

# FLORA OF KODERMA WILDLIFE SANCTUARY, JHARKHAND



भारतीय वनस्पति सर्वेक्षण  
BOTANICAL SURVEY OF INDIA

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*Authors*

**Shyam Biswa**

**†P. Lakshminarasimhan**

**Adani Lokho**



**Botanical Survey of India**  
**Ministry of Environment, Forest and Climate Change**

**2025**



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Date of Publication: March, 2025

Published by

**The Director**

**Botanical Survey of India**

CGO Complex, 3rd MSO Building

Block-F, 5th & 6th Floor

DF-Block, Sector I, Salt Lake City

Kolkata 700064

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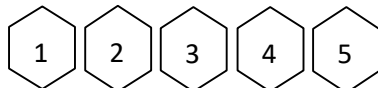
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Back cover:



1. *Ceropegia hirsuta* Wight & Arn
2. *Striga angustifolia* (D. Don) C.J. Saldanha
3. *Grona heterocarpos* (L.) H. Ohashi & K. Ohashi
4. *Crotalaria prostrata* var *levis* Haines
5. *Bombax ceiba* L.

ISBN: 978-81-985174-1-8

E - Publication

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GOVERNMENT OF INDIA  
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& CLIMATE CHANGE  
BOTANICAL SURVEY OF INDIA



### FOREWORD

Jharkhand means "*The Land of Jungles*" because of its forest. There are eleven Wildlife Sanctuaries, one National Park, one Tiger Reserve and one Elephant Reserve. Jharkhand has undulating tracts, hills and ridges ranging from 300 to 900 m, many rivers, valleys and basins and covers a huge forest area of about 23,765 km<sup>2</sup> constituting 29.81% of the state total geographical area.

Koderma Wildlife Sanctuary is one such protected area in Jharkhand covering 150.62 km<sup>2</sup>, which falls in the bio-geographical region of Deccan Peninsula in Chotanagpur Plateau Province and situated towards northern part of the state. In line with the documentation of Floristic wealth in the protected area in our country, BSI has taken up the Koderma WLS for floristic studies during 2010–2015. These results are presented in the form of an e-publication "Flora of Koderma Wildlife Sanctuary, Jharkhand" which documents 437 taxa in 334 genera which belongs to 100 angiosperm families as per APG IV System of classification of plants. Apart from angiosperms, 8 Pteridophyte species were also recorded from the study area. The Flora is presented here with artificial keys for identification of these species along with line diagrams and photographs as value addition.

I congratulate the authors on their significant contribution, which provides an up-to-date status on the flora of Koderma Wildlife Sanctuary representing an unique ecosystem.

This document will surely help the Forest Department, Officials, Biodiversity Management Committees, conservationists, policy makers and field workers in management practices of the protected areas. The students, researchers, academicians, naturalists, and amateurs will be benefitted by using this book as a reference manual for identification of their plants.

(Ashiho Asosii Mao)



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## ACKNOWLEDGEMENTS

The authors would like extend sincere gratitude:

- ✚ To The Director and former Directors for facilities and encouragement.
- ✚ To Head of Office, CNH, BSI and former heads of Office for their help and facilities.
- ✚ To Publication section, and Technical section, BSI (Hqrs.) for their support in publication.
- ✚ To Scientist and ex-Scientist BSI, for their expertise help and constant support.
- ✚ To the Principal Chief Conservator of Forests, Biodiversity Conservation-cum-Chief Wildlife Warden, Jharkhand, the Divisional Forest Officers and the Range Forest Officers and other forest officials of Koderma Wildlife Sanctuary, Jharkhand, for permission to floristically explore the Wildlife Sanctuary and rendering necessary help during the field visits.
- ✚ To the Birhore Community, herbalists, for imparting their invaluable ethnobotanical knowledge.
- ✚ To artists, for their help in some of the illustrations.
- ✚ To field staffs, CNH for their help during the field explorations and support.
- ✚ To fellow colleagues, SRF and JRF for their help.
- ✚ To family members and friends for their continuous help and support during the entire period of work.

**Authors**





## PREFACE

Our planet is facing tremendous threats of losing of flora and fauna and its natural habitats. The Convention on Biological Diversity made all the Parties mandatory on their part to conserve the areas with rich biological diversity and prioritized in-situ conservation with special measures which includes the protected areas. In India, there are 1135 Protected areas, including 106 National Parks, 574 Wildlife Sanctuaries in which Koderma Wildlife Sanctuary is one of them. The scientific research in the Wildlife Protected areas is important for the better understanding of their ecosystems, functions, ecology and the status of the species diversity and their habitats. The information generated through scientific works in these areas will be useful in understanding the ecological processes for taking appropriate actions in conservation and management of both flora and fauna and their natural habitats. In this regard, the Botanical Survey of India (BSI) has given an adequate importance to the documentation of protected areas and has been engaged in the studies of the vegetation/flora of many National Parks and Wildlife Sanctuaries in our country. The present study deals with the analysis of floristic diversity in **Koderma Wildlife Sanctuary** in the state of Jharkhand.

The Koderma Wildlife Sanctuary was notified as a Wildlife Sanctuary in the year 1981 and lies between 24°25' and 24°38' N Latitudes & 85°25' and 85°40' E Longitudes and spread over an area of 150.62 sq km., which falls in the bio-geographical region of Deccan Peninsula in Chotanagpur Plateau Province. This Wildlife Sanctuary lies in the district of Koderma which was carved out from Hazaribagh region in 1994 that lies in the Chotanagpur Plateau.

Two major types of forests are found in the state of Jharkhand viz., Northern Tropical Dry Deciduous Forest or Dry Peninsular Sal Forest and Northern Dry Mixed Deciduous Forest. It is predominant with *Shorea robusta* (Sal), the state tree which is found both in the plains and in hilly tracts and *Butea monosperma* (Palash), the state flower of Jharkhand also known as the “Flame of the Forest”, along with other tree species. The Sanctuary harbours many important flora and fauna and very rich in mica deposits.



The plant families in the present study were arranged as per the Angiosperm Phylogeny Group (APG IV, 2016) system of classification. The genera under a family and the species under a genus have been arranged in alphabetical order. The keys are provided for easy identification and family with the number of genera and species and each genus with the number of species has been given in sequential order – World, India, Jharkhand and KWLS. The latest accepted botanical name, followed by basionym if any and relevant synonyms with detailed citations have been provided for each taxon. The nomenclatures of the plants were updated as per the current International Code of Nomenclature for algae, fungi, and plants (2018), Nomenclatural citation is followed by local vernacular name(s), if any. The detailed description of the specimen examined along with flowering and fruiting period, habitat, and its distribution, the exact locations of the collected plants were given with GPS readings i.e. the coordinates along with elevation of the each plant collected.

The flora of the Koderma Wildlife Sanctuary comprises 437 taxa including 429 species, and 5 varieties and 3 subspecies in 328 genera belonging to 100 angiospermous families as per the APG IV system of classifications. Besides, 8 pteridophyte species have been recorded from the study area.

It is an outcome of methodical and meticulous primary research. It is believed this book will be useful reference material for forest officials, biodiversity management committees, conservationists, policy makers, field workers, botany students, researchers, academicians, naturalists, amateurs, and plant enthusiasts to know about the diversity of the local flora of this region.



*Butea monosperma* – 'State Flower of Jharkhand'

## CONTENTS

|                                                                       |         |
|-----------------------------------------------------------------------|---------|
| Photo plates                                                          | i-lxvii |
| Introduction                                                          | 1       |
| Vegetation                                                            | 4       |
| Faunal Diversity                                                      | 4       |
| Past Botanical Work                                                   | 5       |
| Present Botanical Work                                                | 7       |
| Materials and Methods                                                 | 8       |
| Plan of Presentation                                                  | 8       |
| Statistical Analysis of the Total Flora of Koderma Wildlife Sanctuary | 9       |
| Discussion                                                            | 11      |
| Systematic Enumeration of the Species                                 | 18      |
| References                                                            | 401     |
| Index (Scientific names)                                              | 409     |





*Shorea robusta* – 'State Tree of Jharkhand'

## ABBREVIATIONS USED

c.: circa (about)

CAL: Central National Herbarium

ed.: editor; eds.: editors

ex: from

f. (after a personal name): filius (son)

Fl.: Flowering

Fr.: Fruiting

KWLS: Koderma Wildlife Sanctuary

nom: nomen (name)

nom. alt.: nomen alternativum (alternative name)

nom. cons: nomen conservandum (conserved name)

p.p.: pro parte (partly)

sp.: species (singular); spp. (plural)

subsp.: subspecies

syn.: synonym

var.: variety

& al.: and others

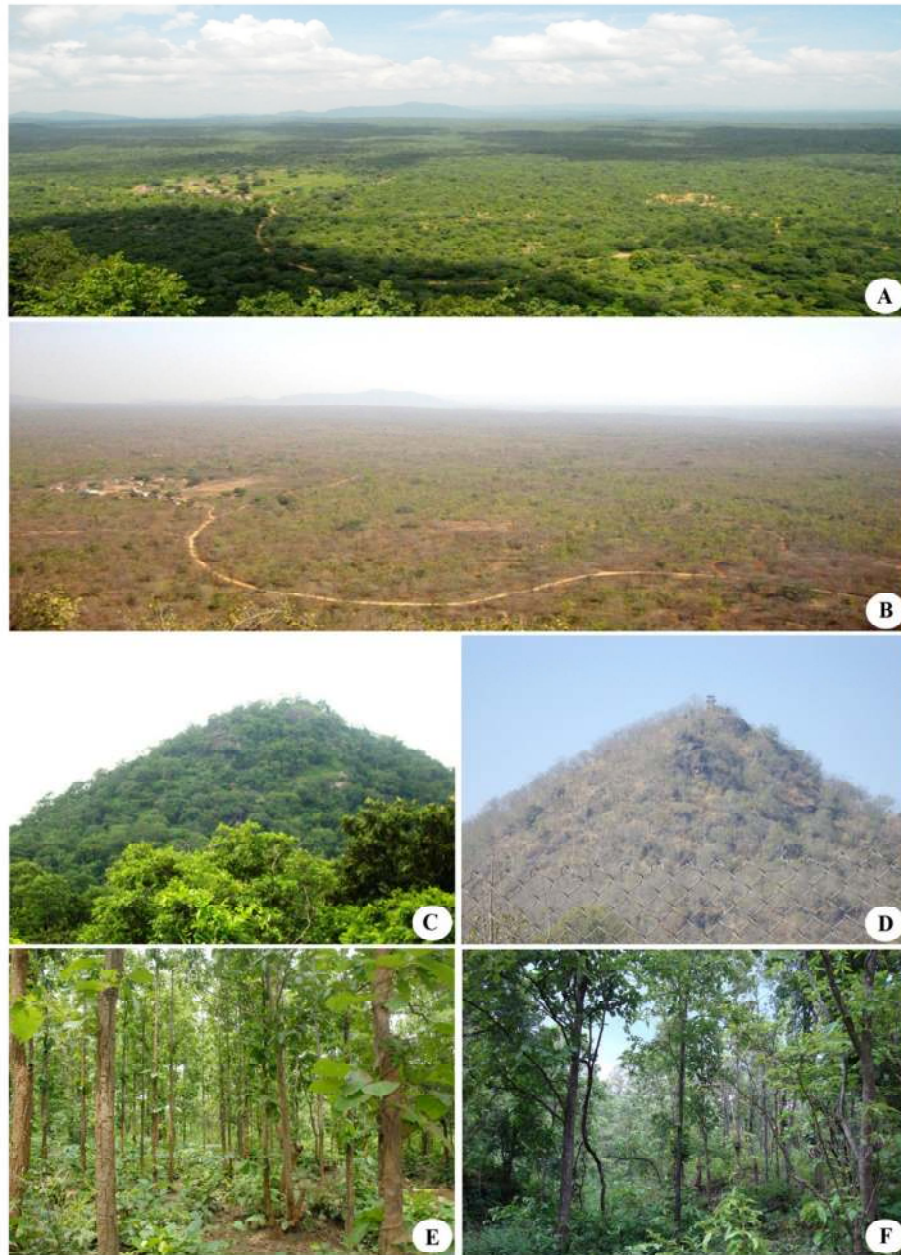


Plate 1. A. Phutlaya Nala; B. Dipluswa Nala; C. Khalaktambi Nadi; D. Taraghati Nala; E. Dhanarjay Nadi, during the monsoon season, inset: during the dry season; F. Rheo-goghar Dam, Chattarbar; G. Check dam at Muglamaram Forest.



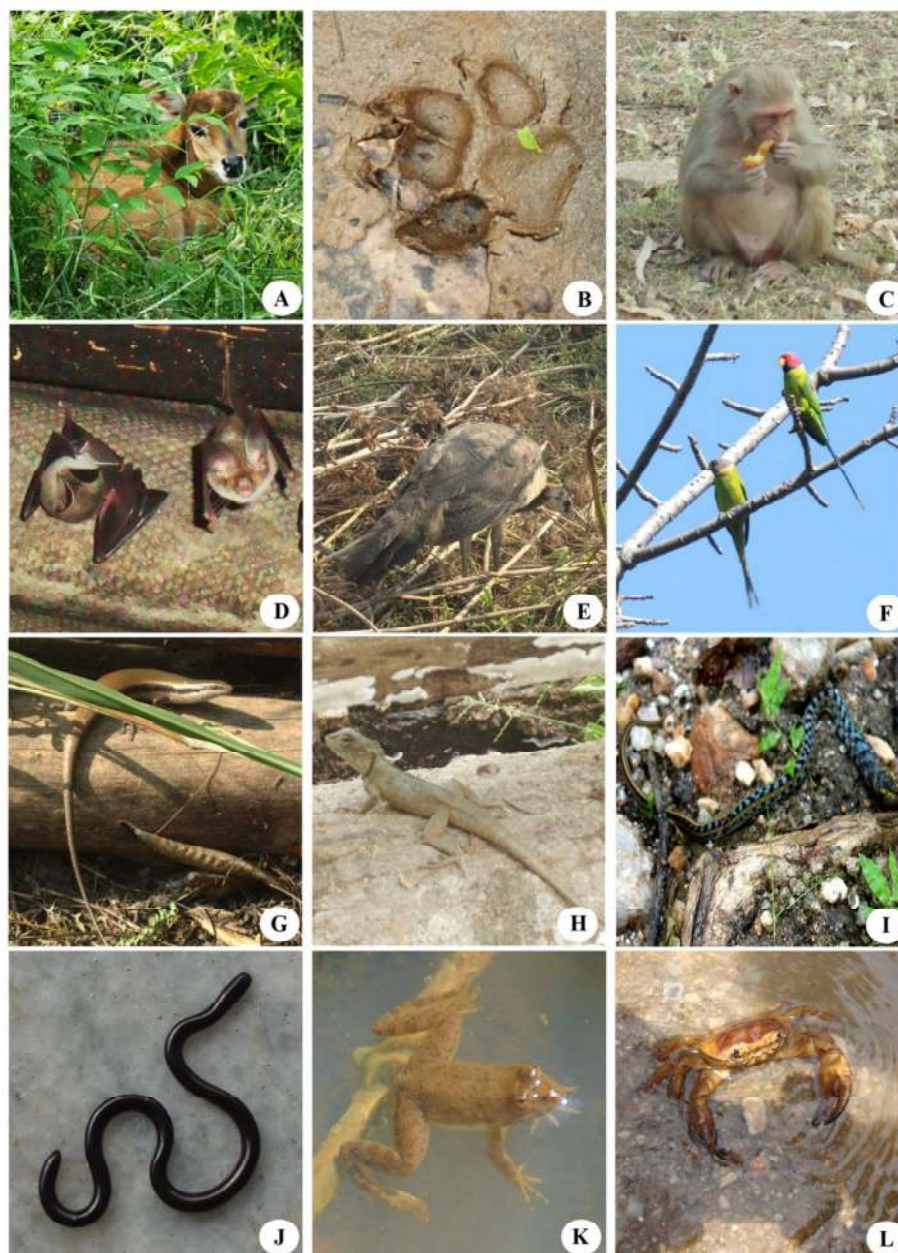
**Plate 2.** A. Koderma Reserve forest entry near Range Forest Office; B. Rishi Dhurwasa Pahar, Deborghati; C. Kari Pahar; D. Dengra Pahar, Chattarbar; E. Plant collection at Muglamaram Reserve Forest; F. Plant collection at Dhawajadhari Pahar; G. Tour team with medicine man at Chattarbar; H. Processing of specimens at field camp.



