrate to dentate at margin, acute to obtuse at apex, to 25 x 24 cm, pubescent above, greyish red or white-tomentose beneath; petioles to 15 cm long. Inflorescences dichotomous umbelled cymes, densely tomentose; primary branch 1-2 cm long; cymes 2-4 cm long;

peduncles stout, ca 10 cm long; tendrils branched. Flowers ca 1.5 mm long, short-pedicelled, red. Calyx cupular, 4- or 5-lobed, wooly. Petals oblong-ovate, ca 1.2 x 0.7 mm, glabrous. Disc restricted to lower half of ovary. Ovary 10-furrowed. Berries globose, 8 - 10 mm, black when ripe, 1 - 4-seeded; seeds obovate to oblong in outline, acute to mucronate at base, 6 - 7 x 4 - 5 mm, with a longitudinal ridge on adaxial surface and an elliptic pit with fissures radiating towards margin on abaxial surface.

Fl.: April - Oct. *Fr.*: Aug. - Dec.

Habitat: Deciduous forests, to 450 m.

Distrib.: Palakkad, Thiruvananthapuram and Wynad. Gangetic Plains, C., E. and S. India. Bangladesh and Myanmar.

Uses: Fruit is said to be edible. Root is used in swellings and root and bark are used against piles.

2. CAYRATIA Juss., nom. cons.

Scandent or creeping shrubs or herbs. Tendrils leaf-opposed, branched or not. Leaves 3 - 7 (- 9)-foliolate, pedate, hairy to glabrous, petioled; leaflets usually petioluled, terminal one usually the largest. Inflorescences axillary corymbose cymes, peduncled. Flowers globose or oblong, bisexual. Calyx cupular, entire or shallowly 4-lobed. Petals 4, free. Stamens 4; filaments short. Disc cupular, sinuate or lobed, adnate to ovary. Style subulate; stigma small. Berries globose or oblong, 2 - 4- seeded; seeds obovate or oblong in outline, usually with 1 or 2 cavities on adaxial surface and usually convex with a linear chalazal knot on abaxial surface; endosperm rectangular or T-shaped in cross section.

Old World tropics, ca 50 species, 9 in India and 6 in Kerala.

Key to species

- 1a. Berries globose or subglobose when dry; seeds planoconvex with a single pit on adaxial side; endosperm rectangular or crescent-shaped in cross section 2
- b. Berries pyriform when dry; seeds convex-carinate with 2 pits 1 on each side of ridge on adaxial side or pits absent or inconspicuous; endosperm T-shaped in cross section 4
- 2a. Berries glabrous; seeds 6 - 7 x ca 5 mm with a circular pit on adaxial side 3
- b. Berries villous; seeds ca 9 x 5 mm with a rectangular pit on adaxial side 2. *C. mollissima*
- 3a. Plant and flowers glabrous; leaves 3-foliolate 4. *C. roxburghii*

- | | |
|--|-------------------------|
| b. Plant and flowers pubescent; leaves 5 - 11-foliolate | 3. <i>C. pedata</i> |
| 4a. Leaves 3-foliolate | 6. <i>C. trifolia</i> |
| b. Leaves 5-foliolate | 5 |
| 5a. Flower buds oblong, glabrous; seeds without pits | 5. <i>C. tenuifolia</i> |
| b. Flower buds ovoid, pubescent; seeds with 2 pits on adaxial side | 1. <i>C. japonica</i> |

1. *Cayratia japonica* (Thunb.) Gagnep. in Notul. Syst. (Paris) 1: 349. 1911; Gamble, Fl. Madras: 236(169). 1918; Vajr., Fl. Palghat: 123. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 120. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 112. 1996; Sivar. & P. Mathew, Fl. Nilambur: 150. 1997; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 269. 2000. *Vitis japonica* Thunb., Fl. Jap.: 104. 1784. *Cissus japonica* (Thunb.) Willd., Sp. Pl. 1: 659. 1798; Planch. in A. & C. DC., Monogr. Phan. 5: 561. 1887. *Vitis mollis* Wall. ex M.A. Lawson in Hook.f., Fl. Brit. India 1: 660. 1875.

Scandent herb; branches subterete, striate, pubescent; tendrils branched or not, slender. Leaves 5-foliolate, pedate, glabrous to pubescent; petioles 3 - 8 cm long; terminal leaflet ovate, orbicular-ovate to elliptic, cuneate to acute or rounded at base, serrate at margin, acuminate to acute at apex, 4 - 8.5 x 3 - 4 cm; petiolules 1 - 2 cm long; lateral leaflets slightly oblique at base with apex and margin as in terminal leaflet, 2.5 - 6.5 x 1.5 - 3 cm; petiolules 3 - 10 mm long. Inflorescences 7

16 cm long; peduncles 5 - 10 cm long, pubescent to glabrous. Flower buds ovoid, pubescent; pedicels 1 - 2 mm long, pubescent. Calyx saucer-like. Petals oblong, ca 1.5 x 0.9 mm. Disc covering ovary. Berries ca 7 mm across, 3 - 4-seeded; seeds obovoid, acute at base, ca 5 x 4 mm with a longitudinal ridge in middle and a pit on either side of it on adaxial surface, with a linear chalazal knot prominently rugose at sides on abaxial surface; endosperm T-shaped in cross section.

Fl.: March - April *Fr.*: May - June.

Habitat: Deciduous forests, 100 - 825 m.

Distrib.: Kannur, Kasaragod, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Andaman & Nicobar Islands, Goa, Karnataka and Sikkim. Africa, Australia, Bangladesh, Bhutan, Cambodia, Japan, Korea, Malaysia, Myanmar, Nepal, Taiwan and Vietnam.

Note: This species varies considerably in the degree of pubescence and the leaves in particular vary from glabrous to densely pubescent. The glabrous form is usually confused with *Cayratia tenuifolia* (Wight & Arn.) Gagnep.

2. *Cayratia mollissima* (Wall.) Gagnep. in Notul. Syst. (Paris) 1: 345. 1911; Gamble, Fl. Madras: 236(169). 1918; Manilal, Fl. Silent Valley: 58. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 103. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 112. 1996; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 270. 2000. *Vitis mollissima* Wall. in Roxb., Fl. Ind. 2: 482. 1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 656. 1875. *Cissus mollissima* (Wall.) Planch. in A. & C. DC., Monogr. Phan. 5: 575. 1887.

Scandent shrub; branches cylindrical, striate, soft-villous, greysih green when dry; tendrils branched, wiry. Leaves 3-foliolate, villous; petioles 5 - 10 cm long; terminal leaflet elliptic-ovate, cuneate to rounded at base, serrate-dentate at margin, acuminate-cuspidate at apex, 10 - 13 x 5 - 8 cm; petiolules 2 - 3.5 cm long; lateral leaflets oblique with apex and margin as in terminal leaflet, 8 - 12 x 3.5 - 6.5 cm; petiolules 0.5 - 1 cm long. Inflorescences divaricately branched cymes, 7 - 10 cm long; peduncles 3 - 6 cm long. Flowers pubescent; pedicels ca 3 mm long. Calyx cupular. Petals oblong, ca 2 x 1 mm. Disc 4-notched. Berries globose, ca 1.5 cm, villous, 3 - 4-seeded; seeds ca 9 x 5 mm with ca 7 x 3.5 mm rectangular cavity on adaxial surface, incurved at margin; abaxial surface convex with a linear chalazal knot.

Fl.: March - April *Fr.*: May - Sept.

Habitat: Moist deciduous forests, 600 - 850 m.

Distrib.: Kannur, Kasaragod, Palakkad, Thrissur and Travancore. Western Ghats of Karnataka and Tamil Nadu. Southeast Asia.

Uses: Fruit is used as a poultice on swellings and aching parts; also used in curry.

3. *Cayratia pedata* (Lam.) Gagnep. in Notul. Syst. (Paris) 1: 346. 1911; Gamble, Fl. Madras: 236(169). 1918; Manilal & Sivar., Fl. Calicut: 69. 1982; B.V. Shetty & P. Singh in Taxon 37: 171. 1988; Nicolson & al. in Regnum Veg. 119: 268. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 103. 1988; Vajr., Fl. Palghat: 123. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 120. 1994; Sivar. & P. Mathew, Fl. Nilambur: 120. 1997; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 271. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 168. 2002. *Cissus pedata* Lam., Encycl. 1: 31. 1783; Planch. in A. & C. DC., Monogr. Phan. 5: 558. 1887. *Vitis pedata* (Lam.) Wall. ex Wight, Cat. Ind. Pl.: 26. 1833; Wight & Arn., Prodr. Fl. Ind. Orient.: 128. 1834. *V. canarensis* Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 123. 1851; M.A. Lawson in Hook.f., Fl. Brit. India 1: 655. 1875;

Rama Rao, Fl. Pl. Travancore: 92. 1914.

Scandent shrubs; branches subterete, pubescent; tendrils branched, pubescent. Leaves 5 - 11-foliolate, pedate, pubescent to glabrous; petioles 7 - 13 cm long; terminal leaflet lanceolate to elliptic, truncate to cuneate at base, serrate at margin, acuminate at apex, 10 - 17 x 4 - 8 cm long; lateral leaflets oblique at base with apex and margin as in terminal leaflet, 7 - 15 x 3.5 - 7 cm; petiolules 1 - 2 cm long. Inflorescences dichasial cymes, 5 - 15 cm long; peduncles 2 - 11 cm long; pubescent. Flowers pubescent to glabrous; pedicels 2 - 3 mm long. Calyx cupular, entire. Petals oblong, 2 - 3 x 1 - 1.5 mm. Disc cupular, 4-lobed, covering ovary. Berries subglobose, flat at apex, ca 1 cm across, 2 - 4-seeded; seeds obellipsoid, ca 6 x 5 mm, with a circular pit in centre of adaxial surface; abaxial surface convex with an elliptic chalazal knot.

Key to varieties

- | | | |
|-----|-----------------------------|-------------------------|
| 1a. | Leaves and petals glabrous | 3.1. var. glabra |
| b. | Leaves and petals pubescent | 3.2. var. pedata |

3.1. var. glabra Gamble, Fl. Madras: 236(169). 1918; Manilal, Fl. Silent Valley: 59. 1988; B.V. Shetty & Malathi in in M.P. Nayar & Sastry. Red Data Book Indian Pl. 2: 247. 1988; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 272. 2000.

Fl.: March - Aug.

Habitat: Evergreen forests.

Distrib.: Palakkad (Silent Valley). Tamil Nadu (Nilgiris). Endemic.

3.2. var. pedata: Gamble, Fl. Madras: 236(169). 1918; Manilal, Fl. Silent Valley: 59. 1988; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 272. 2000.

Mal.: *Tripadi*, *Vallichorianum*, *Veluthachorivalli*

Fl.: March - Sept. *Fr.*: July - Jan.

Habitat: Evergreen and semievergreen forests, to 2500 m.

Distrib.: Almost throughout Kerala. Andaman & Nicobar Islands, C., NE. and S. India. South and SE. Asia.

Uses: Leaf is astringent and refrigerant. Leaf decoction is used to check uterine

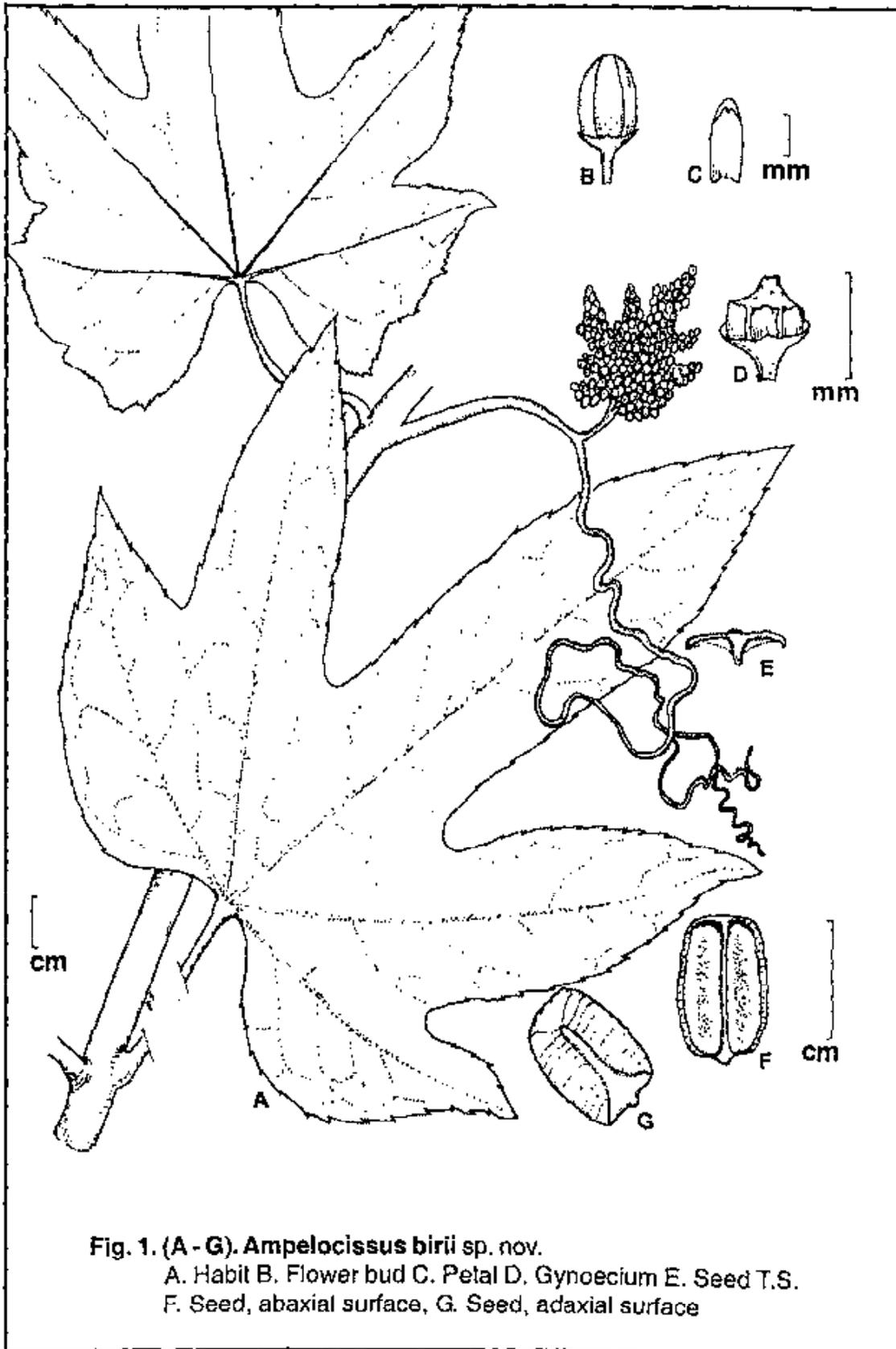


Fig. 1. (A - G). *Ampelocissus birii* sp. nov.
 A. Habit B. Flower bud C. Petal D. Gynoecium E. Seed T.S.
 F. Seed, abaxial surface, G. Seed, adaxial surface

reflexes. Root paste, mildly heated, is applied on heel cracks. Leaf is used as a vegetable.

4. *Cayratia roxburghii* (Planch.) Gagnep. in Notul. Syst. (Paris) 1: 346. 1911 p.p., excl. syn. *Vitis roxburghii* Wight & Arn. 1834; Gamble, Fl. Madras: 236(169). 1918 p.p.; B.V. Shetty & P. Singh in Kew Bull. 44: 471. 1989 & N.P. Singh & al., Fl. India 5: 272. 2000. *Cissus roxburghii* Planch. in A. & C. DC., Monogr. Phan. 5: 572. 1887. *Vitis roxburghii* sensu M.A. Lawson in Hook.f., Fl. Brit. India 1: 655. 1875, non Wight & Arn. 1834; Rama Rao, Fl. Pl. Travancore: 91. 1914.

Scandent shrub; branches cylindrical, striate, glabrous, glaucous; tendrils simple or forked at tip, wiry. Leaves 3-foliolate, glabrous; petioles 3 - 5.5 cm long; terminal leaflet elliptic-lanceolate, rounded or acute at base, undulate-dentate at margin, acuminate at apex, 10 - 16 x 4 - 6 cm; petiolules 1.5 - 2.5 cm long; lateral leaflets oblique with apex and margin as in terminal leaflet, 10 - 13 x 3.5 - 5.5 cm. Inflorescences dichotomous cymes, ca 5 cm long; peduncles ca 2.5 cm long. Flowers glabrous; pedicels ca 2 mm long. Calyx cupular, entire. Petals oblong-ovate, ca 2 x 1 mm. Disc fleshy, covering ovary. Berries ca 1 cm across, 2 - 4-seeded; seeds ca 7 x 5 mm, with a circular pit on adaxial surface; abaxial surface convex with a spatulate chalazal knot.

Fl.: May - Sept. *Fr.*: July - Nov.

Habitat: Semievergreen forests, 750 - 850 m.

Distrib.: Idukki and Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic.

Note: Because of its resemblance to *Cissus trilobata* Lam. in having 3-foliolate glabrous leaves, the 2 species are often confused. Shetty and Singh (1989) dealt with the nomenclature of this species.

5. *Cayratia tenuifolia* (Wight & Arn.) Gagnep. in Notul. Syst. (Paris) 1: 348. 1911; Gamble, Fl. Madras: 237(170). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 103. 1988; Vajr., Fl. Palghat: 124. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 112. 1996; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 273. 2000. *Vitis tenuifolia* Wight & Arn., Prodr. Fl. Ind. Orient.: 129. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 660. 1875 p.p.; Rama Rao, Fl. Pl. Travancore: 91. 1914. *Cissus tenuifolia* (Wight & Arn.) Planch. in A. & C. DC., Monogr. Phan. 5: 563. 1887.

Scandent herb; branches slender, weak, subterete, striate, glabrous; tendrils simple, slender. Leaves 5-foliolate, pedate, glabrous; petioles 2–4.5 cm long; terminal leaflet ovate to ovate-lanceolate, attenuate at base, serrate at margin, acute at apex, 3–6.5 x 1.5–3 cm; petiolules to 5 mm long; lateral leaflets slightly oblique at base with apex and margin as in terminal leaflet, 1.5–4 x 1–2 cm; petiolules 2–4 mm long. Inflorescences divaricately branched cymes, 4–5 cm long; peduncles 1–2 cm long. Flowers glabrous. Calyx truncate or obscurely lobed. Petals ca 1 x 0.7 mm, inflexed at apex. Disc not conspicuous, 4-notched. Berries ca 1 cm across, 1- or 2-seeded; seeds 5–6 x 4–4.5 mm, deeply corrugated on sides; adaxial surface with a longitudinal central ridge without pits; abaxial surface with a linear chalazal knot.

Fl.: June–Dec. *Fr.*: Sept.–June.

Habitat: Deciduous and evergreen forests.

Distrib.: Alappuzha, Idukki, Kannur, Kollam (Rama Rao, *l.c.*), Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Karnataka and Tamil Nadu. Indochina and Sri Lanka.

Note: This species resembles *Cayratia japonica* (Thunb.) Gagnep. but differs mainly in the glabrous leaves and petals, oblong flower buds and seeds without pits. Lawson (*l.c.*) is not justified in considering *Cissus japonica* (Thunb.) Willd. as a synonym of *Vitis tenuifolia* Wight & Arn.

6. *Cayratia trifolia* (L.) Domin in Biblioth. Bot. 89: 370. 1927; Manilal & Sivar., Fl. Calicut: 49. 1982; B.V. Shetty & P. Singh in Taxon 37: 171. 1988; Nicolson & al. in Regnum Veg. 119: 268. 1988; Vajr., Fl. Palghat: 124. 1990; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 275. 2000. *Vitis trifolia* L., Sp. Pl.: 203. 1753. *Cissus carnososa* Lam., Encycl. 1: 31. 1783. *Vitis carnososa* (Lam.) Wall., Numer. List: 206, No. 6018. 1831–1832; Wight, Icon. Pl. Ind. Orient.: t. 171. 1839; M.A. Lawson in Hook.f., Fl. Brit. India 1: 654. 1875; Rama Rao, Fl. Pl. Travancore: 91. 1914. *Cayratia carnososa* (Lam.) Gagnep. in Notul. Syst. (Paris) 1: 347. 1911; Gamble, Fl. Madras: 237(169). 1918; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 120. 1994.

Mal.: *Chorivalli*

Scandent shrub; branches slender, terete, pubescent to glabrous, subfleshy; tendrils branched, wiry. Leaves 3-foliolate, pubescent to glabrous; petioles 2–6

cm long; terminal leaflet broadly elliptic to ovate, cuneate to rounded at base, dentate-serrate to subentire at margin, acute to rounded at apex, 3-8 x 2-7 cm; petiolules 0.5-2.5 cm long; lateral leaflets oblique with apex and margin as in terminal leaflet, 2.5-7 x 2-6 cm; petiolules 2-10 mm long. Inflorescences divaricate cymes, 6-12 cm long; peduncles 2.5-8 cm long, pubescent. Flowers puberulous to pubescent; pedicels 1.5-3 mm long. Calyx cupular, subentire. Petals ovate, ca 2 x 1.2 mm. Disc fleshy, 4-lobed with lobes notched. Berries obovoid-globose, ca 1 cm across, 3- or 4-seeded; seeds triangled-obovoid, ca 6 x 4.5 mm; adaxial surface with a longitudinal ridge and a pit on either side of it; abaxial surface with a linear chalazal knot and transverse ridges on sides.

Fl.: March - Oct. *Fr.*: May - Dec.

Habitat: Deciduous forests, to 450 m.

Distrib.: Kannur, Kasaragod, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad and Thiruvananthapuram. Almost throughout India. South and SE. Asia to Australia.

Uses: Root is astringent; ground with black pepper it is applied as a poultice on boils. A poultice of leaf is applied to ulcers and yoke-sores of bullocks. In case of high fever fomentation with a hot decoction of root or leaf is said to cause perspiration.

3. CISSUS L.

Scandent or erect shrubs, sometimes herbaceous, rarely small trees; tendrils leaf-opposed or absent. Leaves simple, unlobed, rarely digitately 3-7-foliolate, petioled or rarely sessile. Flowers bisexual, in leaf-opposed compound umbelled cymes. Calyx entire or shallowly 4-lobed. Petals 4, free. Stamens 4; filaments short. Disc cup-like, entire or 4-lobed, usually prominent, adnate to ovary. Style subulate; stigma minute or subcapitate. Berries globose to obovoid, 1 (or 2)-seeded; seeds usually obovoid with an encircling raphe, abruptly narrowed at base, smooth or coarsely reticulate; endosperm M- or ...-shaped in cross section.

Tropics and subtropics, ca 200 species, 18 in India and 11 in Kerala.

Key to species

- | | |
|--|---|
| 1a. Branches 4-angled or 4-winged | 2 |
| b. Branches terete or obscurely angled | 3 |

- 2a. Plant succulent; tendrils simple; seeds obovoid, smooth except for ridged raphe 7. *C. quadrangularis*
- b. Plant not succulent; tendrils forked; seeds obtriangled, transversely rugose 4. *C. glyptocarpa*
- 3a. Leaves simple 4
- b. Leaves at least lower ones 3-foliolate 10. *C. trilobata*
- 4a. Leaves blotched with white above and purple beneath 3. *C. discolor*
- b. Leaves green 5
- 5a. Seeds with angled facets 6
- b. Seeds smooth except for ridged raphe, sometimes sides with a faint ridge 8
- 6a. Tomentum grey or fulvous; leaves usually 3 - 5-angled or lobed, conspicuously dentate 11. *C. vitiginea*
- b. Tomentum ferruginous; leaves neither angled nor lobed, bristly serrate 7
- 7a. Trichomes on lower surface of leaves 2-armed; ovary glabrous at summit 1. *C. aristata*
- b. Trichomes on lower surface of leaves predominantly of unbranched type; ovary pubescent at summit 6. *C. latifolia*
- 8a. Plant pubescent 8. *C. repanda*
- b. Plants glabrous 9
- 9a. Tendrils branched; flower buds contorted at apex 9. *C. repens*
- b. Tendrils when present simple; flower buds not contorted at apex 10
- 10a. Erect shrub; leaves suborbicular, sometimes shallowly 3-lobed, dentate-serrate with crenatures incurved 2. *C. arnottiana*
- b. Scandent shrub; leaves ovate-cordate, distantly crenate-serrate 5. *C. heyneana*

1. *Cissus aristata* Blume, Bijdr.: 183. 1825; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 280. 2000. *C. adnata* sensu Gamble, Fl. Madras: 234(168). 1918, non Roxb. 1820.

Scandent shrub; branches subterete, striate, tomentose; tendrils branched. Leaves ovate, truncate to cordate at base, bristly-serrate at margin, acute to acuminate at apex, 7 - 13 x 5 - 11 cm, glabrous to tomentose above, arachnoid-hairy beneath; petioles 3 - 8 cm long, hairy; stipules ca 3 x 2 mm, pubescent. Inflorescences umbelled cymes, 3 - 6 cm long; peduncles 2 - 4.5 cm long, hairy. Flowers hairy; pedicels ca 2 mm long. Calyx cupular, truncate. Petals oblong-ovate, ca 1.2 x 1 mm. Disc conspicuous, 4-notched, covering ovary. Berries obellipsoid, ca 5 mm across, 1-seeded; seed obovoid, oblique at base, ca 5.5 x 4 mm, tessellated

with angled facets on either side of longitudinally encircling ridged raphe.

Fl.: July - Nov. *Fr.*: Oct - Jan.

Distrib.: Malappuram (Nilambur, *Bourne* 6291 K!). Karnataka, Maharashtra, E. and NE. India. South and SE. Asia.

2. ***Cissus arnottiana*** B. V. Shetty & P. Singh in *Kew Bull.* 44: 473. 1989 & N.P. Singh & al., *Fl. India* 5: 281. 2000. *Vitis pallida* sensu M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 647. 1875 p.p., non Wight & Arn. 1834; Rama Rao, *Fl. Pl. Travancore*: 89. 1914. *Cissus pallida* sensu Planch. in A. & C. DC., *Monogr. Phan.* 5: 477. 1887 p.p., non Salisb. 1796; Gamble, *Fl. Madras*: 234(167). 1918; Vajr., *Fl. Palghat*: 125. 1990.

Mal.: *Chunnampu-valli*

Erect shrub; branches terete, woody, glabrous, glaucous; tendrils simple, often absent. Leaves suborbicular, sometimes shallowly 3-lobed, cordate at base, dentate-serrate at margin with incurved serratures, short-acuminate at apex, 7-20 cm across, glabrous; petioles 4-15 cm long. Inflorescences compound umbelled cymes, 3-7 cm long; peduncles 1.5-5 cm long, thick. Flowers pink; pedicels 2-4 mm long, pubescent. Calyx cupular, truncate or obscurely 4-lobed. Petals ovate, ca 2.5 x 1.5 mm, glabrous. Disc 4-lobed, covering ovary, fleshy, white. Berries subglobose, mucronate at apex, 7-8 mm across, 1- or 2-seeded; seeds 7-8 x 5-6 mm, smooth except for longitudinally encircling ridged raphe.

Fl.: May - Oct. *Fr.*: Aug. - Nov.

Habitat: Scrub and dry deciduous forests.

Distrib.: Malappuram, Palakkad, Wynad and Travancore (Rama Rao, *l.c.*). Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Tamil Nadu. Sri Lanka.

Uses: Bruised root is applied on rheumatic swellings. Leaf and young fruit are crushed in water and sprinkled on cots to kill bed bugs. Stem fibre is used for making ropes.

3. ***Cissus discolor*** Blume, *Catalogus*: 39. 1823 & *Bijdr.*: 181. 1825; Planch. in A. & C. DC., *Monogr. Phan.* 5: 496. 1887; Gamble, *Fl. Madras*: 235(168). 1918; Manilal, *Fl. Silent Valley*: 59. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 104. 1988; Vajr., *Fl. Palghat*: 124. 1990; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 113. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 112. 1997; B. V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 282. 2000. *Vitis discolor* (Blume) Dalzell in Hooker's

J. Bot. Kew Gard. Misc. 2: 39. 1850; M.A. Lawson in Hook.f., Fl. Brit. India 1: 647. 1875; Rama Rao, Fl. Pl. Travancore: 89. 1914.

Scandent, herbaceous vine; branches slender, weak, subterete, glabrous; tendrils branched. Leaves ovate to oblong-lanceolate, oblique, truncate to cordate at base, serrate at margin, acuminate at apex, 6 - 20 x 2.5 - 11 cm, blotched with white patches above, purple and shining beneath, glabrous; petioles 1.5 - 7 cm long. Inflorescences divaricately branched umbelled cymes, ca 2.5 cm long; peduncles ca 1 cm long. Flowers glabrescent; pedicels 1.5 - 2 cm long. Calyx cupular, subtruncate. Petals oblong, ca 1.5 x 1 mm. Disc 4-lobed, covering ovary. Berries pyriform, 4 - 5 mm across, red when ripe, 1-seeded; seed pyriform, acute at base, ca 4 x 3 mm with a ridged raphe longitudinally encircling seed and a linear pit on either side of raphe near base, tessellated on either side of raphe with angled facets.

Fl.: July - Nov. *Fr.*: Oct. - Dec.

Habitat: Evergreen forests, to 900 m.

Distrib.: Almost throughout Kerala. Andaman & Nicobar Islands, N. & S. India and Sikkim. South and SE. Asia.

Uses: Plant is ornamental and is also edible.

4. *Cissus glyptocarpa* Thwaites, Enum. Pl. Zeyl.: 62: 1858; Planch. in A. & C. DC., Monogr. Phan. 5: 501. 1887; Gamble, Fl. Madras: 235(168). 1918; Manilal, Fl. Silent Valley: 60. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 104. 1988; Vajr., Fl. Palghat: 125. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 113. 1996; Sivar. & P. Mathew, Fl. Nilambur: 153. 1997; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 285. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 169. 2002. *Vitis glyptocarpa* (Thwaites) M.A. Lawson in Hook.f., Fl. Brit. India 1: 645. 1875; Rama Rao, Fl. Pl. Travancore: 92. 1914.

Scandent, herbaceous vine; branches slender, 4-angled, 4-winged, glabrous; tendrils slender, forked. Leaves ovate, truncate to subcordate at base, distantly spinous-serrate at margin, acuminate at apex, 4 - 11 x 4 - 7 cm, glabrous with minute raphides, pale green; petioles 4-angled, 3 - 6 cm long. Inflorescences umbelled cymes, ca 4 cm long; peduncles 1 - 3.5 cm long. Flowers glabrous; pedicels 2 - 3 mm long. Calyx saucer-like, subtruncate. Petals oblong-ovate, acute at apex, ca 2 x 1 mm. Disc 4-lobed, covering ovary. Berries oblique-pyriform, ca 5 mm across, purple when ripe, 1-seeded; seed obtriangled, 5 - 7 x 4 - 5 mm;

adaxial side with a longitudinal ridge and a linear shallow groove on either side; abaxial side with 3 longitudinal ridges, transversely rugose.

Fl.: April - Aug. *Fr.*: July - Oct.

Habitat: Evergreen forests, 800 - 1050 m.

Distrib.: Kannur, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

5. *Cissus heyneana* Steud., Nomencl. Bot. ed. 2, 1: 372. 1840; Planch. in A. & C. DC., Monogr. Phan. 5: 476. 1887; Gamble, Fl. Madras: 234(167). 1918; B.V. Shetty & P. Singh in Kew Bull. 44: 476. 1989; Sasidh. & Sivar., Fl. Pl. Thrissur: 113. 1996; Sivar. & P. Mathew, Fl. Nilambur: 154. 1997; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 285. 2000. *Vitis heyneana* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 125. 1834, non Roem. & Schult. 1819; M.A. Lawson in Hook.f., Fl. Brit. India 1: 647. 1875; Rama Rao, Fl. Pl. Travancore: 89. 1914.

Scandent shrub; branches terete, glabrous, glaucous, pale, fleshy; tendrils simple, stout. Leaves ovate-cordate, distantly crenate-serrate at margin, acute at apex, 4.5 - 14 x 3 - 10 cm, coriaceous, glabrous; petioles 2.5 - 7 cm long. Inflorescences umbelled cymes, ca 2 cm long; peduncles ca 1 cm long. Flowers glabrous; pedicels ca 3 mm long. Calyx cupular, obscurely 4-lobed. Petals oblong-ovate, acute at apex, ca 2 mm long. Disc 4-lobed, covering ovary. Berries pyriform when dry, ca 6 mm across, 1-seeded; fruiting pedicels clavate; seed obovoid, ca 7 x 4.5 mm, smooth except for longitudinally encircling ridged raphe.

Fl.: March - Sept. *Fr.*: July - Oct.

Habitat: Moist deciduous forests, frequent.

Distrib.: Kollam (Rama Rao, *l.c.*), Malappuram and Thrissur. Tamil Nadu. Sri Lanka.

Note: Shetty and Singh (1989) dealt with the nomenclature of this species. However, the binomial should be attributed to Steudel (1840) who produced a nomen novum, and not to Planchon (1887), as stated by Shetty and Singh (*l.c.*) (Mabberley, pers. comm.).

6. *Cissus latifolia* Lam., Encycl. 1: 30. 1783; B.V. Shetty & P. Singh in Taxon 37: 172. 1988; Nicolson & al. in Regnum Veg. 119: 269. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 113. 1996; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 287. 2000. *Vitis gigantea* Bedd. in Trans. Linn. Soc. London 25: 212.

1865. *Cissus wightii* Planch. in A. & C. DC., Monogr. Phan. 5: 478. 1887. *Vitis glauca* sensu Wight & Arn., Prodr. Fl. Ind. Orient.: 126. 1834 p.p.; M.A. Lawson in Hook.f., Fl. Brit. India 1: 648. 1875 p.p.; Rama Rao, Fl. Pl. Travancore: 90. 1914. *Cissus glauca* auct. non Roxb. 1820: Gamble, Fl. Madras: 234(168). 1918; Manilal & Sivar., Fl. Calicut: 68. 1982; Manilal, Fl. Silent Valley: 2. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 104. 1988; Vajr., Fl. Palghat: 125. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 121. 1994; Sivar. & P. Mathew, Fl. Nilambur: 152. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 169. 2002.

Scandent shrub; branches subterete, striate, glabrous, glaucous; tendrils forked. Leaves broadly ovate to suborbicular, cordate at base, bristly-serrate at margin, acuminate at apex, 10 - 18 x 8 - 13 cm, glabrous above, pubescent on nerves beneath; reticulations prominent; petioles 5 - 11 cm long, glabrous. Inflorescences umbelled cymes, 4 - 10 cm long; peduncles 2 - 5 cm long, pubescent. Flowers puberulous; pedicels 3 - 4 mm long. Calyx cupular, subentire, membranous at margin. Petals oblong, ca 1 x 0.5 mm. Disc 4-notched, 4-lobed, covering about half of ovary. Berries pyriform, ca 7 mm across, 1-seeded; seed ca 7 x 4 mm, tessellated with angled facets on either side of longitudinally encircling ridged raphe.

Fl.: May - Aug. *Fr.*: Aug. - Nov.

Habitat: Semievergreen and evergreen forests, to 850 m.

Distrib.: Almost throughout Kerala. Often cultivated. Western Ghats of Goa, Karnataka and Tamil Nadu. Sri Lanka.

7. *Cissus quadrangularis* L., Syst. Nat. ed. 12, 2: 124. 1767 & Mant. Pl.: 39. 1767; Planch. in A. & C. DC., Monogr. Phan. 5: 509. 1887; Gamble, Fl. Madras: 233(167). 1918; B.V. Shetty & P. Singh in Taxon 37: 172. 1988; Nicolson & al. in Regnum Veg. 119: 269. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 121. 1994; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 288. 2000. *Vitis quadrangularis* (L.) Wall. ex Wight, Cat. Ind. Pl.: 26. 1833 & Icon. Pl. Ind. Orient.: t. 51. 1838; M.A. Lawson in Hook.f., Fl. Brit. India 1: 645. 1875; Rama Rao, Fl. Pl. Travancore: 89. 1914.

Mal.: *Changalaparanda*

Rambler; branches 4-angled with angles usually winged, succulent; tendrils simple, stout. Leaves ovate to reniform, sometimes 3 - 7-lobed, truncate to cordate at base, subentire to denticulate at margin, acute to obtuse at apex, 2 - 6 x

2 - 5 cm, glabrous; petioles 0.5 - 1 cm long; stipules broadly ovate, ca 4 x 2 mm. Inflorescences umbelled cymes, 3 - 4 cm long; peduncles ca 2 cm long. Flowers glabrous; pedicels 2 - 4 mm long. Calyx cupular, obscurely lobed. Petals ovate-oblong, acute at apex, ca 2 x 1.5 mm. Disc 4-lobed, covering ovary. Berries obovoid or globose, apiculate, ca 5 mm across, 1- or 2-seeded; seeds obovoid, ca 5 x 4 mm, smooth except for longitudinally encircling ridged raphe.

Fl.: Feb. - Oct. *Fr.*: July - Feb.

Habitat: Dry forests and plains.

Distrib.: Kottayam, Malappuram, Pathanamthitta, Thiruvananthapuram and Wynad. Often cultivated. Central, E., NE. & S. India and Lakshadweep. Africa, S. and SE. Asia.

Uses: Tender shoot and leaf are used in the preparation of pappadams and also cooked as a vegetable. Ash of the plant is used as a substitute for baking powder. Plant is rich in vitamin C. Stem paste is applied on forehead to get relief from headache and also given in asthma. Tender branch made into a paste and mixed with milk is a purgative. Tender stem and leaf are used in the treatment of bronchitis. Plant juice is said to be beneficial in scurvy, used as an alterative, applied in cases of otorrhoea and epistaxis, and mixed with breast milk is given to infants in fever. Fresh shoot is pounded and applied on burns and wounds, and on saddle-sores of horses and camels. Powdered root is used in the treatment of fractured bones. Plant yields a strong fibre and is also grown as an ornamental in gardens.

8. *Cissus repanda* Vahl, *Symb. Bot.* 3: 18. 1794; Planch. in A. & C. DC., *Monogr. Phan.* 5: 474. 1887; Gamble, *Fl. Madras*: 234(167). 1918; Vajr., *Fl. Palghat*: 125. 1990; B.V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 290. 2000. *Vitis repanda* (Vahl) Wight & Arn., *Prodr. Fl. Ind. Orient.*: 125. 1834; M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 648. 1875; Rama Rao, *Fl. Pl. Travancore*: 90. 1914.

Scandent shrub; branches subterete, woody; young parts appressed-wooly, reddish; tendrils branched. Leaves suborbicular, sometimes 5 - 7-angled, deeply cordate at base, dentate-serrate at margin, short-acuminate at apex, 10 - 20 x 7 - 15 cm, densely reddish appressed-wooly when young, glabrescent; petioles 3 - 7 cm long; stipules falcate, ca 5 x 2.5 mm, pubescent. Inflorescences lax subcorymbosely branched umbelled cymes, 5 - 11 cm long; peduncles 3 - 7 cm

long, hairy. Flowers hairy; pedicels 3 - 4 mm long. Calyx cupular, obscurely 4-lobed. Petals ovate, ca 2 x 1 mm. Disc 4-lobed. Berries ellipsoid-pyriform, mucronate, 5 - 7 mm across, 1-seeded; seed obovoid, ca 8 x 5 mm, smooth except for longitudinally encircling ridged raphe.

Fl.: Feb. - July *Fr.*: March - Aug.

Habitat: Deciduous forests, 150 - 600 m.

Distrib.: Kannur, Kollam, Palakkad and Thrissur. Central, NE. and S. India. South and SE. Asia.

Use: Stem contains a large quantity of potable water.

Note: This species is quite variable in the shape of leaves and degree of tomentum.

9. *Cissus repens* Lam., *Encycl.* 1: 31. 1783; Planch. in A. & C. DC., *Monogr. Phan.* 5: 504. 1887 p.p.; Gamble, *Fl. Madras*: 233(167). 1918; Manilal & Sivar., *Fl. Calicut*: 26. 1982; B.V. Shetty & P. Singh in *Taxon* 37: 173. 1988; Nicolson & al. in *Regnum Veg.* 119: 269. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 105. 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 121. 1994; B.V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 290. 2000. *Vitis repens* (Lam.) Wight & Arn. in Wight, *Cat. Ind. Pl.*: 58. 1833 & *Prodr. Fl. Ind. Orient.*: 125. 1834; M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 646. 1875; Rama Rao, *Fl. Pl. Travancore*: 89. 1914.

Mal.: *Mrigampuli, Neriampulli*

Scandent shrub; branches angled, striate, glabrous, glaucous; tendrils branched. Leaves ovate, cordate at base, dentate-crenate at margin, acuminate at apex, 7 - 15 x 5 - 11 cm, membranous, glabrous; petioles 2.5 - 9 cm long. Inflorescences corymbose umbelled cymes, 5 - 10 cm long; peduncles 2.5 - 5 cm long. Flowers contorted at apex, glabrous; pedicels 3 - 6 mm long. Calyx cupular, subentire. Petals oblong-ovate, acute at apex, ca 2 x 1 mm. Disc 4-lobed, covering ovary. Berries ellipsoid-pyriform, ca 5 mm across, 1-seeded; seed pyriform, ca 5 x 3 mm, with longitudinally encircling ridged raphe and faint ridges on sides.

Fl.: April - Oct. *Fr.*: Sept. - Dec.

Habitat: Evergreen and semievergreen forests, to 1200 m.

Distrib.: Idukki, Kannur, Kasaragod, Kollam (Rama Rao, *l.c.*), Kottayam, Kozhikode, Palakkad, Thiruvananthapuram and Thrissur. Andaman & Nicobar Islands, E., NE. & S. India and Sikkim. South and SE. Asia.

10. *Cissus trilobata* Lam., *Encycl.* 1: 31. 1783; Planch. in A. & C. DC., *Monogr. Phan.* 5: 503. 1887; Gamble, *Fl. Madras*: 233(167). 1918; B.V. Shetty & P. Singh in *Taxon* 37: 173. 1988; Nicolson & al. in *Regnum Veg.* 119: 270. 1988; B.V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 293. 2000. *Vitis rheedei* Wight & Arn. in Wight, *Cat. Ind. Pl.*: 27. 1833, nom. illeg. incl. type of *Cissus trilobata* Lam. 1783 & *Prodr. Fl. Ind. Orient.*: 127. 1834; M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 653. 1875; Rama Rao, *Fl. Pl. Travancore*: 91. 1914. *Puria trilobata* (Lam.) N.C. Nair in Puri & al., *Biol. Land Pl.*: 127. 1974; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 105. 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 122. 1994; N. Mohanan & Sivad., *Fl. Agasthyamala*: 170. 2002. *Cyphostemma trilobata* (Lam.) M.R. Almeida, *Fl. Maharashtra* 1: 273. 1996.

Mal.: *Kareta-sorivalli*

Scandent shrub; branches terete, glabrous, subfleshy; tendrils simple, stout. Leaves 3-foliolate or the upper only 3-lobed, glabrous; petioles 3.5 - 6 cm long; terminal leaflet elliptic-lanceolate, attenuate at base, bristly-serrate at margin, acute to acuminate at apex, 8 - 15 x 2.5 - 4 cm; petiolules ca 4 mm long; lateral leaflets subsessile, oblique at base otherwise as in terminal leaflet. Inflorescences divaricate subumbelled cymes, 2.5 - 4 cm long; peduncles ca 1 cm long. Flowers glabrous; pedicels 2 - 3 mm long. Calyx saucer-like, subtruncate. Petals oblong-ovate, acute at apex, ca 2 x 1 mm. Filaments flat. Disc 4-lobed, covering ovary. Berries obovoid, 6 - 7 mm across, black when ripe, 1-seeded; seed pyriform, mucronate, slightly laterally compressed, ca 6 x 4 mm, smooth except for longitudinally encircling ridged raphe, with two shallow pits at base.