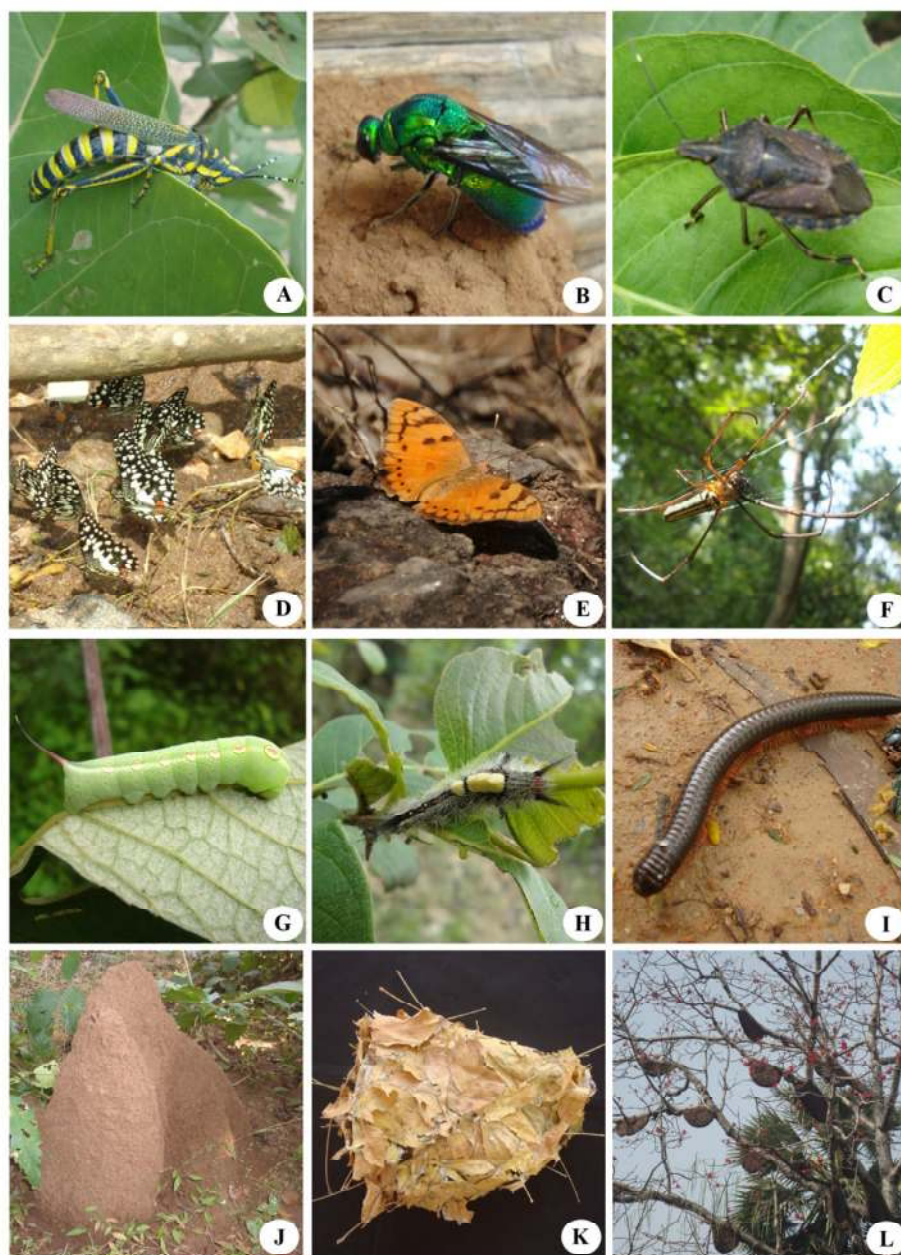


**Plate 3.** A. Koderma Reserve Forest, during monsoon season; B. Koderma Reserve Forest, during dry deciduous season; C. Dhawjadhari Pahar, during monsoon season; D. Dhawjadhari Pahar, during dry deciduous season; E. Dry Peninsular Sal Forest at Lokai; F. Dry Mixed Deciduous Forest at Khalak-tambi.



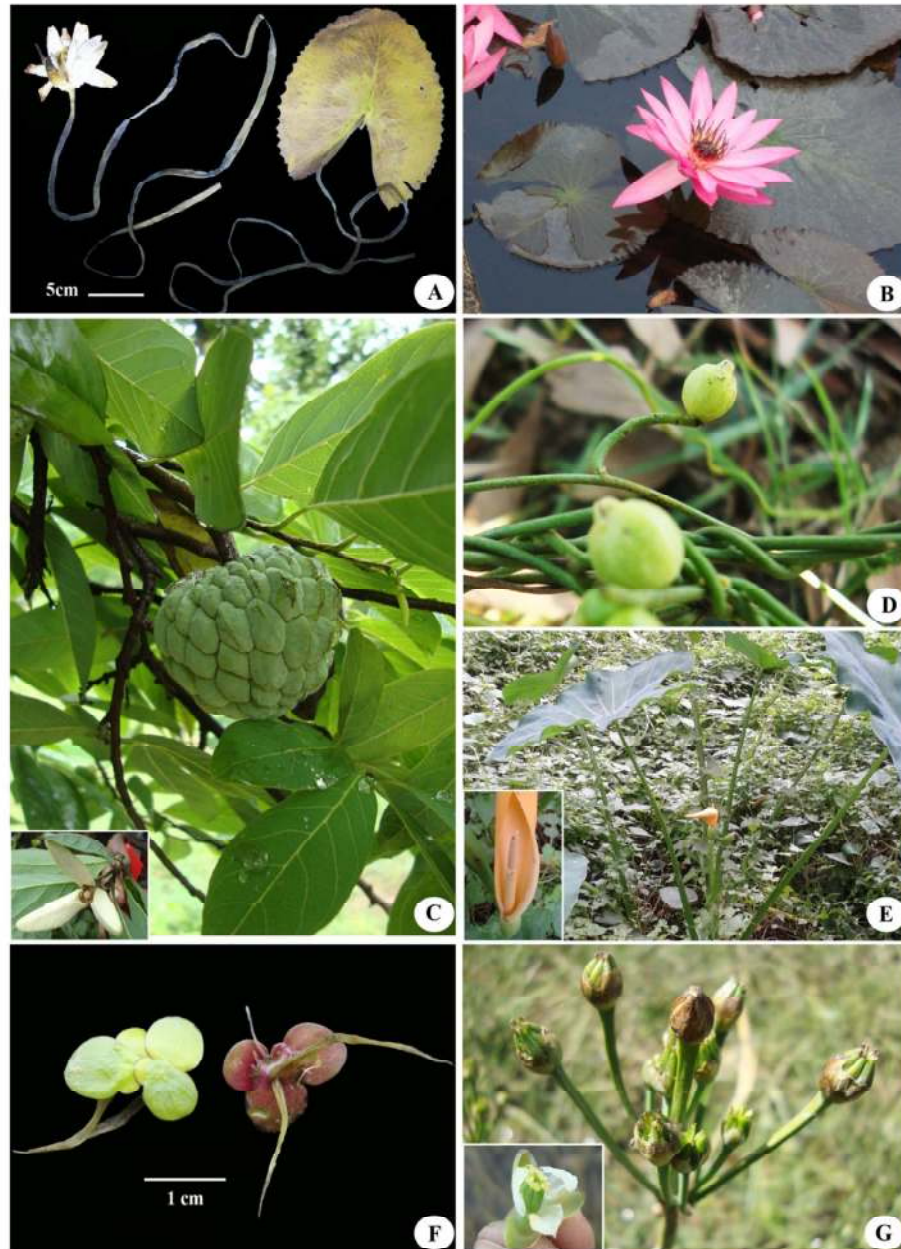


**Plate 4.** A. Neel gai; B. Pug mark of jackal/fox; C. Monkey eating fruit of *Diospyros melanoxylon*; D. Bats; E. Peacock; F. Parrots; G. Skink; H. Lizard; I. Snake; J. Blind Snake; K. Frog; L. Crab.

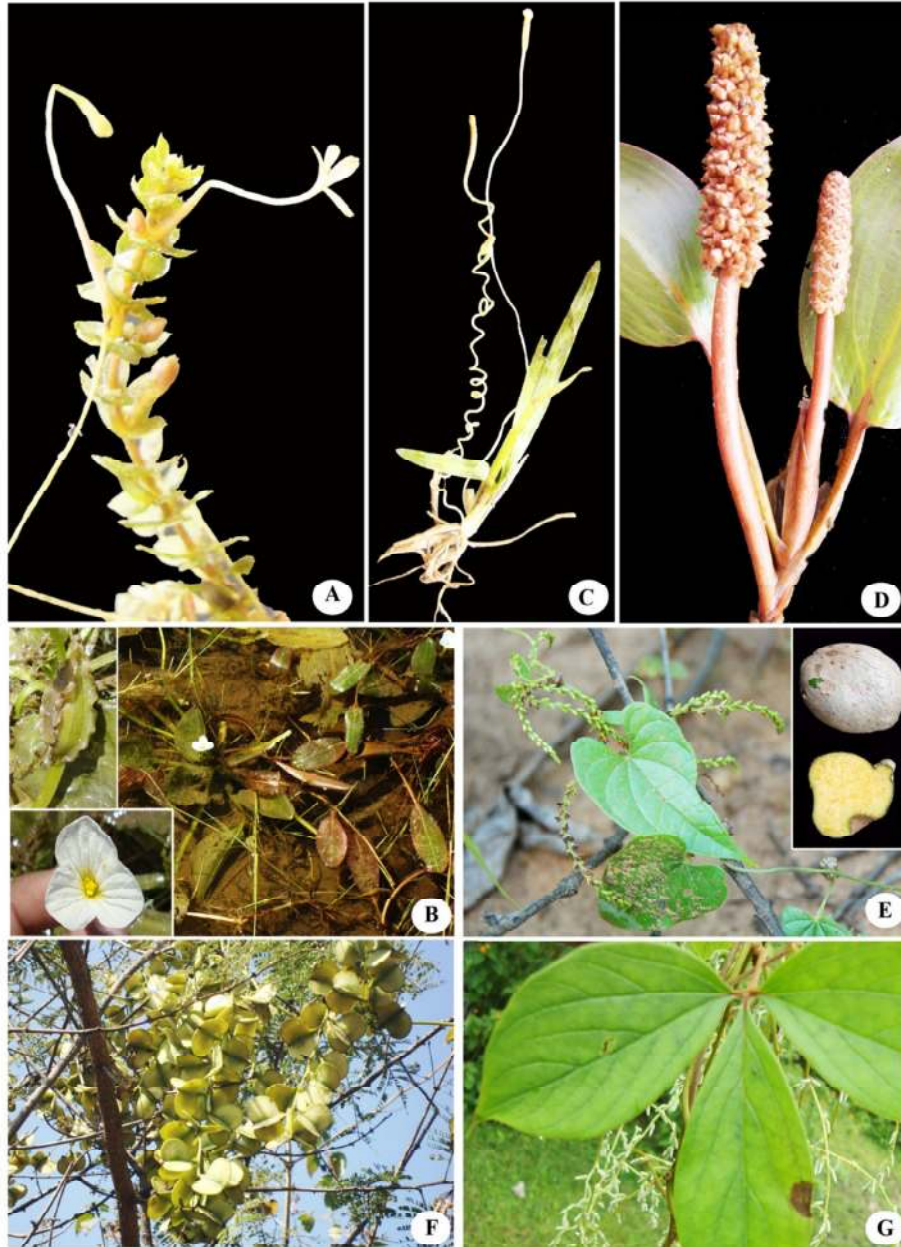


**Plate 5.** A. Grasshopper; B. Fly; C. Bug; D. Butterflies; E. Butterfly; F. Spider; G. Caterpillar; H. Caterpillar; I. Millipede; J. Termite mound; K. Red ant nest; L. Beehives on *Bombax ceiba*.



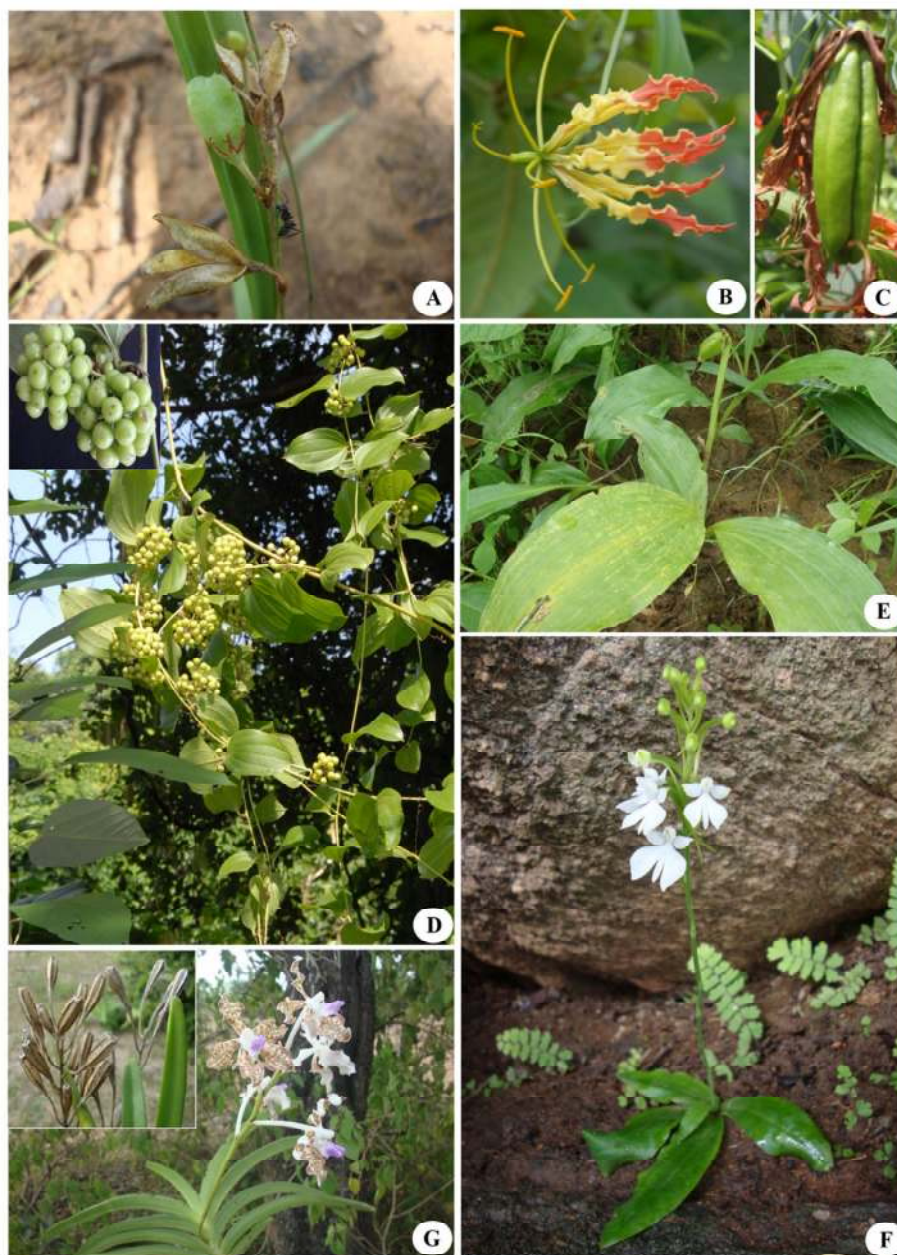


**Plate 6.** A. *Nymphaea pubescens* Willd.; B. *Nymphaea rubra* Roxb. ex Andrews; C. *Annona squamosa* L.; inset: flowering twig; D. *Cassytha filiformis* L.; E. *Colocasia esculenta* (L.) Schott; inset: spathe; F. *Spirodela polyrrhiza* (L.) Schleid.; G. *Butomopsis latifolia* (D. Don) Kunth; inset: flower.

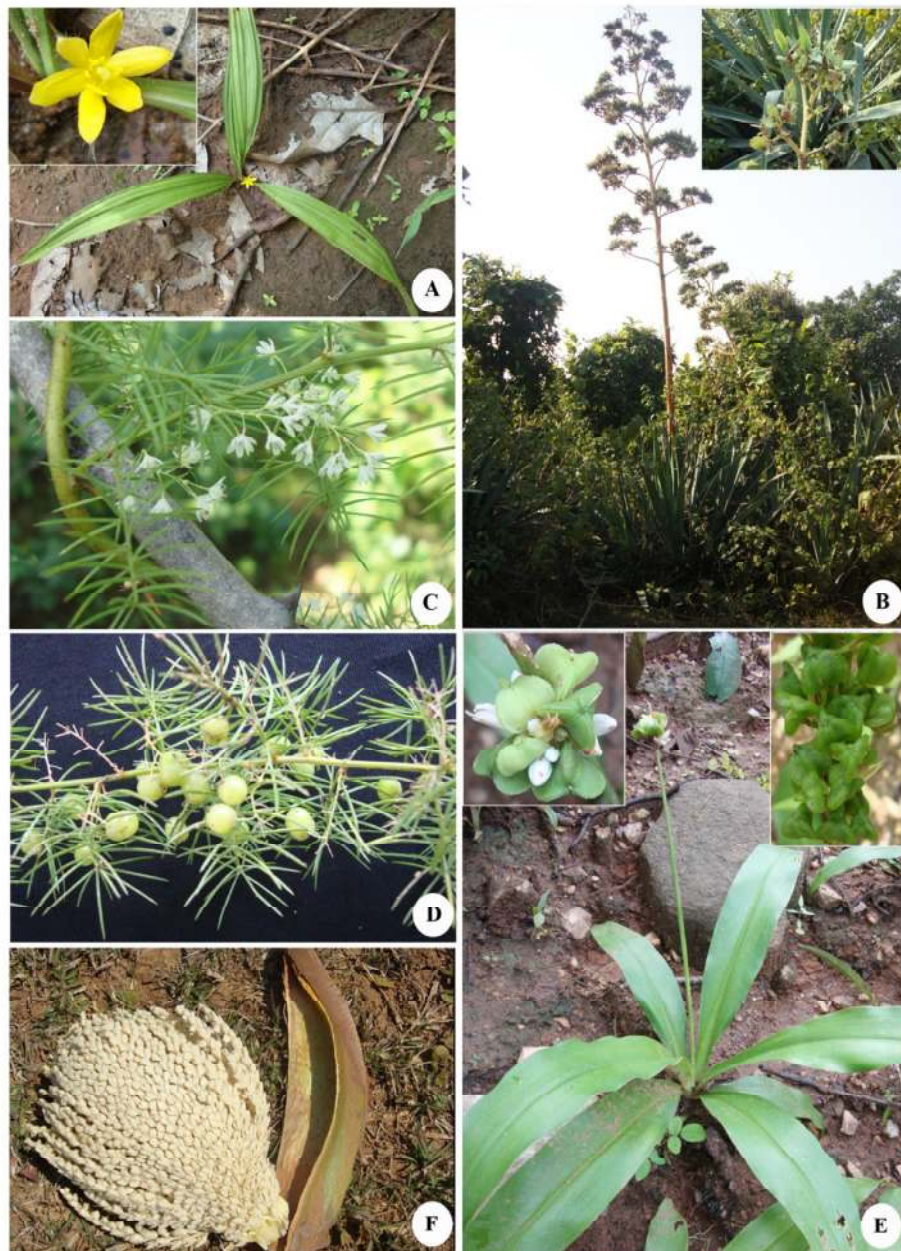


**Plate 7.** A. *Hydrilla verticillata* (L.f.) Royle; inset: a leafy twig; B. *Ottelia alismoides* (L.) Pers.; inset: flower and fruit; C. *Vallisneria spiralis* L.; D. *Potamogeton nodosus* Poir.; E. *Dioscorea bulbifera* L.; inset: bulb; F. *Dioscorea glabra* Roxb.; G. *Dioscorea pentaphylla* L.



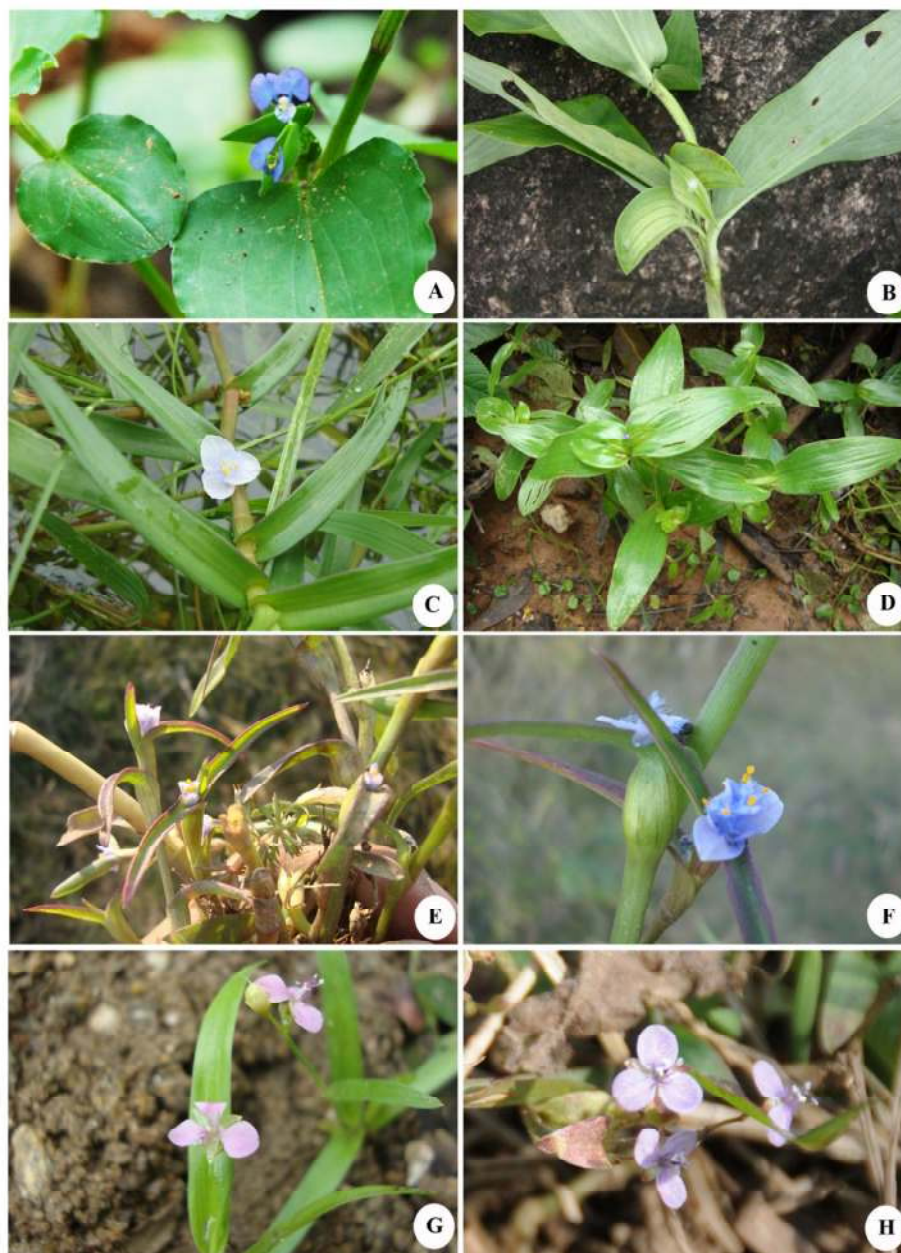


**Plate 8.** A. *Iphigenia indica* (L.) A. Gray ex Kunth; B, C. *Gloriosa superba* L.; B: flower; C: fruit; D. *Smilax zeylanica* L.; inset: fruits; E. *Eulophia picta* (R.Br.) Ormerod; F. *Habenaria plantaginea* Lindl.; G. *Vanda tessellata* (Roxb.) Hook. ex G. Don; inset: fruiting-twig.

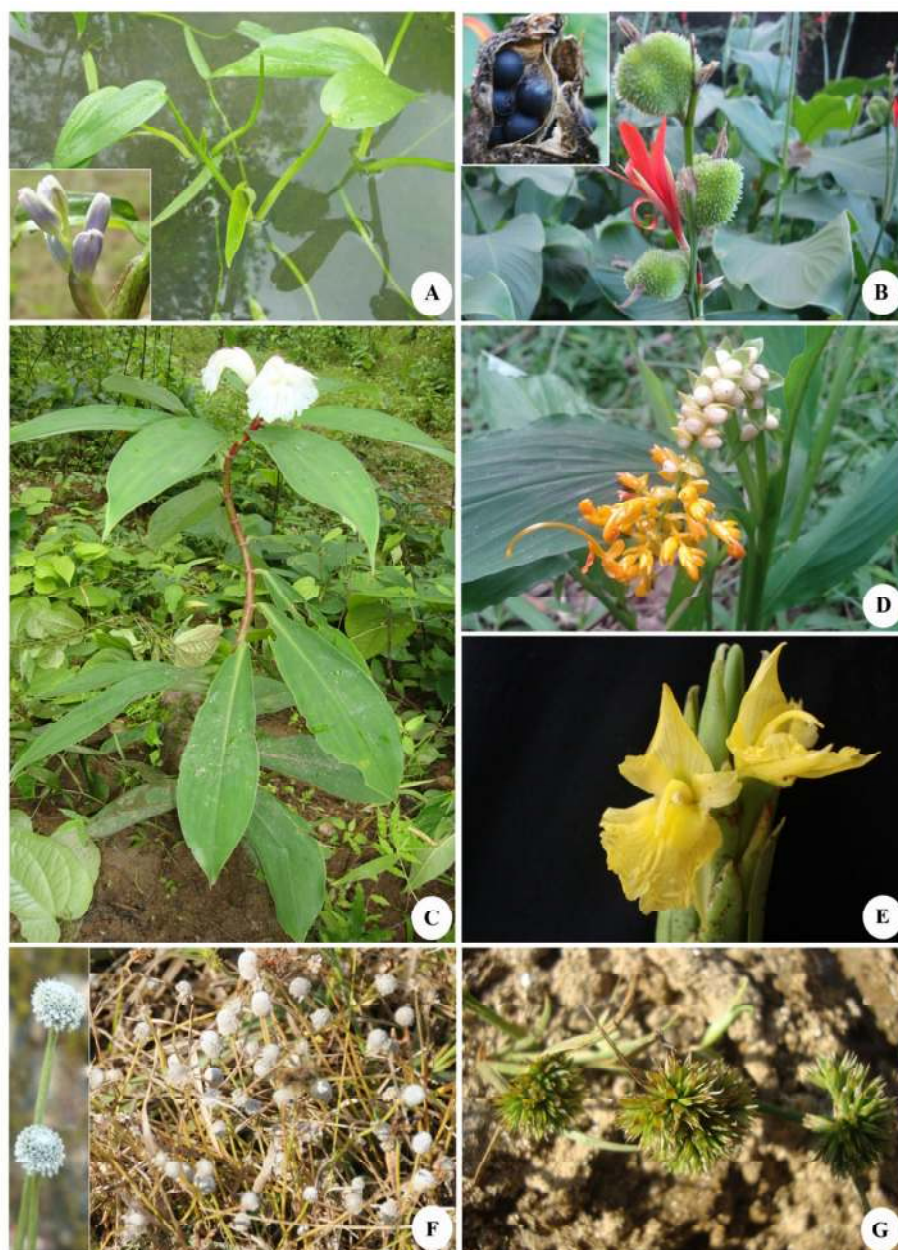


**Plate 9.** A. *Curculigo orchioides* Gaertn.; inset: flower; B. *Agave americana* L.; inset: flowering-twig; C, D. *Asparagus racemosus* Willd.; E. *Chlorophytum arundinaceum* Baker; inset: flowering and fruiting-twig; F. *Phoenix sylvestris* (L.) Roxb.