Fl.: May. - Nov. *Fr.*: July - March.

Habitat: Evergreen and semievergreen forests, to 920 m.

Distrib.: Kannur, Kasaragod, Kollam, Pathanamthitta, Thiruvananthapuram and Thrissur. Lakshadweep, Maharashtra and Tamil Nadu. Sri Lanka.

Note: Nair (*l.c.*) erected a new genus, *Puria*, to accommodate this species mainly on the basis of a unique embryological peculiarity. But morphological features and cytological data support its retention in *Cissus*.

11. *Cissus vitiginea* L., *Sp. Pl.*: 117. 1753 & *Syst. Nat.* ed. 12, 2: 124. 1767; Planch. in A. & C. DC., *Monogr. Phan.* 5: 472. 1887; Gamble, *Fl. Madras*: 234(167). 1918; Vajr., *Fl. Palghat*: 126. 1990; M. Mohanan & A.N. Henry, *Fl.*

Thiruvananth.: 121. 1994; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 294. 2000. *Vitis linnaei* Wight & Arn., Prodr. Fl. Ind. Orient.: 126. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 649. 1875; Rama Rao, Fl. Pl. Travancore: 90. 1914.

Erect or scandent shrub, rarely tree; branches subterete, striate, grey- or fulvous-pubescent; tendrils when present simple, stout, rarely branched. Leaves rotund-ovate to deeply 3 - 5-lobed, cordate to truncate at base, dentate at margin, acute to obtuse at apex, 3.5 - 16 x 4 - 15 cm, puberulous above, grey-pubescent beneath; petioles 1 - 9 cm long, pubescent; stipules ovate, ca 2 x 2 mm, pubescent. Inflorescences umbelled cymes, 5 - 7 cm long; peduncels 2 - 4 cm long. Flowers pubescent; pedicels 2 - 4 mm long. Calyx cupular, 4-lobed. Petals oblong-ovate, ca 2 x 1 mm. Disc 4-lobed, covering ovary, fleshy. Berries pyriform, apiculate, 5 - 7 mm across, purple with a glaucous bloom, 1-seeded; seed obovoid, 7 - 8 x 5 - 7 mm, tessellated on either side of raphe with angled facets.

Fl.: May - Oct. *Fr.*: June - Dec.

Habitat: Wastelands, edges of fields and dam sites, to 100 m.

Distrib.: Kollam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Southern India. Sri Lanka.

Uses: Leaf paste, mildly heated, is taken in stomach disorders and also applied on wounds of cattle. Fruit is said to be eaten.

4. CYPHOSTEMMA (Planch.) Alston

Scandent, erect or prostrate herbs or shrubs; tendrils leaf-opposed or absent. Leaves usually 3 - 9-foliolate, digitate, rarely simple, petioled or not; stipules conspicuous. Inflorescences axillary or pseudoterminal corymbose cymes, peduncled. Flowers bisexual, lageniform. Calyx entire or 4-lobed. Petals 4, free, oblong. Stamens 4; filaments filiform. Disc of 4 fleshy truncate or conic glands, adnate to ovary but free from each other. Ovary glabrous or hairy; style subulate; stigma minutely 2-fid or subentire and subcapitate. Berries usually globose, 1-seeded; seed with a dorsal crest, often rugose; endosperm M-shaped in cross section.

Tropics and subtropics, ca 250 species, 2 in India and 1 in Kerala.

Cyphostemma auriculatum (Roxb.) P. Singh & B.V. Shetty in Taxon 35: 596. 1986; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 298. 2000.

Cissus auriculata Roxb., Fl. Ind. 1: 430. 1820 & 1: 411. 1832; Wight, Icon. Pl. Ind. Orient.: t. 145. 1839; Planch. in A. & C. DC., Monogr. Phan. 5: 565. 1887. *Vitis auriculata* (Roxb.) Wall., Numer. List: 206, No. 6031. 1831 - 1832; M.A. Lawson in Hook.f., Fl. Brit. India 1: 658. 1875. *Cayratia auriculata* (Roxb.) Gamble, Fl. Madras: 237(170). 1918; Vajr., Fl. Palghat: 123. 1990.

Scandent shrub; bark on older stems deeply cracked; branches terete, succulent, softly pubescent; tendrils branched. Leaves digitate, 5-foliolate, soft-pubescent when young; petioles 7 - 15 cm long; stipules falcate, ca 1 x 0.5 cm; terminal leaflet obovate to rhomboid or elliptic, cuneate at base, serrate at margin, acute to short-acuminate at apex, 10 - 13 x 5.5 - 8.5 cm; petiolules 1 - 2 cm long; lateral leaflets 7 - 12 x 4 - 7 cm; petiolules ca 1 cm long. Inflorescences axillary or pseudoterminal much branched divaricate cymes, 11 - 26 cm long; peduncles 8 - 19 cm long, pubescent. Flowers contracted in middle, pubescent; pedicels 2 - 3 mm long. Calyx cupular, truncate. Petals oblong, ca 2.5 x 1.5 mm. Disc of 4 glands, covering most of ovary. Ovary pyramidal, hairy. Berries globose, ca 1 cm, alate when dry, 1-seeded; seed oblong-obovoid to subglobose, ca 8 x 5 mm, with a crest on dorsal side.

Fl.: July - Aug. *Fr.*: Aug. - Nov.

Habitat: Semievergreen forests, to 600 m.

Distrib.: Palakkad. Central, E., S. and W. India. Bangladesh and Myanmar.

Note: This species, first described under the genus *Cissus* by Roxburgh (*l.c.*), was placed in *Cayratia* by Gamble (*l.c.*) and he has been followed by most present day workers. However, the presence of lageniform corolla and the disc of 4 free glands which are characteristic of the genus *Cyphostemma* coupled with cytological evidence prompted Singh and Shetty (1986) to place it in *Cyphostemma*.

5. PARTHENOCISSUS Planch., nom. cons.

Scandent shrubs; tendrils branched, usually with adhesive discs at tips of branches. Leaves digitate, 3 - 5-foliolate, long-petioled; leaflets sessile to petioluled. Flowers bisexual, in leaf-opposed or terminal peduncled corymbose cymes. Calyx cupular, entire or obscurely 5-lobed. Petals 5, free. Stamens 5. Disc thin, obscure, adnate to ovary at base. Style short, stout; stigma subcapitate. Berries subglobose, dark blue to black, 1 - 4-seeded; seeds obovate to obovate-

suborbicular in outline; adaxial surface keeled, angled with 2 narrow parallel infolds; abaxial surface convex with a rounded or elliptic chalazal knot.

Temperate Asia and N. America, ca 10 species, 2 in India and 1 in Kerala.

Parthenocissus semicordata (Wall.) Planch. var. **roylei** (King) Raizada & H.O. Saxena in Indian Forester 92: 319. 1966 & Fl. Mussorie 1: 121. 1978; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 303. 2000. *Vitis semicordata* Wall. var. *roylei* King in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 65: 113. 1896. *Ampelopsis himalayana* Royle, Ill. Bot. Himal. Mts. 1: 149. 1835. *V. neilgherriensis* Wight, Icon. Pl. Ind. Orient.: t. 965. 1845. *V. anamalayana* Bedd. in Trans. Linn. Soc. London 25: 213. 1865; M.A. Lawson in Hook.f., Fl. Brit. India 1: 656. 1875; Rama Rao, Fl. Pl. Travancore: 91. 1914. *V. himalayana* (Royle) Brandis, Forest Fl. N.W. India: 100. 1874; M.A. Lawson in Hook.f., Fl. Brit. India 1: 656. 1875. *Parthenocissus neilgherrensis* (Wight) Planch. in A. & C.D., Monogr. Phan. 5: 450. 1887; Gamble, Fl. Madras: 231(166). 1918; Manilal, Fl. Silent Valley: 60. 1988.

Scandent shrub; branches rough, furrowed, glabrous or nearly so; tendrils branched with adhesive tips. Leaves 3-foliolate, glabrous or nearly so; petioles to 15 cm long; terminal leaflet ovate to obovate, cuneate to rounded at base, cuspidate-serrate at margin, acuminate at apex, 8 - 18 x 4 - 10 cm; lateral leaflets oblique, apex and margin as in terminal leaflet, 8 - 16 x 4 - 8 cm; petiolules to 1 cm long. Inflorescences leaf-opposed or terminal lax divaricate cymes. Flowers glabrous, yellowish green or reddish brown; pedicels 3 - 4 mm long. Calyx angled, entire or irregularly 5-lobed. Petals oblong, 2.5 - 3.5 mm long with a linear 2-fid appendage at apex. Berries ca 7 mm across; seeds ca 6 x 5 mm; adaxial surface keeled; abaxial surface with an elliptic chalazal knot.

Fl.: June - Oct. *Fr.*: Nov. - Jan.

Habitat: Evergreen and semievergreen forests, 850 - 1025 m.

Distrib.: Idukki, Kollam, Kottayam, Palakkad and Pathanamthitta. Himachal Pradesh, Meghalaya, Punjab, Uttar Pradesh and Tamil Nadu. South and SE. Asia.

Uses: Wood is strong, hard, dark brown with silver-grains and is suitable for picture frames etc. Young vine is used as rope for tying bundles of grass. Leaf is used as a fodder and fruit is said to be edible.

6. TETRASTIGMA (Miq.) Planch.

Scandent shrubs, rarely herbaceous, dioecious; tendrils leaf-opposed, branched or not. Leaves usually 3 - 7-foliolate, digitate or pedate, hairy to glabrous; leaflets petioluled or sessile. Flowers unisexual, in axillary peduncled cymose inflorescences. Calyx cupular or saucer-like, entire or obscurely 4-lobed. Petals 4, free, sometimes with a dorsal spur at apex. Stamens 4; filaments short. Disc usually distinct, 4-lobed. Style short, thick or simulating ovary; stigma broad, 4-lobed. Berries globose or ellipsoid, 1 - 4-seeded; seeds obovate to elliptic-oblong in outline; adaxial surface with a linear filiform raphe; abaxial surface with a linear-spatulate or orbicular chalazal knot; endosperm T-shaped in cross section.

Indomalaysia to tropical Australia, 90 species, 16 in India and 4 in Kerala.

Key to species

- | | | |
|-----|--|-----------------------------|
| 1a. | Branches sulcate; berries 2 - 2.5 cm across; seeds ca 12 x 7 mm | 4. T. sulcatum |
| b. | Branches terete or flat; berries less than 1 cm across; seeds 6 - 8 x 4 - 5 mm | 2 |
| 2a. | Leaves 3-foliolate; berries 1-seeded; seeds subglobose | 1. T. gamblei |
| b. | Leaves 3 - 7-pedately-foliolate; berries 2 - 4-seeded; seeds obovoid or oblong-obovoid | 3 |
| 3a. | Branches muricate; leaflets revolute at margin; style distinct | 3. T. nilagiricum |
| b. | Branches smooth; leaflets not revolute at margin; stigma sessile | 2. T. leucostaphylum |

1. *Tetragium gamblei* B.V. Shetty & P. Singh in Kew Bull. 42: 933. 1987 & N.P. Singh & al., Fl. India 5: 312. 2000. *T. canarense* Gamble, Fl. Madras: 228(164). 1918 p.p., non *Vitis canarensis* Dalzell 1851; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 106. 1988. *Vitis canarensis* sensu Rama Rao, Fl. Pl. Travancore: 92. 1914, non Dalzell 1851.

Scandent shrub; branches terete, slender; tendrils simple or 2-fid. Leaves 3-foliolate, glabrous; petioles 4 - 9 cm long; terminal leaflet elliptic to obovate, cuneate at base, serrate-dentate to subentire at margin, acuminate at apex, 7 - 11 x 4 - 7.5 cm; petiolules 1.5 - 2.5 cm long; lateral leaflets elliptic, slightly oblique at base, apex and margin as in terminal leaflet, 5 - 10 x 3.5 - 6.5 cm; petiolules 0.5 - 1 cm long. Inflorescences umbelled cymes, ca 3 cm long; peduncles 1 - 2 cm long. Flowers pubescent; pedicels ca 2 mm long. Calyx subtruncate or obscurely 4-lobed. Petals oblong-ovate, acute at apex, ca 1.75 x 0.8 mm. Disc membranous,

covering base of ovary. Stigma sessile. Berries globose, ca 6 mm, 1-seeded; seed subglobose, ca 6 x 5 mm, transversely striate on sides; adaxial and abaxial surfaces with longitudinal furrows; chalaza spatulate.

Fl.: Nov. - Feb. *Fr.*: Feb. - April.

Habitat: Evergreen and semievergreen forests, 500 - 1000 m.

Distrib.: Kannur, Pathanamthitta and Wynad. Western Ghats of Karnataka and Maharashtra. Endemic.

2. *Tetrastigma leucostaphyllum* (Dennst.) Alston ex Mabb. in *Taxon* 26: 539. 1977; Manilal & Sivar., *Fl. Calicut*: 69. 1982; B.V. Shetty & P. Singh in *Taxon* 37: 173. 1988 & *Kew Bull.* 44: 477. 1989; Manilal, *Fl. Silent Valley*: 60. 1988; Nicolson & al. in *Regnum Veg.* 119: 270. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 106. 1988; Sivar. & P. Mathew, *Fl. Nilambur*: 154. 1997; B.V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 314. 2000. *Cissus leucostaphyla* Dennst., *Schlüssel Hortus Malab.*: 17, 19, 33. 1818. *C. lanceolaria* Roxb., *Fl. Ind.* 1: 430. 1820, nom. illeg. *Vitis lanceolaria* Wall. ex Wight & Arn., *Prodr. Fl. Ind. Orient.*: 128. 1834; M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 660. 1875. *Tetrastigma lanceolarium* Planch. in A. & C. DC., *Monogr. Phan.* 5: 423. 1887 p.p., nom. illeg.; Gamble, *Fl. Madras*: 228(164). 1918; Vajr., *Fl. Palghat*: 126. 1990. *T. muricatum* Gamble, *Fl. Madras*: 229(164). 1918, nom. illeg.

Mal.: *Valiya-chorivalli*

Scandent shrub; branches flat; tendrils simple, stout. Leaves 5 - 7-foliolate, pedate, glabrous; petioles 5 - 15 cm long; terminal leaflet oblong-lanceolate, acute to rounded at base, irregularly serrate-dentate at margin, acuminate at apex, 11 - 19 x 3.5 - 8 cm; petiolules 1.5 - 3 cm long; lateral leaflets oblique, apex and margin as in terminal leaflet, 7 - 15 x 3 - 6 cm; petiolules 0.5 - 2 cm long. Inflorescences subcorymbose cymes, 3 - 7 cm long; peduncles to 4 cm long. Flowers pubescent; pedicels 2 - 3 mm long. Calyx cupular, inconspicuous, sometimes minutely 4-lobed, ciliate-pubescent at margin. Petals sometimes slightly dorsally spurred at apex, ca 1.5 x 0.75 mm. Disc undulate at margin, restricted to base of ovary. Stigma sessile. Berries globose, ca 1 cm, 2 - 4-seeded; seeds obovoid, planoconvex, 6 - 7 x 4 - 5 mm, transversely striate on sides; adaxial surface with a linear raphe broadened at top; abaxial surface with an oblong chalazal knot.

Fl.: Dec. - May *Fr.*: July - Sept.

Habitat: Evergreen and semievergreen forests, 350 - 800 m.

Distrib.: Idukki, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Wynad. Andhra Pradesh, Karnataka, NE. India, Orissa and Tamil Nadu. Bangladesh, Bhutan and Nepal.

Uses: Leaf poultice is applied on boils and plant juice is used in cough.

3. *Tetrastigma nilagiricum* (Miq.) B.V. Shetty in Kew Bull. 44: 477. 1989; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 315. 2000. *Cissus nilagirica* Miq. in Linnaea 26: 221. 1854. *Tetrastigma muricatum* sensu Gamble, Fl. Madras: 229(164). 1918, quoad descr. *T. leucostaphylum* sensu Ramam. in N.C. Nair & A.N. Henry, Fl. Tamil Nadu 1: 82. 1983, non Alston ex Mabb. 1977.

Scandent shrub; branches terete, striate, muricate; tendrils simple, stout. Leaves 3 - 5-foliolate, pedate, light green when dry; petioles 2 - 5 cm long; terminal leaflet elliptic, acute to rounded at base, serrate and retrorse at margin, acute to acuminate at apex, 6 - 13 x 3 - 6 cm; petiolules ca 1 cm long; lateral leaflets oblique, apex and margin as in terminal leaflet, 5 - 9 x 2.5 - 4 cm; petiolules ca 0.5 cm long. Inflorescences umbelled cymes, ca 3 cm long; peduncles to 1 cm long, pubescent. Flowers pubescent, pale green; pedicels 2 - 3 mm long. Calyx 4-lobed. Petals oblong, ca 2 x 1 mm. Disc thick, covering lower half of ovary. Ovary urceolate; style distinct. Berries globose, ca 1 cm; seeds oblong-obovoid, ca 8 x 4.5 mm, deeply crenate on sides; adaxial surface with a linear furrow; abaxial surface with an oblong chalazal knot.

Fl.: Nov. - May *Fr.:* June - Sept.

Habitat: Evergreen and semievergreen forests, 1000 - 2000 m.

Distrib.: Idukki, Kannur, Kollam and Kottayam. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

4. *Tetrastigma sulcatum* (M.A. Lawson) Gamble, Fl. Madras: 229(164). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 106. 1988; Vajr., Fl. Palghat: 126. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 113. 1996; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 319. 2000. *Vitis sulcata* M.A. Lawson in Hook.f., Fl. Brit. India 1: 661. 1875, excl. syn.; Rama Rao, Fl. Pl. Travancore: 92. 1914.

Scandent shrub; branches sulcate, muricate or tubercled. Leaves 3 - 5-foliolate, pedate, glabrous, brown when dry; petioles 5 - 9 cm long; terminal

leaflet elliptic-lanceolate, acute at base, serrate at margin, acuminate at apex, 12-19 x 5-7 cm; petiolules 1.5-3 cm long; lateral leaflets oblique at base, apex and margin as in terminal leaflet, 8-13 x 3-6 cm; petiolules ca 1.5 cm long. Inflorescences corymbose cymes, ca 5 cm long, pubescent. Flowers pubescent; pedicels ca 3 mm long. Calyx cupular, 4-lobed. Petals oblong, ca 2.2 x 1.5 mm. Disc annular, thick. Style short. Berries globose, 2-2.5 cm; seeds oblong-obovoid, ca 12 x 7 mm, faintly crenate on sides; adaxial surface with a longitudinal raphe and a furrow on either side radiating at an angle; abaxial surface with a spatulate chalazal knot.

Fl.: Dec. - May *Fr.*: March - Oct.

Habitat: Evergreen and semievergreen forests, 850-2500 m.

Distrib.: Idukki, Kannur, Kollam, Palakkad, Pathanamthitta and Thrissur. Andhra Pradesh, Goa, Karnataka and Tamil Nadu. Endemic.

Vitis vinifera L., the grape vine, may sometimes be cultivated in gardens.

LEEACEAE

(W. ARISDASON, M. REEMA KUMARI & P. DANIEL)

Small trees, shrubs or herbs with woody base; stems and branches swollen at node, occasionally beset with rows of spines. Leaves alternate, distichous, 1-3-foliolate or 1-4-pinnate, often with caducous pearl glands beneath; petioles variously dilated into long and narrow or short and broad sheathing persistent or caducous stipules. Flowers bisexual, greenish white or red to orange-yellow, usually many in leaf-opposed condensed or laxly branched bracteate cymose inflorescences. Calyx cupular; lobes 4 or 5, 3-angled, glandular at apex. Petals 4 or 5, partially connate below at a line and adnate to staminal tube forming a rim with stamens inserted thereon, valvate in bud, reflexed at maturity. Staminal tube free above and below line of attachment, 4- or 5-lobed at apex, forming a collar below, usually free, sometimes extending as far as ovary. Stamens 4 or 5; filaments extending over to staminal tube through sinus; anthers 2-loculed, syngenesious, rarely free. Carpels 4(or 5), connate into a superior ovary, incompletely divided into 4-6(-8) apparent locules; ovule 1 in each locule, basal; style short; stigma slightly swollen. Berries subglobose-depressed; seeds wedge-shaped; endosperm ruminant.

Old World tropics, unigeneric, 34 species, 11 in India and 5 in Kerala.

Literature: Ridsdale, C.E. 1974. A revision of the family *Leeaceae*. *Blumea* 22: 57 - 100.
Ridsdale, C.E. 1976. *Leeaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 7: 759 - 782.

LEEAE D. Royen ex L., nom. cons.
(Characters as for family)

Key to species

- | | | |
|-----|---|--------------------------|
| 1a. | Flowers greenish white | 2 |
| b. | Flowers crimson-red or orange-yellow | 3. <i>L. guineensis</i> |
| 2a. | Leaves membranous; calyx covered with pearl glands outside | 1. <i>L. aequata</i> |
| b. | Leaves chartaceous, coriaceous or subcoriaceous; calyx not as above | 3 |
| 3a. | Stems and rachises fluted or crispately winged | 2. <i>L. asiatica</i> |
| b. | Stems and rachises neither fluted nor crispately winged | 4 |
| 4a. | Plant with stilt roots; corolla lobes ovate-lanceolate, 1.5 - 3 mm across | 4. <i>L. indica</i> |
| b. | Plant without stilt roots; corolla lobes linear-ovate, 0.8 - 1 mm across | 5. <i>L. macrophylla</i> |

1. *Leea aequata* L., Syst. Nat. ed. 12, 2: 627. 1767; T. Cooke, Fl. Bombay 1: 261. 1902; Gamble, Fl. Madras: 240(172). 1918; Sivar. & P. Mathew, Fl. Nilambur: 155. 1997; B.D. Naithani in N.P. Singh & al., Fl. India 5: 326. 2000. *L. hirta* Roxb. ex Hornem., Hort. Bot. Hafn.: 231. 1813; M.A. Lawson in Hook.f., Fl. Brit. India 1: 668. 1875. *L. kurzii* C.B. Clarke in J. Bot. 19: 165. 1881.

Shrub or small tree, 2 - 3(- 10) m high; young branches villous. Leaves (1 -)2(- 3)-pinnate; rachises 7 - 20 cm long, angled, pubescent; petioles 6 - 15 cm long; stipules oblong-obovate, 3 - 8 x 3 - 6 cm, pubescent to densely hairy, caducous. Leaflets 5 - many, oblong-lanceolate, ovate to -lanceolate, elliptic to -lanceolate or lanceolate, cuneate to truncate, sometimes subcordate or rounded at base, sharply serrate at margin, acuminate to caudate at apex, 7 - 22 x 2.5 - 6 cm, membranous, hispid with scattered grey hairs above, hirsute on nerves, rough with scattered rounded brown peltate glands beneath; lateral nerves 8 - 12 pairs, slender, arched; petiolules of lateral leaflets 3 - 12 mm long, those of terminal ones 2.5 - 3.5 cm long, pubescent. Inflorescences subterminal, 6 - 10 cm long, more or less glandular-hairy; peduncles 1 - 4 cm long; bracts conspicuous, ovate to oblong, 6 - 8 x ca 5 mm. Flowers 5-merous, greenish white. Calyx 3 - 4 x 3 - 4 mm, lobed halfway down, glabrous to densely pubescent, covered with pearl glands outside.

Corolla lobes 2-3 x 1-1.5 mm. Staminal tube 1.5-2.5 mm long; lobes deeply cleft; filaments 1-1.2 mm long; anthers 1-1.2 mm long. Ovary 4-7-loculed; style 1-2 mm long. Fruits globose-depressed, 6-7 mm, orange-red, black when ripe; seeds 3-6.

Fl. & Fr.: June-Jan.

Habitat: Semievergreen forests.

Distrib.: Kollam and Malappuram. Andaman Islands, Arunachal Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and W. Bengal. South and SE. Asia.

2. *Leea asiatica* (L.) Ridsdale in Manilal, Bot. Hist. Hort. Malab.: 189. 1980; Nicolson & al. in Regnum Veg. 119: 160. 1988; Manilal, Fl. Silent Valley: 61. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 107. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 114. 1996; Sivar. & P. Mathew, Fl. Nilambur: 156. 1997; B.D. Naithani in N.P. Singh & al., Fl. India 5: 330. 2000. *Phytolacca asiatica* L., Sp. Pl.: 474. 1753. *Leea crispa* L., Syst. Nat. ed. 12, 2: 637: 1767; M.A. Lawson in Hook.f., Fl. Brit. India 1: 665. 1875; Gamble, Fl. Madras: 240(171). 1918. *L. herbacea* Buch.-Ham. in Trans. Linn. Soc. London 14: 228. 1823; Gamble, Fl. Madras: 240(171). 1918. *L. aspera* Edgew. in Trans. Linn. Soc. London 20: 36. 1848, non Wall. ex G. Don 1831; M.A. Lawson in Hook.f., Fl. Brit. India 1: 665. 1875; Gamble, Fl. Madras: 240(171). 1918. *L. pumila* Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 41: 302. 1872; M.A. Lawson in Hook.f., Fl. Brit. India 1: 666. 1875. *L. edgeworthii* Santapau in Rec. Bot. Surv. India 16(1): 54. 1953.

Undershrub, shrub or tree, to 8 m high; stems, branches, rachises, petiolules and peduncles often fluted and crispately winged. Leaves 1- or 2-pinnate, densely soft-villous beneath when young; petioles 1-4 cm long; stipule represented by a narrow wing; rachises 4-12 cm long; leaflets 5-7, broadly ovate to elliptic or ovate-oblong to elliptic-, rounded to cordate at base, sharply serrate at margin, acute, acuminate to caudate at apex, 10-20 x 4-9 cm, chartaceous to subcoriaceous, glabrous or sparsely hairy above, densely hairy beneath with sparse globose pearl glands; lateral nerves 8-16 pairs; petiolules 5-15 mm long. Inflorescences 2-12 cm long, glabrous or pubescent; peduncles to 6 mm long; bracts ovate to linear-lanceolate, to 6 mm long, subpersistent; bracteoles lanceolate, ca 3 mm long; pedicels 1-2 mm long, pubescent. Flowers greenish white. Calyx ca 2 x 3 mm, pubescent with prominent reticulate nervation, 5-lobed; lobes 3-angled,

0.5 - 0.75 x 0.3 - 0.8 mm. Corolla tube with staminal lobes 3 - 4 mm long, 5-lobed; lobes subulate, 2.5 - 3 x 1 - 1.5 mm. Staminal lobes deeply 2-fid. Stamens free; filaments to 2 mm long; anthers oblong, to 1 cm long, medifixed. Staminal column ca 3 mm long. Ovary globose-subglobose, less than 1 mm across, 4 - 8-loculed; style 1 - 2 mm long; stigma capitate. Fruits globose-depressed, ca 12 mm across, purple black; seeds usually 6, ca 5 x 3 mm.

Fl.: April - Aug. *Fr.*: Oct. - Dec.

Habitat: Evergreen and deciduous forests, to 1000 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thrissur. Almost throughout India. Bangladesh, Bhutan, China, Laos, Myanmar, Nepal, Thailand and Vietnam.

3. *Leea guineensis* G. Don, Gen. Hist. 1: 712. 1831; Sasidh. & Sivar, Fl. Pl. Thrissur: 114. 1996; Sivar. & P. Mathew, Fl. Nilambur: 156. 1997; B.D. Naithani in N.P. Singh & al., Fl. India 5: 336. 2000. *L. aurantiaca* Zoll. & Moritzi in Natuur- Geneesk. Arch. Ned.-Indië 2: 577. 1847; Banerjee & Babu in Indian Forester 97: 19. 1971. *L. wightii* C.B. Clarke in J. Bot. 19: 105. 1881; Gamble, Fl. Madras: 239(171). 1918. *L. acuminata* Wall. ex C.B. Clarke in J. Bot. 19: 141. 1881. *L. staphylea* auct. non Roxb. 1832; Wight, Ill. Ind. Bot. 1: t. 58. 1840.

Undershrub, shrub or small tree, to 5 m high; branches glabrous or sparsely pubescent, rarely densely hairy. Leaves (1-)2- or 3- rarely 4-pinnate. Leaflets usually many; rachises 20 - 60 cm long, glabrous; stipules obovate-oblong, 2 - 4 (- 6) x (1 -)1.5 - 3 cm, glabrous to sparsely pubescent, woody, early caducous. Leaflets ovate, ovate-oblong or oblong-lanceolate, elliptic to elliptic-lanceolate, 10 - 20 x 3 - 7 cm, terminal leaflet usually the largest, rounded to cuneate, rarely truncate or unequal at base, serrate at margin, acuminate at apex, coriaceous, glabrous or sparsely pubescent beneath, sometimes with small globose pearl glands; nerves 8 - 10 pairs, much arched, often with hairy domatia; petiolules 5 - 10 mm long, glabrous or pubescent. Inflorescences 6 - 10 cm long, pubescent or minutely rusty-villous; peduncles 3 - 10 cm long; bracts ovate, deltoid to narrowly 3-angled, to 3 mm long. Flowers red to reddish yellow. Calyx 3 - 4 x 2 - 4 mm, glabrous or pubescent; lobes 5, 1 - 2 x 1 - 2 mm, persistent in fruit. Staminal tube 2 - 3 mm long, upper free part to 2.5 mm, emarginate or shallowly retuse; filaments 0.5 - 1.25 mm long; anthers to 2 mm long. Ovary 4 - 8-loculed; style 1 - 2 mm long,

Fruits globose-depressed, 6 - 8 mm across, orange-red; seeds usually 6, 3-gonous, ca 5 x 4 mm.

Fl. & Fr.: May - Feb.

Habitat: Evergreen forests.

Distrib.: Idukki, Kollam, Malappuram, Palakkad, Pathanamthitta and Thrissur. Andaman Islands, Assam, Maharashtra, Manipur, Meghalaya, Tamil Nadu and Uttar Pradesh. South and SE. Asia to tropical Africa.

Use: Stem is used as a substitute for bamboo in building temporary huts in forests.

4. *Leea indica* (Burm.f.) Merr. in Philipp. J. Sci. 14: 245. 1919; Santapau in Rec. Bot. Surv. India 16(1): 56. 1953; Banerjee in Rec. Bot. Surv. India 19(2): 33. 1965; Manilal & Sivar., Fl. Calicut: 70. 1982; Nicolson & al. in Regnum Veg. 119: 161. 1988; Manilal, Fl. Silent Valley: 61. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 107. 1988; Vajr., Fl. Palghat: 127. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 122. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 114. 1996; Sivar. & P. Mathew, Fl. Nilambur: 157. 1997; B.D. Naithani in N.P. Singh & al., Fl. India 5: 337. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 170. 2002. *Staphylea indica* Burm.f., Fl. Indica: 75, t. 24, f. 2. 1768. *Leea sambucina* Willd., Sp. Pl. 1: 1177. 1798; M.A. Lawson in Hook.f., Fl. Brit. India 1: 666. 1875 p.p. *L. umbraculifera* C.B. Clarke in J. Bot. 19: 141. 1881; Bourd., Forest Trees Travancore: 107. 1908; Rama Rao, Fl. Pl. Travancore: 92. 1914; Gamble, Fl. Madras: 240(172). 1918.

Mal.: *Nazhuku*

Large shrub or small tree, 2 - 5 m high; stem branched or not, warted or smooth, glabrous to pubescent, often with stilt roots, usually fluted at base. Leaves 1- or 2-(or 3-)pinnate; petioles 10 - 20 cm long, purple; stipules obovate-oblong, ca 6 x 3 mm long, glabrous or sparsely pubescent, early caducous; rachises 15 - 40 cm long, stout, glabrous to pubescent. Leaflets opposite, petioluled, oblong, ovate-lanceolate, -oblong or elliptic-lanceolate, rounded to cuneate at base, coarsely serrate to dentate at margin, acute, acuminate to caudate at apex, 7 - 20 x 2 - 9 cm, chartaceous to subcoriaceous, glabrous to hairy; pearl glands small, angled to somewhat globose, caducous; lateral nerves 7 - 12 pairs, raised on both surfaces, arcuate, forked near margin; petiolules 5 - 25 mm long. Inflorescences 10 - 20 cm long, usually lax, sometimes dense, glabrous to pubescent; peduncles 5

10 cm long; bracts narrowly 3-angled to linear, to 4 mm long, early caducous; pedicels 2 - 3 mm long. Flowers 5-merous, greenish white. Calyx 2 - 3 x (2 -)3 4 mm, cleft to middle; lobes 5, deltoid, 1 - 2 x 1 - 2 mm, glabrous to pubescent. Corolla tube to 4 mm long; lobes 5, ovate-lanceolate, cucullate at apex inside, reflexed, 3 - 4 x 1.5 - 3 mm. Stamens 5; staminal tube ca 2.5 mm long; staminal lobes cleft or notched; filaments to 1.5 mm long; anthers oblong, 1 - 1.5 mm long, dehiscent longitudinally. Ovary globose, less than 1 mm, 6-loculed; style 1 - 2 mm long, broadly 3-angled; stigma capitate, punctiform. Fruits globose-depressed, 6 - 7 mm, purple black; seeds 4 - 6, 3-gonous, ca 5 x 4 mm, grooved.

Fl. & Fr.: June - March.

Habitat: Moist deciduous to evergreen forests, to 800 m.

Distrib.: Throughout Kerala. Throughout India. South and SE. Asia to Australia.

5. *Leea macrophylla* Roxb. ex Hornem., Hort. Bot. Hafn. 1: 213. 1813; M.A. Lawson in Hook.f., Fl. Brit. India 1: 664. 1875; Manilal & Sivar., Fl. Calicut: 70. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 108. 1988; Vajr., Fl. Palghat: 127. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 114. 1996; Sivar. & P. Mathew, Fl. Nilambur: 158. 1997; B.D. Naithani in N.P. Singh & al., Fl. India 5: 339. 2000. *L. integrifolia* Roxb., Fl. Ind. 2: 472. 1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 667. 1875. *L. robusta* Roxb., Fl. Ind. 2: 468. 1824; M.A. Lawson in Hook.f., Fl. Brit. India 1: 667. 1875 p.p.; Gamble, Fl. Madras: 240(171). 1918; Sasidh. & Sivar., Fl. Pl. Thrissur: 114. 1996; Sivar. & P. Mathew, Fl. Nilambur: 159. 1997. *L. aspera* Wall. ex G. Don, Gen. Hist. 1: 713. 1831. *L. cinerea* M.A. Lawson in Hook.f., Fl. Brit. India 1: 665. 1875. *L. coriacea* M.A. Lawson in Hook.f., Fl. Brit. India 1: 665. 1875. *L. diffusa* M.A. Lawson in Hook.f., Fl. Brit. India 1: 667. 1875. *L. parallela* Wall. ex M.A. Lawson in Hook.f., Fl. Brit. India 1: 666. 1875. *L. talbotii* King ex Talbot, Forest Fl. Bombay 1: 329. 1909. *L. venkobarrowii* Gamble in Bull. Misc. Inform. 1917: 26. 1917 & Fl. Madras: 240(172). 1918.

Shrub, to 2 m high; young branches, rachises, petioles, petiolules and inflorescences hairy to mealy-pubescent; petioles to 20 cm long; rachises 10 - 15 cm long; stipules obovate, 2 - 6 x 1 - 4 cm. Leaves 1- or 3-foliolate or 1 - 3-pinnate; if 1- or 3-foliolate leaflets oblique, broadly ovate, oblong-ovate, elliptic or rhomboid, 15 - 60 x 10 - 50 cm, cordate at base, acute or short-acuminate at apex; if 1 - 3-pinnate leaflets 7 - 21 or more, oblong, ovate-lanceolate or elliptic -

9 30 x 4 9 cm, rounded at base, serrate at margin, acuminate to caudate at apex, chartaceous to subcoriaceous, glabrous to sparsely hairy above, sparsely to densely hairy sometimes mealy-pubescent beneath; lateral nerves to 14 pairs, pubescent to hairy; petiolules to 25 mm long. Inflorescences 12 45 cm long, much branched; peduncles to 25 cm long; bracts deltoid to narrowly 3-angled, to 6 mm long; pedicels 1 - 2 mm long, pubescent. Flowers greenish white. Calyx 1.5 - 3 x 2.5 - 4 mm, 5-lobed, mealy-pubescent; lobes 3-angled, 0.75 1 x 0.8 1 mm. Corolla tube with staminal lobes 3 - 4 mm long; corolla lobes 5, linear-ovate, thick, 2 - 4 x 0.8 - 1 mm, greyish-pubescent to papillose. Staminal lobes slightly retuse or shallowly cleft. Stamens free, in between staminal lobes; staminal column 2 3 mm long; filaments ca 1 mm long; anthers oblong, ca 1 mm long, medifixed. Ovary globose, 1 1.5 mm, 6-loculed; style to 2 mm long. Fruits subglobose or globose-depressed, 10 - 15 mm across, green; seeds usually 6, 3-gonous, ca 4 x 3 mm.

Fl. & Fr.: Aug. Dec.

Habitat: Moist deciduous and evergreen forests, to 500 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Thrissur and Wynad. Andamans, Andhra Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, Uttar Pradesh, West Bengal. Bangladesh, Bhutan, Cambodia, Laos, Myanmar, Nepal and Thailand.

Uses: Fruit is edible and is also medicinal. Root is said to yield a dye; also reported to be a remedy for ringworm and guinea worm; also applied as a poultice on obstinate sores and sprains.

SAPINDACEAE

(P. SINGH & E. VAJRAVELU)

Trees or shrubs, rarely herbs climbing by tendrils. Leaves alternate, rarely opposite, paripinnate, rarely simple or 2-ternate, usually exstipulate, sometimes the lowest pair of leaflets stipule-like. Inflorescences terminal or axillary, cymose or racemose, often in cincinni or panicles. Flowers unisexual, actino- or zygomorphic, generally monoecious or polygamodioecious. Sepals 5 (3 or 4), free or connate, imbricate, rarely valvate. Petals 5 (3 or 4), free, imbricate, equal or not, often with basal ligulate scales, sometimes absent. Disc lobes annular or unilateral, sometimes flat, wavy, glandular, pubescent or glabrous. Stamens 8 (4, 5, 10, 12 20), inserted within or rarely on disc; filaments free, sometimes basally connate, hairy

or glabrous; anthers 2-loculed, dorsifixed, dehiscent longitudinally. Ovary superior, entire, lobed or divided nearly to base, 3(2 - 4)-loculed; style 1(2 - 4), terminal or between lobes; stigma terminal, lobed or punctiform; ovules 1 or 2 (many), usually ascending, axile, rarely ventral, 2-tegmie, crassinucellar, ana- or campy-
lotropous. Fruit a drupe, berry, capsule, nut, schizocarp or samara; seeds 1 - 4, often arillate, nonendospermous; embryo large, usually curved, often plicate or twisted.

Tropics and subtropics, a few temperate, 131 genera and 1450 species, 18 and 37 in India and, 10 and 13 in Kerala.

Literature: Abdulla, D. 1973. *Sapindaceae*. In: Nasir, E. & Ali, S.I. (ed.), *Fl. W. Pakistan* 39: 1 - 10. Croat, T.B. 1977. *Sapindaceae*. In: *Fl. Panama. Ann. Missouri Bot. Gard.* 63: 419 - 540. Ferrucci, M.S. 1981. Recuentos cromosomicos en *Sapindaceae*. *Bonplandia* 5: 73 - 81. Lo, H.S. & Chen, T.C. 1979. Notes on Chinese *Sapindaceae*. *Acta Phytotax. Sin.* 17: 30 - 39. Mukherjee, S.K. 1980. *Sapindaceae* of Peninsular India. *J. Econ. Tax. Bot.* 1: 77 - 81. Muller, J. & Leenhouts, P.W. 1976. A general survey of pollen types in *Sapindaceae* in relation to taxonomy. In: Ferguson, I.K. & Muller, J. (ed.), *The evolutionary significance of the exine. Linn. Soc. Symp.* 1: 407 - 445. Pijl, L. van der 1957. On the arilloids of *Nephelium*, *Euphoria*, *Litchi* and *Aesculus* and seeds of *Sapindaceae* in general. *Acta Bot. Neerl.* 6: 618 - 641. Radlkofer, L.A.T. 1931 - 1934. *Sapindaceae*. In: Engler, A.H.G. (ed.), *Pflanzenr.* IV: 165 (98 a - h): 1 - 153. Welzen, P.C. von 1988. Key to the Malesian genera of *Sapindaceae*. *Blumea* 33: 215 - 237.

Key to genera

- | | |
|---|-------------------------|
| 1a. Leaves simple; fruits winged | 4. Dodonaea |
| b. Leaves ternate, 2-ternate or pinnately compound; fruits not winged | 2 |
| 2a. Herbaceous climbers; inflorescences with a pair of tendrils | 2. Cardiospermum |
| b. Trees or shrubs; inflorescences without tendrils | 3 |
| 3a. Fruits smooth or wrinkled when dry | 4 |
| b. Fruits warty, tubercled or spiny | 9 |
| 4a. Seeds arillate | 5 |
| b. Seeds exarillate | 7 |
| 5a. Petals absent | 10. Schleicheria |
| b. Petals 4 or 5 | 6 |
| 6a. Leaves 3-foliolate; fruit a globose indehiscent drupe | 1. Allophylus |

- b. Leaves paripinnate, 4 - 12-foliolate; fruit a 2-lobed dehiscent capsule **6. Harpullia**
- 7a. Branches angled; leaves pari or imparipinnate; rachises winged **5. Filicium**
- b. Branches terete; leaves paripinnate; rachises not winged **8**
- 8a. Flowers actinomorphic; ovary glabrous **9. Sapindus**
- b. Flowers zygomorphic; ovary pubescent **7. Lepisanthes**
- 9a. Lowest pair of leaflets stipule-like; petals 4; disc glabrous; fruit a drupe, densely echinate **8. Otonophelium**
- b. Lowest pair of leaflets not stipule-like; petals 5 or 6; disc velutinous; fruit a schizocarp, warty **3. Dimocarpus**

1. ALLOPHYLUS L.

Shrubs or small trees. Leaves 3(1)-foliolate, exstipulate; leaflets entire or serrate. Inflorescences axillary simple or branched racemes. Flowers globose, zygomorphic, bracteate, short-pedicelled, polygamodioecious. Sepals 4, in opposite pairs, widely imbricate, cucullate, outer pair smaller, membranous. Petals 4, smaller than sepals, usually with a scale above claw, white or yellowish. Disc unilateral with 4 glands opposite petals, glabrous. Stamens 8, inserted on receptacle inside disc; filaments free, glabrous or pubescent. Ovary 2-lobed, 2-loculed; ovule 1 in each locule; styles 2, free or connate at base, inner surface stigmatose at apex. Fruit an indehiscent drupe, globose, 1- or 2-lobed, fleshy or dry; seeds with short fleshy aril; embryo curved; cotyledons plicate.

Tropics and subtropics, 1 polymorphic species.

Literature: Mukherjee, S.K. 1972. Indian *Allophylus* (*Sapindaceae*). *Indian Forester* 98: 489 - 496.