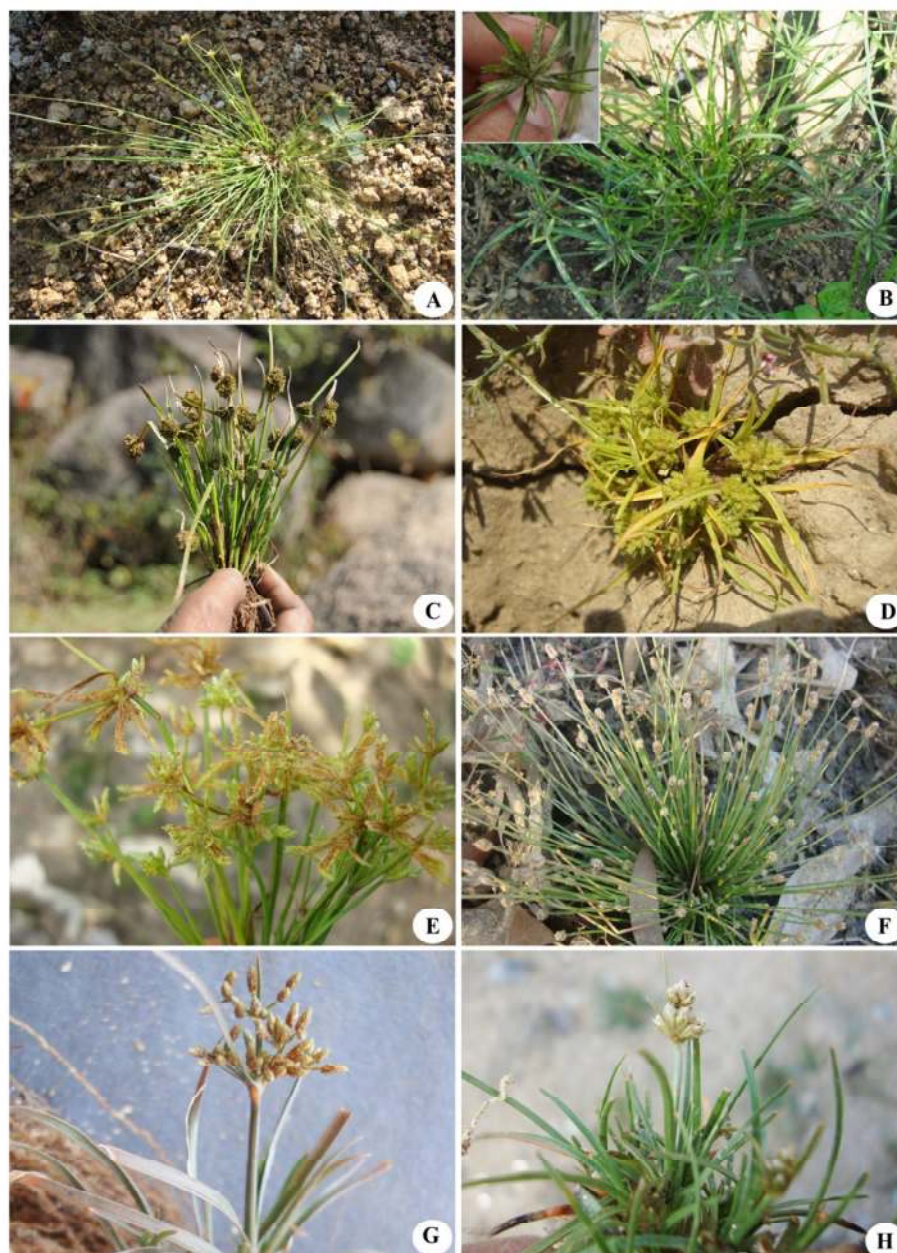


**Plate 10.** A. *Commelina benghalensis* L.; B. *Commelina suffruticosa* Blume; C. *Cyanotis axillaris* (L.) D. Don ex Sweet; D. *Cyanotis cristata* (L.) D. Don; E. & F. *Cyanotis cucullata* (Roth) Kunth.; G. *Murdannia nudiflora* (L.) Brenan.; H. *Murdannia spirata* (L.) G. Brückn.

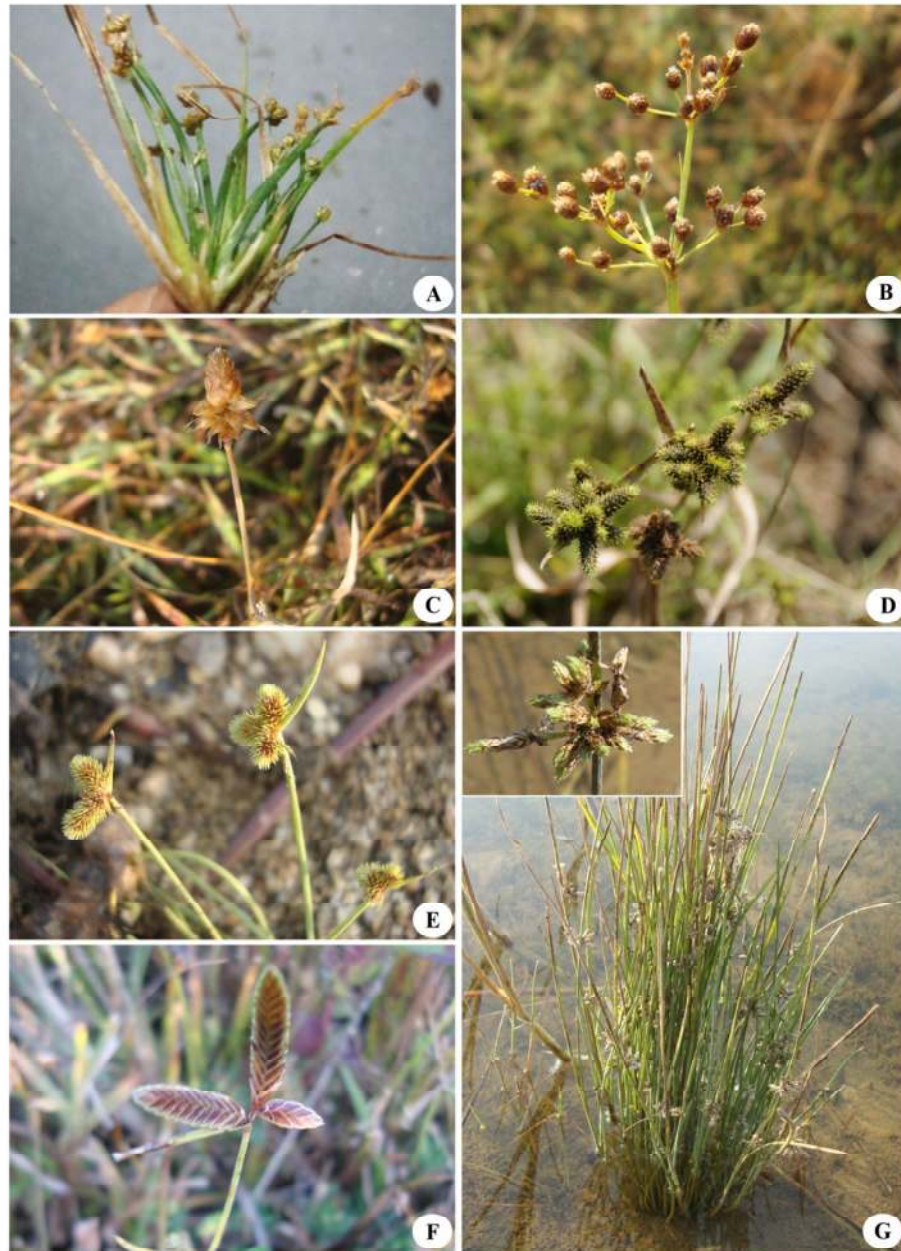


**Plate 11.** A. *Pontederia vaginalis* Burm.f.; B. *Canna indica* L.; inset: fruit with seeds; C. *Hellenia speciosa* (J.Koenig ex Sm.) S.R. Dutta; D. *Globba marantina* L.; E. *Zingiber capitatum* Roxb.; F. *Eriocaulon quinquangulare* L.; G. *Juncus articulatus* L.





**Plate 12.** A. *Bulbostylis barbata* (Rottb.) C.B. Clarke; B. *Cyperus compressus* L.; inset: inflorescence; C. *Cyperus difformis* L.; D. *Cyperus michelianus* (L.) Delile; E. *Cyperus tennispica* Steud. F. *Eleocharis geniculata* (L.) Roem. & Schult.; G. *Fimbristylis aestivalis* (Retz.) Vahl; H. *Fimbristylis cymosa* R. Br.



**Plate 13.** A. *Fimbristylis littoralis* Gaudich.; B. *Fimbristylis quinquangularis* (Vahl) Kunth; C. *Fimbristylis schoenoides* (Retz.) Vahl; D. *Fuirena ciliaris* (L.) Roxb.; E. *Cyperus neochinensis* (Tang & F.T.Wang) Bauters; F. *Cyperus diaphanus* Schrad. ex Schult; G. *Schoenoplectiella lateriflora* (J.F. Gmel.) Lye; inset: inflorescence.



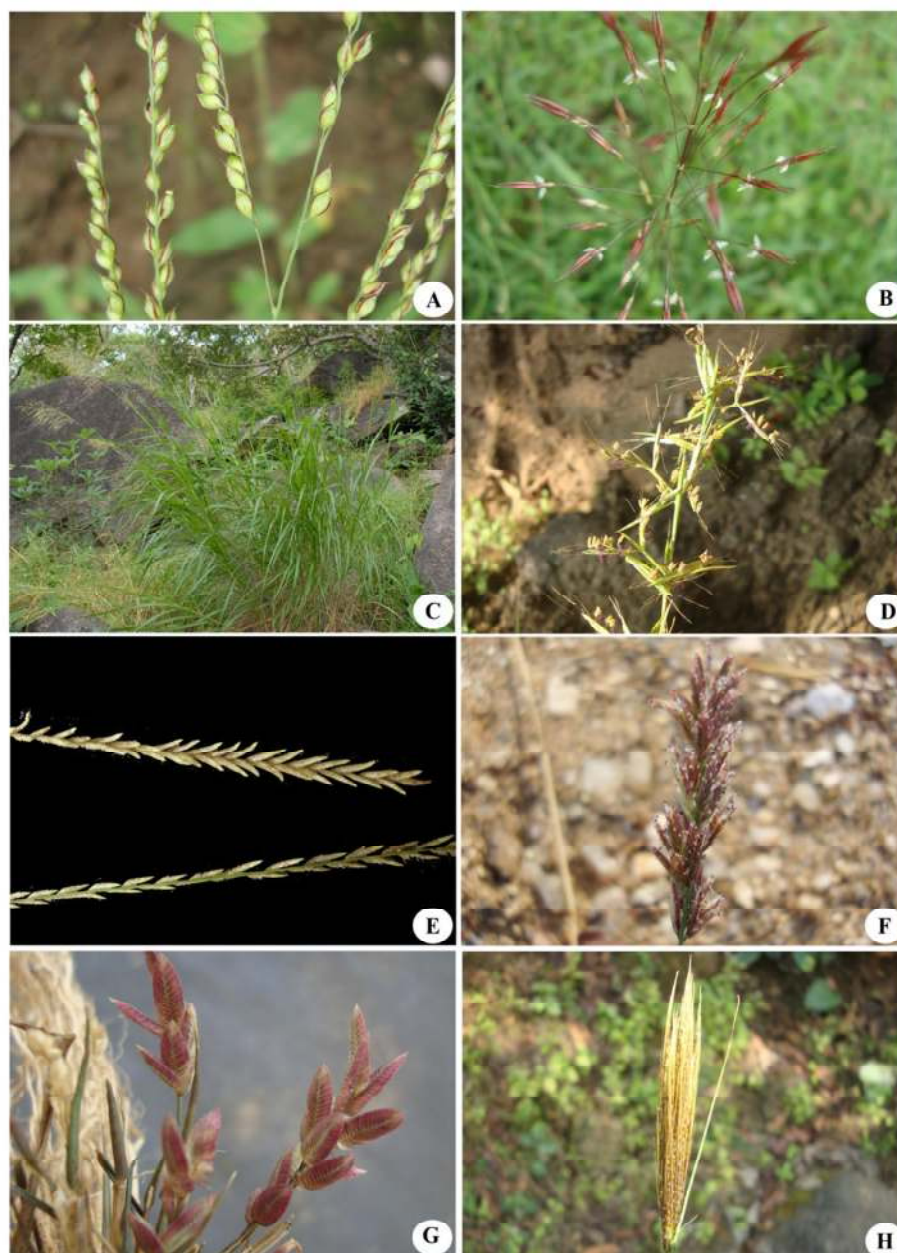
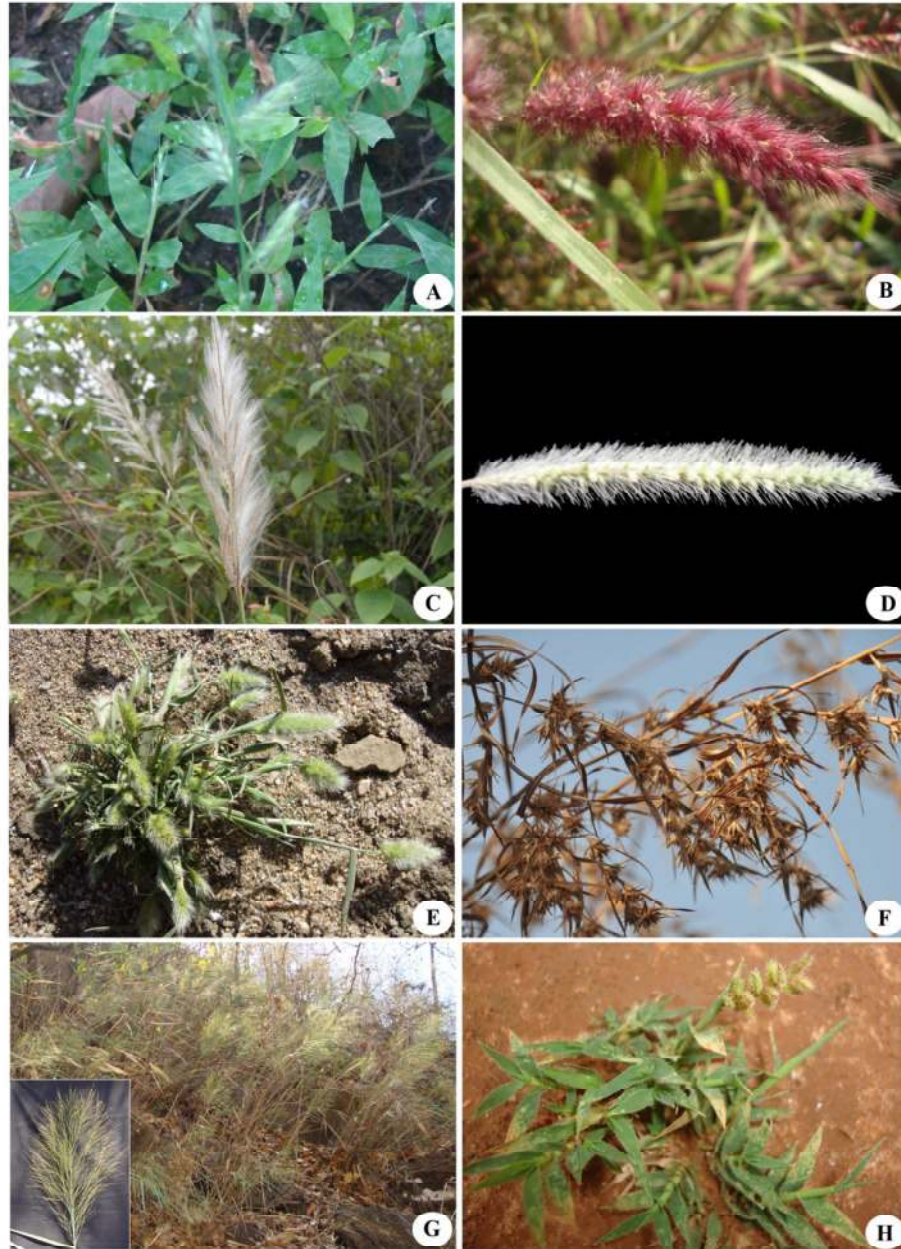
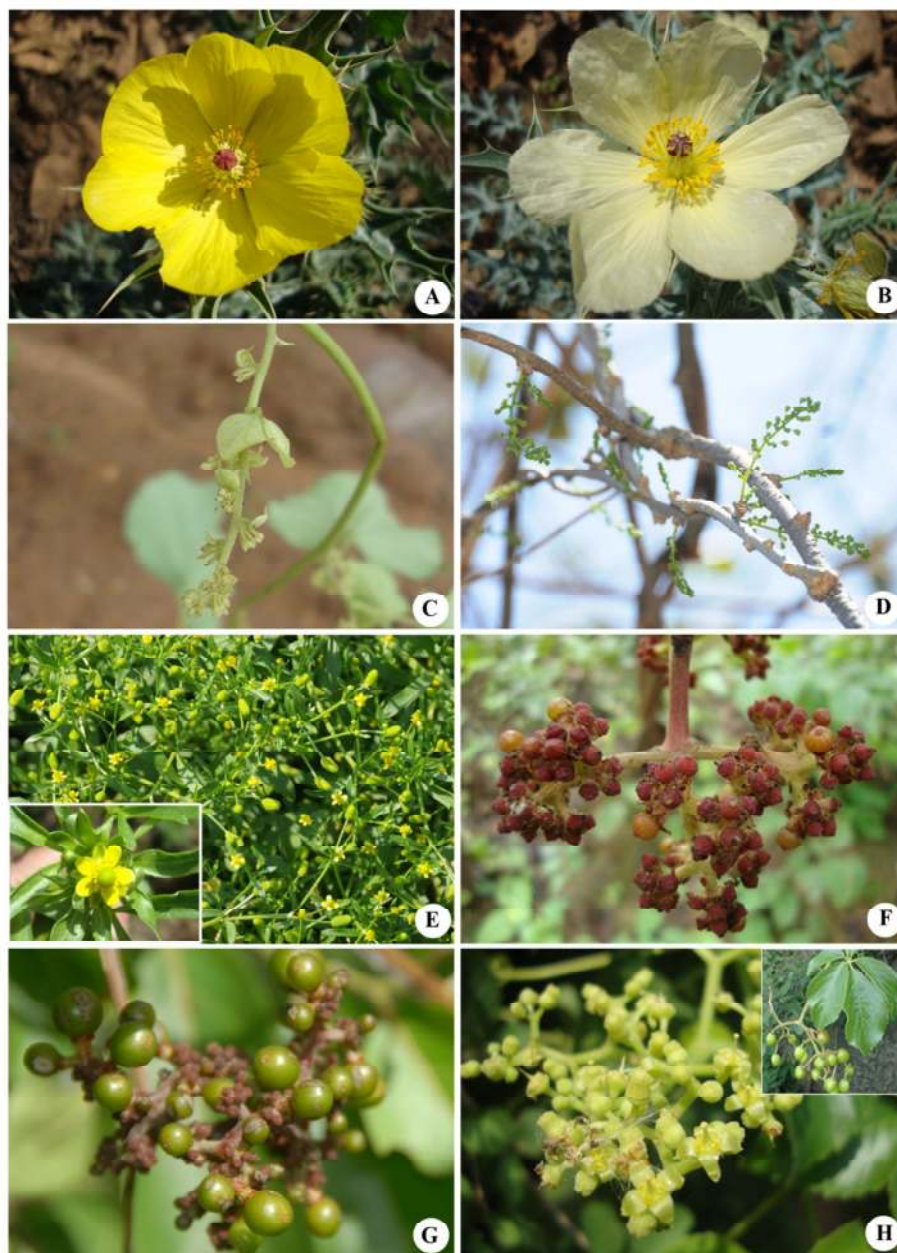