Allophylus cobbe (L.) Raeusch., *Nomencl. Bot.* ed. 3, : 108. 1797; Hiern in Hook.f., *Fl. Brit. India* 1: 673. 1875, incl. syns.; Bourd., *Forest Trees Travancore*: 77. 1908; Rama Rao, *Fl. Pl. Travancore*: 94. 1914; Leenh. in *Blumea* 15: 322. 1967; Nicolson & al. in *Regnum Veg.* 119: 236. 1988; Manilal, *Fl. Silent Valley*: 62. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 109. 1988; Vajr., *Fl. Palghat*: 129. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 123. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 116. 1996; Sivar. & P. Mathew, *Fl. Nilambur*: 160. 1997; P.C. Pant in N.P. Singh & al., *Fl. India* 5: 346. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 172. 2002. *Rhus cobbe* L., *Sp. Pl.*: 267. 1753. *Ornitrophe serrata* Roxb., *Pl.*

Coromandel 1: 44, t. 61. 1796. *Schimidelia distachys* DC., Prodr. 1: 610. 1824. *S. rheedei* Wight, Icon. Pl. Ind. Orient.: t. 964. 1845. *Allophylus serratus* (Roxb.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 44: 185. 1876; Gamble, Fl. Madras: 246(175). 1918; Manilal & Sivar., Fl. Calicut: 71. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 111. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 123. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 116. 1996; P.C. Pant in N.P. Singh & al., Fl. India 5: 349. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 173. 2002. *A. concanicus* Radlk. in Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20: 230. 1890; Gamble, Fl. Madras: 246(176). 1918, incl. var. *lanceolatus*; B.D. Sharma & B.G. Kulkarni in M.P. Nayar & Sastry, Red Data Book Indian Pl. 2: 238. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 110. 1988; Vajr., Fl. Palghat: 129. 1990; Sivar. & P. Mathew, Fl. Nilambur: 161. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 348. 2000. *A. distachys* (DC.) Radlk. in Engl. & Prantl, Nat. Pflanzenfam. 3(5): 313. 1895; Gamble, Fl. Madras: 176(246). 1918; Manilal, Fl. Silent Valley: 63. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 111. 1988; Vajr., Fl. Palghat: 130. 1990. *A. rheedei* (Wight) Radlk. in Engl. & Prantl, Nat. Pflanzenfam. 3(5): 313. 1895; Gamble, Fl. Madras: 246(176). 1918; P.C. Pant in N.P. Singh & al., Fl. India 5: 349. 2000. *A. serrulatus* Radlk. in Rec. Bot. Surv. India 3: 341. 1907; Gamble, Fl. Madras: 246(175). 1918; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 124. 1994; N. Mohanan & Sivad., Fl. Agasthyamala: 173. 2002.

Mal.: *Mukkannan-peru*

Scandent to erect shrub or small tree. Leaves 3-foliolate; petioles 4 - 14.5 cm long; leaflets obovate, ovate or lanceolate, acute at base, dentate or serrate-crenate at margin, acuminate to obtuse at apex, 4.5 - 19 x 2 - 10 cm, subcoriaceous to submembranous, hairy to glabrous; petiolules to 2 cm long. Flowers ca 2.5 mm across, in axillary to 30 cm long simple or branched racemes; peduncles to 6 cm long; pedicels 1 - 2 mm long. Sepals 2 + 2; outer pair elliptic, ciliate; the inner obovate. Petals 4, unilateral, oblong-obovate, clawed, ca 2 mm long, white. Male flowers: Filaments ca 2 mm long, unequal, glabrous; anthers ovoid. Female flowers: Ovary 2-lobed, 2-loculed; style deeply divided; stigma 2-fid; drupes 1- or 2-lobed; lobes globose, ca 5 mm, glabrous, orange-red.

Fl. & Fr.: Throughout the year.

Habitat: Evergreen and semievergreen forests.

Distrib.: Almost throughout Kerala. Andaman & Nicobar Islands, E., NE. and S. India. South and SE. Asia.

Note: Many floras recognize a number of distinct species in the genus. Leenhouts (*l.c.*) opined that about 265 species and 5 varieties described under the genus are mostly based on local populations. Phenetically speaking *Allophylus* consists of but one species, as treated by Leenhouts, which is followed here.

2. CARDIOSPERMUM L.

Climbing herbs. Leaves distichous, 2-ternate; leaflets pinnatifid-pinnatisect. Inflorescences 3-branched racemes or corymbs; the lowest pair of branches modified into tendrils. Flowers zygomorphic, bi- and unisexual, polygamodioecious. Sepals 4, imbricate; outer pair smaller. Petals 4, larger than sepals. Disc unilateral, reduced to 2 linear or rounded glands. Stamens 8, eccentric, unequal. Ovary 3-loculed; locules rounded; style 3-fid, inner surface stigmatic. Capsules inflated, membranous, reticulately nerved, loculicidal, 3-valved; seeds globose with conspicuous hilum.

Tropics especially America, 14 species and 2 in India.

Key to species

- 1a. Leaves obtuse-mucronate at apex, densely pubescent; fruits pyriform, ca 2.5 cm across
1. *C. canescens*
- b. Leaves acuminate at apex, subglabrous; fruits sharply 3-lobed, ca 1.5 cm across
2. *C. halicacabum*

1. *Cardiospermum canescens* Wall., Pl. Asiat. Rar. 1: 14, t. 14. 1829; Wight, Icon. Pl. Ind. Orient.: t. 74. 1838; Hiern in Hook.f., Fl. Brit. India 1: 670. 1875; Rama Rao, Fl. Pl. Travancore: 93. 1914; Gamble, Fl. Madras: 245(175). 1918; Vajr., Fl. Palghat: 130. 1990; P.C. Pant in N.P. Singh & al., Fl. India 5: 355. 2000.

Branches wiry, prominently striate, pubescent. Leaves 2-ternate; leaflets ovate to elliptic, cuneate at base, pinnatifid to coarsely dentate at margin, obtuse-mucronate at apex, 1 - 5 x 0.5 - 2.5 cm, glabrescent above, densely pubescent beneath; lateral nerves 4 - 6 pairs; petioles 5 - 15 mm long, pubescent. Flow-

ers 1 - 1.5 cm across, many, in axillary corymbose racemes; peduncles 7 - 12 cm long; pedicels 2 - 5 mm long; bracts lanceolate, acute, ca 1 x 0.5 mm. Sepals 2 + 2; outer pair suborbicular, pubescent; the inner obovate. Petals 2 + 2, white; inner pair near stamens, oblong, ca 6 x 4 mm; the outer orbicular-obovate with inflexed apical crest, tomentose. Male flowers: Stamens 2 - 4 mm long; filaments pilose. Female flowers: Ovary oblong, ca 2 mm across, tomentose; style ca 1.5 mm long; stigmas 3-fid; capsules globose, bloated, ca 2.5 cm; seeds globose, ca 4 mm, black; hilum small, orbicular.

Fl. & Fr.: Dec. - Jan.

Habitat: Open areas and margins of deciduous forests.

Distrib.: Idukki and Palakkad. Southern India. Myanmar.

2. *Cardiospermum halicacabum* L., Sp. Pl.: 366. 1753; Hiern in Hook.f., Fl. Brit. India 1: 670. 1875; Rama Rao, Fl. Pl. Travancore: 93. 1914; Gamble, Fl. Madras: 244(175). 1918; Manilal & Sivar., Fl. Calicut: 70. 1982; Nicolson & al. in Regnum Veg. 119: 237. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 111. 1988; Vajr., Fl. Palghat: 130. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 124. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 116. 1996; Sivar. & P. Mathew, Fl. Nilambur: 161. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 356. 2000.

Mal.: *Jothishmathi, Paluzhavam, Ulinja, Uzhinja*

Branches wiry, striate, glabrous. Leaves 2-ternate; leaflets ovate-lanceolate, obtuse and slightly decurrent at base, pinnatilobed to pinnatisect, acuminate at apex, 1.5 - 6.5 x 0.5 - 3 cm, glabrescent; petioles to 4 cm long; petiolules to 2 mm long. Flowers ca 4 mm across, few, in axillary umbelled cymes; peduncles to 11.5 cm long; pedicels 0.3 - 2 cm long. Sepals 2 + 2; outer pair suborbicular; the inner oblong-obovate. Petals 2 + 2, white; inner pair oblong, ca 3.5 mm long; the outer ca 2.5 mm long with puberulous apical crest. Male flowers: Stamens ca 2 mm long; filaments pilose. Bisexual flowers: Filaments ca 1.5 mm long; ovary oblong, ca 2 mm across, pubescent; stigma shortly 3-fid, sessile; capsules sharply 3-lobed, ca 2 x 1.5 cm, pubescent; seeds ca 3 mm across with a cordate hilum.

Fl. & Fr.: Throughout the year.

Habitat: Open wastelands and margins of deciduous forests.

Distrib.: Throughout Kerala. Throughout India. Tropics.

Uses: Decoction of whole plant is a laxative, enriches blood and removes disor-

ders and relieves pain in joints.

3. DIMOCARPUS Lour.

Trees or shrubs, monoecious. Leaves alternate or spiral, paripinnate, rarely 1-foliolate, 1-7-paired; leaflets usually alternate, petioluled, papyraceous to thin-coriaceous, glabrous to hairy. Inflorescences terminal or axillary thyrsoid cymes. Calyx cupular, 5-lobed. Petals 5 or 6, without scales. Disc annular, slightly 5-lobed, velutinous. Stamens 8(6-10), equal; filaments slender, hairy; anthers basifixed. Ovary tubercled, hairy, 2-loculed. Fruit a schizocarp, globose to broadly ellipsoid, warty, sometimes densely spiny, glabrescent, indehiscent; seeds globose, arillate.

Southeast Asia to Australia, 5 species and 1 in India.

Literature: Muller, J. 1971. Pollen morphological notes on the genus *Dimocarpus* (*Sapindaceae*). *Blumea* 19: 133-145.

Notes: Leenhouts (*l.c.*) combined the genera *Euphoria* Comm. ex Juss. and *Pseudonephelium* Radlk. as distinguished by Radlkofer (1932) and retained the name *Dimocarpus* Lour. He considered that it is closely related to *Otonephelium* Radlk. which differs from *Dimocarpus* only in the presence of pseudostipules and glabrous disc.

In *Index Nominum Genericorum (Plantarum)* (*Regnum Veg.* 100: 541. 1979) *Dimocarpus* Lour. is considered a later nomenclatural synonym of *Litchi* Sonn. (1782) and hence illegitimate, an opinion based upon the fact that the first species *D. litchi* was considered by Loureiro as representing the Chinese *Li-Chi*. Leenhouts admitted that Loureiro intended to describe the same species that was the type of *Litchi* Sonn. But as he did not cite nor refer to the latter formally, *Dimocarpus* Lour. cannot be treated as a superfluous name.

Loureiro (1790) characterised his new genus by a rather detailed description of the flower and some general remarks on the fruit. The description of flower under the genus is quite clear and can only refer to *Euphoria* sensu Radlk. (1932), still more precisely to the taxon named *D. longan* subsp. *malesianus* Leenh. The description of *D. litchi* can refer partly to *Euphoria* as well as to *Litchi*, some characters, however, to the latter only. Moreover 2 specimens at

BM sent by Loureiro and named *D. litchi* are no doubt *Litchi chinensis* Sonn. So *D. litchi* is a mixture mainly based upon *Litchi chinensis* but for a small part only on *D. longan* subsp. *malesianus*. However, as it is the type of *Dimocarpus* and as the flowers are the important part of generic description, Leenhouts opined that *D. litchi* has to be lectotypified by the flowering part of the type.

Euphoria as originally described by (Comm. ex) Jussieu agrees completely and exclusively with *Litchi* which was also cited. Gmelin (1791) differentiated between these two names, reserving *Euphoria* for the longan but this was contrary to the original description.

More Gaertn. is invalid as it was not intended as a scientific name at all. It was included in the Appendix which gives only vernacular names. It is a Sinhalese name and refers to *D. longan*.

Dimocarpus longan Lour., Fl. Cochinch.: 233. 1790; Leenh. in Blumea 19: 122. 1971; Manilal, Fl. Silent Valley: 63. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 11. 1988; Vajr., Fl. Palghat: 131. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 124. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 117. 1996; Sivar. & P. Mathew, Fl. Nilambur: 162. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 358. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 174. 2002. *Euphoria longana* Lam., Encycl. 3: 574. 1792, nom. illeg.; Bedd., Fl. Sylv. S. India: t. 156. 1871. *Nephelium longana* (Lam.) Cambess. in Mem. Mus. Hist. Nat. 18: 30. 1829; Hiern in Hook.f., Fl. Brit. India 1: 698. 1875; Bourd., Forest Trees Travancore: 111. 1908; Rama Rao, Fl. Pl. Travancore: 95. 1914; Gamble, Fl. Madras: 252(180). 1918.

Mal.: *Pasakotta, Shempunna*

Evergreen tree, to 20 m tall. Leaves paripinnate; leaflets (1)2 - 4(5) pairs, subopposite, oblong to ovate-lanceolate, oblique at base, entire at margin, obtuse or acuminate at apex, 5 - 27 x 3 - 8 cm, coriaceous, shining, glabrescent above, glaucescent beneath; lateral nerves ca 15 pairs; petioles to 10 cm long; petiolules to 1 cm long. Flowers ca 6 mm across, in axillary panicles, creamy white; peduncles to 4 cm long; pedicels 2 - 4 mm long. Calyx cupular, 5- or 6-lobed, ca 4 mm long. Petals 5 or 6, oblong, ca 2.5 mm long, pilose near base. Disc velutinous. Stamens ca 3 mm long, equal, pilose below; anthers ovoid. Bisexual flowers:

Stamens shorter than petals, stout; ovary ovoid, 2-lobed; locules 1-ovuled; style ca 3 mm long; stigma 2-fid; fruits with globose lobes, ca 1.5 cm across, warty, red; seeds with a fleshy aril.

Fl.: Feb. - April *Fr.*: June - Aug.

Habitat: Evergreen forests, to 800 m.

Distrib.: Almost throughout Kerala. Arunachal Pradesh, Assam, Meghalaya, Punjab, Uttar Pradesh and W. Bengal. South and SE. Asia. Cultivated in many SE. Asian countries.

Uses: Occasionally cultivated for the edible fruit. Wood is used for furniture and buildings.

4. DODONAEA Mill.

Shrubs, rarely small trees. Leaves alternate, simple or pinnate. Inflorescences axillary or terminal racemes or panicles. Flowers yellowish green, uni- or bisexual, polygamodioecious. Calyx lobes 2 - 5, imbricate or valvate. Petals absent. Stamens 5 - 8(10), inserted outside disc; filaments shorter than anthers, glabrous; anthers linear-oblong. Disc small. Ovary 3 - 6-loculed; locules 2-ovuled; style 3 - 6-lobed. Fruit a 2 - 6-lobed coriaceous capsule, 2 - 6-winged, dehiscent septically; seeds lenticular or subglobose, compressed, exarillate; cotyledons spirally convolute.

Tropics and subtropics especially Australia, 68 species, 2 in India and 1 in Kerala.

Literature: West, J.G. 1984. A revision of *Dodonaea* Miller (*Sapindaceae*) in Australia. *Brunonia* 7: 1 - 194.

Dodonaea angustifolia L.f., *Suppl. Pl.*: 218. 1782; Leenh. in *Blumea* 28: 280. 1983; P.C. Pant in N.P. Singh & al., *Fl. India* 5: 360. 2000. *D. burmanniana* DC., *Prodr.* 1: 616. 1824; Wight & Arn., *Prodr. Fl. Ind. Orient.*: 114. 1834; Wight, *Ill. Ind. Bot.* 1: t. 52. 1840. *D. viscosa* auct. non (L.) Jacq. 1760: Hiern in Hook.f., *Fl. Brit. India* 1: 697. 1875; Bourd., *Forest Trees Travancore*: 113. 1908; Rama Rao, *Fl. Pl. Travancore*: 96. 1914; Gamble, *Fl. Madras*: 253(181). 1918; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 125. 1994.

Mal.: *Krali*, *Porim-puvana*, *Unnatharuvi*, *Vrali*

Shrub to small tree, to 8 m high. Leaves simple, subsessile, elliptic-oblan-
ceolate, attenuate at base, entire at margin, obtuse to acute at apex, 1.5 - 9 x 0.8
- 2.5 cm, thin-coriaceous. Flowers unisexual, 2 - 6 cm long, in axillary or terminal
racemes or panicles. Sepals 4 or 5, oblong, ca 2 mm long, ciliate. Disc rudimentary.
Male flowers: Stamens 4 - 10; filaments ca 0.8 mm long, glabrous; anthers ca 2.5
mm long. Female flowers: Ovary ca 2 mm across; style ca 5 mm long; stigma 2-
or 3-lobed; capsules ca 2 x 1.5 cm, 2- or 3-winged, strongly nerved; seeds globose,
ca 2.5 mm.

Fl. & Fr.: Oct. - Feb.

Habitat: Shrub in drier parts, attaining a tree habit in sholas, to 2500 m, common.

Distrib.: Idukki, Kollam, Kottayam, Malappuram and Thiruvananthapuram.
Throughout India. Most tropical countries.

Uses: A hedge plant. Wood is used for tool handles.

5. *FILICIUM* Thwaites ex Benth.

Trees; branchlets angled, with wavy scales. Leaves pari- or imparipinnate;
leaflets (6 -)11 - 17(- 20), subopposite, entire; rachises broadly winged.
Inflorescences axillary panicles. Flowers actinomorphic, polygamous. Calyx 5-lobed;
lobes imbricate, caducous. Petals 5, imbricate, without scales. Disc 5-lobed,
tomentose. Stamens 5, inserted within disc; filaments linear, pubescent or glabrous;
anthers ovate. Ovary globose, 2-loculed; ovule 1, pendulous; style bent; stigma
simple or 2-lobed. Fruit a fleshy drupe, 1- or 2-seeded; seeds oblong; testa
membranous; cotyledons foliaceous, crumpled.

Old World tropics, 3 species and 1 in India.

Literature: Gulati, N. & Mathur, S. 1977. Embryology and taxonomy of *Filicium*
decipiens. *Phytomorphology* 27: 261 - 266.

Filicium decipiens (Wight & Arn.) Thwaites, Enum. Pl. Zeyl.: 408. 1864;
Bedd., Fl. Sylv. S. India: t. 129. 1871; Hiern in Hook.f., Fl. Brit. India 1: 539. 1875;
Bourd., Forest Trees Travancore: 77. 1908 (sub *Burseraceae*); Rama Rao, Fl. Pl.
Travancore: 71. 1914 (sub *Burseraceae*); Gamble, Fl. Madras: 249(178). 1918;
V.S. Ramach. & V.J. Nair, Fl. Cannanore: 112. 1988; P.C. Pant in N.P. Singh &
al., Fl. India 5: 363. 2000. *Rhus decipiens* Wight & Arn., Prodr. Fl. Ind. Orient.:
172. 1834; Wight, Ill. Ind. Bot. 1: t. 75. 1840.

Mal.: *Niroli*, *Valmuriccha*

Evergreen tree, to 15 m tall; branchlets covered with scales. Leaves 20 - 30 x 13 - 15 cm; leaflets (6 -)13 - 17(- 20), lanceolate, attenuate at base, entire at margin, acute to retuse at apex, 4.5 - 12 x 1 - 2.5 cm, (juvenile leaflets to 18.5 cm), subcoriaceous, punctate, glabrous, shining; petioles angled, 4 - 10 cm long; rachises broadly winged between leaflets. Flowers 1.5 - 2 mm long, in axillary panicles, white; pedicels stout, ca 4 mm long. Calyx lobes 5, ovate, ca 2 mm long. Petals 5, orbicular, ca 2 mm, equal, unappendaged. Disc annular, 5-lobed, tomentose. Stamens 5, ca 2.5 mm long, equal; filaments glabrous; anthers ovoid. Drupes subglobose, apiculate, ca 1.5 x 1 cm, fleshy, 1- or 2-loculed; seeds 1 or 2, oblong, exarillate.

Fl. & Fr.: Nov. - Aug.

Habitat: Evergreen forests, to 1500 m.

Distrib.: Idukki and Kannur. Southern India, East Africa and Sri Lanka.

Uses: Sometimes introduced as an ornamental tree in parks and gardens for the fern-like foliage. Wood is hard and useful.

6. HARPULLIA Roxb.

Trees. Leaves alternate, paripinnate; leaflets opposite and alternate, entire, subglabrous. Inflorescences axillary or subterminal racemes or panicles. Flowers actinomorphic, uni- and bisexual, polygamodioecious. Sepals 4 or 5, erect, equal, imbricate. Petals 4 or 5, without scales. Disc small, 5-lobed. Stamens 5 - 8, inserted at disc. Ovary ovoid, 2-loculed; locules 2-ovuled; style elongate; stigma linear. Fruit an inflated coriaceous 2-lobed capsule, dehiscing loculicidally; seeds subglobose, usually arillate; cotyledons subglobose, thick.

Indomalaysia to tropical Australia, 37 species, 2 in India and 1 in Kerala.

Harpullia arborea (Blanco) Radlk. in Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 16: 404. 1890; Leenh. & Vente in Blumea 28: 11. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 112. 1988; Vajr., Fl. Palghat: 131. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 117. 1996; Sivar. & P. Mathew, Fl. Nilambur: 163. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 365. 2000. *Ptelea arborea* Blanco, Fl. Filip.: 63. 1837. *Otonychium imbricatum* Blume, Rumphia 3: 180. 1849. *Harpullia imbricata* (Blume) Thwaites, Enum. Pl. Zeyl.:

56. 1858; Gamble, Fl. Madras: 253(180). 1918. *H. cupanioides* auct. non Roxb. 1824; Bedd., Fl. Sylv. S. India: t. 158. 1871; Hiern in Hook.f., Fl. Brit. India 1: 692. 1875 p.p.; Bourd., Forest Trees Travancore: 112. 1908; Rama Rao, Fl. Pl. Travancore: 96. 1914.

Mal.: *Chittila madaku*, Naikodi

Evergreen tree, to 20 m tall; young parts densely tomentose. Leaves to 45 cm long; leaflets 2 - 6 pairs, alternate, oblong-lanceolate, oblique at base, entire at margin, acuminate at apex, 14 - 18 x 2 - 7 cm, membranous; petioles 5 - 15 cm long; petiolules 3 - 8 mm long, hairy in axils. Flowers in axillary or subterminal to 20 cm long panicles, greenish. Sepals 4 or 5, ovate to obovate, 5 - 10 x 3 - 5 mm. Petals spatulate, clawed, 10 - 25 x 3 - 10 mm, glabrous or sparsely hairy in lower half. Disc hairy. Stamens 10 - 15 mm long. Capsules inflated, 2-lobed, 3 - 5 x 2.5 - 4 cm, hairy, orange to scarlet, loculicidally 2-valved; seeds 1 or 2 per lobe, black, arillate.

Fl. & Fr.: Dec. - June.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Assam and S. India. South and SE. Asia to Australia.

Uses: Bark is used as a fish poison. Watery exudate from bark and fruit is used to keep away leeches. Seed oil is used in rheumatism.

7. LEPISANTHES Blume

Trees or shrubs. Leaves spiral, pari- or imparipinnate, sometimes simple; leaflets opposite or alternate. Inflorescences terminal or axillary or rami- to cauliflorous. Flowers unisexual, monoecious, zygomorphic. Sepals 5 or 4, free, imbricate, entire; outer 2 smaller, puberulous. Petals 5 or 4, distinctly clawed; scales hairy or glabrous. Disc complete or partial and luniform, hairy or glabrous. Stamens 8(4 - 18); filaments hairy. Ovary pubescent, 2- or 3 (1 - 4)-loculed; ovule 1 in each locule, axile; style as long as ovary or stigma sessile. Fruits sessile to short-stalked, drupaceous, entire or distinctly lobed, smooth to slightly warty, hairy to glabrous; seeds glabrous to hairy, exarillate; hilum small.

Old World tropics, 24 species, 5 in India and 2 in Kerala.

Literature: Muller. J. 1970. Pollen morphology of the genus *Lepisanthes* (*Sapindaceae*) in relation to its taxonomy. *Blumea* 18: 507 - 561.

Key to species

- 1a. Shrub; leaves imparipinnate; leaflets oblong-lanceolate; fruits ellipsoid **1. *L. erecta***
 b. Tree; leaves paripinnate; leaflets elliptic-oblong; fruits 3-gonous **2. *L. tetraphylla***

1. *Lepisanthes erecta* (Thwaites) Leenh. in *Blumea* 17: 69. 1969; Manilal, Fl. Silent Valley: 64. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 113. 1988; Vajr., Fl. Palghat: 131. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 125. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 118. 1996; P.C. Pant in N.P. Singh & al., Fl. India 5: 368. 2000. *Nephelium erectum* Thwaites, Enum. Pl. Zeyl.: 57. 1858; Bedd., Fl. Sylv. S. India: 74. 1872. *Sapindus erecta* (Thwaites) Hiern in Hook.f., Fl. Brit. India 1: 683. 1875; Rama Rao, Fl. Pl. Travancore: 95. 1914. *Thraulococcus erectus* (Thwaites) Radlk. in Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Acad. Wiss. München 8: 300. 1878; Gamble, Fl. Madras: 251(179). 1918.

Erect shrub, to 3 m high. Leaves to 50 cm long; petioles 7 - 20(- 28) cm long; leaflets 3 - 5(- 6) pairs, subopposite, oblong-lanceolate, cuneate or attenuate at base, entire at margin, bluntly acuminate at apex, 10 - 22 x 3 - 6 cm, glabrous. Flowers in subterminal or terminal 5 - 15 cm long racemose cymes; pedicels 3 - 7 mm long. Sepals 5, imbricate, ovate, 2.5 - 3.5 x 2 - 3 mm, sericeous. Petals spatulate, ca 5 mm long; scale oblong, pubescent. Disc glabrous. Male flowers: Stamens 8; filaments sericeous in upper half. Female flowers: Ovary globose, 3-lobed, pubescent; style ca 2 mm long; stigma 3-lobed; fruits deeply 2- or 3-parted; drupelets ellipsoid, spreading, ca 2.5 x 1.5 cm, yellow-tomentose; pericarp thin; seeds ellipsoid, blackish brown, exarillate.

Fl. & Fr.: Oct. - March.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Kannur, Palakkad, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Tamil Nadu (Anamalais). Sri Lanka.

Note: Leenhouts (*l.c.*) stated that only male flowers are known. There are female flowers in one collection from Palakkad (*Vajravelu* 48926 MH).

2. *Lepisanthes tetraphylla* (Vahl) Radlk. in Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8: 276. 1878; Gamble, Fl. Madras:

247(176). 1918; Leenh. in Blumea 17: 63. 1969; Manilal & Sivar., Fl. Calicut: 64. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 113. 1988; Vajr., Fl. Palghat: 132. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 118. 1996; Sivar. & P. Mathew, Fl. Nilambur: 164. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 372. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 174. 2002. *Sapindus tetraphylla* Vahl, Symb. Bot. 3: 54. 1794. *S. deficiens* Wight & Arn., Prodr. Fl. Ind. Orient.: 111. 1834. *Hemigyrosa deficiens* (Wight & Arn.) Bedd., Fl. Sylv. S. India: t. 231. 1872; Hiern in Hook.f., Fl. Brit. India 1: 671. 1875; Bourd., Forest Trees Travancore: 108. 1908; Rama Rao, Fl. Pl. Travancore: 94. 1914. *Lepisanthes deficiens* (Wight & Arn.) Radlk. in Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8: 276. 1878; Gamble, Fl. Madras: 247(176). 1918.

Tree, to 20 m tall. Leaves paripinnate, to 60 cm long; leaflets alternate, 2 - 6 (- 7) pairs, elliptic-oblong, acute at base, entire at margin, obtuse to acuminate at apex, 6 - 26 x 2.5 - 9 cm, cori- to chartaceous, glabrous; petioles 7 - 10 cm long; petiolules 4 - 7 mm long. Inflorescences axillary or rami- to cauliflorous simple or branched panicles, 10 - 40 cm long. Flowers purple; pedicels 5 - 8 mm long, tomentose. Sepals 5, subequal, obtuse, tomentose outside. Petals 4, spatulate with 1 or 2 scales. Disc 4- or 5-lobed. Male flowers ca 5 mm across; stamens 8; filaments ca 4 mm long, villous; anthers ovoid. Female flowers: Ovary globose, 3-lobed, densely pubescent; style ca 1.5 mm long; stigma discoid to 3-lobed; fruits 3-gonous, ca 2 x 1.5 cm, apiculate, velvety, yellow; seed 1, exarillate.

Fl. & Fr.: Nov. - April.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Idukki, Kannur, Kollam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Southern India. South and SE. Asia.

Use: Fruit has a sweetish edible pulp.

Note: *Lepisanthes deficiens* was treated as a distinct species by Gamble (*l.c.*) but Leenhouts (*l.c.*) recognized it as a race of *L. tetraphylla*. These races can be differentiated as shown below.

- | | | |
|-----|--|----------------------------|
| 1a. | Leaflets 2 - 4 pairs, elliptic-oblong, coriaceous; petals with 2 scales | race 1. tetraphylla |
| b. | Leaflets 4 - 7 pairs, oblong or oblong-lanceolate, membranous; petals with 1 scale | race 2. deficiens |

8. OTONEPHELIUM Radlk.

Evergreen tree. Leaves subsessile, paripinnate; leaflets 2 - 5 pairs; lowest pair reniform, stipule-like; uppermost pair the largest. Inflorescences axillary or terminal panicles of cymules, pubescent; cymules interrupted, subsessile. Flowers actinomorphic, polygamous. Calyx 5-fid; lobes coriaceous, fulvous-tomentose outside, tomentose inside. Petals 5, without scales, early caducous. Stamens 5 - 9; filaments filiform, villous near apex; anthers ovoid, dorsifixed. Disc annular, glabrous. Ovary 2-lobed, 2-loculed; ovule 1 in each locule; style 2- or 3-lobed, tomentose; stigma 2-lobed. Fruits suberect, drupaceous, ovoid, covered with weak prickles ending in bristles; seeds ellipsoid, arillate.

Southern India, unispecific.

Literature: Berg, R.G. van den 1978. Pollen morphology of the genera *Pometia*, *Cubilia*, *Otonephelium* and *Litchi* (*Sapindaceae* - *Nepheliceae*). *Blumea* 24: 369 - 394.

Otonephelium stipulaceum (Bedd.) Radlk. in Act. Congr. Int. Bot., Amsterdam: 71. 1877; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 113. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 118. 1996; Sivar. & P. Mathew, Fl. Nilambur: 164. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 378. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 175. 2002. *Nepheleum stipulaceum* Bedd. in Trans. Linn. Soc. London 25: 212. 1865 & Fl. Sylv. S. India: t. 155. 1871; Hiern in Hook.f., Fl. Brit. India 1: 690. 1875; Bourd., Forest Trees Travancore: 111. 1908; Rama Rao, Fl. Pl. Travancore: 95. 1914; Gamble, Fl. Madras: 252(180). 1918. *Lepisanthes stipulaceum* (Bedd.) J.L. Ellis in B.D. Sharma & al. in Biol. Mem. 2: 34. 1977.

Mal.: *Paviri-mulei*

Tree, to 25 m tall. Leaves paripinnate; leaflets usually 2, rarely 3 - 5 pairs, opposite or subopposite; lowest pair at base of petiole stipule-like, reniform, 1.5 - 6 x 1 - 4 cm; other leaflets oblong-elliptic, cuneate at base, entire at margin, obtuse at apex, 5 - 24(- 30) x 2 - 11(- 14) cm, glabrous; petiolules to 1 cm long. Flowers ca 5 mm across, in terminal or axillary branched racemes, white. Calyx 5-partite; lobes ovate, acute, ca 2 mm long, pubescent. Petals 4, obovate, ca 2 mm long, without claw or appendage. Stamens 5 - 9, ca 4 mm, glabrous. Fruits, to 3.5 x 2.5 cm, densely echinate; setae obtuse, weak, hairy at tip; seeds ca 2 x 1.5 cm, arillate.

Fl.: Feb. - March *Fr.:* June - Aug.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Idukki, Kannur, Kottayam, Malappuram, Pathanamthitta, Thiruvananthapuram and Thrissur. Southern W. Ghats. Endemic.

Note: In floras it is usually mentioned that petals are absent. But according to Bourdillon (*l.c.*) petals are shorter than sepals and caducous. A collection from Thiruvananthapuram (*Vivekananthan* 66109 MH) shows presence of petals which are as long as calyx lobes and are without claw or appendage.

9. SAPINDUS L., nom. cons.

Trees or shrubs. Leaves alternate, paripinnate; leaflets subopposite, entire, coriaceous. Inflorescences axillary or terminal panicles. Flowers actinomorphic, polygamous. Sepals 5, unequal, imbricate. Petals 5, with or without scales inside. Disc annular, fleshy. Stamens 8, inserted within disc; filaments pilose; anthers oblong. Ovary 2 - 4-lobed, 2 - 4-loculed; ovule 1 in each locule. Fruit a drupe, 1 3-lobed, fleshy or coriaceous; lobes ovoid or globose, with saponaceous fibrous pericarp; seeds globose, exarillate; cotyledons thick.

Tropics and subtropics, 13 species, 3 in India and 2 in Kerala.

Literature: Umadevi, I., Daniel, M. & Sabnis, D. 1987. Identity and taxonomy of *Sapindus trifoliatus* Linn. *Curr. Sci.* 56: 369 - 370.

Key to species

- 1a. Leaflets obovate, emarginate at apex, coriaceous; petals glabrous inside; fruit of 3 puberulous to glabrous drupelets 1. *S. emarginatus*
- b. Leaflets elliptic-lanceolate, acuminate at apex, chartaceous; petals villous inside; fruit of 3 velvety drupelets 2. *S. trifoliatus*

1. *Sapindus emarginatus* Vahl, *Symb. Bot.* 3: 54. 1794; Bedd., *Fl. Sylv. S. India*: t. 154. 1871; Gamble, *Fl. Madras*: 250(178). 1918; P.C. Pant in N.P. Singh & al., *Fl. India* 5: 381. 2000. *S. trifoliatus* sensu Hiern in Hook.f., *Fl. Brit. India* 1: 682. 1875 p.p., non L. 1753.

Tree, to 20 m tall; branchlets tomentose. Leaves to 15 cm long; petioles to 5 cm long; leaflets 2 or 3 pairs, subopposite, obovate, cuneate at base, entire at margin, emarginate-retuse at apex, 2.5 - 13.5 x 2 - 5 cm, thick-coriaceous; petiolules to 5 mm long. Flowers ca 5 mm across, in terminal and axillary to 10 cm

long panicles; peduncles ca 2 cm long; pedicels ca 2 mm long. Sepals 5, ovate-orbicular, 3 - 4 mm long, strigose at apex. Petals 5, spatulate, 4 - 5 mm long, clawed with 2 appendages. Stamens 8, equal. Ovary 3-lobed; style ca 1 mm long; stigma 3-lobed. Fruit of 3 drupelets; drupelets globose, ca 1 cm, pubescent when young.

Fl. & Fr.: Nov. March.

Habitat: Deciduous and dry evergreen forests.

Distrib.: Idukki and Malappuram. Southern India; elsewhere cultivated.

Use: Fruit is used as a substitute for soap.

2. *Sapindus trifoliatus* L., Sp. Pl.: 367. 1753; Hiern in Hook.f., Fl. Brit. India 1: 682. 1875 p.p.; Bourd., Forest Trees Travancore: 110. 1908; Rama Rao, Fl. Pl. Travancore: 95. 1914; Nicolson & al. in Regnum Veg. 119: 237. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 119. 1996; Sivar. & P. Mathew, Fl. Nilambur: 165. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 382. 2000. *S. laurifolia* Vahl, Symb. Bot. 3: 54. 1794, nom. superf.; Gamble, Fl. Madras: 250(178). 1918; Manilal & Sivar., Fl. Calicut: 71. 1982; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 114. 1988; Vajr., Fl. Palghat: 132. 1990; N. Mohanan & Sivad., Fl. Agasthyamala: 176. 2002.

Mal.: *Erungi, Pasakotta, Pulinchi, Urungi*

Tree, to 20 m tall; branches glabrescent. Leaves to 30 cm long; petioles 10 - 11 cm long; leaflets usually 2 or 3, rarely 4 pairs, elliptic-lanceolate, subacute at base, entire at margin, acuminate at apex, 5 - 20 x 3 - 7 cm, chartaceous, glabrous, shining above; petiolules 5 - 6 mm long. Flowers ca 5 mm across, in 12 - 20 cm long panicles. Sepals 5, ovate, ca 4 mm long. Petals 5, spatulate, clawed, ca 5 mm long. Stamens 8, equal, ca 5 mm long. Ovary 3-lobed; style ca 1.5 mm long; stigma 3-lobed. Fruits combined drupes, ca 3.5 cm across, fleshy, black when dry.

Fl. & Fr.: Aug. March

Habitat: Evergreen and moist deciduous forests.

Distrib.: Almost throughout Kerala. Southern India. Pakistan and Sri Lanka.

Uses: Called 'soapnut tree' fruit is used as a substitute for soap. Leaf is used as a manure. Root and fruit are used in ayurvedic medicines. Wood is hard and useful.

10. SCHLEICHERA Willd., nom. cons.

Trees. Leaves alternate, paripinnate; leaflets opposite to subopposite, 4 - 6 (- 8); lateral nerves subparallel. Inflorescences simple, axillary, interrupted, paniced. Flowers fascicled, actinomorphic, uni- and bisexual, polygamodioecious. Calyx 4 - 6-fid; lobes valvate. Petals absent. Disc complete, undulate, glabrous. Stamens 5 - 8, inserted at disc; filaments pubescent; anthers oblong. Ovary ovoid, 3-loculed; ovule 1 in each locule; style rigid; stigma 3-lobed. Fruits ovoid, acute, crustaceous, coriaceous, dry, smooth or echinate, indehiscent; seeds erect, enveloped by fleshy aril; embryo conduplicate, unequal.

Indomalesia, unispecific.

Schleichera oleosa (Lour.) Oken, Allg. Naturgesch. 3(2): 1341. 1841; Merr. in J. Arnold Arbor. 31: 284. 1950; Manilal & Sivar., Fl. Calicut: 71. 1982; Manilal, Fl. Silent Valley: 64. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 114. 1988; Vajr., Fl. Palghat: 133. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 119. 1996; Sivar. & P. Mathew, Fl. Nilambur: 166. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 384. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 176. 2002. *Pilosa oleosa* Lour., Fl. Cochinch.: 615. 1790. *Schleichera trijuga* Willd., Sp. Pl. 4: 1096. 1806; Bedd., Fl. Sylv. S. India: t. 119. 1871; Hiern in Hook.f., Fl. Brit. India 1: 681. 1875; Bourd., Forest Trees Travancore: 110. 1908; Rama Rao, Fl. Pl. Travancore: 94. 1914; Gamble, Fl. Madras: 248(177). 1918.

Mal.: *Punnavu*, *Puvam*

Tree, to 25 m tall, densely leafy. Leaves paripinnate, to 20 cm long, glabrous; petioles 4 - 10 cm long; leaflets usually 4 - 6, rarely 8, subsessile to sessile, opposite to subopposite, oblong-elliptic to obovate, rounded to cuneate-subcordate at base, entire at margin, obtuse at apex, 4 - 24 x 2.5 - 10 cm, coriaceous; nerves prominent beneath. Flowers ca 4 mm across, in slender pendulous interrupted to 15 cm long panicles. Calyx lobes 4 - 6, valvate, 3-angled, ca 1 mm long, cream-coloured to yellowish. Disc flat, undulate. Stamens 5 - 8, inserted within disc; filaments ca 1.5 mm long, equal, free, pilose; anthers oblong. Ovary globose, ca 2 mm, 3-loculed; ovule 1, on basal placenta; style terete, ca 2 mm long; stigma 2- or 3-lobed. Fruits ovoid, beaked, ca 2 x 1 cm, glabrous, yellow; seeds ovoid, 1 or 2, ca 1 cm across.

Fl. & Fr.: Feb. Oct.

Habitat: Moist deciduous forests.

Distrib.: Throughout Kerala. Throughout the country. South and SE. Asia.

Uses: Wood is hard and useful for cart-wheels, oil crushers etc. Plant is an excellent host for the lac insect. Fruit is edible. Seed yields the Macassar oil, useful in dandruff treatment.

Litchi chinensis Sonn., *Voy. Indes Orient.* 2: 230, t. 129. 1782.
Nephelium litchi Cambess. in *Mem. Mus. Hist. Nat.* 18: 30. 1829; Hiern in *Hook.f., Fl. Brit. India* 1: 687. 1875; Gamble, *Fl. Madras*: 252(180). 1918.

Rarely cultivated in gardens. In N. India it is often cultivated on a large scale for the delicious fruit.

Blighia sapida J. König in *Ann. Bot. (J. König & Sims)* 2: 571, tt. 16 & 17. 1806.

The akee tree of W. Africa is occasionally cultivated for the edible fruit.

Excluded species

Erioglossum rubiginosum (Roxb.) Blume, *Rumphia* 3: 118. 1847; Gamble, *Fl. Madras*: 248(177). 1918; Mukh. in *J. Econ. Tax. Bot.* 1: 80. 1980.

Gamble (*l.c.*) reported it from the E. Ghats, but Mukherjee (*l.c.*) mentioned Andhra Pradesh, Kerala and Tamil Nadu as its range of distribution. There is no specimen from Kerala at MH.

STAPHYLEACEAE

(W. ARISDASON & P. DANIEL)

Trees or shrubs, sometimes dioecious. Leaves pinnate to 1-foliolate, opposite or spiral; leaflets usually serrate; stipules caducous or absent. Inflorescence a raceme or panicle. Flowers bi- or unisexual, actinomorphic, 5-merous. Sepals sometimes connate, imbricate, often petaloid. Petals imbricate. Stamens alternating with petals on or outside annular nectary-disc; anthers dehiscing by longitudinal slits. Carpels 2 or 3 (- 4), sometimes connate forming a pluriloculed ovary; ovules (1 or 2)6-12 in 2 rows in each locule, on axile or basal placentae, anatropous, 2-tegmic; styles free or somewhat connate. Fruit a head of follicles, a drupe

or berry or an inflated capsule with usually 1 or 2 seeds in each locule; endosperm oily, copious; embryo straight.

America, Eurasia to Malesia, 5 genera and 27 species, 2 and 5 in India and, 1 and 2 in Kerala.

TURPINIA Vent., nom. cons.

Trees or shrubs, glabrous. Leaves opposite, imparipinnate, stipuled; leaflets opposite, serrate or serrulate, herbaceous to subcoriaceous. Inflorescences axillary or terminal panicles, usually glabrous. Flowers bisexual, actinomorphic, 5-merous, to 5 mm across, bracteate and bracteolate. Sepals 5, free, imbricate, ciliate at margin, fleshy, persistent. Petals 5, free, imbricate, unequal, longer than sepals, membranous, usually ciliate at margin, caducous. Disc lobed or crenulate. Stamens 5, episealous, equal, inserted outside disc; anthers globose or ovoid, apiculate. Ovary sessile, broadly ovoid, 3-lobed, 3-loculed; ovules 2, collateral or many in 2 rows; styles 2 or 3 connate into simple; stigma capitate. Berries subglobose; seeds angled, shining, dark brown.

Indomalesia to Japan and tropical America, 10 species, 4 in India and 2 in Kerala.