Plate 14. A. *Alloteropsis cimicina* (L.) Stapf; B. *Chrysopogon aciculatus* (Retz.) Trin.; C. *Chrysopogon hamiltonii* (Hook.f.) Haines; D. *Cymbopogon martinii* (Roxb.) Will. Watson; E. *Eragrostiella bifaria* (Vahl) Bor; F. *Eragrostis coarctata* Stapf; G. *Eragrostis gangetica* (Roxb.) Steud.; H. *Pseudopogonatherum trispicatum* (Schult.) Ohwi.



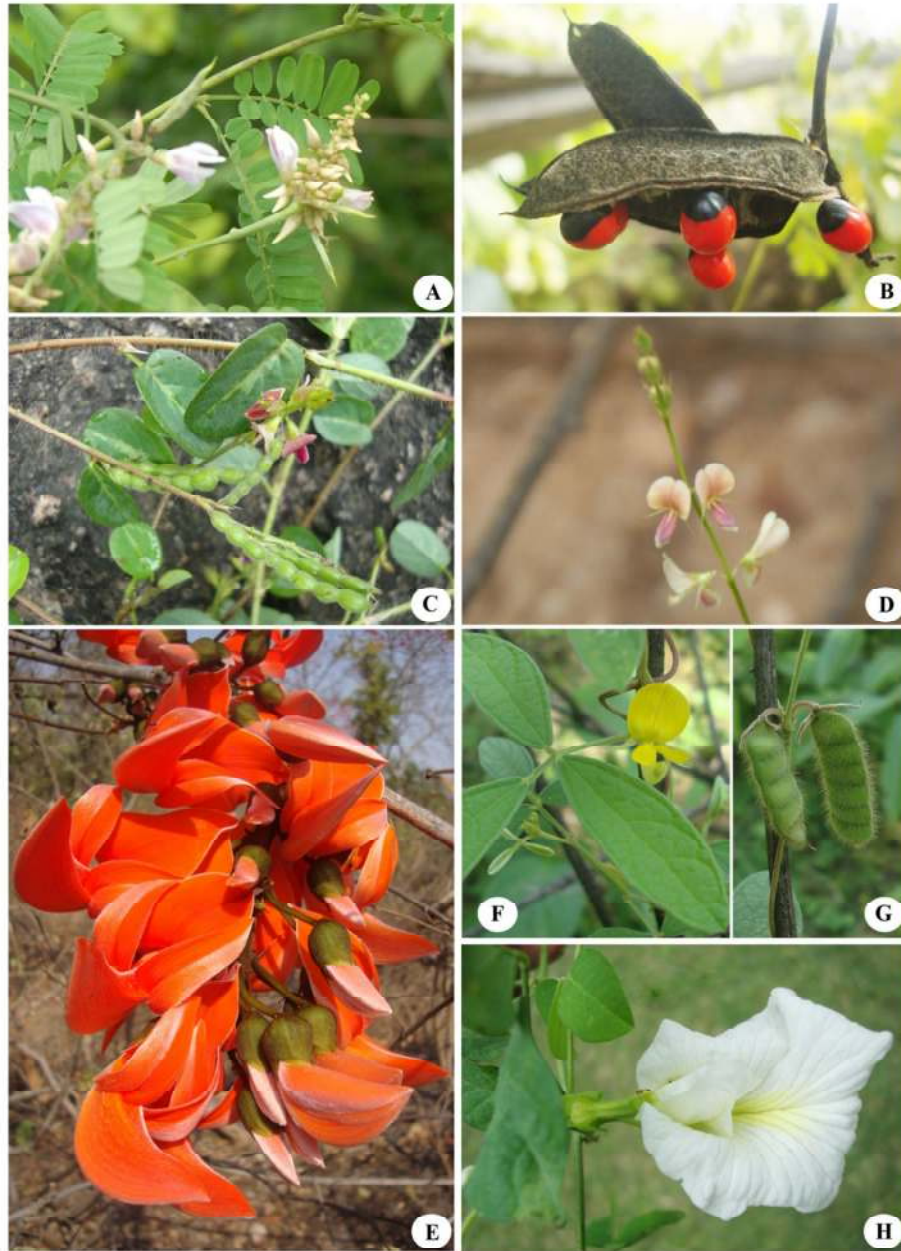


**Plate 15.** A. *Oplismenus burmannii* (Retz.) P. Beauv.; B. *Cenchrus pedicellatus* (Trin.) Morrone; C. *Saccharum spontaneum* L.; D. *Setaria pumila* (Poir.) Roem. & Schult.; E. *Setaria verticillata* (L.) P. Beauv.; F. *Themeda triandra* Forssk.; G. *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda; inset: inflorescence; H. *Tragus roxburghii* Panigr.



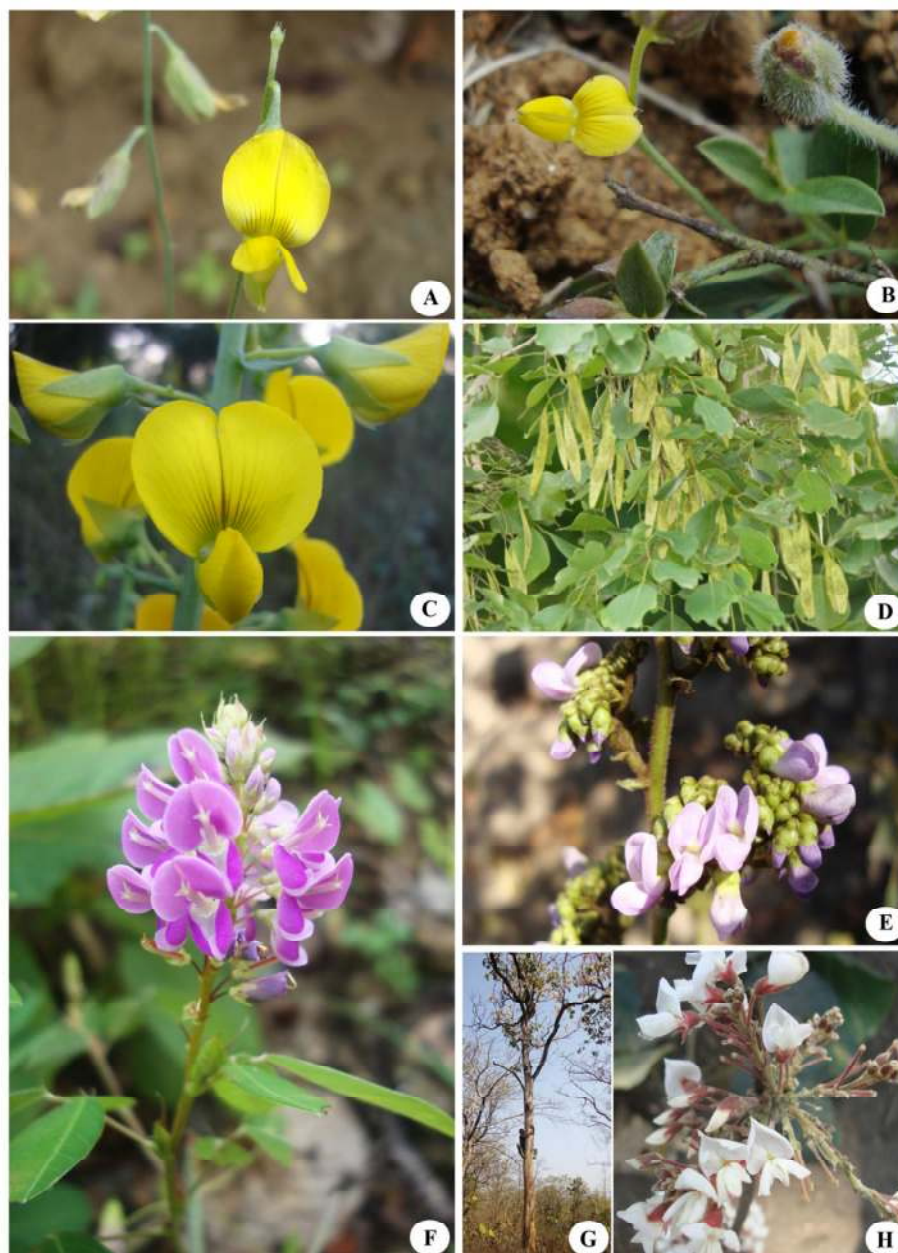
**Plate 16.** A. *Argemone mexicana* L.; B. *Argemone ochroleuca* Sweet; C. *Cissampelos pareira* L.; D. *Tinospora cordifolia* (Willd.) Hook.f. & Thomson; E. *Ranunculus sceleratus* L.; inset: flower; F. *Ampelocissus latifolia* (Roxb.) Planch.; G. *Ampelocissus tomentosa* (B. Heyne & Roth) Planch.; H. *Cyphostemma auriculatum* (Roxb.) P. Singh & B.V. Shetty; inset: fruiting-twig.