Literature: Merrill, E.D. & Perry, L.M. 1941. Observations on the Old World species of *Turpinia* Vent. *J. Arnold Arbor.* 22 :543 - 555

Key to species

1a. Filaments glabrous; ovules 2 in each locule; fruits to 8 mm across

1. *T. cochinchinensis*

b. Filaments short-villous; ovules 6 in each locule; fruits to 3 cm across

2. *T. malabarica*

1. *Turpinia cochinchinensis* (Lour.) Merr. in *J. Arnold Arbor.* 19: 43. 1938; Manilal, *Fl. Silent Valley*: 62. 1988; P.C. Pant in N.P. Singh & al., *Fl. India* 5: 415. 2000. *Triceros cochinchinensis* Lour., *Fl. Cochinch.*: 184. 1790. *Turpinia nepalensis* Wight & Arn., *Prodr. Fl. Ind. Orient.*: 156. 1834; Bourd., *Forest Trees Travancore*: 114. 1908; Rama Rao, *Fl. Pl. Travancore*: 96. 1914; Gamble, *Fl. Madras*: 241(173). 1918; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 108. 1988; Vajr., *Fl. Palghat*: 128. 1990. *T. pomifera* sensu Hiern in Hook. f., *Fl. Brit. India* 1

:698.1875 p.p., non (Roxb.) DC. 1825.

Shrub or tree, to 7 m high, bark corky, grey. Leaflets 3–7, elliptic-oblong, acute to cuneate at base, serrate-crenate at margin, acuminate at apex, 5–10 x 2–5 cm, coriaceous, glabrous; nerves indistinct. Panicles axillary or terminal, to 15 cm long; flowers ca 3 mm across, greenish white; pedicels ca 1 mm long; bracts oblong-ovate, ca 0.8 mm long, ciliate; bracteoles ovate, ca 0.5 mm long. Sepals 5, unequal; larger 3 oblong, obtuse, 2–2.2 x 1–1.2 mm, ciliate; smaller 2 ovate, obtuse, 1.5–1.7 x 1.2–1.5 mm, ciliate, brown. Petals 5, oblong-ovate to -elliptic, ca 2 x 1–1.3 mm, ciliate. Disc 5-lobed. Stamens 5, episepalous; filaments subulate, to 1.2 mm long; anthers globose, ca 0.5 mm. Styles 3, connate into 1, ca 0.8 mm long; stigma capitate. Berries globose, 1–3-lobed.

Fl. & Fr. : Jan.–Nov.

Habitat. Evergreen forests and sholas, 1000–2000 m.

Distrib. : Idukki, Kannur, Kollam, Palakkad and Thiruvananthapuram. Assam, Meghalaya, Sikkim, Tamil Nadu and Uttar Pradesh. China, Myanmar, Nepal and Vietnam.

2. *Turpinia malabarica* Gamble in Bull. Misc. Inform. 1916: 135. 1916 & Fl. Madras: 241(173). 1918; Manilal, Fl. Silent Valley: 62.1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 108. 1988; Vajr., Fl. Palghat: 128. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 115. 1996; Sivar. & P. Mathew, Fl. Nilambur: 159. 1997; P.C. Pant in N.P. Singh & al., Fl. India 5: 416. 2000.

Mal.: *Pamba-vetti*

Tree, ca 10 m tall. Leaves 3–9-foliolate; leaflets elliptic-lanceolate, oblong-elliptic or ovate, acute, cuneate, rounded or oblique at base, serrate to crenate at margin, acuminate at apex, 5–13 x 2–7.5 cm, subcoriaceous, glabrous. Panicles axillary or terminal, to 21.5 cm long; flowers 3–3.5 mm across, yellowish white; pedicels to 2.3 mm long; bracts oblong-lanceolate, serrate, acuminate, 1–1.5 mm long, brown; bracteoles 2, ovate, ca 0.7 mm long, brown. Sepals 5, unequal; larger 3 oblong, obtuse, 2–3 x 1.5–2 mm, ciliate at margin, 1–3-nerved, brown; smaller 2 ovate or oblong-ovate, entire, obtuse, 1.8–2 x ca 1.3 mm, brown. Petals 5, obovate, short-clawed, 2.5–2.8 x 1.5–2 mm, ciliate at margin, nerved. Disc crenulate. Stamens 5, episepalous; filaments subulate, 1.8–2.2 mm long; anthers

more or less globose, 0.5 - 0.8 mm, 2-loculed, dehiscent longitudinally. Styles 3, connate into 1, ca 1 mm long; stigma patelliform. Berries globose, shortly 1 - 3-pointed, glabrous, yellowish brown.

Fl. & Fr.: June - Dec.

Habitat: Evergreen forests and sholas, to 1700 m.

Distrib.: Idduki, Kannur, Kollam, Kottayam, Malappuram, Palakkad, Pathanamthitta and Thrissur. Western Ghats of Karanataka and Tamil Nadu. Sri Lanka.

SABIACEAE

(N.P. BALAKRISHNAN)

Trees or shrubs, erect, often scandent. Leaves alternate, simple or pinnately compound, exstipulate, entire or toothed. Inflorescences axillary and terminal panicles, racemose or flower solitary, usually 5-, rarely 4- or 6-merous. Flowers bisexual or polygamodioecious. Sepals (3 - 5) (- 6), imbricate, basally connate. Petals (3 - 5) (- 7), free or basally connate, imbricate, equal or unequal. Stamens (4 - 5) (- 6), sometimes 3 of them staminodal, antipetalous, inserted at base of or on disc; anthers about as long as wide, sometimes didymous, dorsifixed; connectives sometimes enlarged. Disc annular or cupular, sometimes lobed or dentate, surrounding base of ovary. Ovary superior, often compressed, 2-, rarely 3-carpelled, 2- or 3-loculed; ovules 1 or 2 in each locule, axile, subapical, semianatropous, 1-tegmatic, crassinucellar; styles 2 or 3, elongate or short, free or loosely connate; stigmas apical, minute, rounded. Fruit a drupelet or schizocarp of 2 drupaceous or dry mericarps, sometimes 1 aborted; seed 1 in each locule, compressed or globose; hilum broad; testa membranous or coriaceous; embryo large; endosperm scanty or absent; cotyledons flat, fairly thick, usually folded or contorted; radicle cylindrical, bent against cotyledons.

Tropical America and Asia, 3 genera and ca 80 species, 2 and 11 in India and, 2 and 3 in Kerala.

Literature: Beusekom, C.F. van & Water, Th. P.M. van de 1989. *Subiaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 10: 679 - 715. Nayar, M.P. & Majumdar, S.C. 1990. *Subiaceae*. *Fasc. Fl. India* 20: 115 - 134.

Key to genera

- 1a. Trees; leaves simple or compound, entire, dentate or denticulate; stamens 5, only 2 fertile; drupes subglobose **1. Meliosma**
- b. Climbing shrubs; leaves simple, entire; stamens 4 or 5, all fertile; drupes compressed **2. Sabia**

1. MELIOSMA Blume

Trees or shrubs, evergreen, sometimes deciduous, usually pubescent; twigs more or less lenticelled, often with conspicuous leaf scars. Leaves alternate, simple or imparipinnate; leaflets subopposite, entire, sometimes dentate at margin; rachises and petioles swollen at base. Inflorescences terminal, sometimes axillary, pyramidally paniced, to 4 times branched; bracts small, caducous; bracteoles absent. Flowers actinomorphic, bisexual, minute, numerous, sessile or not. Sepals 5, by reduction sometimes 4, rarely 3, sometimes by addition of bracts seemingly more, to 13 and together forming an involucre, equal or not, persistent. Petals 5; outer 3 valvate or imbricate, more or less unequal, mostly suborbicular and convex, rarely the largest one reniform and broader than long, smaller ones irregularly shaped; inner 2 equal, entire, 2-fid. Stamens 5, 2 fertile ones and 3 staminodes; fertile filaments strap-shaped, incurved at top; anthers globose to ellipsoid, dehiscing transversely; sterile filaments opposite outer petals, deformed, irregularly shaped. Disc annular or cupular, often irregularly shaped with 5 or more teeth, sometimes reduced, rarely absent. Ovary sessile, globose, ovoid or conic, 2- rarely 3-loculed; ovules 2 (or 1) in each locule, superimposed, attached to partition; style minute; stigma simple or 2-fid. Fruit a drupe, subglobose or pyriform, 1-loculed; endocarp stony to crustaceous, splitting into 2 valves; seeds subglobose, more or less concave on ventral side, nonendospermous; testa membranous; embryo with long incurved radicle and folded cotyledons.

Tropical Asia and America, ca 55 species, 5 in India and 2 in Kerala.

Key to species

- 1a. Leaves compound; ovary pubescent **1. M. pinnata**
subsp. **barbulata**
- b. Leaves simple; ovary glabrous **2. M. simplicifolia**

1. **Meliosma pinnata** (Roxb.) Walp. subsp. **barbulata** (Cufod.) Beusekom in Dassan., Rev. Handb. Fl. Ceylon 3: 384. 1981; Manilal, Fl. Silent Valley: 66. 1988; Vajr., Fl. Palghat: 133. 1990; S.C. Majumdar in N.P. Singh & al., Fl. India 5: 423. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 177. 2002. *Meliosma rhoifolia* Maxim. subsp. *barbulata* Cufod. in Oesterr. Bot. Z. 88: 254. 1939. *Millingtonia arnottiana* Wight, Ill. Ind. Bot. 1: 144, t. 53. 1840. *Meliosma arnottiana* (Wight) Walp., Repert. Bot. Syst. 1: 423. 1842; Hook.f., Fl. Brit. India 2: 6. 1876; Bourd., Forest Trees Travancore: 115. 1908; Rama Rao, Fl. Pl. Travancore: 97. 1914; Gamble, Fl. Madras: 256(183). 1918. *M. pinnata* (Roxb.) Walp. subsp. *arnottiana* (Wight) Beusekom in Blumea 19: 499. 1971; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 115. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 120. 1996.

Mal.: *Kalavi*

Evergreen tree, 20 (- 30) m tall. Leaves 9 - 15-foliolate; petioles to 20 cm long; rachises 5 - 40 cm long, glabrous or densely pubescent; leaflets ovate to oblong or elliptic to lanceolate, often asymmetric, acute to rounded or truncate at base, entire or remotely dentate at margin, acute to acuminate or cuspidate to caudate at apex, 15 - 20 x 5 - 8 cm, charta- to coriaceous, moderately pubescent to glabrous, often with domatia in axils of nerves beneath; lateral nerves 3 - 15 pairs, ascending, prominent beneath; petioles to 5 cm long, terminal one the longest. Panicles erect, spreading, widely pyramidal, 10 - 50 cm long, lax to dense; lower branches usually subtended by small or reduced leaves; bracts ovate to narrowly 3-angled, 5 - 6 mm long; pedicels absent or minute. Flowers pale yellowish to white, fragrant. Sepals glabrous or outer ones rarely with a few hairs. Petals glabrous; inner ones deeply 2-fid, ciliolate or fringed at tip. Filaments ca 1 mm long; anthers reddish. Ovary to 1 mm long, densely pubescent; style 1 - 1.5 mm long, glabrous. Fruits subglobose to obovoid, 4 - 10 mm across with thin mesocarp, green, reddish to black when ripe; endocarp suboblique, 3 - 4 mm across, finely reticulate.

Fl.: Nov. - April *Fr.*: May - Sept.

Habitat: Evergreen forests, 500 - 1200 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Northeast India and SW. Ghats. South and SE. Asia.

Use: Timber is useful for making rafters and boxes.

2. *Meliosma simplicifolia* (Roxb.) Walp., Repert. Bot. Syst. 1: 423. 1842; Hook.f., Fl. Brit. India 2: 5. 1876; Bourd., Forest Trees Travancore: 115. 1908; Rama Rao, Fl. Pl. Travancore: 97. 1914; Gamble, Fl. Madras: 256(182). 1918; Manilal, Fl. Silent Valley: 65. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 125. 1994. *Millingtonia simplicifolia* Roxb., Pl. Coromandel 3: 50, t. 254. 1820.

Shrub or tree, to 20 m tall; twigs terete to angled, glabrous to densely puberulous. Leaves simple, elliptic, obovate to lanceolate or obovate-lanceolate, acute to attenuate at base, entire or sometimes spinescently denticulate towards apex, acute to acuminate sometimes cuspidate at apex, 3 - 45 x 1 - 16 cm, membranous, charta- to coriaceous, glabrous to densely pubescent especially on nerves beneath; lateral nerves 7 - 25 pairs, more or less ascending; nervation reticulate, distinct; petioles 1 - 6 cm long, glabrous to pubescent. Panicles terminal, rarely axillary, erect, pyramidal, 10 - 50 cm long, lax to dense, profusely branched to 4 times, sparsely to densely tomentose; lower branches subtended by small leaves. Flowers numerous, solitary or clustered, sessile or subsessile, yellow or white, fragrant. Sepals (4 or) 5, sometimes by addition of empty bracts to 11 (- 13), ovate, equal or not, glabrous to pubescent. Outer petals glabrous; inner ones more or less deeply 2-fid, 0.5 - 1.5 mm long with glabrous to ciliolate lobes. Filaments 0.5 - 1.5 mm long. Ovary glabrous, rarely pubescent; style to 1 mm long. Fruits subglobose, 6 - 10 mm across; endocarp subglobose, often depressed or oblique, 3 - 9 mm across, faintly to strongly reticulate-rugose.

Key to subspecies

- 1a. Leaves coriaceous, usually pubescent beneath; panicles densely ferruginous-pubescent; sepals and bracts (8 -)9 - 11(- 13); endocarp faintly rugose **2.1 subsp. *pungens***
- b. Leaves membranous, usually glabrous; panicles puberulous; sepals and bracts (4 or) 5; endocarp strongly rugose **2.2. subsp. *simplicifolia***

2.1. subsp. *pungens* (Wight & Arn.) Beusekom in Blumea 19: 467. 1971; Vajr., Fl. Palghat: 134. 1990; S.C. Majumdar in N.P. Singh & al., Fl. India 5: 427. 2000. *Millingtonia pungens* Wight & Arn. in Edinburgh New Philos. J. 15: 178. 1833 & Prodr. Fl. Ind. Orient: 115. 1834; Wight, Icon. Pl. Ind. Orient.: t. 964/3. 1845. *Meliosma pungens* (Wight & Arn.) Walp., Repert. Bot. Syst. 1: 115. 1842. *M. wightii* Brandis, Forest Fl. N.W. India: 116. 1874; Hook.f., Fl. Brit. India 2: 4.

1876; Bourd., Forest Trees Travancore: 114. 1908; Rama Rao, Fl. Pl. Travancore: 97. 1914; Gamble, Fl. Madras: 256(182). 1918.

Fl.: March - May *Fr.*: June - Sept.

Habitat: Evergreen forests, 1500 - 2000 m.

Distrib.: Idukki and Palakkad. Western Ghats of Karnataka and Tamil Nadu. Indonesia and Sri Lanka.

2.2. subsp. *simplicifolia*: Beusekom in Blumea 19: 466. 1971; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 115. 1988; Vajr., Fl. Palghat: 134. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 120. 1996; S.C. Majumdar in N.P. Singh & al., Fl. India 5: 427. 2000.

Fl.: Nov. - June *Fr.*: May - Sept.

Habitat: Evergreen forests, mostly near streams, 600 - 1500 m, common.

Distrib.: Almost throughout Kerala. Eastern Ghats of Andhra Pradesh and Orissa, NE. India and SW. Ghats. South and SE. Asia.

2. SABIA Colebr.

Evergreen or deciduous, woody climbers or climbing shrubs. Leaves alternate, simple, petioled, ovate to lanceolate, herba- or coriaceous, glabrous to pubescent, pinnately nerved. Flowers bisexual, 5-merous, actinomorphic, axillary, solitary or arranged in a few many-flowered cymes, appearing with or before new leaves; pedicels somewhat swollen above in fruit; bracts ovate to lanceolate; bracteoles smaller than bracts. Sepals (4 or) 5, equal or not, mostly somewhat connate at base, variable in size and shape, persistent. Petals 5, rarely 6 or 7, imbricate, episepalous, suborbicular, elliptic, ovate or obovate to lanceolate. Stamens (4 or) 5, all fertile, equal or not; filaments flat, inserted at base of disc, adnate to subtending petals at base; anthers globose to ovoid or ellipsoid, erect or inflexed, introrse. Disc annular, mostly crown-shaped. Ovary superior, 2-, rarely 3-carpelled, adaxillary more or less adnate to each other, globose to subreniform, usually laterally somewhat compressed, 2-loculed; ovules 2. Fruit of 1 or 2, dry or drupaceous drupelets, obovoid to subreniform, laterally compressed, gibbous with a sub-basal style; mesocarp thin, pulpy; endocarp crustaceous; seeds 1, rarely 2, reniform; testa coriaceous, dark-dotted; endosperm thin; embryo curved with 2 flat or undulate cotyledons.

South and SE. Asia, 19 species, 6 in India and 1 in Kerala.

Literature: Chen, L. 1943. A revision of the genus *Sabia* Colebr. *Sargentia* 3: 1-75.
Water, Th. P.M. van de 1980. A taxonomic revision of the genus *Sabia* (*Sabiaceae*). *Blumea* 26: 1-64.

Sabia limoniacea Hook.f. & Thomson, Fl. Ind.: 210. 1855; Hook.f., Fl. Brit. India 2: 3. 1876; Sasidh. & Sivar., Fl. PJ. Thrissur: 120. 1996; S.C. Majumdar in N.P. Singh & al., Fl. India 5: 432. 2000. *S. malabarica* Bedd., Icon. Pl. Ind. Orient.: t. 177. 1868-1874; Hook.f., Fl. Brit. India 2: 2. 1876; Gamble, Fl. Madras: 254(182). 1918.

Woody climber, to 10 m long; twigs glabrous, sometimes sparsely pubescent. Leaves oblong-elliptic, -ovate or -lanceolate, acute or rounded at base, acute or obtuse at apex, subcoriaceous, glabrous; lateral nerves 5-9 pairs, patent, ascending or curved; petioles to 2.5 cm long, wrinkled, glabrous. Cymes axillary, solitary, to 2 cm long, 1-4 (6)-flowered, subtended by herbaceous leaves of bracts, often arranged in to 15 cm long racemose or thyrsoid inflorescence, glabrous or laxly tomentellous; pedicels to 7 mm long; bracts oblong, to 4 mm long; bracteoles ovate to oblong, to 1.75 mm long, often near calyx. Flowers green to yellow or white. Sepals broadly ovate to elliptic, acute or rounded, ca 1 mm long, ciliolate. Petals suborbicular to elliptic or obovate, obtuse, 1.7-2.5 x 1.2-2 mm, 5-nerved. Stamens 1.5-2 mm long; filaments flat; anthers ellipsoid, inflexed. Disc crown-shaped, thin. Ovary ovoid, conic or globose, ca 1 mm long; style conic to cylindrical, ca 0.5 mm long. Drupelets globose or obovoid, strongly compressed, 1-1.5 x 1-1.3 cm, red to blue or black when fresh with reticulate pattern near margin.

Fl.: Sept. - Jan. *Fr.:* Dec. - April.

Habitat: Deciduous forests, 300 - 1200 m.

Distrib.: Palakkad (Silent Valley) and Thrissur. Eastern & NE. India and SW. Ghats. South and SE. Asia.

ANACARDIACEAE

(V. CHANDRASEKARAN)

Trees or shrubs, rarely climbers, dio- or monoecious, usually with acrid or resinous juice. Leaves alternate, rarely opposite, simple, 3-foliolate or imparipinnate,

exstipulate; rachises winged or not. Inflorescences terminal or axillary panicles or thyrses. Flowers bisexual, unisexual or polygamous, regular. Calyx of 3 - 5(- 7) sepals, free or connate, often accrescent, sometimes spathaceous. Petals 3 - 5(- 7), free or rarely basally connate, imbricate or valvate. Disc flat, cupular or annular, entire or lobed, rarely obsolete or absent. Stamens 5 (3 - 10) or twice as many as petals, inserted under or rarely at disc; filaments usually subulate; anthers 2-loculed, dorsiflexed, rarely basifixed, dehiscent longitudinally. Ovary superior, rarely inferior, 1 - 6-loculed, rudimentary or, 2- or 3-loculed in male flowers, sometimes with 5 or 6 free carpels; styles usually connate; stigmas apical, subsessile or capitate; ovule 1 in each locule, pendulous from above or side or from an ascending funicle. Fruits usually 1 - 5-loculed, 1 - 5-seeded drupes; stone sometimes dehiscent; seeds with membranous or chartaceous testa; endosperm scanty or absent; embryo straight or curved; cotyledons thin or moderately thick, planoconvex; radicle short.

Tropics and subtropics, 70 genera and ca 875 species, 23 and 68 in India and, 10 and 25 in Kerala.

Literature: Barkley, F.A. 1942. A key to the genera of the *Anacardiaceae*. *Amer. Midl. Nat.* 28: 465 - 474. Brizicky, G.K. 1962. The genera of *Anacardiaceae* in the South-eastern United States. *J. Arnold Arbor.* 43: 359 - 375. Ding Hou 1978. *Florae Malesianae praecursores LVI. Anacardiaceae. Blumea* 24: 1 - 41. Ding Hou 1978. *Anacardiaceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 8: 395 - 548. Sweet, H.R. & Barkley, F.A. 1936. A most useful plant family, the *Anacardiaceae*. *Missouri Bot. Gard. Bull.* 24: 216 - 229.

Key to genera

1a.	Leaves simple	2
b.	Leaves compound	8
2a.	Ovules ascending from a basal funicle	3
b.	Ovules pendulous from top or above middle of locule	6
3a.	Flowers polygamous	4
b.	Flowers bisexual	5
4a.	Stamens 1 - 5 fertile; fruit a fleshy drupe	6. <i>Mangifera</i>
b.	Stamens 8 - 10 all or some fertile; fruit a reniform nut	1. <i>Anacardium</i>
5a.	Stamens 8 - 10	2. <i>Buchanania</i>
b.	Stamens 4 - 6	3. <i>Gluta</i>
6a.	Stamens 4; style 1	7. <i>Nothopegia</i>

- | | | |
|-----|---|----------------------|
| b. | Stamens 5 or 6; styles 3 | 7 |
| 7a. | Petals imbricate; drupes superior | 9. <i>Semecarpus</i> |
| b. | Petals valvate; drupes inferior | 4. <i>Holigarna</i> |
| 8a. | Leaflets with a distinct continuous intramarginal nerve | 10. <i>Spondias</i> |
| b. | Leaflets without an intramarginal nerve | 9 |
| 9a. | Ovule pendulous from a basal funicle | 8. <i>Rhus</i> |
| b. | Ovule pendulous from top or above middle of locule | 5. <i>Lanea</i> |

I. ANACARDIUM L.

Shrubs or trees. Leaves alternate, petioled, simple, entire. Flowers in terminal bracteate panicles, polygamous. Calyx 5-partite; segments erect, imbricate, caducous. Petals 5, linear-lanceolate, recurved, imbricate. Disc filling base of calyx, erect. Stamens 8–10, all or some fertile; filaments connate and adnate to disc. Ovary obovoid or obcordate; style filiform, eccentric; stigma minute; ovule 1, ascending from a basal or lateral funicle. Nut reniform, seated on a large pyriform fleshy body formed of enlarged disc and top of peduncle; pericarp full of oil; seed reniform, ascending; testa membranous, adherent; cotyledons semilunar; radicle short, hooked.

Tropical America, 11 species and 1 introduced in India.

Literature: Ascenso, J.C. & Mota, M.G. 1972. Phylogenetic derivation of the cashew flower. *Bol. Soc. Brot.* 46: 253–257. Copeland, H.F. 1961. Observations on the reproductive structures of *Anacardium occidentale*. *Phytomorphology* 11: 315–325. Johnson, D. 1973. The botany, origin and spread of the cashew - *Anacardium occidentale* L. *J. Plantn. Crops* 1: 1–7.

***Anacardium occidentale* L.**, Sp. Pl.: 383. 1753; Bedd., Fl. Sylv. S. India: t. 163. 1871; Hook.f., Fl. Brit. India 2: 20. 1876; Bourd., Forest Trees Travancore: 121. 1908; Rama Rao, Fl. Pl. Travancore: 98. 1914; Gamble, Fl. Madras: 260(185). 1918; Manilal & Sivar., Fl. Calicut: 73. 1982; Nicolson & al. in Regnum Veg. 119: 47. 1988; Vajr., Fl. Palghat: 135. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 126. 1994; Sivar. & P. Mathew, Fl. Nilambur: 167. 1997; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 437. 2000.

Mal.: *Kasu-mavu*, *Paringi-mavu*

Tree, to 10 m high; trunk short, thick, crooked; branches terete, glabrous.

Leaves obovate or elliptic-oblong, cuneate at base, rounded and sometimes slightly emarginate at apex, 10 - 20 x 6 - 12.5 cm, glabrous, finely reticulate; lateral nerves 10 - 12 pairs, prominent beneath; petioles 0.9 - 1.75 cm long. Panicles to 25 cm long, pubescent; bracts ovate, acute, 5 - 10 mm long, puberulous outside. Flowers ca 8 mm across, yellow streaked with pink. Calyx lobes 5, lanceolate, ca 4 mm long, puberulous outside. Petals 5, linear-lanceolate, 8 - 13 mm long, deflexed from middle, minutely puberulous outside. Stamens usually 9, 1 longer than the rest; anthers ca 1 mm long. Ovary ca 2 mm long, glabrescent, attenuate into a subulate ca 4 mm long style. Fruits reniform, ca 2.5 x 1.5 cm, on a pyriform fleshy receptacle; seed reniform, 1.5 - 2 x ca 1 cm.

Fl.: Jan. Dec. *Fr.*: Jan. May.

Habitat: Cultivated and rarely naturalized especially at low levels.

Distrib.: Throughout Kerala. Coasts of S. India, introduced and naturalized.

Uses: Nut is roasted and the kernel eaten; pedicel is also eaten but is astringent. Pericarp yields an acrid caustic oil.

2. BUCHANANIA Spreng.

Trees. Leaves alternate, petioled, simple, entire. Flowers in terminal and axillary branched panicles, bisexual, white. Calyx 3 - 5-toothed or -lobed, imbricate, persistent. Petals 4 or 5, oblong, recurved, imbricate. Disc orbicular, 5-lobed. Stamens 8 - 10, free, inserted at base of disc; filaments linear; anthers lanceolate, ovate or oblong. Carpels 5 or 6, free, seated in cavity of disc, 1 fertile, rest imperfect; ovule 1, ascending from a basal funicle; style short; stigma truncate. Drupes scantily fleshy; stone crustaceous or bony, 2-valved; seeds gibbous, acute at one end; cotyledons thick; radicle superior.

Indomalaysia to the W. Pacific, ca 25 species, 8 in India and 4 in Kerala.

Key to species

- | | | |
|-----|---|------------------------|
| 1a. | Leaves scarcely coriaceous; inflorescences glabrous | 1. <i>B. axillaris</i> |
| b. | Leaves coriaceous; inflorescences pubescent | 2 |
| 2a. | Leaves broadly oblong, more than 15 x 5 cm; petioles stout | 4. <i>B. lanzan</i> |
| b. | Leaves narrowly oblong, less than 15 x 5 cm; petioles rather slender | 3 |
| 3a. | Leaves elliptic-oblong, obtuse or slightly acute at apex, rusty-villous beneath when young; lateral nerves regular, parallel and straight | 2. <i>B. barberi</i> |

- b. Leaves oblong-lanceolate or elliptic-lanceolate, acuminate at apex, glabrous beneath; lateral nerves ascending, curved and branched 3. *B. lanceolata*

1. ***Buchanania axillaris*** (Desr.) Ramamoorthy in C.J. Saldanha & Nicolson, Fl. Hassan: 374. 1976; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 441. 2000. *Mangifera axillaris* Desr. in Lam., Encycl. 3: 697. 1792. *Buchanania angustifolia* Roxb., Pl. Coromandel 3: 79, t. 262. 1820; Wight, Icon. Pl. Ind. Orient.: t. 101. 1839; Hook.f., Fl. Brit. India 2: 23. 1876; Rama Rao, Fl. Pl. Travancore: 99. 1914; Gamble, Fl. Madras: 259(184). 1918.

Mal.: *Malamavu*

Tree, ca 10 m high, glabrous; branches stout; bark rough, deeply fissured. Leaves linear-oblong, elliptic or elliptic-lanceolate, rounded or acute at base, entire at margin, obtuse, rounded or emarginate at apex, 7.5 - 15 x 3 - 5 cm, glabrous on both surfaces, reticulate; lateral nerves 12 - 15 pairs; petioles 1.75 - 3 cm long, slender. Flowers 3 - 6 mm across, in axillary and terminal glabrous branched panicles, white. Calyx lobes 5, semiorbicular, ca 1 mm long. Petals 5, oblong or ovate, ca 2.5 mm long. Stamens 10; anthers oblong. Ovary pilose. Drupes obliquely globose, ca 1.25 cm, slightly compressed.

Fl. & Fr.: May - Dec.

Habitat: Scrub and deciduous forests.

Distrib.: Kollam and Kottayam. Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. Sri Lanka.

Uses: Kernel of seed is edible. Wood is occasionally used for construction of temporary sheds and for yokes and planking.

2. ***Buchanania barberi*** Gamble in Bull. Misc. Inform. 1916: 135. 1916 & Fl. Madras: 259(184). 1918; Vajr. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 2: 10. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 127. 1994; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 442. 2000.

Tree; branchlets scabrous, greyish brown. Leaves elliptic-oblong, attenuate at base, obtuse or shortly acute at apex, 8 - 13 x 3 - 5 cm, rusty-villous beneath when young; midnerve thick, impressed above; lateral nerves 16 - 20 pairs, straight, parallel; petioles slender, ca 1 cm long. Panicles ca 10 cm long, spreading, ferruginous-villous; bracts and bracteoles ovate, acute. Flowers 6 - 7.5 mm across; pedicels

2 - 3 mm long. Calyx toothed, villous. Petals oblong, acute, ca 2.5 mm long, glabrous. Disc thick, crenulate. Stamens 10; filaments ca 1 mm long, curved; anthers narrow. Fertile ovary ovoid, villous at base.

Fl.: Nov.

Habitat: Coastal forests.

Distrib.: Kollam (Nadarai (Nadayara), C.A. Barber 6737 MH).

Note: Endemic and endangered. Not collected after the type.

3. *Buchanania lanceolata* Wight, *Icon. Pl. Ind. Orient.*: t. 237. 1839; Hook.f., *Fl. Brit. India* 2: 24. 1876; Bourd., *Forest Trees Travancore*: 128. 1908; Rama Rao, *Fl. Pl. Travancore*: 99. 1914; Gamble, *Fl. Madras*: 259(184). 1918; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 127. 1994; D. Chandra & Mukh. in N.P. Singh & al., *Fl. India* 5: 442. 2000.

Mal.: *Malamavu*

Tree, ca 25 m tall. Leaves elliptic-lanceolate to oblong- acute at base, wavy at margin, acuminate at apex, 10 12.5 x 3.5 4.5 cm, glabrous beneath; lateral nerves 16 - 20 pairs, ascending, curved, branched; petioles stout. Flowers ca 3 mm across, in axillary and terminal stout pubescent panicles. Calyx lobes orbicular. Petals ovate-oblong, obtuse, ca 1.5 x 1 mm, reflexed. Disc ca 1 mm, 8-crenate. Stamens 8; filaments subulate; anthers sagittate. Ovary ca 1 mm long, hairy at base. Drupes ca 1.5 cm across, compressed, glabrous, red.

Fl. & Fr.: Aug. May.

Habitat: Evergreen forests, to 675 m.

Distrib.: Kollam, Pathanamthitta and Thiruvananthapuram. Endemic and rare.

4. *Buchanania lanzan* Spreng. in *J. Bot. (Schrader)* 2: 234. 1800; Gamble, *Fl. Madras*: 258(184). 1918; Vajr., *Fl. Palghat*: 136. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 127. 1994; Sivar. & P. Mathew, *Fl. Nilambur*: 168. 1997; D. Chandra & Mukh. in N.P. Singh & al., *Fl. India* 5: 443. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 178. 2002. *B. latifolia* Roxb., *Fl. Ind.* 2: 385. 1832; Bedd., *Fl. Sylv. S. India*: t. 165. 1871; Hook.f., *Fl. Brit. India* 2: 23. 1876; Bourd., *Forest Trees Travancore*: 122. 1908; Rama Rao, *Fl. Pl. Travancore*: 99. 1914.

Mal.: *Mungapera*

Tree, to 16 m tall; branchlets silky-hairy; bark rough, tessellated in promi-

ment squares. Leaves broadly oblong, rounded at base, obtuse or sometimes emarginate at apex, 12 - 25 x 6 - 12.5 cm, glabrescent above, more or less villous beneath, reticulate; nerves impressed above; lateral nerves 10 - 20 pairs; petioles ca 1 cm long, stout, pubescent. Flowers sessile, ca 6 mm across, in terminal and axillary pyramidal ferruginous-pilose panicles, greenish white; panicles shorter than leaves; bracts small, caducous. Calyx lobes 5, broadly ovate, ca 1.5 mm long, ciliate. Petals 5, ovate-oblong, subacute, ca 2.5 mm long, greenish white. Disc fleshy. Stamens 10, as long as or a little shorter than petals; filaments flat; anthers about as long as filaments. Ovaries 1 perfect, conic, villous, other 4 reduced. Drupes subglobose, slightly compressed, ca 1.25 cm long, black; stone hard, 2-valved.

Fl. & Fr.: Oct. - March.

Habitat: Scrub and deciduous forests, to 1350 m.

Distrib.: Idukki, Kollam, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Wynad. Hotter parts of India. Myanmar.

Use: Fruit is edible.

3. GLUTA L.

Trees with acrid resinous juice. Leaves crowded at ends of branches, alternate, simple, entire, coriaceous. Flowers in axillary or terminal panicles, bisexual. Calyx spathaceous, bursting irregularly, caducous. Petals 4 - 6, adnate to disc, imbricate. Disc cylindrical. Stamens 4 - 6, inserted on disc; filaments capillary. Ovary on disc, stipitate or not, oblique, 1-loculed; ovule 1, pendulous from a basal funicle; style lateral, filiform; stigma simple. Drupes stalked, more or less globose, sometimes furrowed, dry; testa adnate to pericarp; cotyledons large, connate, fleshy; radicle short, obtuse, incurved.

Madagascar and Indomalasia, 30 species and 1 in India.

Gluta travancorica Bedd., Fl. Sylv. S. India: t. 60. 1870; Hook.f., Fl. Brit. India 2: 22. 1876; Rama Rao, Fl. Pl. Travancore: 98. 1914; Gamble, Fl. Madras: 261(186). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 116. 1988; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 128. 1994; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 456. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 179. 2002.

Mal.: *Thodappei*

Tree, ca 35 m tall. Leaves obovate-oblong, cuneate at base, entire at margin, rounded at apex, 10 - 15 x 3.5 - 4.5 cm, coriaceous, glabrous; petioles very short. Flowers ca 1 cm long, in terminal and axillary crowded much branched tomentose panicles, cream-coloured or greenish white; bracts ovate or boat-shaped. Calyx cupular, truncate at base, irregularly toothed or lobed, split on one side. Petals 5, elliptic-obovate, obtuse, downy. Disc ca 1 x 1.5 mm. Stamens 5, subulate. Drupes stipitate, transversely oblong, depressed, ca 2.5 x 3.75 cm, brown with white eruptions.

Fl. & Fr.: Almost throughout the year.

Habitat: Evergreen forests, to 1200 m.

Distrib.: Kannur, Kollam, Kottayam and Thiruvananthapuram. Western Ghats of Tamil Nadu. Endemic.

4. HOLIGARNA Buch.- Ham. ex Roxb., nom. cons.

Lofty trees, often with acrid juice. Leaves alternate, simple, entire; petioles with 2 or 4 spur-like appendages. Flowers crowded, in axillary and terminal racemes or panicles. Calyx cupular; teeth 5, imbricate. Petals 5, valvate, connate at base and with edge of disc, densely villous in front. Disc lining calyx tube, obscure in female flowers. Stamens 5 or 6, inserted at edge of disc, connate at base with petals; filaments subulate, glabrous; anthers subglobose. Ovary in male flowers absent, in female ones inferior, 1-loculed; ovule pendulous from above; styles 3 - 5, terminal; stigmas capitate or clavate. Drupes oblong or ovoid, subcompressed, resinous, acrid; stone coriaceous; seed parietal; testa membranous; embryo thick; cotyledons planoconvex; radicle minute.

Indomalesia, 8 species, 7 in India and 5 in Kerala.

Key to species

- 1a. Leaves pubescent beneath; petiole spurs persistent; drupes 1/4 - 1/6 exserted from receptacle 2
- b. Leaves glabrous beneath; petiole spurs caducous; drupes almost entirely within receptacle 3
- 2a. Midnerve glabrous above or puberulous only when young; petiole spurs golden-tomentose

4. *H. grahamii*

- b. Midnerve ciliate above with long hairs when young; petiole spurs villous-pubescent **2. *H. beddomei***
- 3a. Leaves acute at apex; inflorescences pale golden-brown-tomentose **1. *H. arnottiana***
- b. Leaves obtuse or emarginate at apex; inflorescences dark purple-brown-tomentose **4**
- 4a. Leaves obovate, olive brown when dry; lateral nerves ca 12 pairs **3. *H. ferruginea***
- b. Leaves spatulate, nearly black when dry, lateral nerves ca 8 pairs **5. *H. nigra***

1. *Holigarna arnottiana* Hook. f., Fl. Brit. India 2: 36. 1876; Bourd., Forest Trees Travancore: 124. 1908; Rama Rao, Fl. Pl. Travancore: 101. 1914; Gamble, Fl. Madras: 268(191). 1918; Kadambi in Indian Forester 81: 103. 1955; Manilal & Sivar., Fl. Calicut: 73. 1982; Nicolson & al. in Regnum Veg. 119: 48. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 116. 1988; Vajr., Fl. Palghat: 136. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 128. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 121. 1996; Sivar. & P. Mathew, Fl. Nilambur: 169. 1997; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 457. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 179. 2002. *H. longifolia* auct. non Roxb. 1820; Wight & Arn., Prodr. Fl. Ind. Orient.: 169. 1834; Bedd., Fl. Sylv. S. India: t. 167. 1871.

Mal.: *Chera*

Tree, ca 25 m tall; branches stout, densely leafy at apex. Leaves obovate to oblanceolate, decurrent into petiole, acute at apex, 15–30 x 5–10 cm, glabrous on both surfaces; lateral nerves 12–20 pairs, nearly straight, prominent on both surfaces; petioles 0.5–2.5 cm long with 2 caducous spurs at top. Flowers ca 3 mm across, crowded in pale golden brown rufous-tomentose panicles, greenish white or pale yellow. Calyx teeth very small. Petals oblong, acute, ca 2.5 mm long. Drupes long-stalked, obliquely ovoid, rounded at top, ca 2.5 cm long, almost entirely within receptacle, glabrous.

Fl. & Fr.: Jan.–July.

Habitat: Evergreen forests, to 1800 m.

Distrib.: Throughout Kerala. West Coast and W. Ghats from S. Canara southwards. Endemic.

Uses: All parts of the tree yield a black resinous juice which is used as a varnish and for water-proofing boats and furniture. Timber is used for making boats, bullock carts, match boxes and packing cases. Leaf is used as a green manure.

2. *Holigarua beddomei* Hook. f., Fl. Brit. India 2: 38. 1876; Bourd., Forest Trees Travancore: 125. 1908; Rama Rao, Fl. Pl. Travancore: 102: 1914; Gamble, Fl. Madras: 269(192). 1918; Manilal, Fl. Silent Valley: 66. 1988; Sivar. & P. Mathew, Fl. Nilambur: 169. 1997; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 459. 2000.

Tree, ca 50 m tall, with black juice; bark smooth. Leaves oblanceolate, cuneate and sometimes much produced below, acute or acuminate at apex, 25 - 55 x ca 12.5 cm, coriaceous, densely velvety beneath, rufous; lateral nerves 18 - 22 pairs, stout, ferruginous; leaves of young plants membranous, ciliate with long hairs at margin, midnerve and beneath; lateral nerves slender, 40 - 50 pairs, horizontal in lower portion, arching above; petioles short with 2 villous-pubescent spurs. Panicles rusty-tomentose. Calyx cupular, tomentose. Petals tomentose. Stamens 5, ca 1.5 mm long. Disc cupular, ca 1.5 mm across with a tuft of hairs in middle. Drupes long-stalked, ovoid to ellipsoid, rounded at apex, 3 - 3.5 x ca 1.5 cm, glabrous.

Fl. & Fr.: Jan. - June.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Kannur, Kozhikode, Malappuram, Palakkad and Travancore (Bourdillon, *l.c.*; Rama Rao, *l.c.*). Western Ghats of Karnataka and Tamil Nadu. Endemic.

3. *Holigarna ferruginea* Marchand, Rév. Anacardiaceae: 171. 1869; Hook.f., Fl. Brit. India 2: 37. 1876; Rama Rao, Fl. Pl. Travancore: 102. 1914; Gamble, Fl. Madras: 268(191). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 117. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 121. 1996; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 459. 2000.

Tree, 15 - 35 m tall; bark smooth, grey. Leaves obovate, cuneate at base, decurrent into petiole, emarginate and obtuse at apex, 17 - 45 x 7.5 - 10.5 cm, glabrous above, rusty-pubescent beneath, olive brown when dry; lateral nerves ca 12 pairs; petioles with 2 tubercles at top. Flowers 6 - 8 mm across, in robust terminal racemes clothed with dark rusty tomentum, brownish outside and pale green inside. Calyx cupular, ca 3 x 4 mm, rusty-tomentose. Petals ca 3 x 1.5 mm, pubescent. Disc ca 2 mm across, 5-lobed. Stamens longer than petals. Styles 7.5 - 10 cm long. Drupes obovoid, within hypocarp, rusty-tomentose, dark purple.

Fl. & Fr.: Feb. - May.

Habitat: Evergreen and semievergreen forests, to 850 m.

Distrib.: Kannur, Kollam, Kozhikode and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

4. *Holigarna grahamii* (Wight) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42: 305. 1872, quoad basionym, excl. descr.; Hook.f., Fl. Brit. India 2: 37. 1876; Rama Rao, Fl. Pl. Travancore: 102. 1914; Gamble, Fl. Madras: 268(191). 1918; Bennet & K.C. Sahni in Indian Forester 102: 89. 1976; Vajr., Fl. Palghat: 136. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 121. 1996; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 460. 2000. *Semecarpus grahamii* Wight, Icon. Pl. Ind. Orient.: t. 235. 1839. *Holigarna wightii* N.P. Balakr. in J. Bombay Nat. Hist. Soc. 63: 327. 1966.

Tree, 30–40 m tall; young branches ferruginous-tomentose. Leaves oblanceolate or broadly obovate, 3-angled above middle, cuneate at base, acute or acuminate at apex, 30–40 x 10–15 cm, coriaceous, glabrous and shining above, ferruginous-pubescent beneath; lateral nerves 20–30 pairs, prominent and pilose beneath; petioles 12–15 mm long, stout with 1 or 2 golden-tomentose spurs on each side. Flowers in rusty-tomentose terminal panicles, clustered, pale green. Male panicles ca 30 cm long, female ones shorter. Calyx cupular; lobes minute. Petals ca 2.5 x 1.25 mm. Drupes ovoid, ca 2 cm long, within cupular receptacle with 1/6–1/4 of upper part exerted, glabrous.