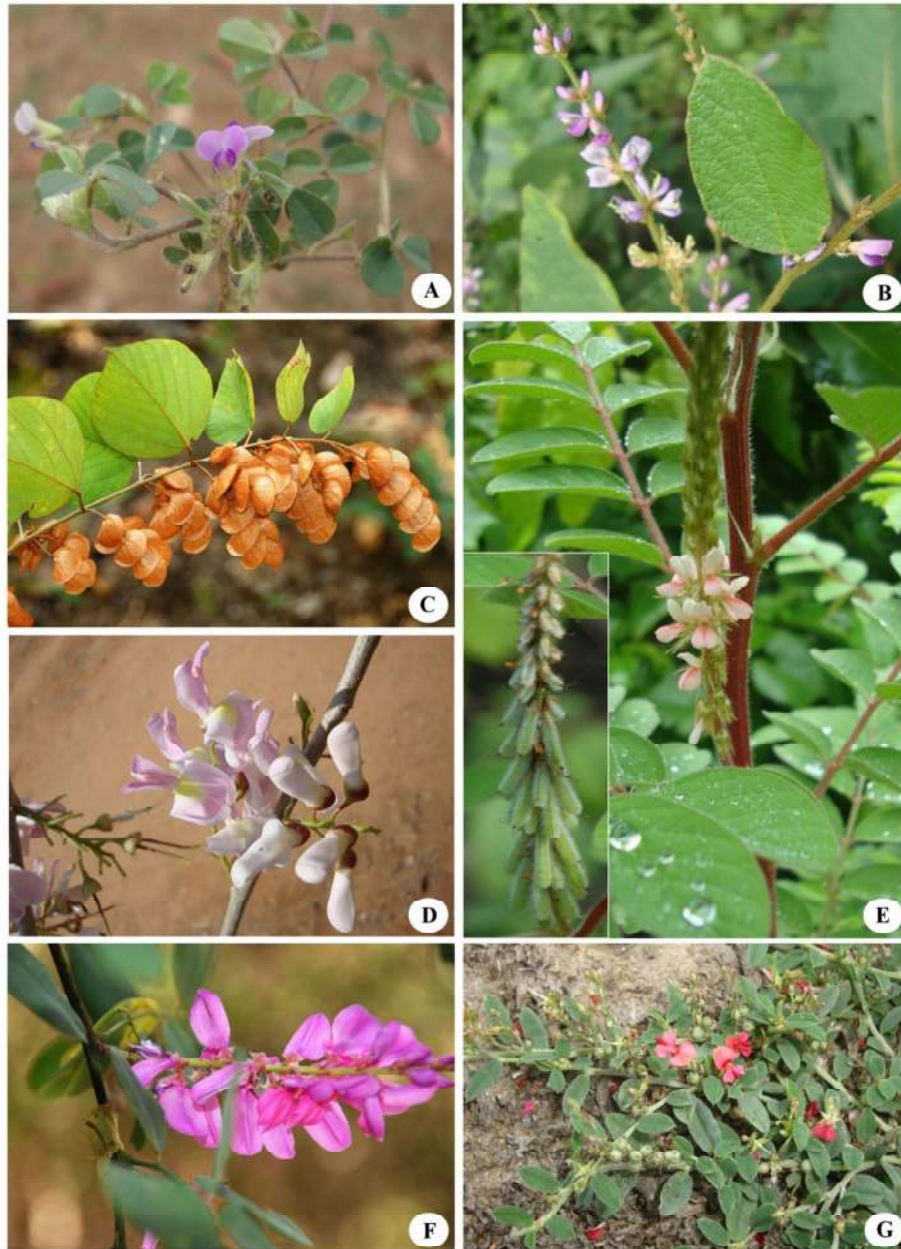


**Plate 17.** A, B. *Abrus precatorius* L.; A. Inflorescence; B. Pods; C. *Alysicarpus monilifer* (L.) DC.; D. *Alysicarpus vaginalis* (L.) DC.; E. *Butea superba* Roxb.; F, G. *Cajanus scarabaeoides* (L.) du Petit-Thou; F. Habit; G. Pods; H. *Clitoria ternatea* L.





**Plate 18.** A. *Crotalaria albida* B. Heyne ex Roth; B. *Crotalaria prostrata* var *levis* Haines; C. *Crotalaria spectabilis* Roth; D. *Dalbergia sissoo* DC.; E. *Dalbergia volubilis* Roxb.; F. *Gona heterocarpos* (L.) H.Ohashi & K.Ohashi.; G, H. *Ougeinia oojeinensis* (Roxb.) Hochr.; G. Habit; H. Flowering-twig.



**Plate 19.** A. *Gona triflora* (L.) H.Ohashi & K.Ohashi; B. *Polhillides velutina* (Willd.) H.Ohashi & K.Ohashi; C. *Flemingia chappar* Buch.-Ham. ex Benth.; D. *Gliricidia sepium* (Jacq.) Kunth ex Walp.; E. *Indigofera astragalina* DC.; F. *Indigofera cassioides* Rottler ex DC.; G. *Indigofera linifolia* (L.f.) Retz.



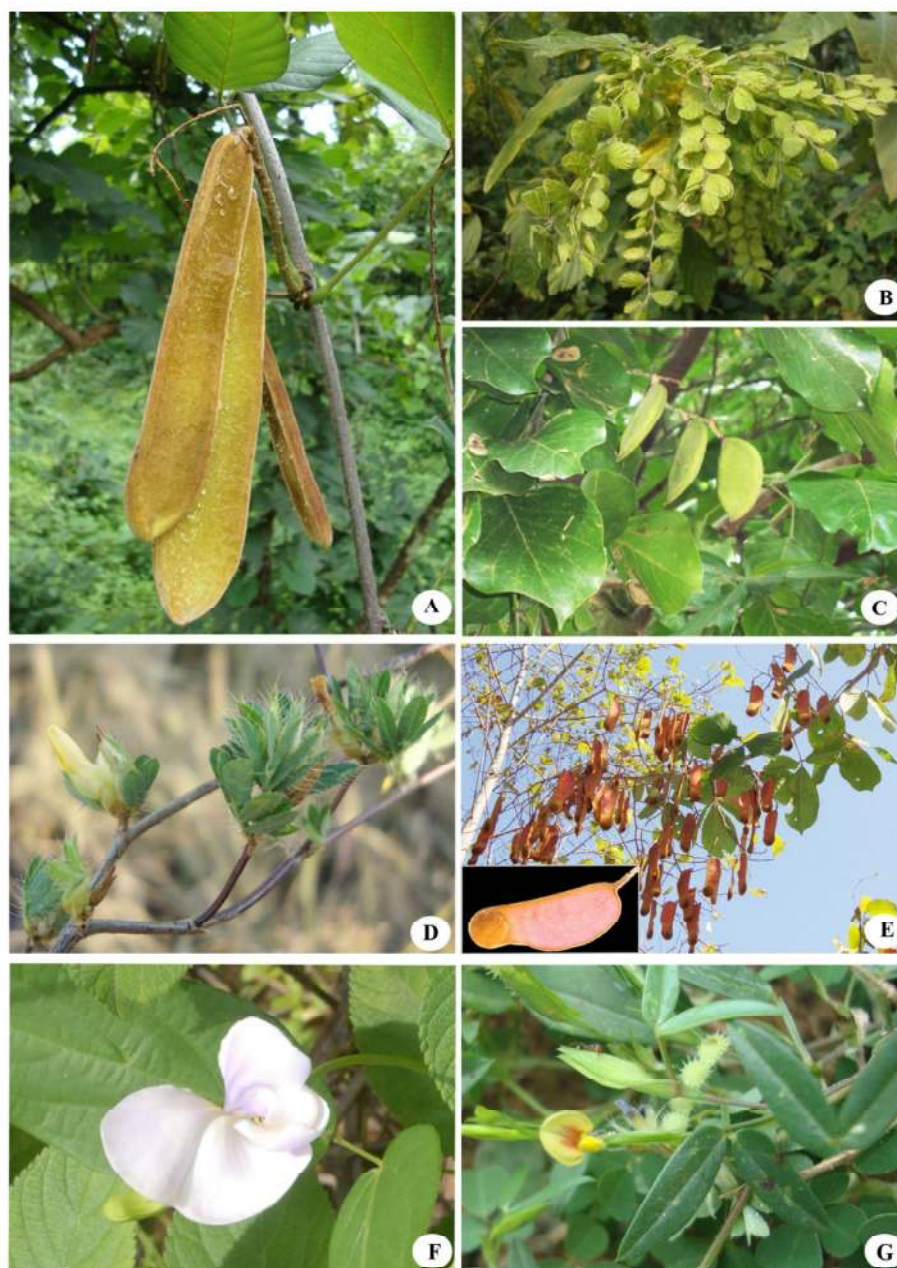


Plate 20. A. *Millettia extensa* (Benth.) Benth. ex Baker; B. *Phyllodium pulchellum* (L.) Desv.; C. *Pongamia pinnata* (L.) Pierre; D. *Smithia conferta* Sm.; E. *Spatholobus parviflorus* (Roxb. ex DC.) Kuntze; F. *Vigna vexillata* (L.) A. Rich.; G. *Zornia gibbosa* Span.



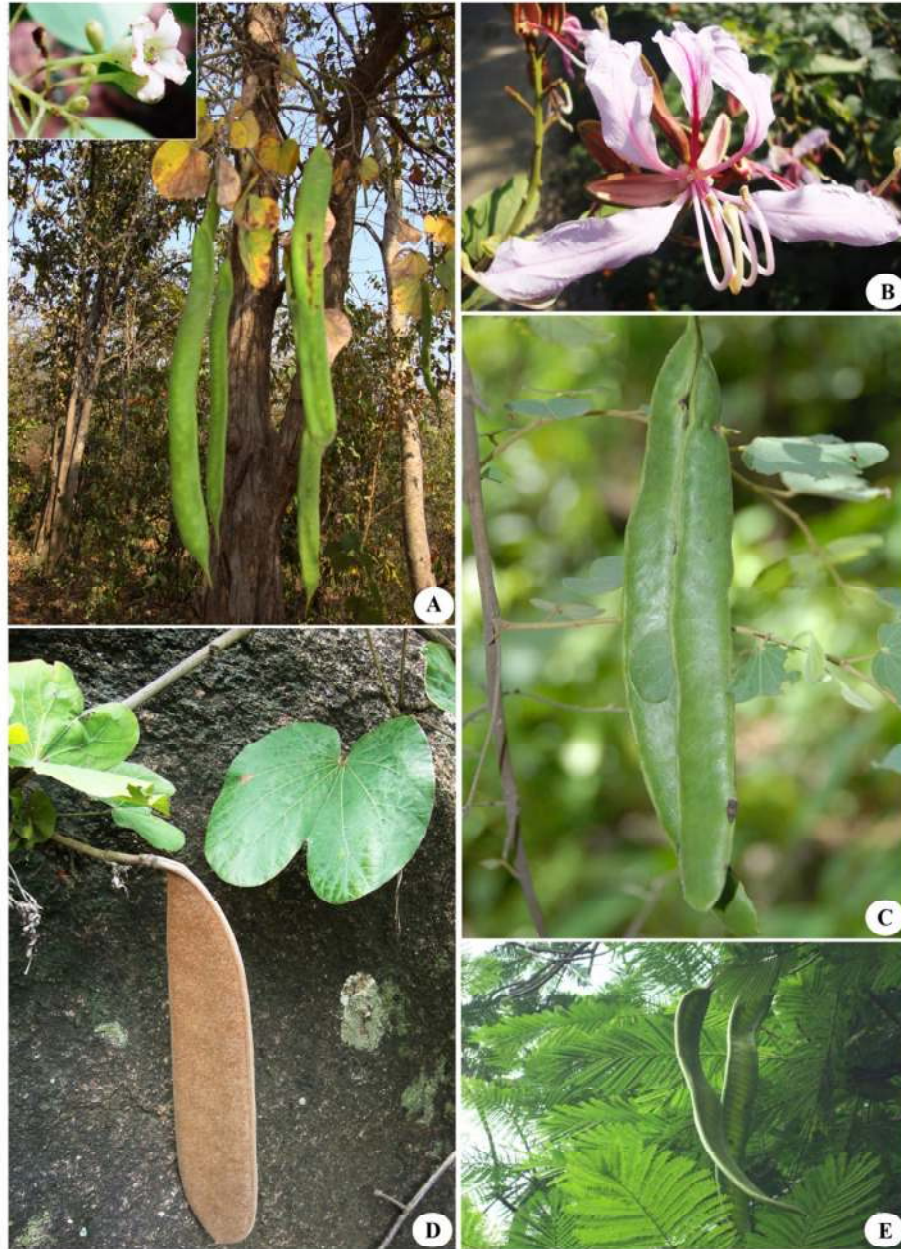
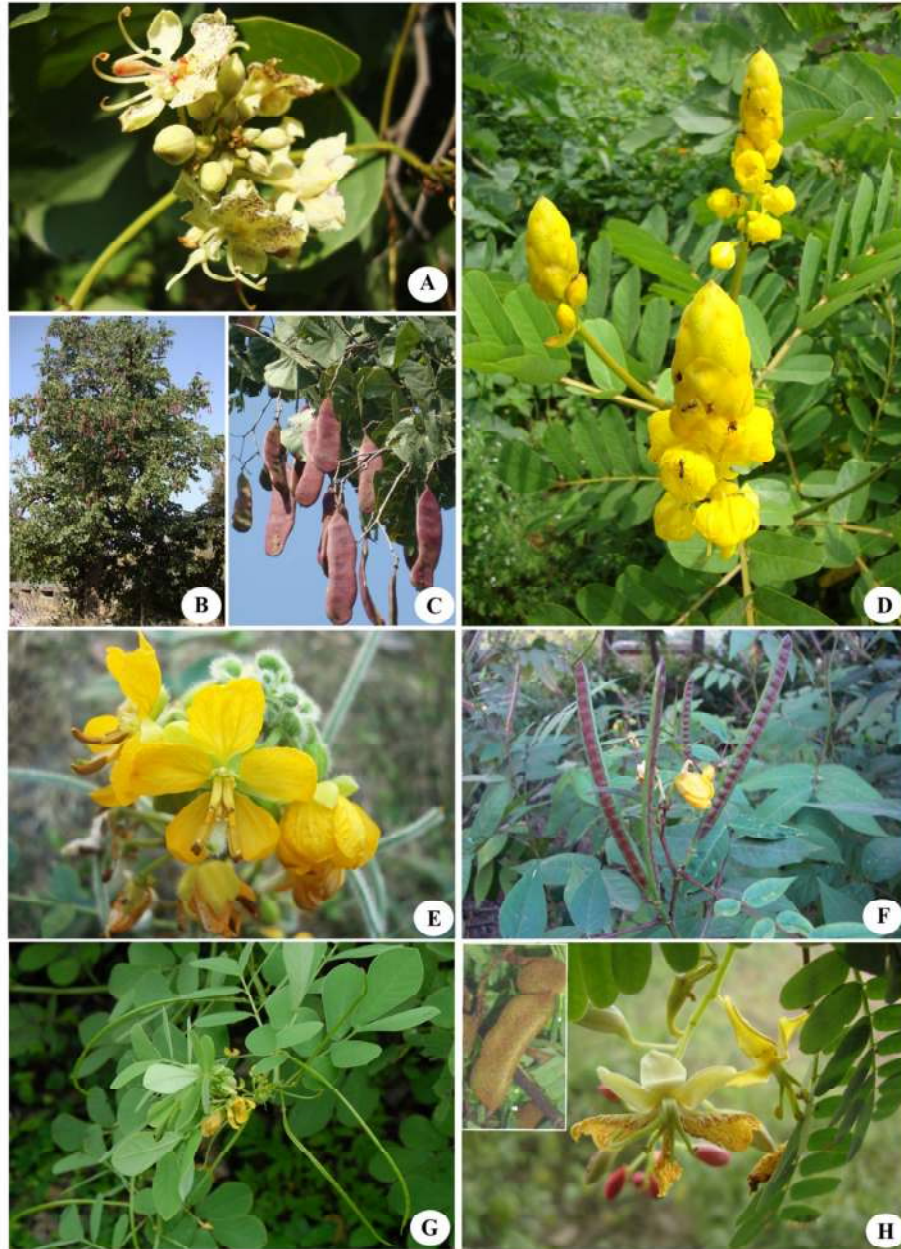
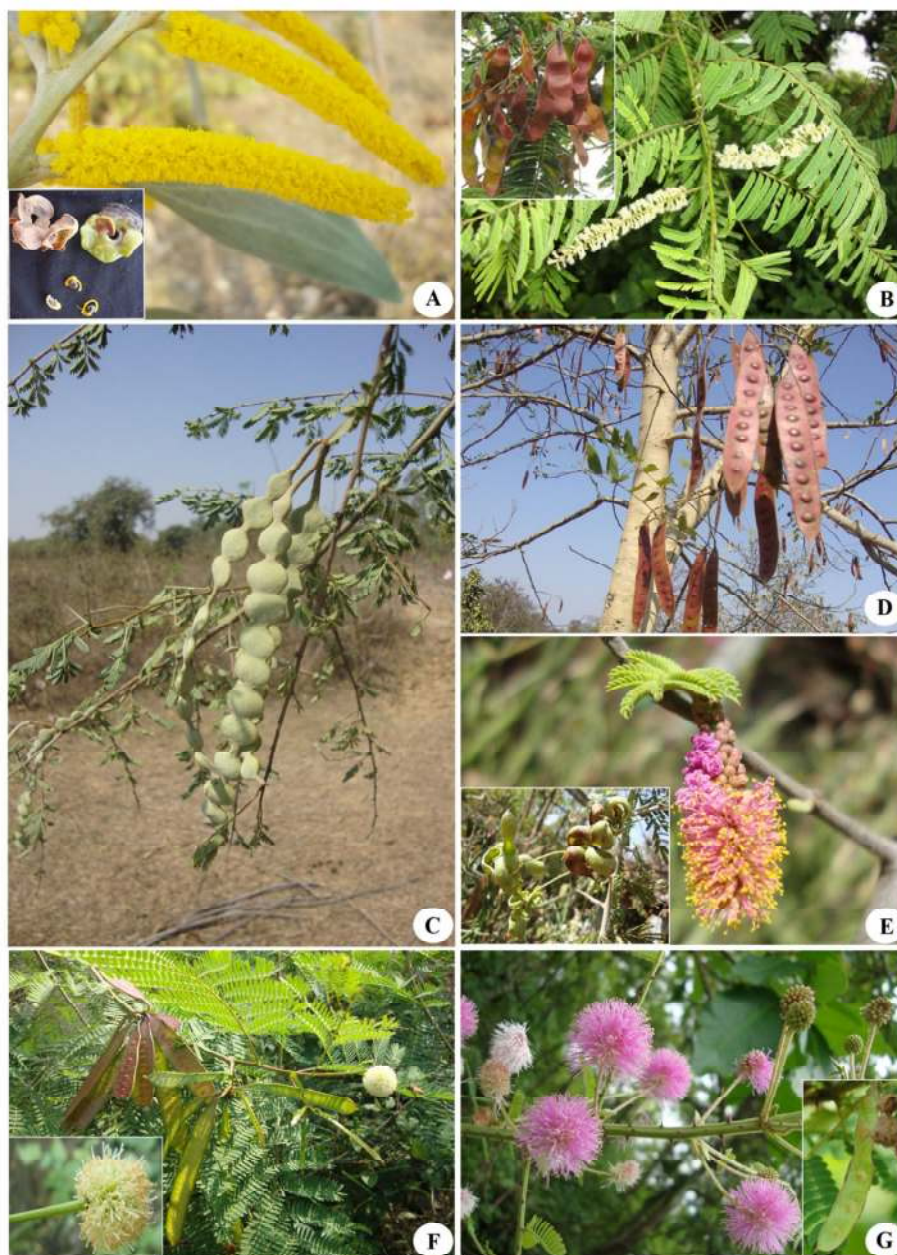


Plate 21. A. *Piliostigma malabaricum* (Roxb.) Benth.; inset: flowering-twig; B. *Bauhinia purpurea* L.; C. *Bauhinia racemosa* Lam.; D. *Phanera vahlII* (Wight & Arn.) Benth.; E. *Delonix regia* (Bojer) Raf.



**Plate 22.** A, B, C. *Phanera roxburghiana* (Voigt) Bandyop., Anand Kumar & Chakrab.; A. Flowering-twig; B. Habit; C. Fruiting-twig; D. *Senna alata* (L.) Roxb.; E. *Senna hirsuta* (L.) H.S. Irwin & Barneby; F. *Senna occidentalis* (L.) Link; G. *Senna tora* (L.) Roxb.; H. *Tamarindus indica* L.; inset: fruit.



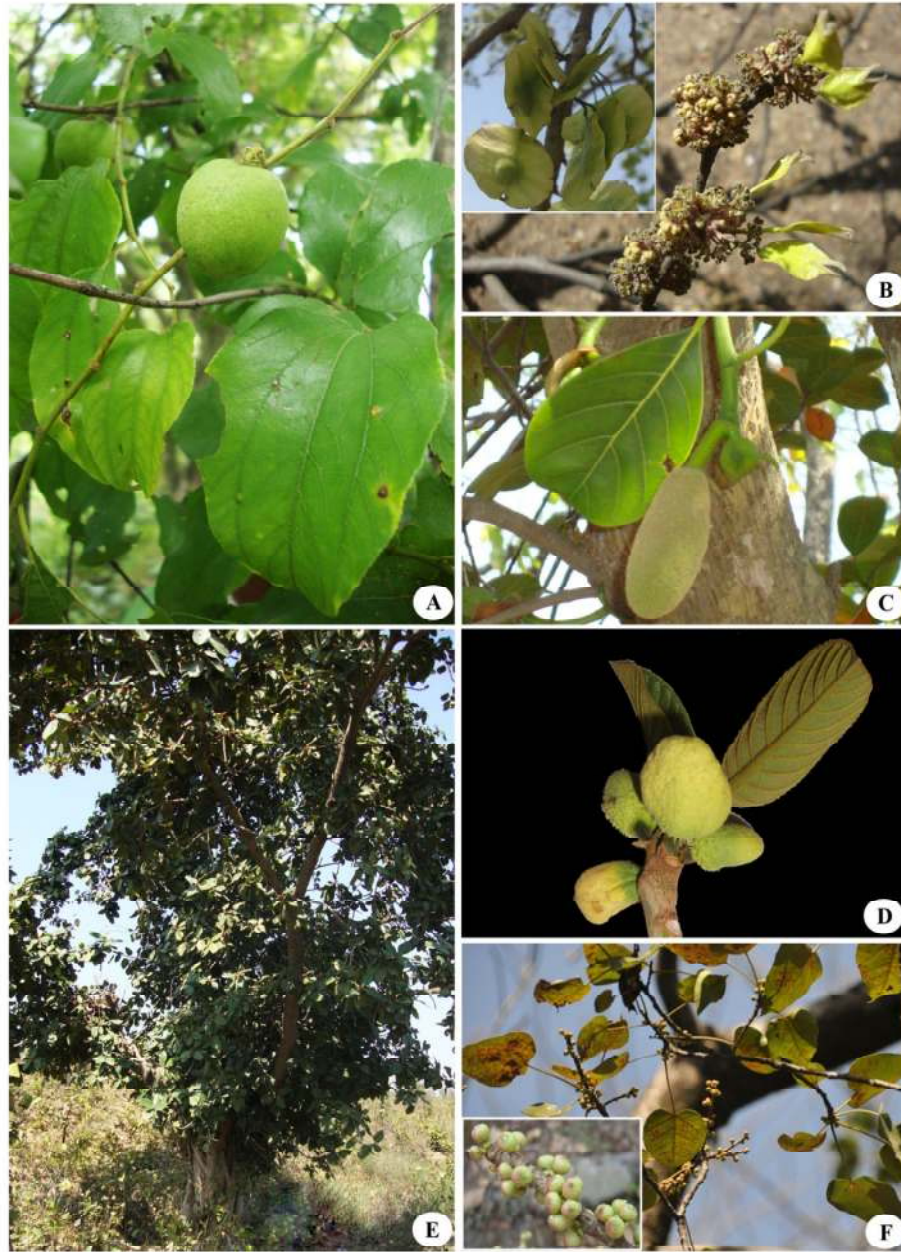


**Plate 23.** A. *Acacia auriculiformis* A. Cunn. ex Benth.; inset: Pods and Seeds; B. *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb.; inset: fruiting-twig; C. *Vachellia nilotica* subsp. *indica* (Benth.) Kyal. & Boatwr.; D. *Albizia procera* (Roxb.) Benth.; E. *Dichrostachys cinerea* (L.) Wight & Arn.; inset: fruiting-twig; F. *Leucaena leucocephala* (Lam.) de Wit.; inset: inflorescence; G. *Mimosa rubicaulis* subsp. *himalayana* (Gamble) H.Ohashi; inset: Pod.





Plate 24. A. *Polygala arvensis* Willd.; B. *Polygala crotalarioides* Buch.-Ham. ex DC.; inset: flower; C. *Polygala linearifolia* Willd.; D. *Potentilla supina* L.; E. *Ventilago denticuiata* Willd.; F. *Ziziphus jujuba* (L.) Gaertn.; G. *Ziziphus oenopolia* (L.) Mill.



**Plate 25.** A. *Ziziphus xylopyrus* (Retz.) Willd.; B. *Holoptelea integrifolia* (Roxb.) Planch.; inset: fruiting-twig; C. *Artocarpus heterophyllus* Lam.; D. *Artocarpus lacucha* Roxb. ex Buch.-Ham.; E. *Ficus altissima* Blume; F. *Ficus arnottiana* (Miq.) Miq.; inset: fruiting-twig.



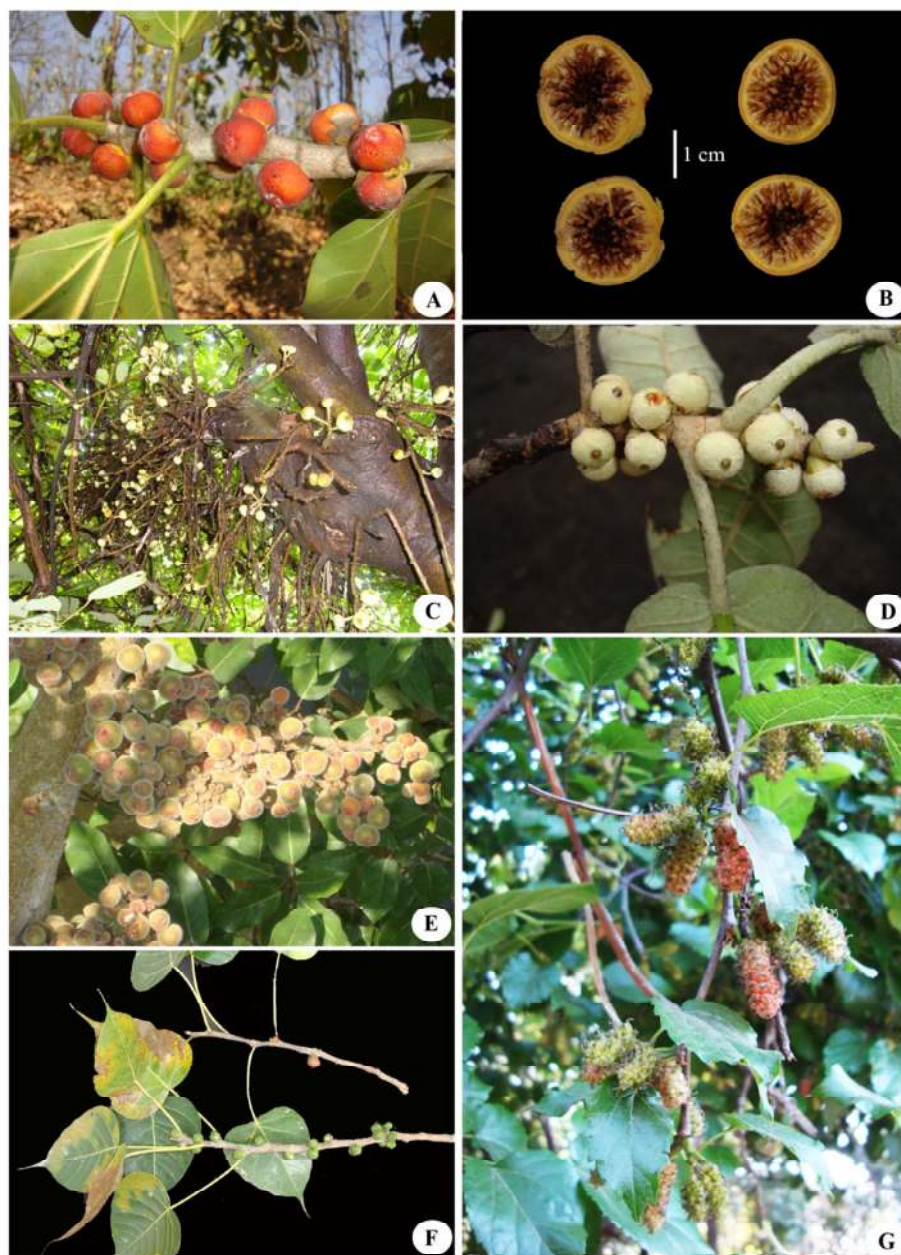
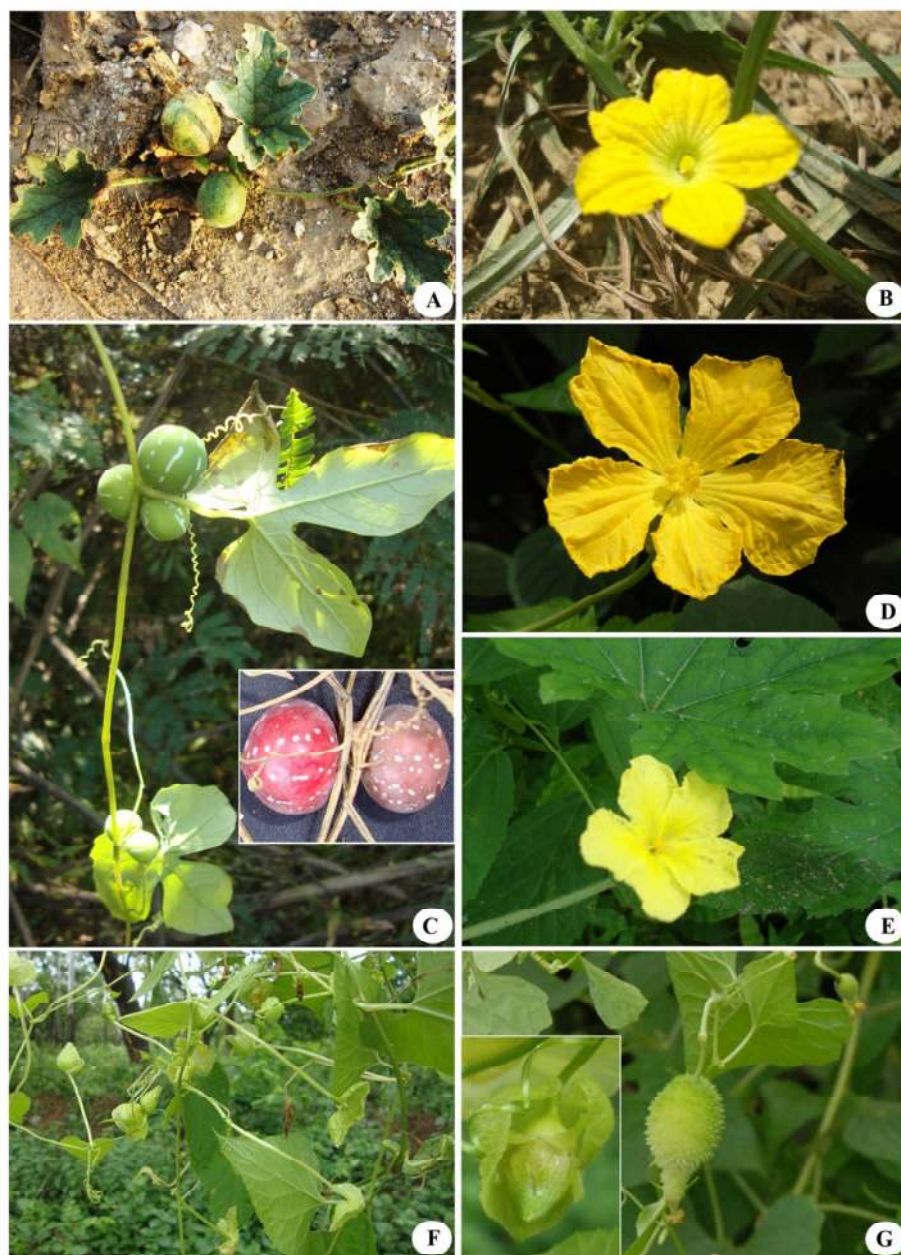


Plate 26. A, B. *Ficus benghalensis* L.; B. Figs; C. *Ficus hispida* L.f.; D. *Ficus mollis* Vahl; E. *Ficus racemosa* L.; F. *Ficus religiosa* L.; G. *Morus indica* L.