Fl. & Fr.: Oct.–Feb.

Habitat: Semievergreen forests, to 600 m.

Distrib.: Kannur, Palakkad, Pathanamthitta, Thrissur and Wynad. Western Ghats. Endemic.

Uses: Wood is said to be suitable for matches and packing cases. Tree yields a black juice which is used as a varnish.

Note: Bennet and Sahni (*l.c.*), and Ramamoorthy (in C.J. Saldanha & Nicolson, *Fl. Hassan*: 375. 1976) discussed the nomenclature of this species independently and came to the same conclusion that it was Kurz who made the combination.

5. *Holigarna nigra* Bourd. in Indian Forester 30: 95. 1904 & Forest Trees Travancore: 125. 1908; Rama Rao, Fl. Pl. Travancore: 102. 1914; Gamble, Fl. Madras: 268(191). 1918; Manilal, Fl. Silent Valley: 66. 1988; Vajr., Fl. Palghat: 137. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 45. 1994; D. Chandra

& Mukh. in N.P. Singh & al., Fl. India 5: 462. 2000.

Mal.: *Cheri*

Tree, ca 35 m tall, dioecious, with reddish black juice; bark smooth, grey. Leaves crowded towards ends of branches, spatulate, entire and revolute at margin, 7.5 - 15 x 2.5 - 6.5 cm, coriaceous, glabrous, nearly black when dry; lateral nerves 6 - 9 pairs; petioles 1.2 - 3.8 cm long with 2 or 4 spurs. Flowers in terminal or axillary lax racemes and panicles clothed with dark purple tomentum, greenish white or purplish green. Male inflorescences to 30 cm long, female ones ca 7.5 cm long. Male flowers ca 4 mm across, female ones rather large; pedicels very short. Calyx black-villous. Petals 5, white-hairy. Stamens 5; filaments subulate; anthers globose, black. Ovary 1-loculed; styles 3 - 5. Drupes ovoid with an accrescent calyx, green.

Fl. & Fr.: March - June.

Habitat: Evergreen forests, 650 - 1350 m.

Distrib.: Idukki, Kollam, Kottayam, Palakkad, Pathanamthitta and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Use: Juice from the tree is used as a varnish.

5. LANNEA A. Rich., nom. cons.

Trees, shrubs or undershrubs. Leaves alternate, imparipinnate, petioled. Flowers unisexual, in simple or paniced terminal fascicled racemes. Calyx 4-lobed. Petals 4, imbricate. Disc intrastaminal. Ovary ovoid or oblong, 4-loculed, usually 1 (or 2) fertile; styles 4, short; stigmas small, subglobose. Drupes ovoid or obovoid, compressed; seeds compressed; cotyledons planoconvex.

Tropical Africa and Indomalesia, ca 40 species and 1 in India.

Lannea coromandelica (Houtt.) Merr. in J. Arnold Arbor. 19: 353. 1938; Manilal & Sivar., Fl. Calicut: 72. 1982; Nicolson & al. in Regnum Veg. 119: 48. 1988; Manilal, Fl. Silent Valley: 66. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 117. 1988; Vajr., Fl. Palghat: 137. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 128. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 122. 1996; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 463. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 180. 2002. *Dialium coromandelicum* Houtt., Nat. Hist. 2: 39, t. 5,

f. 2. 1774. *Odina wodier* Roxb., Fl. Ind. 2: 293. 1832; Wight, Icon. Pl. Ind. Orient.: t. 60. 1838; Hook.f., Fl. Brit. India 2: 29. 1876; Bourd., Forest Trees Travancore: 126. 1908; Rama Rao, Fl. Pl. Travancore: 100. 1914; Gamble, Fl. Madras: 263(187). 1918.

Mal.: *Kalagam*

Tree, ca 20 m tall; bark fissured; young branchlets more or less stellate-puberulous; twigs thick with leaf scars. Leaves crowded at ends of branches, imparipinnate, 25 - 45 cm long; leaflets 7 - 11, ovate-oblong, broadly elliptic or elliptic-oblong, acute or rounded and often oblique at base, entire at margin, acuminate at apex, 7.5 - 15 x 2.5 - 5 cm, puberulous especially on nerves beneath; lateral nerves 6 - 8 pairs; petiolules ca 3 mm long, those of terminal leaflets much longer. Flowers crowded in fascicles in terminal or axillary racemes, yellowish white or purplish; male racemes compound, female ones simple; pedicels very short, fulvous-pubescent; bracts ovate, acute, ca 1 mm long, ciliate-pubescent outside. Calyx lobes 4, ovate-orbicular, ca 1.25 mm long, ciliate. Petals 4, ovate-oblong or elliptic, acute, ca 3 x 1 mm. Stamens 8, ca 3 mm long. Disc ca 1 mm long. Ovary in female flowers ovoid-oblong, 4-lobed, rudimentary in male ones. Drupes ovoid or broadly ellipsoid, sometimes compressed and slightly subreniform, ca 1 x 0.6 cm, red; seeds reniform.

Fl.: Feb. - Dec. *Fr.*: May - Jan.

Habitat: Deciduous and semievergreen forests, to 950 m.

Distrib.: Throughout Kerala. Throughout India. South and SE. Asia.

Uses: Often planted in avenues. Leaf is a good fodder. The copious gum is rarely collected in S. India. Gum from bark is used in medicine, calico-printing and confectionery.

6. MANGIFERA L.

Trees, monoecious. Leaves alternate, simple, petioled, entire. Flowers in terminal panicles, polygamous, greenish yellow; pedicels jointed. Calyx 4- or 5-partite; segments imbricate, caducous. Petals 4 or 5, free or adnate to disc, imbricate. Disc fleshy, 4- or 5-lobed. Stamens 1 - 5, inserted just within disc or on it, 1 rarely more perfect and much larger than others with imperfect or smaller anthers or reduced to teeth, or absent. Ovary sessile, oblique, 1-loculed; ovule pendulous;

funicle basal or inserted on side of locule, rarely horizontal; style lateral. Drupes fleshy; stone compressed, fibrous; seed compressed; testa papery; cotyledons planoconvex, often unequal and lobed.

Indomalaysia, 40 - 60 species, 6 in India and 1 in Kerala.

Literature: Bhat, S.S. 1944. Classification of mangoes. *Curr. Sci.* 13: 135 - 136. Gangolly, S.R. & Singh, D. 1950. Distribution of the mango (*Mangifera indica* L.) and its varieties. *Indian J. Hort.* 7: 7 - 16. Mukherjee, S.K. 1949. A monograph on the genus *Mangifera* L. *Lloydia* 12: 73 - 136. Mukherjee, S.K. 1951. Pollen analysis in *Mangifera* L. in relation to fruit set and taxonomy. *J. Indian Bot. Soc.* 30: 49 - 55. Mukherjee, S.K. 1953. The mango - its botany, cultivation, uses and future improvement especially as observed in India. *Econ. Bot.* 7: 130 - 162. Mukherjee, S.K. 1953. Origin, distribution and phylogenetic affinity of the species of *Mangifera* L. *J. Linn. Soc., Bot.* 55: 65 - 83. Naik, K.C. & Gangolly, S.R. 1950. *A monograph on classification and nomenclature of South Indian mangoes.* Rhodes, A.M. & al. 1970. A numerical taxonomic study of the mango (*Mangifera indica* L.). *J. Amer. Soc. Hort. Sci.* 95: 252 - 256.

***Mangifera indica* L.**, Sp. Pl.: 200. 1753; Bedd., Fl. Sylv. S. India: t. 162. 1871; Hook.f., Fl. Brit. India 2: 13. 1876; Bourd., Forest Trees Travancore: 117. 1908; Rama Rao, Fl. Pl. Travancore: 97. 1914; Gamble, Fl. Madras: 259(185). 1918; Manilal & Sivar., Fl. Calicut: 73. 1982; Nicolson & al. in Regnum Veg. 119: 48. 1988; Manilal, Fl. Silent Valley: 67. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 117. 1988; Vajr., Fl. Palghat: 138. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 129. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 122. 1996; Sivar. & P. Mathew, Fl. Nilambur: 169. 1997; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 466. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 181. 2002.

Mal.: *Mava*

Evergreen tree, 30 - 50 m tall, spreading. Leaves crowded at ends of branches, oblong or oblong-lanceolate, narrow at base, entire or often undulate at margin, acute, acuminate or subobtuse at apex, 12 - 25 x 3.5 - 7.5 cm, glabrous, shining; petioles 1 - 6 cm long. Flowers ca 5 mm long, in large many-flowered pubescent panicles, greenish yellow or white; pedicels short, thick; bracteoles ovate. Calyx lobes ovate or oblong, concave, pubescent outside. Petals ovate or oblong, subacute, reflexed, glabrous with 3 strong orange ridges on inner face. Disc 5-lobed, fleshy. Stamen 1, inserted at disc; filament subulate; anther purple. Ovary glabrous. Drupes

obliquely pyriform or subovoid, subcompressed, 5 - 20 cm long, fleshy; stone compressed, fibrous.

Fl. & Fr.: Jan. - May.

Habitat: Along streams in all forest types.

Distrib.: Throughout Kerala, Tropical Himalayas and hills of C., E. and S. India; cultivated in plains. Nepal to SE. Asia.

Uses: Fruit edible which is eaten fresh or made into preserves or pickles. Wood is moderately hard and used for planking, packing cases, boats and other purposes.

7. NOTHOPEGIA Blume, nom. cons.

Small trees. Leaves alternate or opposite, petioled, entire, coriaceous. Flowers in short axillary racemes, polygamous. Calyx 4- or 5-lobed, persistent. Petals 4 or 5, spreading, imbricate. Disc annular, 4- or 5-lobed. Stamens 4, inserted at margin of disc; filaments free, villous, pilose or glabrous. Ovary sessile, free, ovoid, 1-loculed; ovule 1, pendulous from above; style very short; stigma simple. Drupes globose-depressed, striate, tipped with style, seated on slightly swollen receptacle, fleshy, cellular; testa membranous; cotyledons thick, planoconvex; radicle very short, sublateral.

India and Sri Lanka, 7 species, 7 in India and 6 in Kerala.

Key to species

- | | | |
|-----|--|----------------------------|
| 1a. | Drupes ovoid, acute at apex; pericarp thick | 2 |
| b. | Drupes oblong or globose, depressed at apex; pericarp thin | 3 |
| 2a. | Leaves obovate, shortly and bluntly apiculate; lateral nerves 12 - 15 pairs; petioles stout | |
| | | 3. <i>N. colebrookiana</i> |
| b. | Leaves linear to lanceolate or elliptic, acute; lateral nerves 15 - 25 pairs; petioles slender | |
| | | 4. <i>N. heyneana</i> |
| 3a. | Leaves and branchlets rusty-villous | 4 |
| b. | Leaves and branchlets glabrous | 5 |
| 4a. | Petals glabrous inside; disc 4-lobed; filaments hairy at base | 1. <i>N. aureo-fulva</i> |
| b. | Petals densely villous inside; disc annular; filaments villous | 6. <i>N. travancorica</i> |
| 5a. | Leaves lanceolate, to 13 x 4 cm; lateral nerves rather obscure; petioles straight; filaments villous | |
| | | 2. <i>N. beddomei</i> |
| b. | Leaves oblong, elliptic-ovate or obovate, to 20 x 7.5 cm; lateral nerves prominent; petioles | |

twisted; filaments glabrous or slightly pubescent

5. *N. racemosa*

1. *Nothopogia aureo-fulva* Bedd. ex Hook.f., Fl. Brit. India 2: 40. 1876; Rama Rao, Fl. Pl. Travancore: 102. 1914; Gamble, Fl. Madras: 266(189). 1918; Vajr. in M.P. Nayar & Sastry, Red Data Book Indian Pl. 2: 12. 1988; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 472. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 182. 2002.

Tree, 3–5 m high; branches fulvous-tomentose. Leaves opposite to subopposite, linear-oblong to -lanceolate, obtuse at base, entire at margin, acuminate at apex, to 20 x 5 cm, waxy above; lateral nerves 20–30 pairs; midnerve hairy at base. Racemes axillary, 1–3 cm long. Flowers polygamous. Calyx to 1 mm long, 4-lobed, hairy outside. Petals 4, to 2 mm long, brownish, glabrous. Disc 4-lobed. Stamens 4, between lobes of disc; filaments hairy at base. Pistillode present in male flowers. Ovary ovoid, to 3 mm long, 1-loculed, 1-ovuled; stigma capitate. Drupes globose, 3–5 mm with persistent stigma, maroon.

Fl. & Fr.: March–May.

Habitat: Along streams in evergreen forests, to 900 m.

Distrib.: Kollam (N. Sasidharan KFRI, pers. comm.) and Thiruvananthapuram. Western Ghats of Tamil Nadu (Tirunelveli). Endemic and endangered.

2. *Nothopogia beddomei* Gamble, Fl. Madras: 265(189). 1918. & in Bull. Misc. Inform. 1918: 227. 1918; Manilal, Fl. Silent Valley: 67. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 118. 1988, excl. var.; Vajr., Fl. Palghat: 138. 1990; Sivar. & P. Mathew, Fl. Nilambur: 170. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 182. 2002. *N. colebrookiana* sensu Bedd., Fl. Sylv. S. India: t. 164. 1871, non (Wight) Blume 1851; Hook.f., Fl. Brit. India 2: 40. 1876 p.p.

Trees, to 20 m tall. Leaves alternate, lanceolate, obtuse to subacute at base, entire or wavy at margin, acuminate or caudate at apex, 7.5–13 x 2.5–4 cm, thin, glabrous; lateral nerves to 30 pairs, rather obscure; petioles slender, 7–12 mm long. Flowers unisexual, 2–6 mm across, in slender 2.5–5 cm long racemes, pale yellow. Calyx lobes 4, 3-angled, ca 1 mm long. Petals 4, oblong-oblancheolate, ca 3 mm long, imbricate. Disc annular, 4- or 5-lobed. Stamens 4, inserted at margin of disc, fertile; filaments ca 2.5 mm long, villous; anthers ovoid, ca 1 mm long. Ovary ovoid, ca 1.5 mm long, 1-loculed; ovule 1, pendulous on a flat funicle; style attenuate; stigma capitate. Drupes oblong, de-

pressed at apex, striate; pericarp thin.

Key to varieties

- 1a. Leaves rather thick; peduncles densely rusty-pubescent; flowers 4 - 6 mm long
2.1. var. *beddomei*
- b. Leaves rather thin; peduncles faintly rusty-puberulous; flowers ca 2 mm long
2.2. var. *wynaadica*

2.1. var. *beddomei*: J.L. Ellis & V. Chandras. in Bull. Bot. Surv. India 12: 257. 1972; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 473. 2000.

Fl. & Fr.: Dec. - June.

Habitat: Along streams and in shades of large trees in wet deciduous and semievergreen forests, to 850 m.

Distrib.: Kannur, Malappuram, Palakkad, Pathanamthitta and Thiruvananthapuram. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2.2. var. *wynaadica* J.L. Ellis & V. Chandras. in Bull. Bot. Surv. India 12: 257. 1972; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 473. 2000 (as *wynaedica*).

Fl.: Dec. - April.

Habitat: Evergreen forests, to 1050 m.

Distrib.: Kannur and Wynad. Endemic.

3. *Nothopegia colebrookiana* (Wight) Blume, Mus. Bot. 1(13): 203. 1850; Hook.f., Fl. Brit. India 2: 40. 1876 p.p.; Bourd., Forest Trees Travancore: 119, 1908; Rama Rao, Fl. Pl. Travancore: 102. 1914; Gamble, Fl. Madras: 265(189). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 118. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 124. 1996; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 474. 2000. *Pegia colebrookiana* Wight, Icon. Pl. Ind. Orient.: t. 236. 1839.

Tree, 5 - 8 m high, with acrid milky juice. Leaves elliptic-lanceolate, oblong or obovate, decurrent into petiole at base, wavy at margin, acute to acuminate and short-apiculate at apex, 5 - 20 x 2.5 - 7.5 cm, glabrous, shining above, pale beneath; lateral nerves 12 - 20 pairs, not prominent beneath; petioles stout, 1 - 1.75 cm long. Flowers ca 2 mm long, pale yellow; female flowers sessile or subsessile in

rufous-pubescent ca 4 cm long racemes: male racemes much longer and more branched than female ones, more or less pubescent. Calyx 4-lobed. Petals 4, linear-oblong, obtuse, recurved at apex, ca 2.5 x 1 mm, hairy on back. Stamens 4; filaments almost glabrous. Drupes depressed above, ca 1.25 cm across, longitudinally striate, red; pulp copious.

Fl. & Fr.: Jan. May.

Habitat: Evergreen forests, to 975 m.

Distrib.: Idukki, Kannur, Kollam and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Use: Fruit pulp is edible.

4. *Nothopegia heyneana* (Hook. f.) Gamble, Fl. Madras: 265(189). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 119. 1988; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 474. 2000. *N. colebrookiana* (Wight) Blume var. *heyneana* Hook. f., Fl. Brit. India 2: 40. 1876.

Tree, to 7 m high. Leaves variable, linear to lanceolate or elliptic, acute to rounded at base, acute at apex, 4 - 13 x 1 - 4 cm, thin-coriaceous, glabrous; lateral nerves 15 - 25 pairs; petioles slender, 2 - 5 mm long. Flowers in racemes; male racemes slender, to 1.25 cm long; female ones longer. Calyx lobes ovate. Petals white. Filaments villous. Drupes ovoid, apiculate, ca 1 cm across, striate, blue.

Fl. & Fr.: Dec. May.

Habitat: Semievergreen forests, to 675 m.

Distrib.: Kannur and Wynad. Western Ghats of Tamil Nadu. Endemic.

5. *Nothopegia racemosa* (Dalzell) Ramamoorthy in C.J. Saldanha & Nicolson, Fl. Hassan: 377. 1976; Manilal, Fl. Silent Valley: 67. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 119. 1988; Vajr., Fl. Palghat: 138. 1990; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 476. 2000. *Glycyarpus racemosus* Dalzell in J. Asiat. Soc. Bombay 3: 69. 1849 & Hooker's Icon. Pl.: t. 842. 1852. *Nothopegia colebrookiana* sensu Hook. f., Fl. Brit. India 2: 40. 1876 p.p., non (Wight) Blume 1850. *N. dalzellii* Gamble, Fl. Madras: 265(189). 1918, incl. var. *angustifolia*.

Tree, 5 - 15 m tall; branchlets glabrous. Leaves oblong-lanceolate, elliptic-ovate, obovate or narrow-lanceolate, acute to rounded at base, entire at

margin, acuminate at apex, to 20 x 7.5 cm, glabrous; lateral nerves ca 20 pairs, parallel, prominent or not; petioles 1.25 - 2.5 cm long, twisted. Racemes slender, to 7.5 cm long, often paniced. Flowers 2 - 3 mm across, pale greenish yellow or white. Calyx 4-partite, persistent; lobes ovate, obtuse. Petals 4, linear-oblong, glabrous, imbricate. Stamens 4; filaments free, glabrous or slightly pubescent; anthers introrse. Ovary rudimentary in male flowers, sessile, 1-loculed in female flowers; ovule 1; style short; stigma capitate. Drupes oblong, depressed at apex, striate.

Fl. & Fr.: May - Feb.

Habitat: Along streams in evergreen forests, ca 800 m.

Distrib.: Kannur and Palakkad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

Editors' note: Ding Hou (*Blumea* 24: 33 - 34, 1978) made a new combination *Nothopegia castaneaefolia* (Roth) Ding Hou based on *Ficus castaneaefolia* (Roth, *Nov. Pl. Sp.*: 389, 1821). After studying an isotype of *Ficus castaneaefolia* Roth at L, collected by Benjamin Heyne in southern India in 1818, consisting of a small twig with 3 leaves and one young fruit Ding Hou (*l.c.*) concluded that *K.C. Kanodia* 96408 from Goa described as *Nothopegia dalzellii* Gamble is very similar to the type referred to above except that the papillae are invisible under lower leaf surface. He emphasized that in his opinion it undoubtedly belongs to *N. castaneaefolia*. *Nothopegia dalzellii* Gamble is a superfluous name since it includes the type of *Glycyarpus racemosus* Dalzell (1849). Ding Hou (*l.c.*) did not refer to *N. racemosa* (Dalzell) Ramamoorthy (in C.J. Saldanha & Nicolson, *Fl. Hassan*: 377, 1976). Some Indian authors who accepted the opinion of Ding Hou cited *N. racemosa* as a synonym of *N. castaneaefolia* (*vide* M.R. Almeida, *Fl. Maharashtra* 1: 290, 1996; Prasanna in N.P. Singh & Karth., *Fl. Maharashtra* 1: 585, 2000). Since *N. racemosa* is reported to occur on the W. Ghats from Concan southwards and Ding Hou had seen only one specimen from Goa, critical examination of ample material throughout the range of this species needs to be done. Till then it appears desirable to follow the widely accepted name *N. racemosa* for this species.

6. *Nothopegia travancorica* Bedd. ex Hook. f., *Fl. Brit. India* 2: 40, 1876; Rama Rao, *Fl. Pl. Travancore*: 102, 1914; Gamble, *Fl. Madras*: 265(189), 1918; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 119, 1988; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 129, 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 124, 1996; D.

Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 477. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 184. 2002.

Small tree, ca 5 m high; branchlets rusty-villous. Leaves elliptic-lanceolate or linear-oblong, acute at base, acuminate at apex, 15 - 17.5 x 3 - 4.5 cm, thick at margin, ciliate towards base, membranous, green and pubescent on midnerve beneath; lateral nerves 30 - 35 pairs, slightly arched; petioles 7 - 12.5 mm long, pubescent. Flowers in very short racemes, white. Calyx tomentose. Petals ovate-lanceolate, densely villous inside. Filaments villous. Drupes apiculate, blue. *Fl. & Fr.*: Aug. - Feb.

Habitat: Usually in shades near streams in evergreen forests, to 1000 m.

Distrib.: Kannur, Kasaragod, Kollam, Pathanamthitta, Thiruvananthapuram, Thrissur and Wynad. Western Ghats of Karnataka and Tamil Nadu. Endemic.

8. RHUS L.

Trees or shrubs, often with acrid juice. Leaves alternate, simple, 3-foliolate or imparipinnate; leaflets entire or serrate. Flowers in terminal or axillary panicles, polygamous. Calyx 5-partite; lobes imbricate, persistent. Petals 5, spreading, imbricate. Disc cupular, lobed. Stamens 5, inserted below disc; filaments subulate, glabrous; anthers dorsifixed. Ovary sessile, ovoid or globose, 1-loculed; ovule pendulous from a basal funicle; styles 3, free or connate; stigmas simple or capitate. Drupes compressed, dry; stone coria-, crustaceous or bony; cotyledons flat.

Subtropical and temperate regions, ca 200 species, 12 in India and 1 in Kerala.

Literature: Brizicky, G.K. 1963. Taxonomic and nomenclatural notes on the genus *Rhus* (Anacardiaceae). *J. Arnold Arbor.* 44: 60 - 80. Young, D.A. 1979. Heartwood flavonoids and the infrageneric relationships of *Rhus* (Anacardiaceae). *Amer. J. Bot.* 66: 502 - 510.

Rhus sinuata Thunb., Prodr. Pl. Cap.: 52. 1794; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 494. 2000. *R. mysorensis* G. Don, Gen. Hist. 2: 74. 1832; B. Heyne ex Wight & Arn., Prodr. Fl. Ind. Orient.: 172. 1834; Hook.f., Fl. Brit. India 2: 9. 1876; Rama Rao, Fl. Pl. Travancore: 97. 1914; Gamble, Fl. Madras: 264(188). 1918; Vajr., Fl. Palghat: 138. 1990.

Small tree or shrub, 3 - 5 m high; branches woody, often spiny, pubescent

when young. Leaves 3-foliolate; petioles 1.2 - 1.5 cm long; leaflets obovate, cuneate, sinuate-toothed or sublobed, with a few scattered hairs above, soft-pubescent beneath; terminal leaflet sessile or short-petioluled, much larger than lateral ones, 2.5 - 4 x 1.5 - 2 cm; lateral leaflets sessile, 1.25 - 2 x 1 - 1.5 cm. Flowers ca 2 mm across, in terminal or axillary pubescent panicles, greenish yellow; bracts linear, pubescent. Calyx lobes 5, ovate, pubescent outside. Petals 5, ovate or oblong, subacute, 1 - 2 x ca 0.5 mm, glabrous. Disc 5-lobed; lobes often notched. Stamens 5, fertile; filaments free, equal, glabrous; anthers ovoid. Ovary 1-loculed; styles 3, connate at base, eccentric. Drupes subglobose, 3 - 4 mm across, glabrous, shining, brown.

Fl. & Fr.: Dec. - Jan.

Habitat: Dry deciduous forests, to 825 m.

Distrib.: Palakkad and Travancore (Rama Rao, *l.c.*). Deccan, NW. and S. India. Pakistan.

9. SEMECARPUS L.f.

Trees, dioecious. Leaves alternate, simple, entire, coriaceous. Flowers in terminal, rarely axillary panicles, polygamous. Calyx 5- or 6-fid; segments caducous. Petals 5 or 6, imbricate. Disc annular, broad. Stamens 5 or 6, inserted at base of disc, imperfect in female flowers. Ovary rudimentary or absent in male flowers, 1-loculed in female ones; ovule pendulous from a basal funicle; styles 3; stigmas subclavate. Drupes oblong, subglobose or reniform, oblique, fleshy, seated on a fleshy receptacle formed of swollen disc and calyx base; pericarp filled with acrid resin; testa coriaceous with a somewhat fleshy inner coat; embryo thick; cotyledons planoconvex; radicle superior.

Indomalesia, ca 60 species, 7 in India and 3 in Kerala.

Key to species

- | | | |
|-----|--|---------------------------|
| 1a. | Leaves and inflorescences pubescent; ovary villous | 1. <i>S. anacardium</i> |
| b. | Leaves and inflorescences glabrous; ovary glabrous or with a few scattered hairs | 2 |
| 2a. | Leaves obovate-oblong, acute at base, obtuse at apex, to 50 x 15 cm | 3. <i>S. travancorica</i> |
| b. | Leaves oblanceolate, auricled at base, acuminate at apex, to 37.5 x 7.5 cm | 2. <i>S. auriculata</i> |

1. *Semecarpus anacardium* L. f., *Suppl. Pl.*: 182. 1782; Wight, *Icon. Pl. Ind. Orient.*: t. 553. 1842; Hook.f., *Fl. Brit. India* 2: 30. 1876; Bourd., *Forest Trees Travancore*: 120. 1908; Rama Rao, *Fl. Pl. Travancore*: 100. 1914; Gamble, *Fl. Madras*: 266(190). 1918; Vajr., *Fl. Palghat*: 139. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 129. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 124. 1996; D. Chandra & Mukh. in N.P. Singh & al., *Fl. India* 5: 500. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 185. 2002.

Mal.: *Thenkotta*

Tree, ca 8 m high; bark brown. Leaves oblong or obovate-oblong, rounded, cordate or cuneate at base, sometimes short-auricled, rounded at apex, 17 - 60 x 10 - 30 cm, cartilaginous at margin, glabrous above, more or less pubescent beneath; lateral nerves 15 - 25 pairs, prominent on both surfaces; petioles 1.25 - 4 cm long. Flowers subsessile, 6 - 8 mm across, fascicled in pubescent panicles, greenish white; panicles as long as leaves or shorter; female ones pilose. Calyx segments 5, 3-angled, ca 1 mm long, pilose outside. Petals 5, ovate, acute, 4 - 5 x ca 2 mm. Stamens 10; filaments subulate; anthers ovoid. Ovary rudimentary and hairy in male flowers, subglobose, densely pilose and crowned with 3 styles in female ones. Drupes obliquely ovoid or oblong, ca 2.5 cm long, seated on a fleshy orange hypocarp, smooth, shining, black when ripe.

Fl. & Fr.: May - Feb.

Habitat: Deciduous forests, to 925 m.

Distrib.: Kollam, Kottayam, Pathanamthitta, Palakkad, Thiruvananthapuram and Thrissur. Tropical India. Tropical Asia to Australia.

2. *Semecarpus auriculata* Bedd., *Fl. Sylv. S. India*: 232. 1870 & *Icon. Pl. Ind. Orient.*: t. 187. 1868 - 1874; Hook.f., *Fl. Brit. India* 2: 32. 1876; Rama Rao, *Fl. Pl. Travancore*: 101. 1914; Gamble, *Fl. Madras*: 267(190). 1918; D. Chandra & Mukh. in N.P. Singh & al., *Fl. India* 5: 502. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 185. 2002; Augustine in *Indian J. Forest.* 25: 340. 2002.

Mal.: *Charei*

Tree, 15 - 20 m tall, dioecious. Leaves oblanceolate, attenuate and auricled at base and with 2 rounded lobes above petioles, acuminate at apex, to 37.5 x 7.5 cm, membranous at margin, glabrous, with prominent reticulations beneath;

petioles 4–6 mm long. Male flowers very small, 3- or 4-merous, numerous, in compound glabrous panicles, yellowish white; panicles longer than leaves; calyx slightly pubescent; petals glabrous, nerved; abortive ovary very small, round with a turbinate apex. Female flowers more than twice as long as male ones, 4- or 5-merous, few, in much shorter panicles, greenish yellow; calyx very slightly pubescent; petals prominently nerved; stigmas large; drupes obliquely obovate, ca 1.25 cm across; hypocarp cupular, short, broad.

Fl. & Fr.: Nov. – March.

Habitat: Evergreen forests, to 1000 m.

Distrib.: Idukki, Kollam, Pathanamthitta, Thiruvananthapuram and Wynad. Western Ghats of Tamil Nadu. Endemic.

Use: Wood is used for making match boxes.

3. *Semecarpus travancorica* Bedd., *Fl. Sylv. S. India*: t. 232. 1872; Hook.f., *Fl. Brit. India* 2: 31. 1876; Bourd., *Forest Trees Travancore*: 120. 1908; Rama Rao, *Fl. Pl. Travancore*: 101. 1914; Gamble, *Fl. Madras*: 267(190). 1918; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 129. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 124. 1996; D. Chandra & Mukh. in N.P. Singh & al., *Fl. India* 5: 504. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 186. 2002.

Mal.: *Avukaram*

Tree, ca 30 m tall; bark grey, black-blotched. Leaves oblong or obovate-oblong, acute at base, rounded at apex, to 50 x 15 cm, coriaceous, dark green and much shining above, glabrous and reticulate beneath; lateral nerves 16–18 pairs; petioles 2.5–5 cm long. Flowers in axillary and terminal compound panicles, greenish yellow. Calyx slightly puberulous and ciliate. Petals 5 or 6. Ovary glabrous or with a few scattered hairs. Drupes obliquely oblong, rounded at apex, ca 2.5 cm long; hypocarp short, broad, furrowed.

Fl. & Fr.: June – March.

Habitat: Evergreen forests, to 1800 m.

Distrib.: Idukki, Kollam, Kottayam, Pathanamthitta, Thiruvananthapuram and Thrissur. Western Ghats of Tamil Nadu. Endemic.

10. SPONDIAS L.

Trees, deciduous. Leaves usually crowded at ends of branches, alternate, imparipinnate; leaflets subopposite, usually caudate-acuminate. Flowers in terminal spreading panicles, bisexual or polygamous. Calyx lobes 4 or 5, imbricate, caducous. Petals 4 or 5, valvate, spreading. Disc annular, crenate. Stamens 8 - 10. Ovary glabrous, 4-, 5- or 1-loculed; ovule 1 in each locule, pendulous; styles 4, 5 or 1; stigmas shortly spatulate. Drupes fleshy, 1 - 5-seeded; endocarp woody; cotyledons planoconvex.

Southeast Asia and tropical America, ca 10 species and 2 in India.

Key to species

- | | | |
|-----|--|----------------------|
| 1a. | Lateral nerves in leaves 8 - 10 pairs; carpel 1 | 1. <i>S. indica</i> |
| b. | Lateral nerves in leaves numerous pairs; carpels 5 | 2. <i>S. pinnata</i> |

1. *Spondias indica* (Wight & Arn.) Airy Shaw & Forman in Kew Bull. 21: 16. 1967 - 1968; Manilal, Fl. Silent Valley: 68. 1988; Vajr., Fl. Palghat: 139. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 130. 1994; Sivar. & P. Mathew, Fl. Nilambur: 171. 1997; N. Mohanan & Sivad., Fl. Agasthyamala: 186. 2002. *Solenocarpus indicus* Wight & Arn., Prodr. Fl. Ind. Orient.: 172. 1834 (as *indica*); Bedd., Fl. Sylv. S. India: t. 233. 1874; Hook.f., Fl. Brit. India 2: 27. 1876; Bourd., Forest Trees Travancore: 126. 1908; Rama Rao, Fl. Pl. Travancore: 99: 1914; Gamble, Fl. Madras: 262(187). 1918; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 120. 1988; Sasidh. & Sivar., Fl. Pl. Thrissur: 125. 1996; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 505. 2000.

Tree, to 25 m tall. Leaves imparipinnate; rachises slender, angled; leaflets sessile except terminal one, oblong, oblique at base, crenate at margin, acuminate at apex, 5 - 9 x ca 3 cm, glabrous on both surfaces, pale beneath; lateral nerves 8 - 10 pairs, faint; petiolules of terminal leaflets ca 12 mm long. Flowers in much branched panicles, white; branches angled, puberulous. Calyx lobes deltoid, caducous. Petals 5, ovate to oblong-lanceolate, recurved, ca 3 x 1 mm. Disc annular, crenately lobed, surrounding ovary at base. Stamens 10, inserted at base of disc; filaments slender; anthers oblong. Ovary free, sessile, 1-loculed; ovule 1, pendulous from above; style thick, furrowed; stigma obliquely truncate. Drupes oblong, truncate, compressed; pericarp oily; stone bony; seed linear, compressed.

Fl.: March - April *Fr.*: May - Dec.

Habitat: Evergreen and moist deciduous forests, to 960 m.

Distrib.: Idukki, Kannur, Kollam, Malappuram, Palakkad, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. *Spondias pinnata* (L. f.) Kurz, Prelim. Rep. Forest Pegu A: 44. & B: 42. 1875; Manilal & Sivar., Fl. Calicut: 72. 1982; Nicolson & al. in Regnum Veg. 119: 49. 1988; Vajr., Fl. Palghat: 139. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur: 125. 1996; Sivar. & P. Mathew, Fl. Nilambur: 171. 1997; D. Chandra & Mukh. in N.P. Singh & al., Fl. India 5: 507. 2000. *Mangifera pinnata* L.f., Suppl. Pl.: 156. 1782. *Spondias mangifera* Willd., Sp. Pl. 2: 751. 1799; Wight, Ill. Ind. Bot. 1: t. 76. 1840; Hook.f., Fl. Brit. India 2: 42. 1876; Bourd., Forest Trees Travancore: 127. 1908; Rama Rao, Fl. Pl. Travancore: 102. 1914; Gamble, Fl. Madras: 261(186). 1918. *S. acuminata* Roxb., Fl. Ind. 2: 453. 1832; Hook.f., Fl. Brit. India 2: 42. 1876; Rama Rao, Fl. Pl. Travancore: 103. 1914; Gamble, Fl. Madras: 262(187). 1918.

Mal.: *Ambalam, Kattampazham*

Tree, to 12 m tall; trunk straight; bark smooth, grey. Leaves usually crowded at ends of branches, imparipinnate; leaflets oblong or elliptic-oblong, rounded, obtuse or obliquely and abruptly cuneate to attenuate at base, crenate, serrate or entire at margin, abruptly acuminate at apex, 7 - 17.5 x 3 - 7.5 cm, glabrous; lateral nerves numerous, jointed by a strong intramarginal one; petiolules 5 - 6 mm long. Flowers in sparingly branched panicles, pinkish green. Calyx lobes 5, 3-angled. Petals 5, ovate-oblong or elliptic-, acute, 2.5 - 3 mm long. Disc crenate. Stamens 10, 1.25 - 1.5 mm long; filaments slender; anthers broadly ovoid. Ovary ovoid or subglobose, 4- or 5-loculed; ovule 1 in each locule; styles 4 or 5, free; stigmas spreading. Drupes ovoid or ellipsoid, ca 3.75 cm long, yellow when ripe; stones woody, hard, rough with irregular furrows and cavities, fibrous outside; seeds usually 1, rarely 2 or 3.

Fl. & Fr.: March - Oct.

Habitat: Deciduous and semievergreen forests, to 675 m.

Distrib.: Idukki, Kannur, Kasaragod, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta and Thrissur. Andaman Islands, Assam, Bihar, Karnataka, Meghalaya, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and W. Bengal. South and SE. Asia.

Uses: Timber is used for planks. Gum is used in cotton printing and bark in tanning fishing nets.

Note: The tree is apparently fire-resistant because of the thick bark.

MORINGACEAE

(N.C. NAIR)

Deciduous trees with soft white wood. Leaves exstipulate, alternate, 2- or 3-pinnate; pinnae and leaflets imparipinnate, opposite; glands at base conspicuous; leaflets entire. Flowers large, irregular, in axillary divaricate panicles, 5-merous, bisexual. Calyx cupular; lobes 5, imbricate, unequal, petaloid. Petals 5, unequal, upper 2 the smallest, lower 1 the largest and erect, lateral ones reflexed. Disc lining calyx. Stamens inserted at rim of disc; fertile ones 5, opposite petals and alternating with 5 - 7 staminodes; anthers oblong, 1-loculed, dorsifixed; filaments free, dilated at base. Ovary stipitate, 1-loculed; ovules many, 2-seriate on 3 parietal placentae; style tubular; stigma truncate, perforate. Capsules elongate, terete, ribbed, torulose, beaked, corky and pitted inside, loculicidally 3-valved; seeds many in pits of valves; testa corky, 3-winged or not; endosperm absent; plumule many-leaved.

Semiarid Africa to Asia, unigeneric, 12 species, 2 in India and 1 in Kerala.

Note: Members of the family have myrosin cells, a unique character of the Capparales.

Literature: Chatterjee, D. 1948. Notes on the affinities of *Moringaceae*. *Sci. & Cult.* 14: 253 - 254. Datta, R.M. & Mitra, I.N. 1947. The systematic position of the family *Moringaceae* based on a study of *Moringa pterygosperma* Gaertn. (*M. oleifera* Lam.). *J. Bombay Nat. Hist. Soc.* 47: 355 - 357. Gershenzon, J. & Mabry, T.J. 1983. Secondary metabolites and the higher classification of angiosperms. *Nord. J. Bot.* 3: 5 - 34. Hegnauer, R. 1969. Chemical evidence for the classification of some plant taxa. In: Harborne, J.B. & Swain, T. (ed.), *Perspectives in phytochemistry*: 121 - 138. Pax, F. 1936. *Moringaceae*. In: Engler, H.G.A. & Prantl, K.A.E. (ed.), *Nat. Pflanzenfam.* ed. 2. 17b: 693 - 698.

MORINGA Adans.
(Characters as for family)

Literature: Bullock, A.A. 1960. Nomenclatural notes XII. The types of some generic names. *Kew Bull.* 14: 40 - 45. Cobin, M. 1947. The horse radish tree (*Moringa oleifera* Lam.). *Fairchild Trop. Gard. Bull.* 42: 3. Puri, V. 1941. The life history of *Moringa oleifera* Lamk. *J. Indian Bot. Soc.* 20: 263 - 284.

Moringa oleifera Lam., *Encycl.* 1: 398. 1785; Gamble, *Fl. Madras:* 269(192). 1918; Manilal & Sivar., *Fl. Calicut:* 73. 1982; Nicolson & al. in *Regnum Veg.* 119: 189. 1988; Uniyal in N.P. Singh & al., *Fl. India* 5: 516. 2000. *M. pterygosperma* Gaertn., *Fruct. Sem. Pl.* 2: 314, t. 147, f. 2. 1791; Hook.f., *Fl. Brit. India* 2: 45. 1876; Bourd., *Forest Trees Travancore:* 112. 1908; Rama Rao, *Fl. Pl. Travancore:* 103. 1914; Vajr., *Fl. Palghat:* 140. 1990.

Mal.: *Muringa*

Tree, to 15 m tall; bark corky; young parts tomentose. Leaves usually 3-pinnate, to 60 cm long; rachises slender, slightly sheathing at base; pinnae 4 - 6 pairs; leaflets opposite, 6 - 9 pairs, elliptic, ovate or obovate, rounded at apex, to 2.5 x 2 cm, pale beneath; petiolules slender; glands linear, hairy. Panicles spreading; bracts linear. Flowers to 2.8 cm across, gently fragrant. Sepals linear-lanceolate, reflexed. Petals narrowly spatulate, white. Fertile stamens villous at base. Ovary stipitate, hairy. Capsules pendulous, to 1.5 m long, 9-ribbed; seeds 3-gonous, shortly winged at angles, white or greyish.

Fl. & Fr.: Jan. Dec.

Cultivated throughout Kerala and often runs wild near cultivation. Possibly indigenous in the sub Himalayan tracts and grown throughout India.

Uses: Leaf, flower and tender fruit are eaten as a vegetable. Root and gum are medicinal. Frequently grown as a support for pepper vine.

CONNARACEAE

(N.P. BALAKRISHNAN)

Trees, shrubs or lianas, rarely scandent shrubs, rarely plants dioecious; indumentum of simple or branched hairs, often with capitate-glandular hairs. Leaves alternate, usually imparipinnate, sometimes 1-foliolate; leaflets subopposite, pin-

nately nerved or 3-nerved at base, entire, rarely with 2 or 3 teeth, exstipulate; rachises and petiolules pulvinate at base. Inflorescences terminal, axillary or in nodes of fallen leaves, paniced, fascicled or spicate, bracteate; pedicels slender, jointed near apex. Flowers bi-, sometimes functionally unisexual, actinomorphic, 5(or 4)-merous, hypogynous, sometimes heteromorphic with styles and stamens of 2 or 3 different lengths. Sepals 5 (4 or 3), free or shortly connate at base, imbricate or valvate, orbicular, accrescent in fruit and clasping at base. Petals 5 (or 4), free, rarely slightly connate, linear-oblong, rarely loriform and circinate in bud. Stamens 5(4) or 10(8) in 2 series, the inner sometimes staminodal; filaments alternately long and short, free or often shortly connate at base; anthers as long as broad, curved outwards, dorsifixed, introrse, dehiscing longitudinally. Disc present or not. Pistils (1 -)5(- 8), sometimes narrowly stipitate at base, epipetalous, each 1-loculed; ovules 2 (or 3), ventral or sub-basal, 2-tegmic, ortho- or semianatropous; style slender, somewhat elongate; stigma apical, capitate or obscurely 2-lobed. Fruits dry, sometimes slightly fleshy, usually follicled, often curved, indehiscent, sometimes dehiscent by ventral suture or along both sutures; seed 1(2), usually arillate or sarcotestal; embryo straight; cotyledons flat or planoconvex; endosperm copious or scanty, hard or fleshy, sometimes oily or absent; radicle small.

Tropics especially Old World, 20 genera and 180 species, 4 and 16 in India and, 3 and 5 in Kerala.

Literature: Dickison, W.C. 1979. A survey of pollen morphology of *Connaraceae*. *Pollen & Spores* 21: 31 - 79. Leenhouts, P.W. 1958. *Connaraceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 5: 495 - 541. Leenhouts, P.W. 1972. *Connaraceae*. In: Steenis, C.G.G.J. van (ed.), *Fl. Males.* 1, 6(Add. & Corr.): 933 - 936.

Key to genera

- 1a. Calyx usually accrescent; fertile pistils 4 or 5 per flower; fruits more than 1 per flower
3. Rourea
- b. Calyx hardly accrescent or not; fertile pistil 1 per flower, others imperfect; fruit 1 per flower
2
- 2a. Trees; leaves 1-foliolate; panicles axillary, small, glomeruled; floral parts without glands; calyx lobes valvate; fertile stamens 5
2. Ellipanthus
- b. Lianas; leaves rarely 1-foliolate; panicles terminal or in upper leaf axils, to 20 cm long; floral parts often with capitate glandular hairs; calyx lobes imbricate; fertile stamens 10 or 5
1. Connarus

1. CONNARUS L.

Shrubs, small trees, scandent shrubs or lianas. Leaves imparipinnate; leaflets (3-5) (- more), rarely 1-foliolate, entire, pellucid-dotted. Inflorescences axillary panicles, often combined into large much branched terminal compound panicles. Flowers 5-merous, bisexual, heterodistylous. Calyx lobes 5, imbricate, glandular-punctate, persistent, not accrescent in fruit, usually embracing base of fruit stalk. Petals 5, free, linear-lanceolate, ligulate or oblong, slightly broad above, glandular-punctate, imbricate in bud. Disc absent. Stamens 10, glandular-punctate, shortly monadelphous at base, alternately long and short, those opposite petals with short filaments and often staminodal without anthers. Pistils 5, usually 4 imperfect or obsolete, fertile 1 hairy with slender subulate style and capitate stigma; ovule 1 on marginal placenta. Fruit a pod-like follicle, inflated, laterally compressed, usually nearly straight on dorsal suture and curved or bulged just above stalk on ventral suture, sometimes not stalked; seeds smooth, shining, black or dark purple, covered with orange or yellow fleshy 2-lobed aril at base; endosperm absent; cotyledons planoconvex, fleshy; radicle small.

Tropics, 77 species, 10 in India and 3 in Kerala.

Key to species

- 1a. Lateral nerves in leaflets 5-8 pairs; sepals obtuse at apex; petals glabrous or sparsely puberulous outside; fruits with ventral suture keeled and dorsal suture gibbous
2. **C. paniculatus**
- b. Lateral nerves in leaflets 3-6 pairs; sepals acute at apex; petals densely pubescent outside; fruits with ventral suture not keeled, dorsal suture straight or slightly curved 2
- 2a. Fruits usually pyriform or ellipsoid, broad at base, slightly laterally beaked behind apex; valves brown-tomentose inside 3. **C. sclerocarpus**
- b. Fruits usually spindle-shaped or falcately ellipsoid, narrow at base, terminally beaked at apex; valves glabrous inside 1. **C. monocarpus**

1. Connarus monocarpus L., Sp. Pl.: 675. 1753 (as *monocarps*); Hook.f., Fl. Brit. India 2: 50. 1876; Rama Rao, Fl. Pl. Travancore: 104. 1914; Gamble, Fl. Madras: 272(194). 1918; Manilal & Sivar., Fl. Calicut: 74. 1982; Nicolson & al. in Regnum Veg. 119: 86. 1988; Vajr., Fl. Palghat: 141. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 130. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 126. 1996;

M.S. Mondal in N.P. Singh & al., Fl. India 5: 526. 2000. *C. pinnata* Lam., Encycl. 2: 95. 1786.

Mal.: *Naikuriel*, *Perimkuriel*

Low, straggling shrub, to 5 m or liana, to 25 m long; main stems to 1.5 cm across; bark striate, minutely pustulated; branches glabrous, minutely lenticelled; young parts ferruginous-tomentose. Leaves imparipinnate, glabrous; rachises 2 - 10 cm long, wrinkled at base, glabrous; leaflets (3 -)5, elliptic to oblong-ovate or ovate-lanceolate, cuneate, obtuse or rounded to subcordate at base, obtusely caudate-acuminate at apex, 4 - 12 x 2 - 5 cm, charta- to coriaceous, glabrous, shining, dark green above, pale with minute brown scales beneath; lateral nerves 3 - 5 pairs, slender, mostly transversely or obliquely oriented; reticulations rather dense, not prominent; petiolules to 5 mm long. Inflorescences terminal or axillary, paniced, thyrsoid, dense-flowered, to 15 cm long, shortly and densely tomentose; rachises minutely ferruginous-tomentose; bracts minute; pedicels 3 - 5 mm long, puberulous. Sepals ovate or elliptic, acute, 3 - 4 x ca 1.5 mm, distinctly keeled, densely pubescent outside, glabrous inside, sparsely glandular-punctate. Petals linear-lanceolate to oblanceolate, cuneate at base, obtuse or rounded at apex, 6 - 9 x 2 - 3 mm, densely pubescent and sparsely glandular-punctate outside, glabrous inside, pale yellow. Stamens 10, all fertile, rarely the epipetalous ones sterile; filaments with a few scattered glandular hairs, shortly connate at base, outer ones ca 8 mm long, the inner ca 2 mm long. Ovary globose, brownish-pubescent. Follicles on 7 - 8 mm long stalk, obliquely spindle-shaped or falcately ellipsoid, narrow at base, broad above, terminally beaked-acute at apex, 4 - 5 x 1.5 - 2 cm, bright yellow to orange; pericarp thin, coriaceous, smooth and minutely striate outside, glabrous inside; seed 1, ovoid, laterally compressed, 2 - 2.3 x 1 - 1.2 cm, shining, brownish purple to black with yellow irregularly lobed cupular pulpy aril covering a quarter.

Fl. & Fr.: Jan. - Dec.

Habitat: Secondary forests, sacred groves and wastelands, to 300 m.

Distrib.: Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Sri Lanka.

2. *Connarus paniculatus* Roxb., Fl. Ind. 3: 139. 1832; Hook.f., Fl. Brit.

India 2: 52. 1876; Gamble, Fl. Madras: 273(194). 1918; Manilal, Fl. Silent Valley: 68. 1988; V.S. Ramach. & V.J. Nair, Fl. Cannanore: 120. 1988; M.S. Mondal in N.P. Singh & al., Fl. India 5: 529. 2000. *C. wightii* Hook. f., Fl. Brit. India 2: 51. 1876; Rama Rao, Fl. Pl. Travancore: 101. 1914; Gamble, Fl. Madras: 272(194). 1918; Vajr., Fl. Palghat: 141. 1990; Sivar. & P. Mathew, Fl. Nilambur: 172. 1997; M.S. Mondal in N.P. Singh & al., Fl. India 5: 532. 2000. *C. ritchiei* Hook. f., Fl. Brit. India 2: 51. 1876; Rama Rao, Fl. Pl. Travancore: 101. 1914; Gamble, Fl. Madras: 273(194). 1918.

Tree, 5 - 6 m high, sometimes a shrub or large liana; bark minutely lenticelled, cinnamon-coloured; innovations minutely ferruginous-tomentose, early glabrescent. Leaves imparipinnate, glabrous; rachises 4 - 20 cm long; leaflets 3 - 7, elliptic-ovate or oblong-elliptic to lanceolate, narrow to rounded or subpeltate at base, obtusely acuminate at apex, 4 - 20 x 2.5 - 6.5 cm, rigidly chartaceous, shining, densely and distinctly arcuate-reticulate beneath; lateral nerves 5 - 8 pairs, arcuate, ascending or patent; petiolules ca 5 mm long. Inflorescences terminal and axillary, paniced. 10 - 40 cm long; peduncles 2 - 18 cm long, densely ferruginous-tomentose to glabrescent; pedicels rusty-tomentose; bracts scaly, minute. Sepals boat-shaped, obtuse, ca 3 mm long, rusty-tomentose and glandular-punctate on both sides. Petals narrowly spatulate, obtuse, ca 6 mm long, yellow or white and sparsely puberulous outside, white and glandular-punctate inside. Stamens 10, all fertile; filaments connate at base for ca 1 mm, glandular-pubescent. Ovary red. Follicles obovoid or oblong, laterally compressed-inflated, obtuse or acutely apiculate at oblique lateral apex, attenuate at base with ca 5 mm long slender stalk, 2 - 3.5 x 1.6 - 1.8 cm, bright red turning brown when dry; ventral suture curved, keeled, the dorsal gibbous; valves thin-coriaceous, glabrous outside, reddish brown, densely pubescent to glabrescent and glandular inside; seeds compressed, 2 - 2.5 x 1 - 1.5 cm, black with cupular yellow aril covering 1/4.

Fl. & Fr.: Jan. - Dec.

Habitat: Evergreen forests, to 800 m.

Distrib.: Idukki, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad and Pathanamthitta. Western Ghats of Karnataka and Tamil Nadu, E. Ghats of Andhra Pradesh and Orissa and NE. India. South and SE. Asia.

3. *Connarus sclerocarpus* (Wight & Arn.) G. Schellenb. in Gamble, Fl. Madras: 273(194). 1918; Candollea 2: 98. 1925 & Engl., Pflanzenr. 103: 253. 1938; Vajr., Fl. Palghat: 141. 1990; M. Mohanan & A.N. Henry, Fl. Thiruvananth.: 130. 1994; Sasidh. & Sivar., Fl. Pl. Thrissur: 130. 1996; M.S. Mondal in N.P. Singh & al., Fl. India 5: 531. 2000; N. Mohanan & Sivad., Fl. Agasthyamala: 187. 2002. *Rourea sclerocarpa* Wight & Arn., Prodr. Fl. Ind. Orient.: 262. 1834; Hook.f., Fl. Brit. India 2: 51. 1876. *Connarus parameswaranii* Ramam. & Rajan in J. Bombay Nat. Hist. Soc. 85: 390, ff. 1 - 9. 1988; M.S. Mondal in N.P. Singh & al., Fl. India 5: 530. 2000.

Scandent or spreading shrub or liana; bark verrucose, brown-lenticelled; innovations densely brown-tomentose. Leaves imparipinnate; rachises 5 - 12 cm long, glabrous; leaflets 3 or 5, ovate, elliptic to obovate or oblong-ob lanceolate, narrow and rounded at base, entire at margin, abruptly short-acuminate at apex, 4 - 15 x 3 - 7.5 cm, coriaceous, shining, glabrous, greyish brown when dry; midnerve grooved above; lateral nerves 4 - 6(- 7) pairs, slender, ascending or straight and anastomosing at margin, ridged beneath and faint above; lowest pair often opposite at midnerve; petiolules 3 - 5 mm long, hardened, warty and rugulose transverse-ridged, brown-tomentose when young, jointed at base. Inflorescences terminal, paniced, ca 16 x 19 cm; main peduncles 1 - 4 cm long; rachises and branches densely rusty-brown-tomentose; pedicels 5 - 10 mm long; bracts subulate or lanceolate, densely pubescent outside, glabrous inside. Flowers ca 4 mm across. Sepals 5, connate at base, lanceolate, acute, 3 - 5 x 1 - 2 mm, thick, brownish-rusty-tomentose outside, glabrous inside. Petals oblong-lanceolate, acute, 4 - 7 x 1 - 2 mm, densely to sparsely tomentose outside, glabrous inside, pale pink or white with pinkish tinge. Stamens 10, all fertile; filaments connate at base, often glandular-dotted, long ones 3.5 - 4 mm long, short ones 1.5 - 2 mm; anthers globose, basifixed. Ovary globose, 1.5 - 2 mm, hairy, 1-loculed; style slender, ca 1 mm long; stigma capitate. Follicles obliquely pyriform, obovoid or ellipsoid, laterally compressed and beaked-apiculate at apex, ca 5 x 2.5 cm, on to 1 cm long thick stalk at base, brown-tomentose when young; valves woody, faintly obtusely ridged, shining and glabrous outside when mature, brown-tomentose inside; ventral suture curved, the dorsal straight; seed 1, lobed-arillate at base.

Fl. & Fr.: March - Nov.

Habitat: Evergreen forests, 300 - 1800 m.

Distrib.: Idukki, Kasaragod, Kollam, Palakkad, Pathanamthitta, Thiruvananthapuram and Thrissur. Western Ghats of Karnataka and Tamil Nadu. Endemic.

2. ELLIPANTHUS Hook.f.

Shrubs or small trees; branchlets densely hairy when young, subglabrous when old. Leaves 1-foliolate, entire; petioles jointed. Inflorescences axillary, paniced to glomeruled; bracts lanceolate, early caducous. Flowers 4- or 5-merous, protandrous, bi- or unisexual, often polygamous, homostylous. Sepals densely pubescent outside, persistent in fruit, not accrescent, valvate in bud. Petals 4 or 5, free, longer than sepals, white, greenish or cream-coloured, imbricate in bud. Stamens twice as many as petals, episepalous 5 fertile, epipetalous 5 staminodal without anthers, much smaller; filaments connate at base; tube glabrous outside, pilose inside; anthers broadly cordate. Ovary 1, obliquely ovoid, somewhat laterally inserted, pilose; style short, slender; stigma disc-shaped to 2-lobed, rather large. Fruits slightly to strongly dorsally geniculate, basally constricted into a short or long stalk, densely tomentose, yellowish to brownish when ripe; fertile part more or less flat-ovoid, opening lengthwise by a slit; pericarp woody; seeds oblong-ellipsoid, blunt at both ends, shining, black; aril yellow or orange, covering basal part; endosperm thick, hard; cotyledons planoconvex.

East Africa and Madagascar to Malesia, 7 species, 2 in India and 1 in Kerala.

Ellipanthus neglectus Gamble in Bull. Misc. Inform. 1917: 26. 1917 & Fl. Madras: 273(195). 1918; G. Schellenb. in Engl., Pflanzenr. 103: 186. 1938. *E. thwaitesii* auct. non Brandis 1906: Bourd., For. Trees Travancore: 128. 1908; Rama Rao, Fl. Pl. Travancore: 104. 1914. *E. tomentosus* auct. non Kurz 1872: S.R. Sriniv. in N.C. Nair & A.N. Henry, Fl. Tamil Nadu 1: 90. 1983, excl. syn. *E. neglectus* Gamble 1917; M.S. Mondal in N.P. Singh & al., Fl. India 5: 537. 2000; Sasidh. & al. in J. Econ. Tax. Bot. 26: 61. 2002.

Mal.: *Padappen*

Small tree; branches terete; innovations densely ferruginous-tomentose. Leaves elliptic or oblanceolate, cuneate at base, abruptly acuminate at apex with to 1.5 cm long acumen, 8–12 x 3–5.5 cm, coriaceous, shining and glabrous except midnerve above and sometimes lateral nerves beneath, brownish when

dry; midnerve grooved and finely puberulous above, ridged and sparsely puberulous beneath; lateral nerves 7 or 8 pairs, arcuate, flat above, ridged beneath; reticulations fine, conspicuously raised beneath, distinct above; petioles rugose-pulvinate at base, jointed at apex, 9 - 13 mm long, densely rusty-tomentose, jointed 1 - 2 mm below base of leaf blade with portion above joint transversely warty-rugose. Flowers in axillary fascicled short racemes or condensed panicles; rachises 1 - 1.5 cm long, ferruginous-tomentose. Calyx patelliform, 1.5 - 2 mm long; lobes 5, 3-angled, acute, 0.5 - 1 mm long. Petals 4, oblong, 4 - 5 mm long, villous outside, glabrous inside. Stamens 5; staminodes 5; filaments 2 - 3 mm long, densely ferruginous-hairy; anthers oblong, less than 1 mm long. Ovary hirsute, 1-loculed, 1-ovuled. Follicles on 6 - 7 mm long stalk, ovoid, 2 - 2.5 cm long, densely velvety-tomentose; seed reddish purple to blue black with pink aril at base.

Fl. & Fr.: Feb. - March.

Habitat: Evergreen forests, to 800 m.

Distrib.: Kollam and Pathanamthitta. Western Ghats of Tamil Nadu (Tirunelveli). Endemic and endangered.

Note: Leenhouts (1958) suspected *E. neglectus* to be synonymous with *E. tomentosus* Kurz of SE. Asia. However, the former is found to be quite distinct in the presence of glabrous leaves with fine reticulations on both surfaces, slightly thick and revolute margin, patelliform short calyx, longer petals and shorter fruit stalks.

3. ROUREA Aubl., nom. cons.

Lianas, scandent shrubs or trees. Leaves imparipinnate; leaflets subopposite or alternate, entire. Inflorescences axillary or pseudoterminal panicles. Flowers bisexual, 5-merous, heterodistylous; pedicels jointed. Calyx campanulate, deeply 5-lobed, accrescent, hardened and clasping fruit at base; lobes imbricate, suborbicular to ovate, dorsally carinate, hairy at apex. Petals 5, linear-oblong, longer than calyx, glabrous. Stamens 10, all fertile; filaments slightly connate at base, episepalous ones long, others short; anthers minute. Carpels 5, free, pubescent, usually 4 imperfect and 1 fertile; style glabrous, slender; stigma capitellate and faintly 2-lobed. Fruit 1, rarely 2 per flower, sessile, folioid, curved-falcate, coriaceous, opening by ventral suture; valves glabrous inside; seed 1, shining, black, erect with a basal fleshy orange aril; endosperm absent; cotyledons planoconvex, fleshy; radicle small.

Tropics, 40 - 70 species, 3 in India and 1 in Kerala.

Rourea minor (Gaertn.) Merr., *Interpr. Herb. Amboin.*: 413. 1917; Alston, *Handb. Fl. Ceylon* 6(Suppl.): 67. 1931; Manilal & Sivar., *Fl. Calicut*: 74. 1982; Nicolson & al. in *Regnum Veg.* 119: 86. 1988; V.S. Ramach. & V.J. Nair, *Fl. Cannanore*: 120. 1988; Vajr., *Fl. Palghat*: 141. 1990; M. Mohanan & A.N. Henry, *Fl. Thiruvananth.*: 131. 1994; Sasidh. & Sivar., *Fl. Pl. Thrissur*: 126. 1996; M.S. Mondal in N.P. Singh & al., *Fl. India* 5: 538. 2000; N. Mohanan & Sivad., *Fl. Agasthyamala*: 188. 2002. *Aegiceras minus* Gaertn., *Fruct. Sem. Pl.* 1: 216, t. 46. 1788. *Connarus santaloides* Vahl, *Symb. Bot.* 3: 87. 1794. *Rourea santaloides* (Vahl) Wight & Arn., *Prodr. Fl. Ind. Orient.*: 144. 1834; Hook.f., *Fl. Brit. India* 2: 47. 1876; Rama Rao, *Fl. Pl. Travancore*: 104. 1914; Gamble, *Fl. Madras*: 271(193). 1918.

Mal.: *Kurikithali, Kurivel*

Climbing shrub or liana, to 20 m long; main stems to 10 cm across; bark smooth, greyish brown; branchlets glabrous, dark brown. Leaves 1- or 3-9(13)-foliolate; rachises 7 - 25 cm long, pulvinate at base, glabrous; leaflets ovate to oblong-lanceolate or suborbicular, sometimes terminal one obovate, oblique to subequal and acute, rounded or subcordate at base, shortly or broadly caudate-acuminate with blunt apex, 5 - 12 x 2 - 5 cm, charta- to coriaceous, smooth and shining on both surfaces or minutely papillose and dull glaucous beneath; nerves pinnate or rarely 3-nerved at base; lateral nerves 4 - 9 pairs, looped and jointed near margin; reticulations distinctly tessellated. Inflorescences mainly in upper leaf axils and pseudoterminal, lax, paniced or subracemose consisting of 1 - 5 axes, central one to 20 cm long, others shorter, glabrous; pedicels 0.5 - 1 cm long, glabrous. Calyx 2 - 3 mm long, minutely glandular-hairy to glabrous; lobes ovate or suborbicular. Petals linear, 4 - 5 mm long, yellowish or red with prominent nerves. Filaments ca 2.5 mm long. Ovary pubescent to glabrous; styles 3.5 - 4 mm long in long-styled form, ca 1.5 mm in short-styled form. Fruits obliquely ellipsoid to ovoid, acute to blunt at apex, straight or falcately curved, tapering to apiculate apex, 1.5 - 3 x ca 1 cm, chestnut brown; seed obovoid or oblong, 1 - 1.5 cm long; testa membranous, enveloped by red aril at base.

Fl. & Fr.: Jan. - Dec.

Habitat: Primary and secondary forests and roadside thickets, to 1500 m.

Distrib.: Almost throughout Kerala. Western Ghats from Karnataka (S. Canara) to Tamil Nadu (Kanyakumari), Andaman & Nicobar Islands and NE. India. South and SE. Asia.

Use: Branch is used as rope.

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INDEX TO BOTANICAL NAMES

(Excluding plants cited in the chapter introduction)

- ABELMOSCHUS Medik. 399
- A. angulosus** Wall. ex Wight & Arn. 400
 var. *angulosus* Wall. ex Wight & Arn. 405
 var. *grandiflorus* Thwaites 405
 var. *purpureus* Thwaites 405
- A. crinitus** Wall. 400, 401
- A. esculentus** (L.) Moench 400, 402
- A. ficulneus* (L.) Wight & Arn. 405
- A. manihot** (L.) Medik. 400, 402
 subsp. *manihot* 403
 var. *pungens* (Roxb.) Hochr. 403
 subsp. *tetraphyllus* (Roxb. ex Hornem.) Borss. Waalk. 403
- A. moschatus** Medik. 400, 404
- ABUTILEAE Endl. 376
- ABUTILON Mill. 376, 377
- A. crispum* (L.) Medik. 384
- A. glaucum* (Cav.) Sweet 380
- A. graveolens* (Roxb.) ex Hornem.) Wight & Arn. ex Wight 378
- A. hirtum** (Lam.) Sweet 377
- A. indicum** (L.) Sweet 377, 378
 subsp. *indicum* 379
- A. muticum* (Delile ex DC.) Sweet 380
- A. neilgherrense** Munro ex Wight 377, 379
 var. *fischeri* 379
 var. *neilgherrense* 379
- A. pannosum** (G Forst.) Schletdl. 377, 380
- A. persicum** (Burm.f.) Merr. 377, 381
- A. polyandrum* (Roxb.) Wight & Arn. ex Wight 381
- A. ramosum** (Cav.) Guill & Perr. 377, 382
- A. striatum** Dickson ex Lindl. 377, 383
- A. tomentosa* (Roxb.) Wight & Arn. 380
- Achyranthes corymbosa* L. 313
- ACRONYCHIA J.R. Forst. & G. Forst., nom. cons. 580, 581
- A. pedunculata** (L.) Miq. 582
- A. laurifolia* Blume 582
- ACROTREMA Jack 119
- A. arnottianum** Wight 119
- Adenantha kurzii* Prain 618
- A. triphysa* Dennst. 618
- Aegiceras minus* Gaertn. 829
- AEGLE Corrêa, nom. cons. 581, 583
- A. marmelos** (L.) Corrêa 583
- AGLAIA Lour., nom. cons. 636, 637
- A. anamalayana* (Bedd.) Kosterm. 659
- A. barberi** Gamble 638
- A. bourdillonii* Gamble 640
- A. canarensis** Gamble 638, 639
- A. elaeagnoidea** (A. Juss.) Benth. 638, 639
 var. *beddomei* (Gamble) K.K.N. Nair 640
 var. *bourdillonii* (Gamble) K.K.N. Nair 640
 var. *courtallensis* (Gamble) K.K.N. Nair 640, 641
 var. *elaeanoidea* 640, 641
- A. jainii** M.V. Viswan. & K. Ramach. 638, 642
- A. indica** (Hook.f.) Harms 638, 642
- A. lawii** (Wight) C.J. Saldanha 638, 643
- A. maiae** Bourd. 638, 643
- A. malabarica** Sasidh. 638, 644
- A. minutiflora** Bedd. 638, 645
 var. *griffithi* Hiern 645
 var. *travancorica* Hiern 645
- A. polystachya* Wall. 646
- A. roxburghiana*

(Wight & Arn.) Miq.	639	<i>A. rohituka</i> (Roxb.) Wight & Arn.	646
var. <i>beddomei</i> Gamble	640	AMPELOCISSUS Planch.,	
var. <i>courtallensis</i> Gamble	641	nom. cons.	737
<i>A. roxburghiana</i> sensu Bedd. non		<i>A. arnottiana</i> Planch.	739
Wight & Arn.	640,641	A. birii P. Singh & B.V. Shetty	738
A. simplicifolia (Bedd.) Harms	637, 645	A. indica (L.) Planch.	737, 738
<i>A. tamilnadensis</i> N.C. Nair & Rajan	642	A. latifolia (Roxb.) Planch.	738, 739
<i>A. travancorica</i> (Hiern) Bourd.	645	A. tomentosa (Roth.) Planch.	737, 740
AILANTHUS Desf., nom. cons.	616,617	<i>Ampelopsis himalayana</i> Royle	759
A. excelsa Roxb.	617	<i>Amyris anisata</i> Willd.	593
<i>A. malabarica</i> DC.	618	<i>A. dentata</i> Willd.	593
A. triphysa (Dennst.) Alston	617,618	ANACARDIACEAE	795
ALCEAL.	432	ANACARDIUM L.	796,797
A. rosea L.	432	A. occidentale L.	797
ALLOPHYLUS L.	770,771	ANACOLOSA (Blume) Blume	672
A. cobbe (L.) Raeusch.	771	A. densiflora Bedd.	672
<i>A. concanicus</i> Radlk.	772	ANAMIRTA Colebr.	177,178
<i>A. distachys</i> (DC.) Radlk.	772	A. cocculus (L.) Wight & Arn.	178
<i>A. rheedei</i> (Wight) Radlk.	772	<i>Anavinga lanceolata</i> Lam.	264,266
<i>A. serratus</i> (Roxb.) Kurz	772	<i>A. ovata</i> Lam.	266
<i>A. serrulatus</i> Radlk.	772	ANCISTROCLADACEAE	374
ALPHONSEA		ANCISTROCLADUS Wall.,	
Hook.f. & Thomson	133	nom. cons.	374
A. sclerocarpa Thwaites	133,134	A. heyneanus Wall. ex J. Graham	374
<i>A. zeylanica</i>		<i>Andersonia rohituka</i> Roxb.	646
Hook.f. & Thomson	133	ANNONACEAE	131
<i>A. zeylanica</i> sensu		ANNONA L.	132,134
Sivar. & P. Mathew non		A. cherimola Mill.	135
Hook.f. & Thomson	132	A. glabra L.	134,135
<i>Alsine prostrata</i> Forssk.	314	<i>A. hexapetala</i> L.f.	138
<i>Alsodeia</i> Thouars	255	A. muricata L.	134,136
<i>A. bengalensis</i> Wall.	255	<i>A. palustris</i> L.	135
<i>A. griffithii</i> Hook.f. & Thomson	254	A. reticulata L.	135,136
<i>A. virgata</i> Thwaites	254	A. squamosa L.	135,137
<i>A. wallichiana</i> Hook.f. & Thomson	254	APHANAMIXIS Blume	636,646
<i>A. zeylanica</i> (Arn.) Thwaites	253	A. polystachya (Wall.) R. Parker	646
<i>Althea burchellii</i> DC.	436	APODYTES E. Meyer ex Arn.	683
<i>A. rosea</i> (L.) Cav.	432	<i>A. beddomei</i> Mast.	683
<i>Amoora canarana</i> (Turcz.) Hiern	642	<i>A. benthamiana</i> Wight	683
<i>A. ficiformis</i> Wight	653	A. dimidiata E. Meyer ex Arn.	683
<i>A. lawii</i> (Wight) Bedd.	643	AQUIFOLIACEAE	691

ARGEMONEL.	207	BALSAMINACEAE	524
<i>A. mexicana</i> L.	207	<i>Balsamodendron berryi</i> Arn.	631
<i>Arnicratea grahamii</i>		<i>B. myrrha</i> T. Nees	632
(Wight) N. Halle	717	<i>Banisteria benghalensis</i> L.	516
ARTABOTRYS R. Br.	132,138	<i>Bartramia indica</i> L.	497
A. hexapetalus (L.f.) Bhandari	138	<i>Beddomea indica</i> Hook.f.	641
<i>A. odoratissimus</i> R. Br.	138	<i>B. simplicifolia</i> Bedd.	645
A. zeylanicus		BERBERIDACEAE	195
Hook.f. & Thomson	138,139	BERBERIS L.	196
<i>A. suaveolens</i> (Blume) Blume	140	<i>B. aristata</i> DC.	198,199
<i>Artocarpus ponga</i> Dennst.	366	<i>B. leschenaultii</i> Wight & Arn.	198
ASPIDOPTERYS A. Juss.	514	<i>B. nepalensis</i> Spreng.	199
A. canarensis Dalzell	514	var. <i>leschenaultii</i> (Wight	
<i>A. glomerata</i> Wight	520	& Arn.) Hook.f. & Thomson	198
<i>Asteriastigma</i> Bedd.	282	B. tinctoria Lesch.	197
<i>A. macrocarpa</i> Bedd.	280	<i>Bergera königii</i> L.	604
ATALANTIA Corrêa,		BERGIAL.	321
nom. cons.	581, 584	B. ammannioides Roxb. ex Roth	321
<i>A. ceylanica</i> Oliv.	587	<i>B. aquatica</i> Roxb.	322
<i>A. floribunda</i> Wight	585	B. capensis L.	321, 322
A. monophylla (L.) Corrêa	584	<i>B. verticillata</i> Willd.	322
A. racemosa Wight	584, 585	BERRYA Roxb., nom. & orth. cons.	478
var. <i>bourdillonii</i>		<i>B. ammonilla</i> Roxb.	479
K.N. Nair & M.P. Nayar	586	B. cordifolia (Willd.) Burret	479
var. <i>racemosa</i>	586	Beusekom	
A. wightii Tanaka	584, 587	BHESA Buch. - Ham. ex Arn.	696, 697
<i>Atragene zeylanica</i> L.	115	B. indica (Bedd.) Ding Hou	697
<i>Atrategia wynaadensis</i> Bedd.	148	<i>B. paniculata</i> Arn.	698
AVERRHOAL.	566	BIOPHYTUM DC.	566, 568
A. bilimbi L.	567	<i>B. apodiscias</i>	
A. carambola L.	567	(Turcz) Edgew. & Hook.f.	581
<i>Aurantium maximum</i> Burm.	591	B. candolleianum Wight	569
AZADIRACHTA A. Juss.	637, 647	B. congestiflorum	
A. indica A. Juss.	648	Govind.	569, 570
BALANITES Delile, nom. cons.	519	B. insigne Ganitle	569, 571
<i>B. aegyptiaca</i> auct. non (L.) Delile	519	B. intermedium Wight	569, 571
B. roxburghii Planch.	519	B. longipedunculatum Govind.	569, 572
<i>Balarocarpus erosa</i> Bedd.	363	B. nervifolium Thwaites	569, 572
<i>B. utilis</i> Bedd.	367	<i>B. petersianum</i> Klotzsch.	581
<i>Balsamina leschenaultii</i> DC.	548	B. reinwardtii	
<i>B. minor</i> DC.	550	(Zucc.) Klotzsch.	569, 573

<i>B. sensitivium</i> (L.) DC.		subsp. rapa	212,213
var. <i>candolleianum</i> (Wight)		<i>Brindonia indica</i> Thouars	338
Edgew. & Hook. f.	569	BRUCEA J.F. Mill., nom. cons.	616, 619
var. <i>nervifolium</i> (Thwaites)		<i>Brucea amarissima</i> sensu	
Edgew. & Hook. f.	572	N.C. Nair non(Lour.) Merr.	619
B. sensitivum (L.) DC.	569, 574	B. javanica (L.) Merr.	619
B. umbraculum Welw.	569, 575	<i>B. sumatrana</i> Roxb.	619
B. veldkampii		BUCHANANIA Spreng.	796, 798
A.E.S. Khan & al.	569, 575	<i>B. angustifolia</i> Roxb.	799
BIXACEAE	256	B. axillaris (Desr.)	
BLXAL.	257	Ramamoorthy	798, 799
B. orellana L.	257	B. barberi Gamble	798, 799
<i>Blackwellia ceylanica</i> Gardner	272	B. lanceolata Wight	799, 800
<i>B. tetrandra</i> Wight	272	B. lanzan Spreng.	798, 800
Blighia sapida J. König & Sims	787	<i>B. latifolia</i> Roxb.	800
<i>Bocagea dalzellii</i> (Bedd.)		BURSERACEAE	626
Hook. f. & Thomson	170	CABOMBA Aubl.	203
BOMBACACEAE	442	<i>C. aquatica</i> auct. non Aubl.	204
BOMBAX L., nom. cons.	442, 443	CABOMBACEAE	203
B. ceiba L.	443	C. caroliniana A. Gray	204
B. insignis Wall.	443, 444	CADABA Forssk.	222, 223
<i>B. malabaricum</i> DC.	443	C. trifoliata (Roxb.) Wight & Arn.	223
<i>B. pentandrum</i> L.	451	CALOPHYLLUM L.	329
<i>B. pyramidale</i> Cav.	449	<i>C. akara</i> Burm. f.	125
<i>B. religiosum</i> L.	261	<i>C. angustifolium</i>	
<i>B. scopulorum</i> Dunn	445	Dalzell & A. Gibson	333
BOSWELLIA Roxb. ex Colebr.	626, 627	<i>C. apetalum</i> Willd.	330
<i>B. glabra</i> Roxb.	634	C. austroindicum	
B. serrata Roxb. ex Colebr.	627	Kosterm. ex P.F. Stevens	329, 330
BRASSICA L.	209, 210	<i>C. blumei</i> Wight	335
<i>B. campestris</i> L.	214	C. calaba L.	339, 330
subsp. <i>rapa</i> (L.) Hook. f.		<i>C. decipiens</i> Wight	331
& T. Anderson	213	<i>C. elatum</i> Bedd.	332
B. juncea (L.) Czern.	210	C. inophyllum L.	329, 332
B. nigra (L.) W.D.J. Koch	210, 211	<i>C. nagassarium</i> Burm. f.	349
B. oleracea L.	210, 211	C. polyanthum Wall. ex Choisy	329, 333
var. <i>botrytis</i> L.	212	<i>C. suriga</i> Buch.-Ham.	
var. <i>capitata</i> L.	212	ex Roxb.	347
Brassica rapa L.	210, 212	<i>C. tomentosum</i> auct. non Wight	333
subsp. <i>campestris</i> (L.)		<i>C. trapezifolium</i>	
A.R. Clapham	212	auct. non Thwaites	330

- C. wightianum*
Wall. ex Planch. & Triana 331
- Calysaccion longifolium* Wight 347
- Cambogia gummi - gutta* L. 335
- Camellia sinensis** (L.) Kuntze 358
- Campylospermum malabaricum*
(DC.) Tiegh. 623
- Campylus* Lour. 195
- C. sinensis* Lour. 195
- CANANGA (A. DC.) Hook.f. &
Thomson, nom. cons. 133, 140
- C. odorata** (Lam.)
Hook.f. & Thomson 140
- CANARIUM L. 627, 628
- C. commune* L. 630
- C. strictum** Roxb. 628, 629
- C. vulgare** Leenh. 628, 630
- CANSJERA Juss., nom. cons. 679
- C. scandens* Roxb. 680
- C. rheedii** J.F. Gmel. 680
- CAPPARACEAE** 222
- CAPPARIS L. 222, 224
- C. baduoca* auct. non L. 233
- C. brevispina** DC. 225
- C. cleghornii** Dunn 225, 226
- C. divaricata** Lam. 225, 227
- C. diversifolia** Wight & Arn. 225, 228
- C. floribunda** Wight 225, 229
- C. fusifera** Dunn 225, 229
- C. grandiflora**
Hook.f. & Thomson 225, 230
- C. grandis** L.f. 225, 231
- C. heyneana* Wall.
ex Wight & Arn., 233
- C. horrida* L.f., 236
- C. magna* Lour. 248
- C. moonii** Wight 225, 232
- C. parviflora* Hook.f. & Thomson 234
- C. parviflora*
sensu Bedd. non Boiss. 229
- C. rheedei** DC. 225, 232
- C. roxburghi* sensu
Hook.f. & Thomson non DC. 226
- C. sepiaria** L. 225, 233
- C. shevaroyensis** Sundararagh. 225, 234
- C. stylosa* DC. 227
- C. tenera** Dalzell 225, 235
- C. tomentella* Dunn 229
- C. zeylanica* sensu Hook.f. &
Thomson non L. 225
- C. zeylanica** L. 225, 236
- CAPSELLA Medik., nom. cons. 209, 213
- C. bursa-pastoris** (L.) Medik. 214
- Carapa moluccensis* auct. non Lam. 668
- C. obovata* Blume 667
- CARDAMINEL. 209, 214
- C. africana** L. 215
- C. hirsuta** L. 215
var. *sylvatica* (Link.)
Hook.f. & T. Anderson 215
- C. subumbellata*
Hook.f. & T. Anderson 216
- C. trichocarpa**
Hochst. ex A. Rich. 215, 216
- CARDIOSPERMUM L. 770, 773
- C. canescens** Wall. 773
- C. halicacabum** L. 773, 774
- CARYOPHYLLACEAE** 308
- CASEARIA Jacq. 261
- C. anavinga* Pers. 264
- C. bourdillonii** N. Mukh. 262
- C. championii* sensu R.L. Mitra
non Thwaites 262
- C. coriacea* Thwaites 266
- C. elliptica* Willd. 266
- C. esculenta* auct. non Roxb. 262
- C. esculenta* Roxb. 264
- C. graveolens** Dalzell 262, 263
- C. lanceolata* Miq. 266
- C. ovata** (Lam.) Willd. 262, 264
- C. rubescens** Dalzell 262, 265
var. *gamblei* N. Mukh. 265

- var. **rubescens** 265, **266**
C. thwaitesii Briq. 262
C. tomentosa Roxb. 262, **266**
C. varians auct. non Thwaites 262
C. wynadensis Bedd. 262, **267**
C. zeylanica (Gaertn.) Thwaites 264
 CASSINE L. 696, **698**
C. albens (Retz.) Kosterm. **698**
C. kedarnathii
 Sasidh. & Swarupan. 698, **699**
C. paniculata (Wight & Arn.)
 Lobr. - Callén 698, **699**
Catha wallichii G. Don 719
 CAYRATIA Juss., nom. cons. 737, **741**
C. auriculata (Roxb.) Gamble 758
*C. carnos*a (Lam.) Gagnep. 747
C. japonica (Thunb.) Gagnep. **742**
C. molissima (Wall.) Gagnep. 741, **743**
C. pedata (Lam.) Gagnep. 742, **743**
 var. **glabra** Gamble **744**
 var. **pedata** **744**
C. roxburghii (Planch.)
 Gagnep. 741, **746**
C. tenuifolia (Wight & Arn.)
 Gagnep. 742, **746**, 747
C. trifolia (L.) Domin 742
Ceanothus asiaticus L. 724
Cedrela toona Roxb. ex Rottler 663
Cedrus mahagoni L. 662
 CEIBA Mill. 447, **450**
C. pentandra (L.) Gaertn. 450
CELASTRACEAE **695**
 CELASTRUS L. 696, **700**
C. emarginatus Willd. 710
C. montanus Roth 710
C. opposita Wall. 715
C. ovatus Wall. ex Wight & Arn. 711
C. paniculatus Willd. **700**
C. rigidus Wall. 711
C. wallichiana
 Spreng. ex Wight & Arn. 711
CERASTIUM L. **309**
C. glomeratum Thuill. **309**
C. vulgatum L. 309
 var. *glomeratum* (Thuill.)
 Edgew. & Hook.f. 309
Chailletia gelonioides
 (Roxb.) Hook.f. 670
Chalcas paniculata L. 605
Chilmoria pentandra Buch.-Ham. 276
 CHLORORXYLON DC.,
 nom. cons. 580, **587**
C. swietenia DC. **588**
 CHUKRASIA A. Juss. 637, **649**
C. tabularis A. Juss. **649**
 CIPADESSA Blume 636, **650**
C. baccifera (Roth) Miq. **650**
C. fruticosa Blume 650
 CISSAMPELOS L. 177, 178, **179**
C. hernandifolia Willd. 189
C. hirsuta Buch.-Ham. ex DC. 180
C. pareira L. 180
C. pareira L. var. **hirsuta** (Buch.-
 Ham. ex DC.) Forman **180**
 CISSUS L. 737, **748**
C. adnata sensu Gamble non Roxb. 749
C. aristata Blume 749
C. arnottiana
 B. V. Shetty & P. Singh 749, **750**
C. auriculata Roxb. 758
*C. carnos*a Lam. 747
C. discolor Blume 749, **750**
C. glauca auct. non Roxb. 753
C. glyptocarpa Thwaites 749, **751**
C. heyneana Steud. 749, **752**
C. japonica (Thunb.) Willd. 742, 747
C. lanceolaria Roxb. 761
C. latifolia Lam. 749, **752**
C. leucostaphyla Dennst. 761
C. mollissima (Wall.) Planch. 743
C. nilagirica Miq. 770
C. pallida sensu Planch. non Salisb. 750

- C. pedata* Lam. 743
C. quadrangularis L. 749, **753**
C. repanda Vahl 749, **754**
C. repens Lam. 749, **755**
C. roxburghii Planch. 746
C. tenuifolia (Wight & Arn.) Planch. 746
C. trilobata Lam. 749, **756**
C. vitiginea L. 749, **756**
C. wightii Planch. 753
 CITRUS L. 581, **588**
C. acida Roxb. 589
C. aurantifolia (Christm. & Panz) Swingle **589**
C. aurantium L. 589, **590**
 var. *limonum* Wight & Arn. 590
C. decunana L. 597
C. limon (L.) Burm.f. 589, **590**
C. madraspatana Hort ex Tanaka 590
C. maxima (Burm.f.) Merr. 589, **591**
C. medica L. 589, **592**
 var. *acida* (Roxb.) Hook.f. 589
 var. *limon* L. 597
 var. *limonum* (Wight & Arn.) Hook.f. 590
 CLAUSENA Burm.f. 581, 592
C. anisata (Willd.) Hook.f. ex Benth. **593**
C. austroindica B.C. Stone & K.N. Nair 593, **594**
C. dentata (Willd.) M. Roem. 593
 var. *pubescens* (Wight & Arn.) Tanaka 593
C. excavata Burm.f. 595
C. heptaphylla auct. non (Roxb.) Wight & Arn. 594
C. indica (Dalzell) Oliv. 593, **595**
C. pubescens Wight & Arn. 599
C. willdenowii Wight & Arn. 593
 var. *pubescens* (Wight & Arn.) 599
 CLEMATIS L. 111, **112**
C. bourdillonii Dunn 112
C. gouriana Roxb. ex DC. 112, **113**
C. hedysarifolia DC. 114
C. munroiana Wight 112, **114**
C. narvelioides Kuntze 115
C. smilacifolia auct. non Wall. 114
C. wightiana Wall. ex Wight & Arn. 112, **114**
 CLEOMEL. 222, **237**
C. angustifolia Forssk. **238**
C. aspera J. König ex DC. 238, **239**
C. burmannii Wight & Arn. 238, **239**
C. burmannii sensu Manilal & Sivar. non Wight & Arn. 243
C. chelidonii L.f. 238, **240**
C. gynandra L. 237, **241**
C. icosandra L. 246
C. monophylla L. 237, **242**
C. pentaphylla L. 241
C. rutidosperma DC. 238, **243**
C. speciosa Raf. 238, **244**
C. spinosa Jacq. 238, **245**
C. tenella L.f. 240
C. viscosa L. 238, **245**
Cleyera gymnanthera Wight & Arn. 357
 CLUSIACEAE 328
Clypea discolor Blume 190
C. hernandifolia (Willd.) Wight & Arn. 189
C. wightii Arn. 191
 COCCULUS DC., nom. cons. 177, 178, **180**
C. burmannii DC. 186
C. cordifolius (Willd.) DC. 193
C. glaucescens Blume 187
C. incanus Colebr. 188
C. laurifolius DC. 181
C. leaeba (Delile) DC. 182
C. macrocarpus Wight & Arn. 187
C. malabaricus (Lam.) DC. 194
C. pendulus (J.R. Forst. & G Forst.) Diels 181, **182**
C. tomentosus Colebr. 195

COCHLOSPERMUM Kunth.		<i>C. religiosa</i> auct. non G. Forst.	249
nom. cons.	257, 258	<i>C. religiosa</i> var. <i>nurvala</i> (Buch.-	
<i>C. gossypium</i> DC.	259	Ham.) Hook.f. & Thomson	248
C. religiosum (L.) Alston	259	var. <i>roxburghii</i> (R. Br.) Hook.f.	
COLUBRINA Rich. ex Brongn.,		& Thomson	247
nom. cons.	723	<i>C. religiosa</i> sensu Dunn non	
C. asiatica (L.) Brongn.	724	G. Forst.	249, 250
C. travancorica Bedd.	724	<i>C. roxburghii</i> R. Br.	247
COMMIPHORA Jacq.,		<i>C. marmelos</i> L.	583
nom. cons.	627, 630	CRUCIFERAE (Brassicaceae)	208
C. berryi (Arn.) Engl.	631	CULLENIA Wight	442
C. caudata (Wight & Arn.)	631, 632	C. exarillata A. Robyns	448
C. myrrha (T. Nees) Engl.	631, 632	<i>C. excelsa</i> Wight	448
CONNARACEAE	821	CYATHOCALYX Champ. ex	
CONNARUS L.	822, 823	Hook.f. & Thomson	132, 141
C. monocarpus L.	823	C. zeylanica Hook.f. & Thomson	141
C. paniculatus Roxb.	823, 824	CYCLEA Arn. ex Wight	177, 178, 184
<i>C. parameswaranii</i> Ramam. & Rajan	826	C. arnottii Miers	184, 186
<i>C. pinnata</i> Lam.	833	C. barbata Miers	184, 185
<i>C. ritchiei</i> Hook.f.	825	<i>C. burmannii</i> (DC.)	
<i>C. santaloides</i> Vahl	829	Hook.f. & Thomson	186
C. sclerocarpus (Wight & Arn.)		C. fissicalyx Dunn	184, 185
G. Schellenb.	823, 826	<i>C. peltata</i> Miers	185
<i>C. wightii</i> Hook.f.	825	<i>C. peltata</i> sensu	
CORCHORUS L.	478, 479	Hook.f. & Thomson non	185
<i>C. acutangulus</i> auct. non Forssk.	480	<i>C. peltata</i> Miq.	185
C. aestuans L.	480	C. peltata (Lam.)	
C. capsularis L.	480, 481	Hook.f. & Thomson	184, 186
C. olitorius L.	480, 481	CYPHOSTEMMA (Planch.)	
C. trilocularis L.	480, 482	Alston	737, 757
C. urticifolius Wight & Arn.	480, 483	C. auriculatum (Roxb.) P. Singh &	
CORONOPUS Zinn, nom. cons.	209, 216	B.V. Shetty	757
C. didymus (L.) Sm.	217	<i>C. trilobata</i> (Lam.) M.R. Almeida	756
COSCINIUM Colebr.	177, 178, 182	DECASCHISTIEAE Fryxell	376, 397
C. fenestratum (Gaertn.) Colebr.	183	DECASCHISTIA Wight & Arn.	397
CRATAEVA L.	222, 247	D. crotonifolia Wight & Arn.	398
C. adansonii DC. subsp. <i>odora</i>		<i>D. trilobata</i> Wight	402
(Buch.-Ham.) M. Jacobs	247	DESMOS Lour.	132, 142
C. magna (Lour.) DC.	247, 248	D. chinensis Lour.	143
<i>C. nurvala</i> Buch.-Ham.	248	D. lawii (Hook.f. & Thomson)	
<i>C. odora</i> Buch.-Ham.	247	Safford	143

<i>D. ramarowii</i> (Dunn) D. Das	150	D. beddomci Heirn	652
D. viridiflorus (Bedd.) Safford	143, 144	D. binectariferum (Roxb.)	
<i>Dialium coromandelicum</i> Houtt.	806	Hook.f. ex Bedd.	651, 652
Dianthus caryophyllus L.	314	D. ficiforme (Wight) Gamble	652, 653
DICHAPETALACEAE	669	<i>D. glandulosum</i> Talbot	654
DICHAPETALUM Thouars	669	D. malabaricum Bedd. ex Heirn	652, 653
D. gelonioides (Roxb.) Engl.	670	<i>D. purpureum</i> Bourd.	653
DILLENIAEAE	118	ELAEOCARPACEAE	498
DILLENIA L.	120	ELAEOCARPUS L.	498
D. bracteata Wight	120	<i>E. cuneatus</i> Wight	507
D. indica L.	120, 121	<i>E. ferrugineus</i> (Wight) Bedd.	501
D. pentagyna Roxb.	120, 122	E. glandulosus Wall. ex Merr.	499
<i>D. repanda</i> Roxb.	120	<i>E. monocera</i> sensu Mast. non Cav.	504
<i>D. speciosa</i> Thunb.	121	E. munroii (Wight) Mast.	499, 500
D. suffruticosa (Griff.) Martelli	120, 123	<i>E. oblongus</i> auct. non Gaertn.	504
DIMOCARPUS Lour.	771, 775	<i>E. oblongus</i> Gaertn.	507
D. litchi	784	<i>E. perim-kara</i> DC.	502
D. longan Lour.	776	E. recurvatus Corner	499, 501
<i>D. longan</i> subsp. <i>malesianus</i>	784	E. serratus L.	499, 502
DIPLOCLISIA Miers	177, 178, 187	<i>E. tectorius</i> sensu	
D. glaucescens (Blume) Diels	187	Ramamoorthy non (Lour.) Poir.	499
DIPTEROCARPACEAE	358	E. tuberculatus Roxb.	499, 503
DIPTEROCARPUS C.F. Gaertn.	359	E. venustus Bedd.	499, 504
D. bourdillonii Brandis	360	<i>Elaeodendron glaucum</i>	
D. indicus Bedd.	360, 361	auct. non Pers.	698
<i>D. turbinatus</i> sensu		<i>E. glaucum</i> sensu	
Dyer non. C.F. Gaertn.	361	M.A. Lawson non Pers.	700
DODONAEA Mill.	770, 777	<i>E. paniculatum</i> Wight & Arn.	700
D. angustifolia L.f.	777	<i>E. roxburghii</i> Wight & Arn.	698
<i>D. burmanniana</i> DC.	777	ELATINACEAE	320
<i>D. viscosa</i> auct. non (L.) Jacq.	777	ELATINE L.	321, 323
DOMBEYA Cav., nom. cons.	451	<i>E. americana</i> Arn.	323
D. calantha K. Schum.	451	<i>E. ammannioides</i> (Roxb. ex	
DRYMARIA Willd. ex Schult.	309, 310	Roth) Wight & Arn.	321
<i>D. cordata</i> (L.) Willd. ex Roem. &		E. triandra Schkuhr	323
Schult. subsp. <i>diandra</i>		<i>E. verticillata</i> (Willd.) Wight & Arn.	322
(Blume) J.A. Duke	310	ELLIPANTHUS Hook.f.	822, 827
<i>D. cordata</i> auct. non		E. neglectus Gamble	827
Willd. ex Roem. & Schult.	310	<i>E. thwaitesii</i> auct. non Brandis	827
D. diandra Blume	310	<i>E. tomentosus</i> auct. non Kurz	827
DYSOXYLUM Blume	637, 651	<i>Epibatrium pendulum</i> J.R. Forst. &	
		G Forst.	822

<i>Eriodendron anfractuosum</i> DC.	451	E. nitida Korth.	355
<i>E. pentandrum</i> (L.) Kurz	451	<i>Fagara lunuankenda</i> Gaertn.	609
<i>Erioglossum rubiginosum</i> (Roxb.) Blume	787	<i>F. rhetsa</i> Roxb.	615
ERIOILAENA DC.	450, 452	<i>Fallopia retusa</i> Lour.	489
E. lushingtonii Dunn	452	<i>Feronia elephantum</i> Corrêa	600
E. quinquelocularis (Wight & Arn.) Wight	452, 453	FILICIUM Thwaites ex Benth.	771, 778
ERYTHROXYLACEAE	509	F. decipiens (Wight & Arn.) Thwaites	778
ERYTHROXYLUMP. Browne	509	FLORIA Mattei	399, 405
<i>E. acuminatum</i> (Arn.) Walp.	511	F. vitifolia (L.) Mattei	405
E. coca Lam.	513	FIRMIANA Marsili	450, 453
<i>E. indicum</i> (DC.) Bedd.	511	F. colorata (Roxb.) R. Br.	454
E. lanceolatum (Wight) Walp.	510	FLACOURTIA Comm. ex L'Hér. 261,	268
var. <i>obtusifolium</i> (Wight) Walp.	512	<i>F. cataphracta</i> Roxb. ex Willd.	270
<i>E. lucidum</i> Moon ex Hook. f.	511	F. indica (Burm. f.) Merr.	269
E. monogynum Roxb.	510, 511	F. inermis Roxb.	271
E. moonii Hochr.	510, 511	F. jangomas (Lour.) Raeusch.	269, 270
E. obtusifolium (Wight) Hook. f.	510, 512	<i>F. latifolia</i> (Hook. f. & Thomson) T. Cooke	285
ERYTHROPALUM Blume	671, 673	F. montana J. Graham	269, 271
<i>E. populifolium</i> (Arn.) Mast.	674	<i>F. ramontchi</i> L'Hér.	269
E. scandens Blume	674	<i>F. sepiaria</i> Roxb.	269
<i>E. vagum</i> (Griff.) Mast.	674	FLACOURTIACEAE (incl. Samydaceae)	260
<i>Espera cordifolia</i> Willd.	479	<i>Gaertnera racemosa</i> Roxb.	516
<i>Euodia lunuankenda</i> (Gaertn.) Merr.	609	GALPHIMIA	517
<i>E. roxburghiana</i> (Cham.) Benth.	609	<i>G. glauca</i> Merr.	517
EUONYMUS L., nom. & orth. cons.	697, 701	G. gracilis Bartl.	517
E. angulatus Wight	702	<i>Ganitrus sphaericus</i> Gaertn.	502
E. crenulatus Wall. ex Wight & Arn.	702, 703	GARCINIAL.	328, 334
E. dichotomus B. Heyne ex Wall.	702, 703	<i>G. cambogia</i> (Gaertn.) Desr. var. <i>conicarpa</i> (Wight) T. Anderson	336
<i>E. goughii</i> Wight	704	var. <i>papilla</i> (Wight) T. Anderson	337
E. indicus B. Heyne ex Wall.	702, 704	<i>G. echinocarpa</i> auct. non Thwaites	341
E. lawsonii C. B. Clarke ex Prain	702, 704	var. <i>monticola</i> Maheshw.	344
E. paniculatus Wight ex M. A. Lawson	702, 705	<i>G. elliptica</i> Wight	342
<i>Euphoria</i> Comm. ex Juss.	784	G. gummi-gutta (L.) N. Robson	335
<i>E. longana</i> Lam.	776	var. <i>conicarpa</i> (Wight) N. P. Singh	336
EURYA Thunb.	354		
<i>E. japonica</i> auct. non Thunb.	358		

- var. **gummi-gutta** 339
 var. **papilla** (Wight)
 N.P. Singh 336, **337**
G. imbertii Bourd. 335, **337**
G. indica (Thouars) Choisy 335, **337**
G. malabarica Talbot 343
G. mangostana L. 346
G. morella (Gaertn.) Desr. 335, **338**
G. morella sensu T. Anderson non
 (Gaertn.) Desr. 339
G. ovalifolius (Roxb.) Hook.f. ex
 T. Anderson 342
 var. *macrantha* T. Anderson 343
G. papilla Wight 337
G. pictoria (Roxb.) W. Wight 345
G. pictoria Roxb. ex Buch.-Ham. 340
G. pictoria Roxb. ex
 Buch.-Ham. 335, **339**
G. rubro-echinata Kosterm. 334, **341**
G. spicata (Wight &
 Arn.) Hook.f. 334, **342**
 var. *glomerata* Vesque 342
 var. *macrantha* Vesque 343
G. talbotii Raizada ex Santapau 334, **343**
G. tinctoria (DC.) Dunn 348
G. travancorica Bedd. 335, **343**
G. wightii T. Anderson 335, **344**
G. xanthochymus Hook.f. ex
 T. Anderson 334, **345**
 GARUGA Roxb. 627, **633**
G. floribunda Decne.
 var. **gamblei** (King ex
 W.W. Sm.) Kalkman 633
G. gamblei King ex W.W. Sm. 633
G. pinnata Roxb. 633, **634**
GERANIACEAE 521
GERANIUM L. 522
G. affene Wight & Arn. 523
G. nepalense Sweet 522
GLUTAL 796, **801**
G. travancorica Bedd. 801
GLYCOSMIS Corrêa, nom. cons. 581, **596**
G. angustifolia
 Wall. ex Wight & Arn. 596, **598**
G. arborea (Roxb.) DC. 599
G. conchinchinensis sensu Gamble
 non (Lour.) Pierre ex Engl. 598, 599
G. cyanocarpa (Blume)
 Spreng. var. *cymosa* Kurz 600
G. cymosa (Kurz) V. Naray. 600
G. macrocarpa Wight 596, **597**
G. mauritiana (Lam.) Tanaka 596, **598**
 var. *angustifolia* Tanaka 604
G. pentaphylla (Retz.) DC. 596, **599**
 var. 2.subvar. *angustifolia*
 Hook.f. 597
 var. *macrocarpa* (Wight) Hook.f. 597
G. pentaphylla sensu Hook.f. non
 (Lour.) Pierre ex Engl. 598
Glycyarpus racemosus Dalzell 812
GLYPTOPETALUM Thwaites 697, **705**
G. grandiflorum Bedd. 705
G. zeylanicum Thwaites 705, **706**
Gmelina indica Burm.f. 269
GOMPHANDRA Wall. ex Lindl. 683, **684**
G. axillaris Wall. ex Voigt 685
G. coriacea Wight 685
G. polymorpha Wight 685
G. tetrandra (Wall.) Sleumer 685
GOMPHIA Schreb. 622
G. angustifolia Vahl 622
G. malabarica DC. 622
G. serrata (Gaertn.) Kanis 622
GONIOTHALAMUS (Bulme)
 Hook.f. & Thomson 132, **145**
G. cardiopetalus (Dalzell)
 Hook.f. & Thomson 146
G. rhynchantherus Dunn 145, **146**
G. salicina Hook.f. & Thomson 149
G. thwaitesii Hook.f. &
 Thomson 145, **147**
G. wightii Hook.f. & Thomson 145, **148**

- G. wynaadensis** (Bedd.) Bedd. 145, 148
 GORDONIA Ellis, nom. cons. 354, 356
G. obtusa Wall. ex Wight & Arn. 356
 GOSSYPIUM L. 399, 406
G. arboreum L. 407
 var. **arboreum** 408
 var. **obtusifolium** (Roxb.)
 Roberty 408
G. barbadense L. 407, 408
G. herbaceum L. 407, 409
 var. **hirsutum** (L.) Mast. 410
 var. **obtusifolium** (Roxb.) Mast. 408
G. hirsutum L. 407
G. obtusifolium Roxb. 408
 GOUANIA Jacq. 723, 725
G. microcarpa DC. 725
 GREWIA L. 478, 483, 488
G. abutilifolia Vent. ex Juss. 484, 485
G. aspera 485
G. barberi J.R. Drumm. ex Dunn 497
G. bracteata B. Heyne ex Roth 485, 486
G. carpinifolia sensu
 Mast. non Juss. 486
G. caudata Wall. ex G. Don 460
G. columnaris Sm. 491
G. diplocarpa Thwaites 489
G. disperma sensu Dunn non
 Rottler ex Spreng. 492
G. emarginata Wight & Arn. 490
G. flavescens Juss. 484, 486
G. gamblei J.R. Drumm. ex Dunn 485, 487
G. glabra Blume 492
G. heterotricha Mast. 485, 487
G. hirsuta Vahl 484, 488
G. laevigata auct. non Vahl 492
G. lanceaefolia Roxb. 485, 489
G. lawsoniana J.R. Drumm. ex Dunn 487
G. leptopetala (Brandis ex
 T. Cooke) 493
G. microcos L. 489
G. multiflora auct. non Juss. 492
G. nervosa (Lour.) Panigrahi 484, 489
G. obtusa Wall. ex Dunn 486
G. oppositifolia Buch.-Ham. ex
 D. Don 484, 490
G. orientalis L. 485, 491
G. orientalis sensu Mast. non. 491
G. paniculata Roxb. ex DC. 489
G. pilosa sensu Mast. non Lam. 491
G. rhamnifolia B. Heyne ex
 Roth 484, 491
G. ritchiei Mast. 487
G. serrulata DC. 485, 492
G. tilifolia Vahl
 var. **argentea** Burret 493
G. tilifolia Vahl 484, 493
 var. **leptopetala**
 Brandis ex T. Cooke 493
G. tomentosa sensu
 V. Naray. & R.S. Rao non Juss. 488
G. umbellata auct. non Roxb. 488
G. umbellifera Bedd. 494
G. villosa Willd. 495
G. wightiana J.R. Drumm. ex Dunn 490
Guaiacum officinale L. 521
Guarea binectarifera Roxb. 652
Guatteria cerasoides (Roxb.) Dunal 163
G. coffeoides Thwaites ex
 Hook.f. & Thomson 164
G. fragrans Dalzell 166
G. korintii Dunal 165
 GUAZUMA Mill. 451, 455
G. tomentosa Kunth 455
G. ulmifolia Lam. 455
GUTTIFERAE 328
Gymnosporia emarginata
 (Willd.) Thwaites 710
G. montana (Roth) Benth. 710
G. ovata (Wall. ex. Wight & Arn.)
 M.A. Lawson 711
G. wallichiana (Spreng. ex
 Wight & Arn.) M.A. Lawson 711

- Gynandropsis gynandra* (L.) Briq. 241
G. pentaphylla (L.) DC. 241
G. speciosa (Raf.) DC. 244
Hapalosa loeflingiae Wall. ex
Wight & Arn. 314
HARPULLIA Roxb. 771, 779
H. arborea (Blanco) Radlk. 779
H. cupanioides auct. non Roxb. 780
H. imbricata (Blume) Thwaites 779
HELICTERESL. 450, 456
H. isora L. 456
Hemigyrosa deficiens
(Wight & Arn.) Bedd. 782
HERISSANTIA Medik. 376, 383
H. crispa (L.) Medik. 383
HERITIERA Aiton 450, 457
H. littoralis Dryand. 457, 458
H. papilio Bedd. 457, 458
Hesperuthusa crenulata (Roxb.)
M. Roem. 606
Heynea affinis A. Juss. 664
H. trifoliata A. Juss. ex Harms 666
H. trijuga Roxb. ex Sims 664
HIBISCEAE Endl. 376, 398
HIBISCUS L., nom. cons. 399, 410
H. abelmoschus L. 404
H. acetocella Welw. ex Hiern 412
H. aculeatus Roxb. 413
H. angulosus (Wall. ex
Wight & Arn.) Steud. 400
H. cancellatus Roxb. 405
H. collinus Roxb. 417
H. crinitus (Wall.) G. Don 401
H. esculentus L. 402
H. furcatus Roxb. ex DC. 413
H. hirtus L. 411, 412
H. hispidissimus Griff. 411, 413
H. lampas Cav. 430
H. lobatus (Murr.) Kuntze 411, 414
H. lunariifolius Willd. 412, 415
H. manihot L. 402
H. mutabilis L. 412, 416
H. odoratus (Willd.)
Roxb. ex Wight & Arn. 438
H. plantanifolius (Willd.) Sweet 411, 417
H. populneus L. 431
H. pruriens Roxb. ex Hornem. 415
H. pungens Roxb. 403
H. radiatus Cav. 411, 418
H. rosa-sinensis L. 411, 419
var. *liliflorus* Hochr. 419
var. **rosa-sinensis** 419, 420
var. *schizopetalus* Dyer 420
H. sabdariffa L. 412, 421
var. *altissima* Webster 426
var. *sabdariffa* 426
H. schizopetalus (Dyer) Hook.f. 411, 420
H. setinervis Dunn 400
H. solandra Her. 414
H. sreenarayanianus
Anil Kumar & Ravi 412, 420
H. surattensis L. 411, 422
H. syriacus L. 411, 423
H. tetraphyllus Roxb. ex Hornem. 403
H. tiliaceus L. 411, 424
subsp. *tiliaceus* 424
H. trionum L. 412, 425
H. vitifolius L. 405
H. zeylanicus L. 438
Hippocratea arnottiana Wight 707
H. bourdillonii Gamble 708
H. grahamii Wight 716
H. indica Willd. 717
H. obtusifolia Roxb. 708
HIPTAGE Gaertn., nom. cons. 514, 515
H. acuminata Wall. ex A. Juss. 516
H. benghalensis (L.) Kurz 516
H. madablota Gaertn. 516
H. sericea Hook.f. & Hochr. 517
HOLIGARNA Buch.-Ham. ex
Roxb., nom. cons. 797, 802
H. arnottiana Hook.f. 803

- H. beddomei** Hook.f. 803, **804**
H. ferruginea Marchand 803, **804**
H. grahamii (Wight) Kurz 802, **805**
H. longifolia auct. non Roxb. 803
H. nigra Bourd. 803, **805**
H. wightii N.P. Balakr. 805
HOMALIUM Jacq. 261, **272**
H. ceylanicum (Gardner) Benth. **272**
 subsp. **ceylanicum** **273**
H. jainii A.N. Henry & Swamin. **272, 273**
H. travancoricum Bedd. **272, 274**
HOPEA Roxb., nom. cons. 359, **362**
H. erosa (Bedd.) Slooten **363**
H. glabra Wight & Arn. 363, **364**
H. jacobi C.E.C. Fisch. 363, **364**
H. longifolia Dyer 367
H. malabarica Bedd. 367
H. parviflora Bedd. 362, **365, 368**
H. ponga (Dennst.) Mabb. 363, **366**
H. racophloea Dyer 363, **367**
H. utilis (Bedd.) Bole 362, **367**
H. wightiana Wall. ex Wight & Arn. 366
 var. *glabra* (Wight & Arn.)
 Bedd. 364
HUGONIA L. 506
H. belli Sedgw. **506**
H. mystax L. 506, **507**
HYBANTHUS Jacq., nom. cons. **250, 251**
H. enneaspermus (L.) F. Muell. **251**
H. travancoricus (Bedd.) Melch. **251, 252**
HYDNOCARPUS Gaertn. 261, **274**
H. alpina Wight **275**
H. kurzii (King) Warb. 281
H. laurifolia (Dennst.) Sleumer 276
H. macrocarpa (Bedd.) Warb. 280
H. pendulus Manilal & al. **275, 276**
H. pentandra (Buch.-Ham.)
 Oken **275, 276**
H. wightiana Blume 276
HYDROCERA Blume ex Wight &
 Arn. 524
H. triflora (L.) Wight & Arn. 525
HYPERICACEAE 324
HYPERICUM L. 325
H. humifusum sensu Dyer non L. 327
H. japonicum Thunb. ex Murr. 325, **326**
H. mysurense B. Heyne ex
 Wight & Arn. 325, **326**
H. nepaulense sensu Dyer non
 Choisy 327
H. wightianum Wall. ex
 Wight & Arn. 325, **327**
ICACINACEAE **682**
ILEX L. **692**
I. denticulata Wall. ex Wight 692, **693**
I. malabarica Bedd. 692, **693**
I. thwaitesii Loes. ex Gamble 694
I. walkeri Wight & Gardner ex
 Thwaites 692, **694**
I. wightiana Wall. ex Wight 692, **694**
IMPATIENS L. 524, **525**
I. acaulis Arn. 526, **530**
I. albidula Wight 543
I. aliciae C.E.C. Fisch. 529, **531**
I. anaimudica C.E.C. Fisch. 528, **531**
I. auriculata Wight 526, **532**
I. bababudanensis Hook.f. 546
I. ballardi Bedd. 564
I. balsamina L. 529, **532**
I. beddomei Hook.f. 540
I. bipartita Arn. 545
I. campanulata Wight 527, **533**
I. chinensis auct. non L. 539
I. chinensis L.
 var. **brevicornis** E. Barnes 528, **534**
I. clavicornu Turcz. 526, **535**
I. cochinea Hook.f. 530, **535**
I. coelotropis C.E.C. Fisch. 530, **536**
I. cordata Wight 528, **536**
I. cordata sensu Hook.f. non Wight 547
I. crenata Bedd. 526, **537**
I. cuspidata Arn. 529, **537**

- I. dasysperma** Wight 529, 538
I. denisonii Bedd. 526, 538
I. diversifolia Wall. ex
Wight & Arn. 528, 539
I. elegans Bedd. 528, 539
I. fasciculata Lam. 539
I. flaccida Arn. 529, 540
I. flaccida sensu Hook.f., non Arn. 540
I. floribunda Wight 529, 540
I. fruticosa Lesch. ex DC. 530, 541
I. gardneriana Wight 529, 541
I. goughii Wight 527, 542
I. grandis B. Heyne ex Wall. 528, 542
I. henslowiana Arn. 530, 543
I. herbicola Hook.f. 530, 544
I. hookeriana Arn. 543
I. inconspicua Benth. ex
Wight & Arn. 530, 544
I. jerdoniae Wight 527, 545
var. *parasitica* (Bedd.) Hook.f. 554
I. johnii E. Barnes 529, 545
I. kleinii Wight & Arn. 550
I. kulamavuensis Pandur. &
V.J. Nair 527, 546
I. latifolia L. 529, 546
I. latifolia sensu Hook.f. non L. 537
I. leptura Hook.f. 528, 547
I. leschenaultii (DC.) Wall. ex
Wight & Arn. 529, 547
I. levinge Gamble ex Hook.f. 540
I. ligulata Bedd. 530, 548
I. lucida B. Heyne ex Hook.f. 530, 549
I. macrocarpa Hook.f. 530, 549
I. maculata Wight 528, 550
I. minor (DC.) Bennet 528, 550
I. modesta Wight 526, 551
I. munnarensis E. Barnes 528, 551
I. nataliae Hook.f. 530, 552
I. omissa Hook.f. 554
I. oppositifolia L. 528, 552
I. pallidiflora Hook.f. 528, 553
I. pandata E. Barnes 526, 553
I. parasitica Bedd. 527, 554
I. parviflora Bedd. 527, 554
I. phoenicea Bedd. 527, 555
I. platyadena C.E.C. Fisch. 527, 555
I. pusilla B. Heyne ex Hook.f. &
Thomson 544
I. rivalis Wight 557
I. rivulicola Hook.f. 556
I. rupicola Hook.f. 529, 556
I. scabriuscula B. Heyne ex
Roxb. 529, 556
I. scapiflora B. Heyne ex Roxb. 526, 557
I. scapiflora sensu Wight & Arn.
non B. Heyne ex Roth 540
I. setosa Hook.f. & Thomson 541
I. sholayarensis M. Kumar &
S. Seq. 527, 557
I. sivarajanii M. Kumar &
S. Seq. 526, 558
I. stocksii Hook.f. & Thomson 537
I. tangachee Bedd. 528, 559
I. tomentosa
B. Heyne ex Wight & Arn. 530, 559
I. travancorica Bedd. 527, 560
I. trichocarpa Hook.f. 530, 560
I. triflora L. 524
I. umbellata B. Heyne ex Roxb. 527, 561
I. uncinata Wight 527, 561
I. verecunda Hook.f. 528, 562
I. verticillata Wight 527, 562
I. violacea M. Kumar & S. Seq. 527, 563
I. viscida Wight 527, 564
I. viscosa Bedd. 527, 564
I. wightiana Bedd. 528, 565
Ionidium suffruticosum (L.)
Roem. & Schult. 251
I. travancoricum Bedd. 252
Jambolifera pedunculata L. 582
JULOSTYLIS Thwaites 399, 426
J. ampumalaiensis Pradceep & Sivar. 426

- J. angustifolia** (Arn.) Thwaites 426, **427**
J. polyandra Ravi &
 Anil Kumar 426, **427**
 KADSURA Juss. 129
K. heteroclita (Roxb.) Craib 130
K. roxburghiana Arn. 130
K. wightiana Arn. 130
 KLEINHOVIA L. 450, **459**
K. hospita L. 459
Kurrimia bipartita M.A. Lawson 697
K. indica (Bedd.) Gamble 697
K. paniculata (Wall. ex Arn.) Arn. 698
 KYDIA Roxb. 399, **428**
K. angustifolia Arn. 427
K. calycina Roxb. **429**
K. fraterna Roxb. 429
K. roxburghiana Wight 429
 LANNEA A. Rich., nom. cons. 797, **806**
L. coromandelica (Houtt.) Merr. **806**
Lansium anamalaiense Bedd. 658
L. anamalanum Bedd. 668
Lasianthera tetrandra Wall. 685
Lebretonia glechomifolia A. Rich. 437
L. procumbens
 Wall. ex Wight & Arn. 436
LEEACEAE 763
 LEEA D. Royen ex L., nom. cons. 764
L. acuminata Wall. ex C.B. Clarke 766
L. aequata L. 764
L. asiatica (L.) Ridsdale 764, **765**
L. aspera Edgew. 765
L. aspera Wall. ex G. Don 768
L. aurantiaca Zoll. & Moritzi 766
L. cinerea M.A. Lawson 768
L. coriacea M.A. Lawson 768
L. crispa L. 765
L. diffusa M.A. Lawson 768
L. edgeworthii Santapau 765
L. guineensis G. Don 764, **766**
L. herbacea Buch.-Ham. 765
L. hirta Roxb. ex Hornem. 764
L. indica (Burm.f.) Merr. 764, **767**
L. integrifolia Roxb. 768
L. kurzii C.B. Clarke 764
L. macrophylla Roxb. ex
 Hornem. 764, **768**
L. parallela Wall. ex M.A. Lawson 768
L. pumila Kurz 765
L. robusta Roxb. 768
L. sambucina Willd. 767
L. staphylea auct. non Roxb. 766
L. talbotii King ex Talbot 768
L. umbraculifera C.B. Clarke 767
L. venkobarrowii Gamble 768
L. wightii C.B. Clarke 766
 LEPIDIUM L. 209, **217**
L. didymum L. 217
L. sativum L. **218**
 LEPISANTHES Blume 771, **780**
L. deficiens (Wight & Arn.)
 Radlk. 782
L. erecta (Thwaites) Leenh. **781**
L. stipulaceum (Bedd.) J.L. Ellis 783
L. tetraphylla (Vahl) Radlk. **781**
 LEPTONYCHIA Turcz. 451, **460**
L. caudata (Wall. ex G. Don) Burret **460**
L. moacurroides Bedd. 460
 LIMONIA L. 581, **600**
L. acidissima L. **600**
L. acidissima auct. non L. 606
L. arborea Roxb. 599
L. aurantifolia Christm. & Panz. 596
L. crenulata Roxb. 606
L. monophylla L. 585
L. pentaphylla Retz. 599
L. pusilla Gaertn. 281
L. trifolia Burm.f. 612
L. trifoliolata L. 612
LINACEAE 505
 LINUM L. 506, **508**
L. mysurense B. Heyne ex Benth. 508
L. usitatissimum L. 508

<i>Litchi chinensis</i> Sonn.	787	<i>M. axillaris</i> Desr.	799
LOESENERIELLA A.C. Sm.	696, 706	M. indica L.	808
L. arnottiana (Wight) A.C. Sm.	707	<i>M. pinnata</i> L.f.	828
L. bourdillonii (Gamble) Raju	707, 708	<i>Mangostana cambogia</i> Gaertn.	335
L. obtusifolia (Roxb.) A.C. Sm.	707, 708	<i>M. morella</i> Gaertn.	339
LOPHOPETALUM		<i>M. foetida</i> (Wight) Miers	688
Wight & Arn.	696, 709	<i>Mappia oblonga</i> Miers	688
L. wightianum Arn.	709	<i>M. ovata</i> Miers	688
LUVUNGA Buch.-Ham.		<i>M. tomentosa</i> Miers	688
ex Wight & Arn.	581, 601	<i>M. wightiana</i> Meirs	688
L. eleutherandra Dalzell	601	<i>Marottia oleosa</i> Raf.	276
<i>L. sarmentosa</i> auct., non (Blume)		MAYTENUS Molina	696, 710
Kurz	601	M. emarginata (Willd.) Ding Hou	710
<i>Mackaya populifolia</i> Arn.	674	M. ovata (Wall. ex Wight &	
Maesopsis eminii Engl.	736	Arn.) Loes	710, 711
MAGNOLIACEAE	126	<i>M. wallichiana</i> (Wight &	
MAHONIA Nutt. nom. cons.	196, 197	Arn.) Raju & Babu	711
M. leschenaultii (Wight &		M. wallichii (G Don)	
Arn.) Takeda	198	Bennet & K.C. Sahni	710, 711
MALACHRAL.	433, 434	<i>Meesia serrata</i> Gaertn.	622
M. capitata (L.) L.	434	MEIOGYNE Miq.	132, 149
MALPHIGHIACEAE	513	M. pannosa (Dalzell) J. Sinclair	149
Malphighia coccigera L.	517	M. ramarowii (Dunn) Gandhi	149
MALVACEAE	375	MELHANIA Forssk.	451, 461
MALVASTRUM A. Gray,		M. incana B. Heyne ex Wight & Arn.	461
nom. cons.	376, 384	MELIAL.	637, 654
<i>M. coromandeliana</i> L.	385	<i>Melia azadirachta</i> L.	648
M. coromandelianum (L.) Garcke	385	M. azedarach L.	655
<i>M. tricuspidata</i> R. Br.	385	<i>M. baccifera</i> Roth	650
<i>M. tricuspidatum</i> (R. Br.) A. Gray	383	<i>M. composita</i> Willd.	662
MALVAVISCUS Fabr.	433, 435	M. dubia Cav.	655
<i>M. arboreus</i> Cav.		<i>M. koetjape</i> Burm.f.	668
var. <i>penduliflorus</i> (DC.) Schery	435	MELIACEAE	635
M. penduliflorus DC.	435	MELICOPE J.R. Forst. &	
MALVEAE A. Gray	376	G Forst.	586, 609
MAMMEA L.	328, 347	M. lunuankenda (Gaertn.)	
<i>M. longifolia</i> (Wight)		T.G Hartley	609
Planch. & Triana	347	MELIOSMA Blume	791
M. suriga (Buch.-Ham. ex Roxb.)		<i>M. arnottiana</i> (Wight) Walp.	792
Kosterm.	347	M. pinnata (Roxb.) Walp.	
MANGIFERAL.	796, 807	subsp. <i>barbulata</i> (Cufod.)	

Beusekom	791,792	Wight & Arn.	453
<i>M. pungens</i> (Wight & Arn.) Walp.	793	Microcos paniculata L.	494
<i>M. rhoifolia</i> Maxim.		MICROTROPIS Wall.	
subsp. <i>barbulata</i> Cufod.	792	ex Meisn., nom. cons.	696, 712
M. simplicifolia (Roxb.) Walp.	791,793	M. latifolia Wight ex M.A. Lawson	713
subsp. pungens (Wight & Arn.)		M. microcarpa Wight	712, 713
Beusekom	791,792	<i>M. ovalifolia</i> Wight	713
subsp. simplicifolia	793,794	M. ramiflora Wight	712, 714
<i>M. wightii</i> Brandis	793	M. stocksii Gamble	713, 714
MELOCHIAL.	451, 462	M. wallichiana Wight ex	
M. corchorifolia L.	462	Thwaites	712, 715
<i>M. cordata</i> Burm.f.	393	MILUSA Lesch. ex A. DC.	133,151
M. nodiflora Sw.	462, 463	M. eriocarpa Dunn	151,152
<i>M. umbellata</i> (Houtt.) Stapf	464	M. indica Lesch. ex A. DC.	151,152
MENISPERMACEAE	176	<i>M. indica</i> var. <i>tomentosa</i> Hook.f. &	
<i>Menispermum acuminatum</i> Lam.	193	Thomson	152
<i>M. cocculus</i> L.	179	<i>M. montana</i> Gardner ex	
<i>M. cordifolium</i> Willd.	193	Hook.f. & Thomson	152
<i>M. fenestratum</i> Gaertn.	183	var. <i>tomentosa</i> Thwaites	152
<i>M. glaucum</i> Lam.	188	M. nilagirica Bedd.	151,153
<i>M. japonicum</i> Thunb.	189	M. tomentosa (Roxb.)	
<i>M. laeaba</i> Delile	182	Finet & Gagnep.	151,153
<i>M. malabaricum</i> Lam.	194	M. velutina (Dunal)	
<i>M. peltatum</i> Lam.	186	Hook.f. & Thomson	151,154
MESUA L.	329, 348	M. wightiana	
M. ferrea L.	349	Hook.f. & Thomson	151,155
var. <i>thwaitesii</i> (Planch. &		<i>Millingtonia arnottiana</i> Wight	792
Triana) Vesque	350	<i>M. pinnata</i> subsp. <i>arnottiana</i> (Wight)	
<i>M. nagana</i> Gardner	349	Beusekom	792
<i>M. nagassarium</i> (Burm.f.) Kosterm.	349	<i>M. pungens</i> Wight & Arn.	793
<i>M. pulchella</i> Planch. & Triana	351	<i>M. simplicifolia</i> Roxb.	793
<i>M. roxburghii</i> Wight	349	<i>Milnea roxburghiana</i> Wight & Arn.	639
M. thwaitesii Planch. & Triana	349, 350	MIQUELIA Meisn., nom. cons.	683, 686
MICHELIAL.	126	M. dentata Bedd.	686
M. champaca L.	127	MITREPHORA	
M. nilagirica Zenker	127,128	Hook.f. & Thomson	133,155
<i>M. pulneyensis</i> Wight	128	M. grandiflora Bedd.	156
<i>M. rheedii</i> Wight	127	M. heyneana (Hook.f. & Thomson)	
<i>M. nilagirica</i> var. <i>walkeri</i> Hook.f. &		Thwaites	156
Thomson	129	<i>Moacura gelonioides</i> Roxb.	670
<i>Microchlaena quinquelocularis</i>		<i>Modeccopsis vaga</i> Griff.	674

<i>Monocera munroii</i> Wight	500	<i>N. longana</i> (Lam.) Cambess.	776
<i>M. telluginea</i> Wight	506	<i>N. stipulaceum</i> Bedd.	783
<i>M. turberculata</i>		<i>Nimmonia lawii</i> Wight	643
(Roxb.) Wight & Arn.	503	<i>Niotia lucida</i> Wall.	627
MORINGACEAE	820	NOTHAPODYTES Blume	683,687
MORINGA Adans.	821	<i>N. foetida</i> (Wight) Sleumer	688
M. oleifera Lam.	821	N. nimmoniana (J. Graham) Mabb.	688
<i>M. pterygosperma</i> Gaertn.	821	NOTHOPEGIA Blume,	
<i>Munniskia laurifolia</i> Dennst.	276	nom. cons.	796,809
MUNRONIA Wight	637,656	N. aureo-fulva	
<i>M. neelgherrica</i> Wight	657	Bedd. ex Hook.f.	809,810
M. pinnata (Wall.) Theob.	656	N. beddomei Gamble	809,810
<i>M. wallichii</i> Wight	656	var. beddomei	811
Muntingia calabura L.	505	var. wynaadica J.L. Ellis & V. Chandras.	811
MURRAYA J. König ex L.,		N. colebrookiana	
nom. & orth. cons.	581,604	(Wight) Blume	809,811
<i>M. exotica</i> L.	605	var. <i>heyneana</i> Hook.f.	812
M. königii (L.) Spreng.	604	<i>N. colebrookiana</i> sensu	
M. paniculata (L.) Jack	604,605	Bedd. non (Wight) Blume	810
NARAVELIA		<i>N. colebrookiana</i> sensu Hook.f.(Wight)	
Adans., nom. & orth. cons.	111,115	Blume	812
N. zeylanica (L.) DC.	115	<i>N. dalzelli</i> Gamble	812
NAREGAMIA Wight & Arn.,		N. heyneana (Hook.f.) Gamble	809,812
nom. cons.	636,657	N. racemsoa (Dalzell)	
N. alata Wight & Arn.	657	Ramamoorthy	810,812
NARINGI Adans.	581,606	N. travancorica Bedd. ex	
N. crenulata (Roxb.) Nicolson	606	Hook.f.	809,813
NASTURTIUM W.T. Aiton,		NYMPHAEACEAE	198,205
nom. cons.	209,218	NYMPHAEA L., nom. cons.	199
<i>N. indicum</i> (L.) DC.	221	<i>N. lotus</i> L.	
<i>N. indicum</i> sensu Hook.f. &		var. <i>pubescens</i> (Willd.)	
T. Anderson non (L.) DC.	221	Hook.f. & Thomson	201
<i>N. madagascariensis</i> DC.	221	<i>N. lotus</i> sensu Hook.f. &	
N. officinale W.T. Aiton.	218	Thomson non L.	203
<i>Nelumbium speciosum</i> Willd.	205	N. nouchali Burm.f.	199,200
NELUMBO Adans.	205	<i>N. pubescens</i> sensu Dunn non Willd.	202
N. nucifera Gaertn.	205	N. pubescens Willd.	200,201
NELUMBONACEAE	205	N. rubra Roxb. ex Andrews	200,201
<i>Nemedra elaeagnoidea</i> A. Juss.	639	<i>N. stellata</i> Willd.	200
<i>Nephelium erectum</i> Thwaites	781	OCHNACEAE	621
<i>N. litchi</i> Cambess.	795		

OCHNAL.	622, 623	<i>O. apodiscias</i> Turcz.	575
<i>O. heyneana</i> Wight & Arn.	624	O. corniculata L.	576, 577
O. lanceolata Spreng.	624	O. corymbosa DC.	577, 578
var. wightiana		O. dehradunensis Raizada	577, 578
(Wall. ex Wight & Arn.) Vajr.	624	<i>O. intermedia</i> A. Rich.	578
O. obtusata DC.	624, 625	<i>O. latifolia</i> sensu Calder non Kunth	579
<i>O. squarrosa</i> auct. non L.	625	<i>O. martiana</i> Zucc.	578
<i>Ochrocarpus longifolius</i>		<i>O. reinwardtii</i> Zucc.	573
(Wight) T. Anderson	347	<i>O. richardiana</i> Babu	578
OCHROMA Sw.	442	<i>O. sensitiva</i> L.	574
O. lagopus Sw.	449	PAPAVERACEAE	206
<i>O. pyramidale</i> (Cav.) Urb.	449	<i>Paragrewia poilanei</i>	
<i>Odina wodier</i> Roxb.	807	Gagnep. ex R.S. Rao	461
OLACACEAE	671	PARAMIGNYA Wight	581, 607
OLAX L.	672, 675	<i>P. armata</i> auct. non (Thwaites) Oliv.	608
O. imbricata Roxb.	675	P. beddomei Tanaka	608
<i>O. wightiana</i> Wall. ex Wight & Arn.	675	P. monophylla Wight	607, 608
var. <i>nigrescens</i> Gamble	675	PARTHENOCISSUS Planch.,	
OPILIACEAE	679	nom. cons.	737, 758
OPILIA Roxb.	679, 681	<i>P. neilgherrensis</i> (Wight) Planch.	759
O. amentacea Roxb.	681	P. semicordata (Wall.) Planch.	
<i>Oraoma canarana</i> Turcz.	642	var. roylei (King) Raizada &	
<i>Ornitrophe serrata</i> Roxb.	780	H.O. Saxena	759
OROPHEA Blume	132, 157	<i>Patonia parviflora</i> Wight	175
O. erythrocarpa Bedd.	158	<i>Paullinia asiatica</i> L.	610
<i>O. heyneana</i> Hook.f. & Thomson	157	PAVONIA Cav., nom. cons.	434, 436
<i>O. malabarica</i> Sasidh. & Sivar.	160	P. burchellii (DC.) Dyer	436
<i>O. polycarpa</i> A. DC.	162	<i>P. glechomifolia</i> (A. Rich.)	
O. sivarajanii Sasidh.	158, 159	Garcke ex Schweinf.	437
O. thomsonii Bedd.	158, 159	P. odorata Willd.	436, 437
O. uniflora Hook.f. & Thomson	158, 160	<i>P. plantanifolia</i> Willd.	417
O. zeylanica Hook.f. &		<i>P. procumbens</i> (Wall. ex Wight	
Thomson	159, 160, 161	& Arn.) Walp.	437
<i>Orygia portulacifolia</i> Forrsk.	319	P. zeylanica (L.) Cav.	436, 438
OTONEPIELIUM Radlk.	771, 783	<i>Pegia colebrookiana</i> Wight	811
O. stipulaceum (Bedd.) Radlk.	783	Pelargonium graveolens Aiton	523
<i>Otonyichium imbricatum</i> Blume	779	<i>Pentapetes acerifolia</i> L.	465
<i>Ouratea angustifolia</i>		<i>P. phoenicea</i> L.	477
(Vahl) Baill. ex Laness.	622	PERICAMPYLUS Miers.,	
OXALIDACEAE	565	nom. cons.	177, 178, 188
OXALIS L.	566, 576	P. glaucus (L. am.) Merr.	188

- P. incanus* (Colebr.) Hook.f. & Thomson 188
- Pertaloba zeylanica* Arn. 253
- PHAEANTHUS**
- Hook.f. & Thomson 133,161
- P. malabaricus** Bedd. 161
- Phoberos crenatus* Wight 278
- P. gaertneri* Thwaites 279
- P. wightianus* Wight & Arn. 278
- Phytolacca asiatica* L. 765
- Pilosa oleosa* Lour. 786
- Piptostylis indica* Dalzell 595
- PITTOSPORACEAE** 283
- PITTOSPORUM** Banks ex Gaertn., nom.cons. 283
- P. dasycaulon** Miq. 284
- P. floribundum* Royle 285
- P. floribundum* Wight & Arn. 284
- P. napaulense** (DC.) Rehder & E.H. Wilson 284, 285
- P. neelgherrense** Wight & Arn. 284, 286
- P. tetraspermum** Wight & Arn. 284, 286
- P. wightii* A.K. Mukh. 285
- PLEUROSTYLIA** Wight & Arn. 696, 715
- P. opposita** (Wall.) Alston 715
- P. wightii* Wight & Arn. 716
- POECILONEURON** Bedd. 329,351
- P. indicum** Bedd. 351,352
- P. pauciflorum** Bedd. 352, 353
- POLYALTHIA** Blume 133,162
- P. cardiopetala* Dalzell 146
- P. cerasoides** (Roxb.) Bedd. 163
- P. coffeoides** (Thwaites ex Hook.f. & Thomson) Thwaites 163,164
- P. fragrans** (Dalzell) Bedd. 162,164
- P. korintii** (Dunal) Benth. & Hook.f. ex Hook.f. & Thomson 163,165
- P. longifolia** (Sonn.) Thwaites 163,166
- P. persicaefolia* (Hook.f. & Thomson) Thwaites 168
- P. rufescens** Hook.f. & Thomson 163,167
- P. shendurunii** Basha & Sasidh. 163,167
- P. suberosa** (Roxb.) Thwaites 163,168
- POLYCARPAEA** Lam., nom. cons. 309, 311
- P. aurea** (Wight) Dunn 312
- P. corymbosa** (L.) Lam. 311,313
- var. *aurea* Wight 312
- POLYCARPON** L. 309, 313
- P. prostratum** (Forssk.) Asch. & Schweinf. 314
- P. loeflingiae* (Wall. ex Wight & Arn.) Benth. ex Edgew. & Hook.f. 314
- POLYGALACEAE** 287
- POLYGALAI.** 288
- P. arillata** D. Don 289, 290
- var. *arillata* 291
- var. *chartacea* (Mukerjee) G.S. Giri 291
- P. arvensis** Willd. 290, 291
- P. bolbothrix** Dunn 289, 292
- var. *bolbothrix* 296
- var. *devicolamensis* (Mukerjee) R.N. Banerjee & N.P. Balakr. 293,294
- var. *pulniensis* (Mukerjee) R.N. Banerjee & N.P. Balakr. 294
- P. brachystachya* Blume 302
- P. brachystachya* DC. 306
- P. buxiformis** Hassk. 290, 294
- P. chinensis* auct. non L. 291,298
- Polygala chinensis** L. 290, 295
- var. *brachystachya* A.W. Benn. 300,303
- var. *linarifolia* (Willd.) Chodat 300
- var. *linarifolia* sensu Mukerjee non (Willd.) Chodat 292
- P. ciliata* L. 305
- P. ciliata* sensu Wight & Arn. non L. 293
- P. dunnii* Panigrahi 300
- P. elongata** Klein ex Willd. 289, 296

- P. elongata* sensu
A.W. Benn. non Klein ex Willd. 304
- P. erioptera** DC. 289, 297
- P. erioptera* var. *vahliana* (DC.)
Chodat 297
- P. glomerata* Lour. 295
- P. heyneana* Wight & Arn. 302
- P. jacobii** Chandrab. 290, 298
- P. javana** DC. 289, 298
var. *angustifolia* Thwaites 299
- P. linearifolia** Willd. 290, 299
- P. persicariifolia** DC. 289, 300
- P. ramaswamtiana* Mukerjee 293
f. *devicolamensis* Mukerjee 293
- P. raoi* R.N. Banerjee &
L.K. Banerjee 301
- P. rosmarinifolia** Wight & Arn. 290, 301
- P. serpyllifolia* Poir. 294
- P. sibirica** L. 289, 302
var. *heyneana* A.W. Benn. 299
- P. telephioides** Willd. 289, 303
- P. telephioides* sensu
A.W. Benn. non Willd. 294
- P. vahliana* DC. 297
- P. wightiana* Wight & Arn. 296
- P. wightiana** Wall.
ex Wight & Arn. 289, 304
- Pongelion wightii* Teigh. 617
- POPOWIA** Endl. 132, 169
- P. beddomeana** Hook.f. & Thomson 169
- P. ramosissima* sensu Bedd. non
Hook.f. & Thomson 169
- PORTULACACEAE** 315
- PORTULACA** L. 315, 316
- P. cuneifolia* Vahl 319
- P. grandiflora** Hook. 319
- P. oleracea** L. 316, 317
var. *linearifolia* Sivar. &
Manilal 317
- P. pilosa** L. 316, 317
subsp. *grandiflora* (Hook.)
R. Geesink 319
subsp. *pilosa* var. *tuberosa*
(Roxb.) Sivar. 318
- P. quadrifida** L. 316, 318
- P. suffruticosa* Wall. ex Wight & Arn. 317
- P. tuberosa* Roxb. 317
- Premna nimmoniana* J. Graham 688
- Pristimera indica* (Willd.) A.C. Sm. 717
- Protium caudatum* Wight & Arn. 632
- Pseudonephelium* Radlk. 784
- Ptelea arborea* Blanco 779
- Pterocymbium tinctorium**
(Blanco) Merr. 477
- PTEROSPERMUM** Schreb.,
nom. cons. 450, 464
- P. acerifolium** (L.) Willd. 464, 465
- P. diversifolium** Blume 464, 465
- P. glabrescens* Wight & Arn. 465
- P. heyneanum* Wall. ex Wight & Arn. 468
- P. obtusifolium** Wight ex Mast. 464, 466
- P. reticulatum** Wight & Arn. 464, 467
- P. rubiginosum**
B. Heyne ex Wight & Arn. 464, 467
- P. xylocarpum** (Gaertn.) Santapau
& Wagh 464, 468
- PTERYGOTA** Schott & Endl. 450, 469
- P. alata** (Roxb.) R. Br. 469
- Puria trilobata* (Lam.) N.C. Nair 756
- PYRENACANTHA** Wight,
nom. cons. 683, 689
- P. volubilis** Wight 689
- Quassia amara** L. 621
- Q. indica* (Gaertn.) Noot. 621
- RANUNCULACEAE** 111
- RANUNCULUS** L. 111, 116
- R. diffusus* DC. 117
- R. peninsularis** C.J. Saldanha 116
- R. reniformis* Wall. ex Wight & Arn. 117
- R. subpinnatus** Wight & Arn. 116, 117
- R. wallichianus** Wight & Arn. 116, 117
- RAPHANUS** L. 209, 219

R. sativus L.	219	S. limoniacea Hook.f. & Thomson	795
REINWARDTIODENDRON		<i>S. malabarica</i> Bedd.	795
Koord.	637, 658	SABIACEAE	790
R. anamallaiense (Bedd.) Mabb.	658	<i>Saccopetalum tomentosum</i> (Roxb.)	
<i>R. anamalayanum</i> C.J. Saldanha	659	Hook.f. & Thomson	153
REISSANTIA N. Hallé	696, 716	SAGERAEA Dalzell	133, 170
R. grahamii (Wight) Ding Hou	716	S. dalzellii Bedd.	170
R. indica (Willd.) N. Hallé	716, 717	S. grandiflora Dunn	170, 171
RHAMNACEAE	722	<i>S. laurifolia</i> sensu Sasidh. &	
<i>Rhamnus jujuba</i> L.	732	Sivar. non (J. Graham) Blatt.	170
<i>R. myrtina</i> Burm.f.	728	SAGERETIA Brongn.	723, 726
<i>R. nummularia</i> Burm.f.	733	S. hamosa (Wall.) Brongn.	726
<i>R. oenoplia</i> L.	734	<i>S. oppositifolia</i> Brongn.	727
<i>R. parviflora</i> Roem. & Schult.	727	S. parviflora (Roem. & Schult.)	
<i>R. xylopyrus</i> Retz.	743	G. Don	726, 727
RHUSL.	797, 814	SALACIA L., nom. cons.	696, 718
<i>R. cobbe</i> L.	771	S. beddomei Gamble	718, 719
<i>R. decipiens</i> Wight & Arn.	778	S. chinensis L.	718, 719
<i>R. javanica</i> L.	619	S. fruticosa B. Heyne ex	
<i>R. mysorensis</i> G. Don	814	M.A. Lawson	718, 720
R. sinuata Thunb.	814	S. macrosperma Wight	718, 720
RINOREA Aubl., nom. cons.	250, 253	S. malabarica Gamble	718, 721
R. bengalensis (Wall.) Kuntze	253	S. oblonga Wall. ex Wight &	
RORIPPA Scop.	209, 220	Arn.	718, 721
R. indica (L.) Hiern	220	<i>S. prinoides</i> DC.	719
R. madagascariensis (DC.)		S. reticulata Wight	718, 722
H. Hara	220, 221	SALOMONIA Lour., nom. cons.	288, 305
<i>R. nasturtium-aquaticum</i> (L.) Hayek	218	S. ciliata (L.) DC.	305
ROUREA Aubl., nom. cons.	823, 828	<i>S. oblongifolia</i> DC.	305
R. minor (Gaertn.) Merr.	829	<i>S. obovata</i> Wight	305
<i>R. santaloides</i> (Vahl) Wight & Arn.	829	SAMADERA Gaertn.,	
<i>R. sclerocarpa</i> Wight & Arn.	826	nom. cons.	616, 620
RUTAL.	580, 609	S. indica Gaertn.	620
<i>R. angustifolia</i> Pers.	616	<i>S. lucida</i> (Wall.) Planch.	620
R. chalepensis L.	609	SAMYDACEAE	260
<i>R. graveolens</i> sensu		<i>Sandoricum indicum</i> Cav.	668
Manilal & Sivar. non L.	609	S. koetjape (Burm.f.) Merr.	668
<i>R. graveolens</i> L. var.		SAPINDACEAE	769
<i>angustifolia</i> Hook.f.	609	SAPINDUS L., nom. cons.	771, 784
RUTACEAE	579	<i>S. deficiens</i> Wight & Arn.	782
SABIA Colebr.	791, 794	S. emarginatus Vahl	784

<i>S. erecta</i> (Thwaites) Hiern	781	S. roxburghii G. Don	369
<i>S. laurifolia</i> Vahl	794	<i>S. laccifera</i> (Wight & Arn.)	
<i>S. tetraphylla</i> Vahl	782	B. Heyne ex Wall.	369
S. trifoliatum L.	784, 785	<i>S. talura</i> Roxb.	372
<i>S. trifoliatum</i> sensu Hiern non L.	784	SIDA L.	376, 386
SARCOSTIGMA Wight & Arn. 683,	690	S. acuta Burm.f.	386, 387
S. kleinii Wight & Arn.	690	S. alnifolia L.	387, 388
<i>Schimidelia distachys</i> DC.	780	<i>S. balica</i> Miq.	391
<i>S. rheedei</i> Wight	780	<i>S. beddomei</i> K.C. Jacob	393
SCHISANDRACEAE	129	<i>S. capitata</i> L.	434
SCHLEICHERA Willd.,		<i>S. carpinifolia</i> sensu Mast. non L.f.	387
nom. cons.	770, 786	<i>S. carpinifolia</i>	
S. oleosa (Lour.) Oken	786	var. <i>acuta</i> (Burm.f.) Kurz	387
<i>S. trijuga</i> Willd.	786	S. cordata (Burm.f.) Borss.	
<i>Schrebera albens</i> Retz.	698	Waalk.	387, 389
<i>Sclerostylis atalantioides</i> sensu		<i>S. corylifolia</i> Wall. ex Mast.	396
Wight non Wight & Arn.	585	S. cordifolia L.	387, 390
SCOLOPIA Schreb., nom. cons.	261, 277	<i>S. crispa</i> L.	384
<i>S. acuminata</i> Clos	279	<i>S. cuneifolia</i> Roxb.	397
S. crenata (Wight) Clos	278	S. elongata Blume	
<i>S. gaertneri</i> (Thwaites) Thwaites	279	var. <i>balica</i> (Miq.) Borss.	
<i>S. schreberi</i> J.F. Gmel.	281	Waalk.	387, 391
<i>S. aculeata</i> Sm.	610	<i>S. elongata</i> Blume	391
S. pusilla (Gaertn.)		<i>S. fryxellii</i> Sivar. & Pradeep	394
Willd.	278, 279	<i>S. glauca</i> Cav.	380
SCUTIA (Comm. ex DC.)		<i>S. glutinosa</i> Roxb.	392
Brongn., nom. cons.	723, 728	<i>S. graveolens</i> Roxb. ex Hornem.	378
<i>S. indica</i> Brongn.	728	<i>S. herbacea</i> Cav.	394
S. myrtina (Burm.f.) Kurz	728	<i>S. hirta</i> Lam.	377
SEMECARPUS L.f.	797, 815	<i>S. humilis</i> Cav.	389
S. anacardium L.f.	815, 816	var. <i>veronicaefolia</i> (Lam.) Mast.	389
S. auriculata Bedd.	815, 816	<i>S. indica</i> L.	379
<i>S. grahamii</i> Wight	805	<i>S. javensis</i> Cav. subsp. <i>expilosa</i>	
S. travancorica Bedd.	815, 817	auct. non Borss. Waalk.	393
<i>Senacia napaulensis</i> DC.	285	S. linifolia Cav.	387, 392
<i>Senebiera didyma</i> (L.) Pers.	217	<i>S. mutica</i> Delile ex DC.	380
<i>Sethia acuminata</i> Arn.	511	<i>S. muticum</i> (Delile ex DC.) Sweet	380
<i>S. indica</i> DC.	511	S. mysorensis Wight & Arn.	387, 392
<i>S. lanceolata</i> Wight	510	<i>S. pannosa</i> G. Forst.	380
var. <i>obtusifolia</i> Wight	517	<i>S. persica</i> Burm.f.	381
SHOREA Roxb. ex C.F. Gaertn.	359, 368	<i>S. polyandra</i> Roxb.	381

<i>S. ramosa</i> Cav.	382	STAPHYLEACEAE	787
S. repens Dombey ex Cav.	387, 393	<i>Stemonurus foetidus</i> Wight	688
<i>S. retusa</i> L.	392	STEPHANIA Lour.	177, 178, 189
Sida rhombifolia L.	387, 394	<i>S. hernandifolia</i> sensu Hook.f. & Thomson non Walp.	189
subsp. <i>alnifolia</i> (L.) Ugbor.	388	S. japonica (Thunb.) Miers	189
subsp. <i>retusa</i> (L.) Borss. Waalk.	392	var. discolor (Blume) Forman	190
var. <i>retusa</i> (L.) Mast.	388	var. japonica	190
subsp. <i>rhombifolia</i>	394	<i>S. rotunda</i> sensu	
var. <i>rhombifolia</i>	394	Hook.f. & Thomson non Lour.	191
var. <i>scabrida</i> (Wight & Arn.) Mast.	395	S. wightii (Arn.) Dunn	189, 190
<i>S. rhomboidea</i> Roxb. ex Fleming	394	STERCULIACEAE	449
<i>S. rotundifolia</i> Lam.	390	STERCULIAL	450, 470
S. scabrida Wight & Arn.	387, 395	<i>S. alata</i> Roxb.	469
<i>S. schimperiana</i> Hochst.	397	S. balanghas L.	471
S. spinosa L.	387, 395	var. <i>glabrescens</i> Mast.	471
<i>S. striata</i> (Dicks. ex Lindl.) Dietr.	383	<i>S. colorata</i> Roxb.	454
S. subcordata Span.	387, 396	S. foetida L.	470, 472
<i>S. tomentosa</i> Roxb.	384	S. guttata Roxb. ex DC.	471, 472
<i>S. veronicaefolia</i> Lam.	389	<i>S. heynei</i> Bedd.	474
SIMAROUBACEAE	616	<i>S. rubicunda</i> Wall. ex Mast.	454
<i>Sinapis juncea</i> L.	210	S. urens Roxb.	471, 473
<i>S. nigra</i> L.	211	S. villosa Roxb. ex Sm.	471, 474
<i>Sisymbrium indicum</i> L.	221	<i>Stigmaroia jangomas</i> Lour.	272
<i>S. nasturtium-aquaticum</i> L.	218	<i>Stroemia trifoliata</i> Roxb.	223
<i>Smythea bombaiensis</i> (Dalzell) S.P. Banerjee & P.K. Mukh.	737	STROMBOSIA Blume	672, 676
<i>Solandra lobata</i> Murr.	414	S. ceylanica Gardner	677
<i>Solenocarpus indicus</i> Wight & Arn.	818	SWIETENIA Jacq.	637, 660
SOYMIDA A. Juss.	637, 659	<i>S. febrifuga</i> Roxb.	660
S. febrifuga (Roxb.) A. Juss.	660	<i>S. chloroxylon</i> Roxb.	588
SPONDIASL.	797, 818	S. macrophylla King	661
<i>S. acuminata</i> Roxb.	819	S. mahagoni (L.) Jacq.	661
S. indica (Wight & Arn.) Airy Shaw & Forman	818	TALINUM Adans., nom. cons.	316, 319
<i>S. mangifera</i> Willd.	819	<i>T. cuneifolium</i> (Vahl) Willd.	319
S. pinnata (L.f.) Kurz	818, 819	T. portulacifolium (Forssk.) Asch. & Schweinf.	319
<i>Stalagmitis indica</i> (Thouars) G Don	342	T. triangulare (Jacq.) Willd.	320
<i>S. ovalifolius</i> G. Don	342	TARAKTOGENOS Hassk.	261, 280
<i>Staphylea indica</i> Burm.f.	767	T. macrocarpa (Bedd.) N.P. Balakr.	280
		TERNSTROEMIA Mutis ex L.f., nom. cons.	354

T. gymnanthera (Wight & Arn.) Bedd.	357	<i>T. racemosa</i> Colebr.	192
<i>T. japonica</i> auct. non Thunb.	357	TINOSPORA Miers,	
TETRACERAL.	119,124	nom. cons.	177, 178, 192
T. akara (Burm.f.) Merr.	125	T. cordifolia (Willd.) Miers	193
<i>T. indica</i> sensu Manilal & Sivar. non (Houtt. ex Christm. & Panz.) Merr.	125	<i>T. malabarica</i> (Lam.) Miers ex Hook.f. & Thomson	194
<i>T. rheedei</i> DC.	125	T. sinensis (Lour.) Merr.	193, 194, 195
<i>T. laevis</i> auct. non Vahl	125	<i>T. tomentosa</i> (Colebr.) Hook.f. & Thomson	194, 195
TETRASTIGMA (Miq.) Planch.	737, 760	TODDALIA Juss., nom. cons.	581, 610
<i>T. canarense</i> Gamble	760	<i>T. aculeata</i> (Sm.) Pers.	611
T. gamblei B.V. Shetty & P. Singh	760	T. asiatica (L.) Lam.	610
<i>T. lanceolarium</i> Planch.	761	var. <i>floribunda</i> (Wall.) Kurz	611
T. leucostaphylum (Dennst.) Alston ex Mabb.	760, 761	<i>T. bilocularis</i> Wight & Arn.	613
<i>T. leucostaphylum</i> sensu Ramam. non Alston ex Mabb.	762	TOONA (Endl.) M. Roem.	636, 662
<i>T. muricatum</i> sensu Gamble	762	T. ciliata M. Roem.	663
<i>T. muricatum</i> Gamble	761	TRIBULUS L.	519, 520
T. nilagiricum (Miq.) B.V. Shetty	760, 762	<i>T. cistoides</i> L.	521
T. sulcatum (M.A. Lawson) Gamble	760, 762	T. terrestris L.	520
THEACEAE	353	Triceros cochinchinensis Lour.	797
THEOBROMA L.	451, 475	TRICHILIA P. Browne, nom. cons.	636, 664
T. cacao L.	476	<i>T. affinis</i> A. Juss.	664
THESPESIA Sol. ex Corrêa, nom. cons.	399, 430	T. connaroides (Wight & Arn.) Bentv.	664
T. lampas (Cav.) Dalzell & A. Gibson	430	<i>T. trijuga</i> Vall.	664
T. populnea (L.) Sol. ex Corrêa	430, 431	TRIPHASIA Lour.	581, 611
<i>Thlaspi bursa-pastoris</i> L.	214	<i>T. aurantiola</i> Lour.	612
<i>Thraulococcus erectus</i> (Thwaites) Radlk.	781	T. trifolia (Burm.f.) P. Wilson	612
TILIACEAE	477	<i>T. trifoliolata</i> (L.) DC.	612
TILIACORA Colebr., nom. cons.	177, 191	TRIUMFETTA L.	478, 495
T. acuminata (Lam.) Hook.f. & Thomson	191	<i>T. angulata</i> Lam.	497
		T. annua L.	496
		<i>T. bartramia</i> L.	497
		<i>T. indica</i> Lam.	497
		T. pilosa Roth	496
		T. rhomboidea Jacq.	496, 497
		<i>T. tungarensis</i> Billore	497
		<i>Trochisandra indica</i> Bedd.	697
		Tropaeolum majus L.	523
		TURPINIA Vent., nom. cons.	788

T. cochinchinensis (Lour.) Merr.	788	<i>Vareca zeylanica</i> Gaertn.	264
T. malabarica Gamble	788, 789	VATERIAL.	359, 370
<i>T. nepalensis</i> Wight & Arn.	788	V. indica L.	370
<i>T. pomifera</i> sensu Hiern non (Roxb.) DC.	788	V. macrocarpa B.L. Gupta	370, 371
TURRAEAL.	636, 665	<i>V. malabarica</i> Blume	370
<i>T. pinnata</i> Wall.	656	<i>V. roxburghiana</i> Wight	373
T. villosa A.W. Benn.	665	VATICAL.	359, 372
Tytonia G Don	530	V. chinensis L.	373
<i>Unona discolor</i> Vahl	143	<i>V. laccifera</i> Wight & Arn.	369
<i>U. lawii</i> Hook. f. & Thomson	143	<i>V. roxburghiana</i> (Wight & Arn.) Blume	373
<i>U. narum</i> Dunal	173	<i>Velago xylocarpa</i> Gaertn.	468
<i>U. pannosa</i> Dalzell	149	VENTILAGO Gaertn.	723, 729
<i>U. ramarowii</i> Dunn	150	V. bombaiensis Dalzell	729
<i>U. viridiflora</i> Bedd.	144	<i>V. calyculata</i> Tul.	730
URENEAE Benth. & Hook. f.	376, 433	V. denticulata Willd.	729, 730
URENAL.	434, 439	V. gamblei Suess.	729, 730
U. lobata L.	440	<i>V. lanceolata</i> Gamble	730
<i>U. lobata</i> L. subsp. <i>lobata</i> var. <i>lobata</i> Borss. Waalk.	440	VEPRIS Comm. ex A. Juss.	581, 612
<i>U. lobata</i> L. subsp. <i>lobata</i> var. <i>viminea</i> (Cav.) Gürke	440	V. bilocularis (Wight & Arn.) Engl.	613
<i>U. lobata</i> L. subsp. <i>sinuata</i> (L.) Borss. Waalk.	441	VIOLACEAE	249
U. sinuata L.	440, 441	VIOLA L.	250, 254
<i>U. viminea</i> Cav.	440	V. betonicifolia Sm.	255
UVARIAL.	132, 171	<i>V. enneasperma</i> L.	251
<i>U. cerasoides</i> Roxb.	163	<i>V. patrinii</i> auct. non DC.	255
<i>U. heteroclita</i> Roxb.	130	V. pilosa Blume	255, 256
U. hookeri King	172	<i>V. serpens</i> Wall. ex Ging.	256
<i>U. longifolia</i> Sonn.	167	<i>V. suffruticosa</i> L.	251
U. narum (Dunal) Blume	173	V. tricolor L.	256
<i>U. narum</i> Wall. ex Hook. f. & Thomson		VITACEAE	736
var. <i>macrophylla</i>		<i>Vitis anamalayana</i> Bedd.	759
Hook. f. & Thomson	172	<i>V. auriculata</i> (Roxb.) Wall.	758
<i>U. odorata</i> Lam.	140	<i>V. canarensis</i> Dalzell	743
<i>U. suberosa</i> Roxb.	168	<i>V. canarensis</i> sensu Rama Rao non Dalzell	743, 760
<i>U. tomentosa</i> Roxb.	153	<i>V. carnososa</i> (Lam.) Wall.	747
<i>U. velutina</i> Dunal	154	<i>V. discolor</i> (Blume) Dalzell	750
U. zeylanica L.	172, 174	<i>V. gigantea</i> Bedd.	752
		<i>V. glauca</i> sensu Wight & Arn. non	
		<i>V. glyptocarpa</i> (Thwaites)	
		M.A. Lawson	751

<i>V. heyneana</i> Wall. ex Wight & Arn.	752	<i>X. tinctorius</i> DC.	345
<i>V. himalayana</i> (Royle) Brandis	759	XANTHOPHYLLACEAE	306
<i>V. indica</i> L.	738	XANTHOPHYLLUM Roxb.,	
<i>V. japonica</i> Thunb.	742	nom. cons.	307
<i>V. lanceolaria</i> Wall. ex Wight & Arn.	769	X. flavescens Roxb.	
<i>V. latifolia</i> Roxb.	739	var. flavescens	307
<i>V. linnaei</i> Wight & Arn.	757	<i>X. arnottianum</i> Wight	307
<i>V. mollis</i> Wall. ex M.A. Lawson	742	XIMENJIA L.	672, 677
<i>V. mollissima</i> Wall.	743	X. americana L.	678
<i>V. neilgherriensis</i> Wight	759	XYLOCARPUS J. König	637, 667
<i>V. pallida</i> sensu		X. granatum J. König	667
M.A. Lawson non Wight & Arn.	750	<i>X. obovatus</i> (Blume) A. Juss.	667
<i>V. pedata</i> (Lam.) Wall. ex Wight	743	XYLOPIA L., nom. cons.	132, 174
<i>V. quadrangularis</i> (L.) Wall.		X. parviflora (Wight) Hook.f. &	
ex Wight	753	Thomson	175
<i>V. repanda</i> (Vahl) Wight & Arn.	754	XYLOSMA G. Forst.,	
<i>V. repens</i> (Lam.) Wight & Arn.	755	nom. cons.	261, 281
<i>V. rheedei</i> Wight & Arn.	756	X. latifolia Hook.f. & Thomson	282
<i>V. roxburghii</i> sensu		ZANTHOXYLUM L.	580, 613
M.A. Lawson non Wight & Arn.	746	<i>Z. connaroides</i> Wight & Arn.	664
<i>V. roxburghii</i> Wight & Arn.	754	Z. ovalifolium Wight	614
<i>V. semicordata</i> Wall.		var. <i>sepiarium</i> (Wight) Hook.f.	614
var. <i>roylei</i> King	759	Z. rhetsa (Roxb.) DC.	614, 615
<i>V. sulcata</i> M.A. Lawson	762	<i>Z. roxburghianum</i> Cham.	609
<i>V. tenuifolia</i> Wight & Arn.	746, 747	<i>Z. sepiarium</i> Wight	621
<i>V. tomentosa</i> Roth	740	<i>Z. triphyllum</i> Wight	609
<i>V. trifolia</i> L.	747	ZIZIPIIUS Mill.	723, 731
V. vinifera L.	763	<i>Z. hamosa</i> Wall.	726
WALSURA Roxb.	636, 666	<i>Z. jujuba</i> (L.) Gaertn.	732
<i>W. piscidia</i> Roxb.	666	<i>Z. jujuba</i> Lam.	
W. trifoliata (A. Juss.) Harms	666	var. <i>fructicosa</i> Haines	732
WALTHERIA L.	451, 476	Z. mauritiana Lam.	732
W. indica L.	476	var. fructicosa (Haines)	
<i>Wormia bracteata</i> (Wight)		Sebastine & N.P. Balakr.	732
Hook.f. & Thomson	121	var. mauritiana	732, 733
<i>W. suffruticosa</i> Griff.	123	Z. nummularia (Burm.f.)	
<i>Xanthochymus ovalifolius</i>		Wight & Arn.	732, 733
J. Graham non Roxb.	343	var. nummularia	733
<i>X. ovalifolius</i> Roxb.	342	Z. oenoplia (L.) Mill.	732, 734
<i>X. pictorius</i> Roxb.	341, 345	Z. rugosa Lam.	731, 734
<i>X. spicatus</i> Wight & Arn.	342	Z. xylopyrus (Retz.) Willd.	732, 735
		ZYGOPHYLLACEAE	518

INDEX TO LOCAL NAMES

Aathi	137	Charatta-anjali	360
Adakka payini	373	Charei	816
Akara-patsjoti	125	Chathurapuli	568
Akil	652, 663	Chavakampu	623
Akkaramkolli	313	Cheemappanni	259
Alli	261	Chella	165
Ambalam	819	Chembarathi	419
Ambel	200, 201	Chembravalli	739
Amirthunka	137	Chemmaram	647
Anaivilavu	623	Chemmeen puli	567
Anakurumthoti	388	Chempanni	259
Anathondi	469	Chenthamara	206
Ana-vananki	264	Chera	803
Anavya	345	Chera kanji	279
Aneperala	323	Cheri	806, 816
Anna-karana	267	Cheriakattunaregam	606
Appakadukka	259	Cheriavallikanjiram	680
Aranamaram	166	Cherrumullikkachedi	269
Ariavella	246	Cheru-kanchi	267
Arya-vaepu	648	Cheruparuvu	387
Aryaval	246	Cherupunna	331
Assotham	166	Cheruran	463
Atangi	356	Chigiri	339
Athamaram	137	Chinapparathi	416
Attukaruka	344	Chittamruthu	193
Attuparuthi	424	Chittila madaku	780
Attupunna	331	Chokatti	623
Avukaram	817	Chorivalli	747
Bhasmavalli	494	Chorunna	166
Bilimbi	567	Chunnampu-valli	750
Brahmadanti	207	Churranakil	644
Caralu	278	Chuvanna-akil	649
Cataacci	493	Cocoa	476
Chadicha	493	Curry narenga	592
Chalirin pazham	271	Daramba	339
Chalita	121	Eheru piney	373
Champakam	127	Elantha	732
Changalaparanda	753	Elavu	444
Charalmaram	271	Erumichinarakam	589

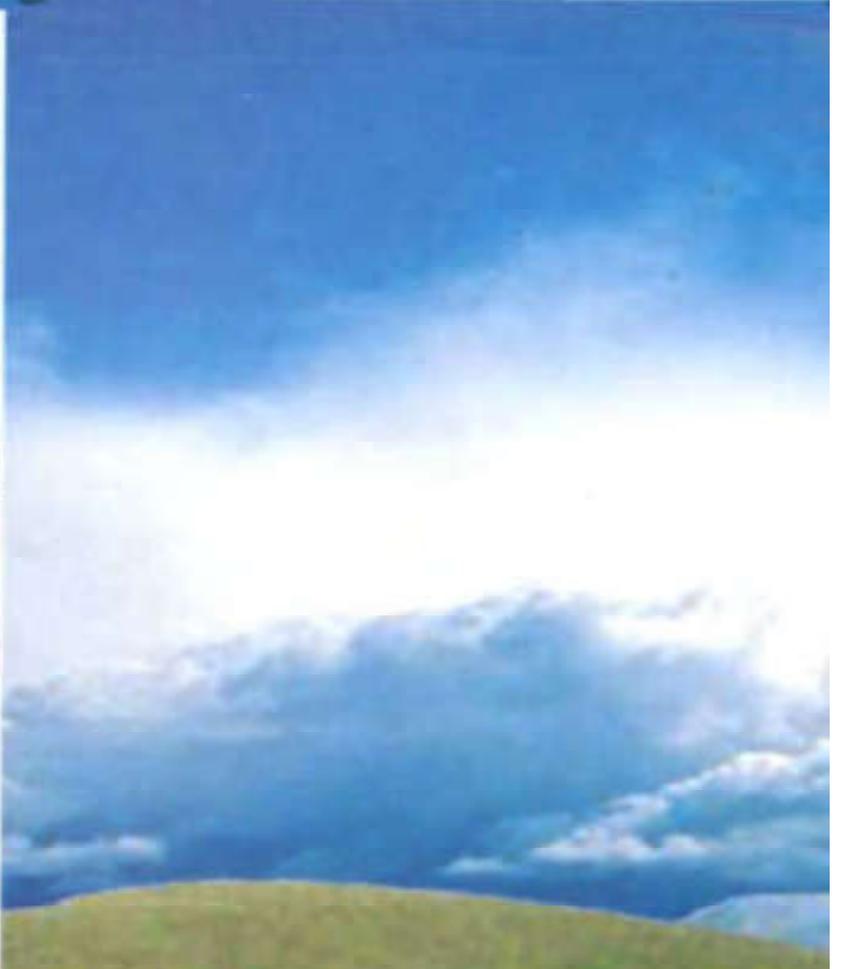
Erungi	785	Karatolal	374
Gilam	592	Kareta-sorivalli	756
Gorakkapuli	336	Kareyam	634
Ilapongu	364	Karichakka	567
Ilavu	446	Karikunnan	267
Ilumbipuli	567	Karingotta	621
Irumbagam	365	Karinjotta	621
Irumbanpuli	567	Karivepu	604
Irunbakkam	364	Karpuravalli	192
Irupu	365	Karukkampuli	339
Isvarmuri	456	Karukongu	364
Iutali	728	Karungali	307
Jothishmathi	774	Karuttukungiliyam	629
Kaccapatta	286	Karuvall	165
Kachapatta	286	Karuvembu	634
Kadugu	211	Karvela	241
Kadumpuli	336	Kasu-mavu	797
Kaivum	456	Katpuvarasu	430
Kakkatudali	611	Kattamirthu	194
Kalapoo	413	Kattampazham	819
Kalasam	807	Katta-pinna	333
Kalavi	792	Kattapunna	331
Kalilavu	445	Kattatha	135
Kal-manikkam	673,677	Kattavanakku	429
Kalpayin	361	Kattu kara	499
Kaipinc	360	Kattu-champakam	128
Kalpottan	175	Kattukadugu	246
Kalthamara	251	Kattukalasan	634
Kambagam	365	Kattukarana	355
Kanakaitha	170	Kattuvellurem	406
Kana-kaiitha	154,170	Kattukariveppila	593
Kaneli	603	Kattukasthuri	404
Kanjimaram	667	Kattukurunthotti	387
Kara	502,735	Kattumulla	605
Karagil	613,642	Kattunaregam	585
Karaiccingari	630	Kattunaregam	606
Karakong	363	Kattuparathi	430
Karanai	448	Kattupunna	121
Karangali	360	Kattushembagam	140
Karanini	448	Kattuvalli	180
Karantavalli	740	Kavalam	471

Kavalam	471	Mala-maravatti	275
Kayonenar	492	Malamarotti	275
Kayyonnar	491	Malamavu	799,800
Kilimaram	632	Malampavatta	264
Killi	249	Malampongu	344
Kithondi	473	Malam-thodali	468
Kodakapuli	336	Malankuruparutthi	460
Kodangi	165	Malan-tudali	735
Kodapuli	336	Mala-paruthi	454
Kodapunna	123	Malathangi	180
Kodathani	469	Mala-uram	467
Kodi	277	Malavaeppu	649
Kolivala	344	Mala-viriam	467
Kongu	364	Malavurum	466
Korakkadi	664	Mangusta	346
Korongu	448	Mangustan	346
Kosaramba	634	Manilanilam	137
Koti	277	Manja nara	170
Kotta	735, 490	Manjanangu	342
Kottakka	490	Manjapunna	331
Kottavalli	734	Manorangini	139
Kozhichemparuthi	420	Manyarei	170
Krali	777	Maramanjai	183
Kunkumachedi	258	Maravetti	277
Kunthirikka-payin	629	Marotti	277
Kuppa-manjal	258	Mathagiri-vembu	663
Kuramullu	269	Mattipal	618
Kuranganka	258	Matti-pongilyam	617
Kurikithali	829	Mavu	808
Kurilvali	172	Mechingom	532
Kurintipanel	165	Mela-veppu	663
Kurivel	829	Modirakanni	507
Kurriveppilla	604	Mottal	307
Kurumthotti	394	Mrigampuli	755
Kurumulli	269	Mukkannan-peru	772
Kuttuvellurem	406	Mukkutti	569
Kuvalam	583	Mukuram	458
Madakka	307	Mulakuchemparathi	435
Madanakameswari	139	Mullaathi	136
Madhuramlaphala	591	Mullangi	219
Mahogani	662	Mullenchaka	136

Mulli	734	Olaparuthi	424
Mullila pula	444	Onapu	534
Mullilavu	444, 446, 615	Oorpum	440, 441
Mullu-kara	735	Orelathamara	251
Mungapera	800	Pabba	649
Muringa	821	Padakizhengu	186
Muttakhose	212	Padappen	827
Nagadhali	609	Padathali	186
Naggara	503	Padavalli	186
Naikadugu	246	Paeamirthu	194
Naikodi	780	Paerilla-pacha	667
Naikuriel	824	Painimaram	371
Naithckku	123	Palaka-unam.	468
Nakam	458	Palimaranga	344
Nanga	349	Paluzhavam	774
Narela	163	Pambaram	466
Narthondi	471	Pamba-vetti	789
Narumpannal	173	Pampukonta	485
Nazhuku	767	Panchi	599
Neddunar	165	Panel	599
Neduna	165	Panichakamm	416
Neduvai kongu	367	Panji	407
Neerambel	201	Panjimaram	446
Neervalu	249	Panninurunga	264
Neiringampuli	413	Pantappayan	629
Nelantaragam	658	Para	341
Neriampulli	755	Parankippazha	137
Nilacheera	317	Paringi-mavu	797
Nilam thangi	574	Paruthi	408, 410
Nilamparanda	251	Pasakotta	776
Nilampunna	119	Pasakotta	785
Niraduvithu	277	Paviri-mulei	783
Nir-mathalam	249	Payani	371
Nirmulei	645	Payippala	491
Niroli	779	Penampuli	338
Nirparathi	424	Peri	349
Nirvalom	249	Perim kara	502
Nirvetti	277	Perimkuriel	824
Njazel	641	Periyanka	296
Odichukuthinaregam	591	Perumpayani	371
Ola	356	Perumpiney	371

Pilahi	503	Seethapazham	137
Pily	534	Seraya	348
Pinaru	336	Shempunna	776
Pinna	332	Sidhamirthu	193
Pinenga	336	Sitambal	200
Pinnapai	333	Somi	660
Pinnarpuli	339	Somunthiri	668
Poichchai	421	Suran-punna	348
Polechi	421	Syalita	121
Poila	179	Taluram	369
Pongilyam	618	Tamara	206
Pongu	366	Thaivela	241
Ponnummatham	207	Thalira	270
Pooia	446	Thambagam	365
Pooparuthi	424,431	Thelli	629
Poovarasu	431	Thenkotta	816
Porapunna	331	Thodali	735
Porim-puvana	777	Thodappei	802
Pothondi	469	Thondi	471
Pottakavalam	473	Thookkuchembarathi	420
Pottakavalom	472	Thurthi	381
Puachetti	623	Thuthalimullu	734
Pudangalli	353	Todalimullu	734
Pula-maram	444	Tripadi	744
Pulimaranga	344	Udiram	440,441
Pulinchi	785	Ulinja	774
Puli-vayila	353	Umiatharuvi	777
Pulivenda	412	Uppanacham	413
Puliyaral	577	Uram	379,440,441
Pullarrei	165	Uren	441
Pungari	500	Urungi	785
Punna	121,332	Utharasham	455
Punnavu	786	Uzhinja	774
Punyava	640	Vadiyambu	114
Pura	331	Vakka	475
Puvam	786	Valambari	456
Ramachitha	137	Valiya kara	502
Rudraksham	455	Valiya-chorivalli	761
Rusakam	592	Valiyapirapitica	740
Santhu	175	Vallichorianum	744
Sarelmaram	278	Vallikanjiram	192

Vallikurunthoti	389	Vellambel	200
Valmuriccha	779	Vella-oorai	406
Vancholam	166	Velluppan	390
Vandakamin	659	Velluram	379,390
Varippanpuli	568	Velukku	429
Vattakurumthotti	393	Veluthachorivalli	744
Vatti	440	Veluthapala	349
Vavangu	361	Vempu	429
Vayala	352	Venda	402
Vayankatha	270	Venkotta	700
Vayila	352	Veradaku	728
Vazhapunna	123	Vetinar	453
Vedi-vembu	663	Vidukaneli	582
Velayani	361	Vila	600
Veliparuthi	424	Villa	164
Velipparuthi	406	Viluni	154
Vella payin	371	Viri	333
Vella payini	373	Vlatti	600
Vella-kundirukkam	627	Vrali	777
Vella-kunnan	263		



ISBN-81-8177-008-0