**Plate 27.** A, B. *Cucumis melo* L.; A. fruting-twig; B. Flower; C. *Diplocyclos palmatus* (L.) C. Jeffrey; inset: ripened fruits; D. *Luffa cylindrica* (L.) M. Roem.; E. *Momordica charantia* L.; F, G. *Momordica dioica* Roxb. ex Willd.; A: Habit; B: fruting-twig; inset: flower.



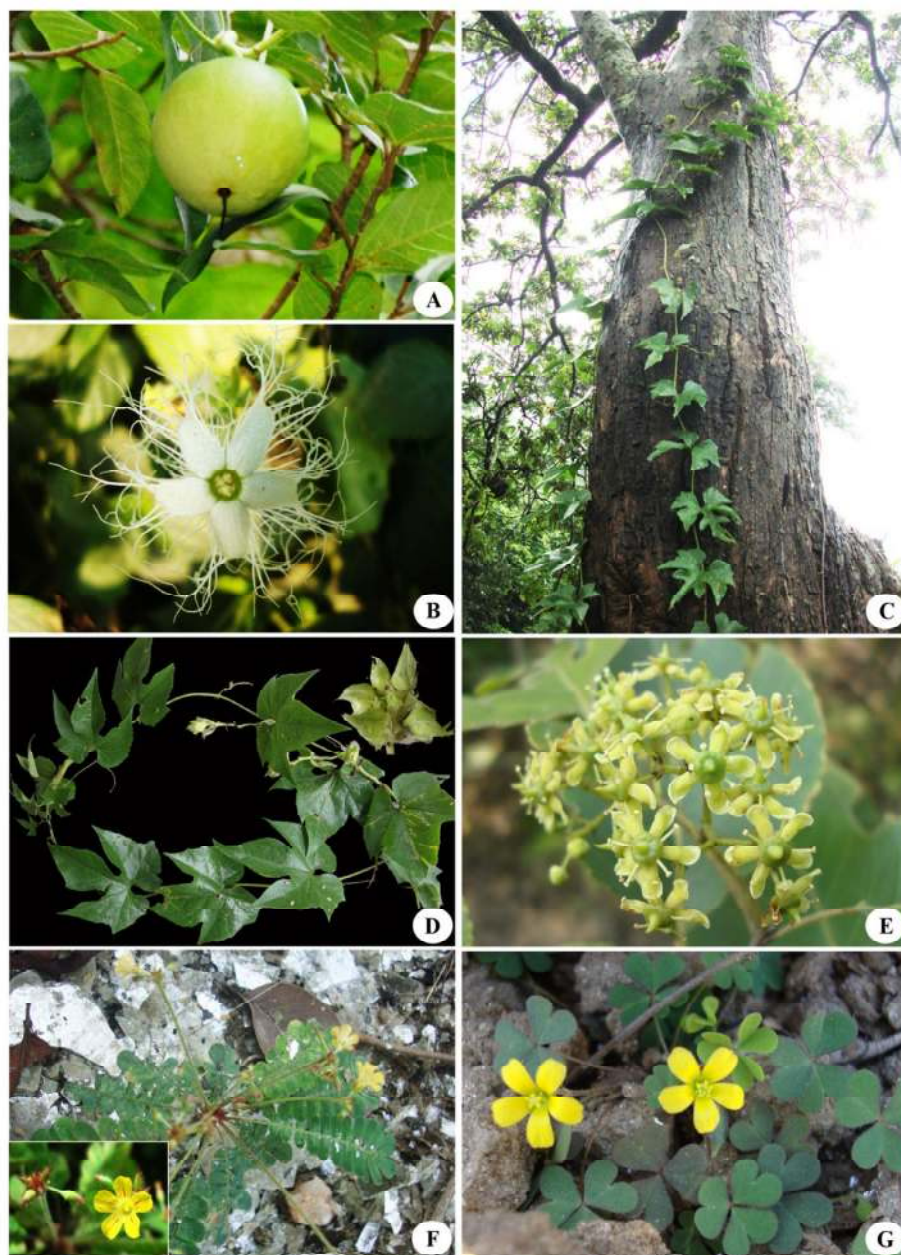
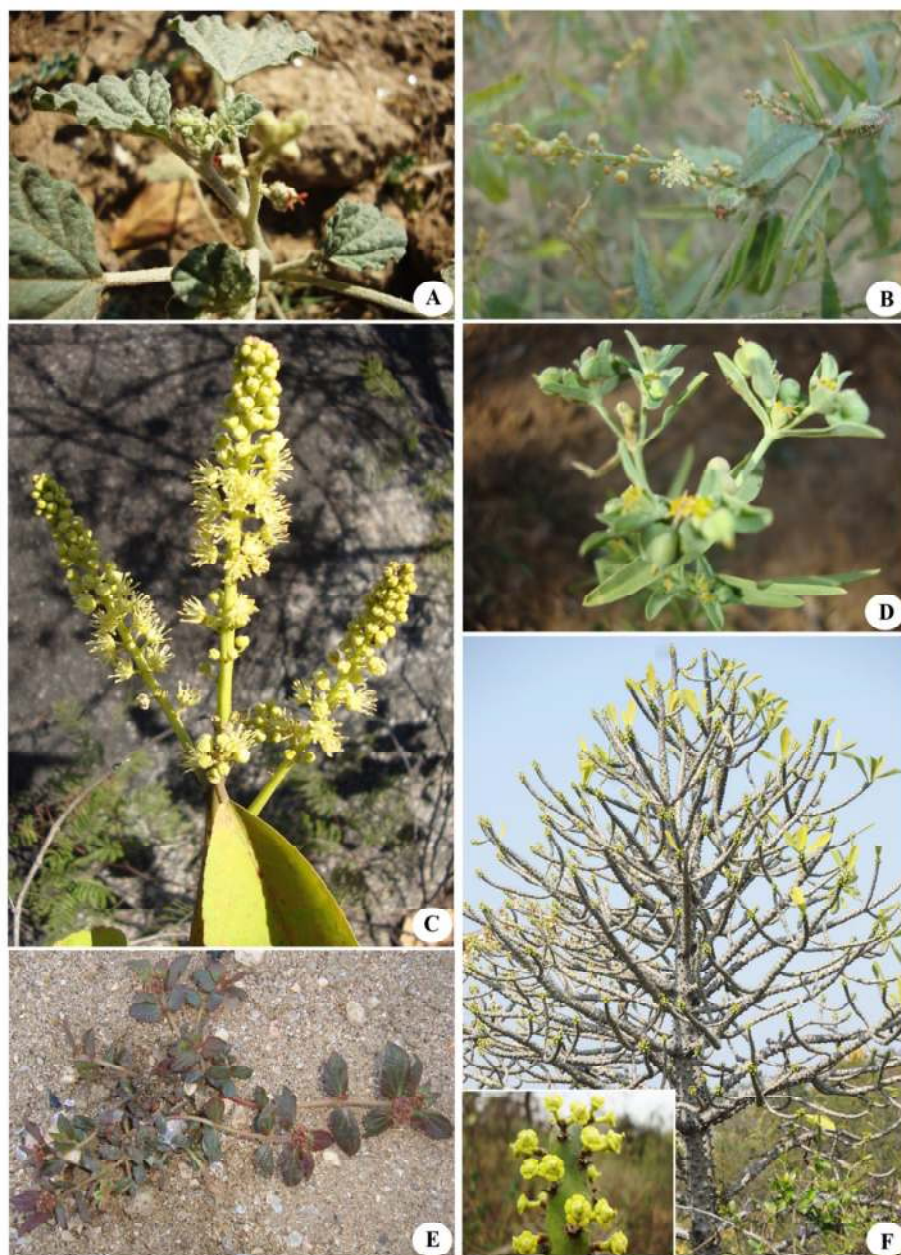


Plate 28. A. *Trichosanthes bracteata* (Lam.) Voigt ; B. *Trichosanthes cucumerina* L.; C, D. *Trichosanthes tricuspidata* Lour.; C. Habit; D. flowering-twig inset: flower buds; E. *Elaeodendron glaucum* (Rottb.) Pers.; F. *Biophytum sensitivum* (L.) DC.; inset: flowering-twig; G. *Oxalis corniculata* L.



Plate 29. A. *Bergia ammannioides* Roxb. ex Roth; B. *Hybanthus enneaspermus* (L.) F. Muell. C. *Passiflora foetida* L.; inset: fruit.; D. *Casearia tomentosa* Roxb.; E, F. *Flacourtia indica* (Burm.f.) Merr.; E. flowering-twig; F. fruiting-twig.





**Plate 30.** A. *Chrozophora rottleri* (Geisler) Adr. Juss. ex Spreng.; B. *Croton bonplandianus* Baill.; C. *Croton persimilis* Müll. Arg.; D. *Euphorbia dracunculoides* Lam.; E. *Euphorbia hirta* L.; F. *Euphorbia nivulia* Buch.- Ham.; inset: flowering twig.

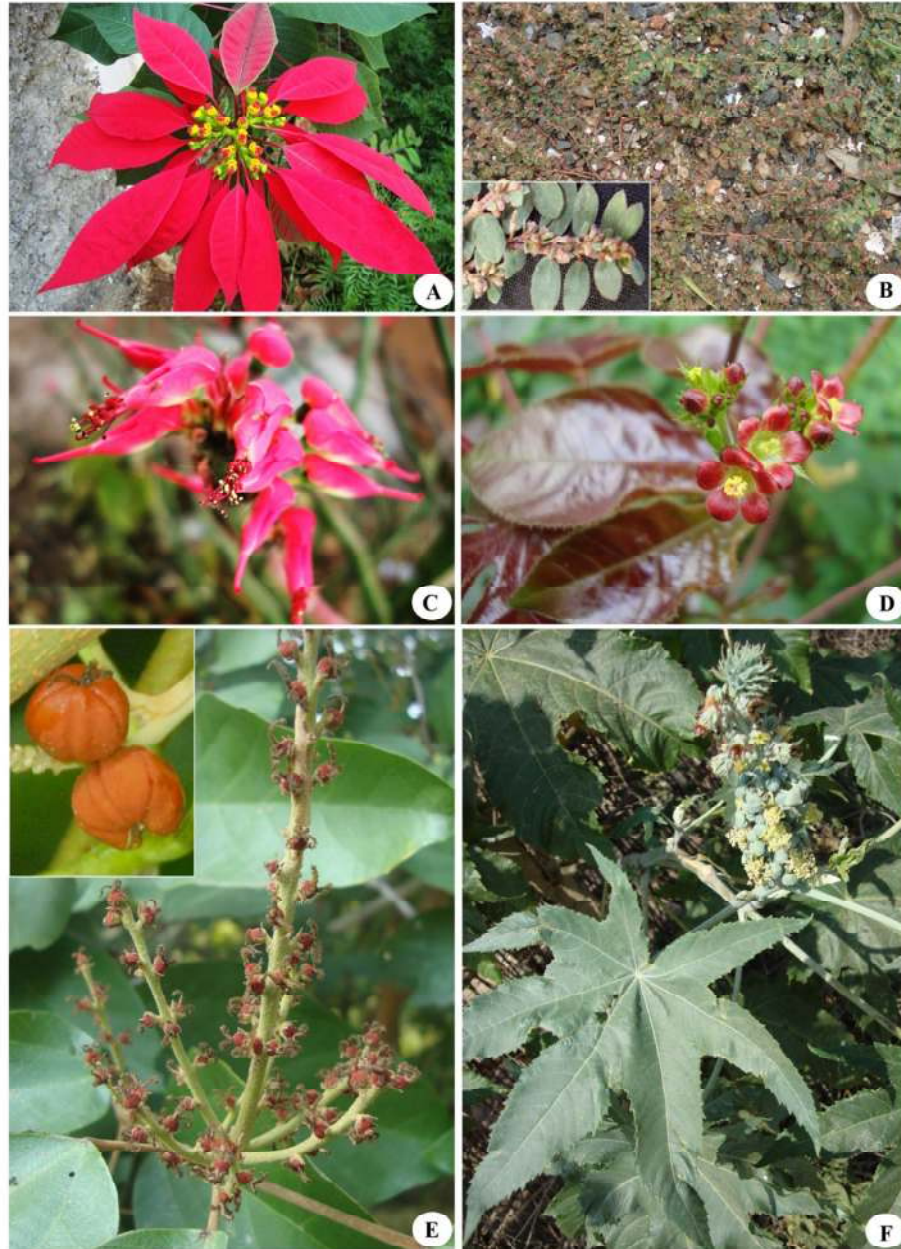


Plate 31. A. *Euphorbia pulcherrima* Willd. ex Klotzsch; B. *Euphorbia thymifolia* L.; C. *Euphorbia tithymaloides* L.; D. *Jatropha gossypifolia* L.; E. *Mallotus philippensis* (Lam.) Müll. Arg.; inset: fruits; F. *Ricinus communis* L.



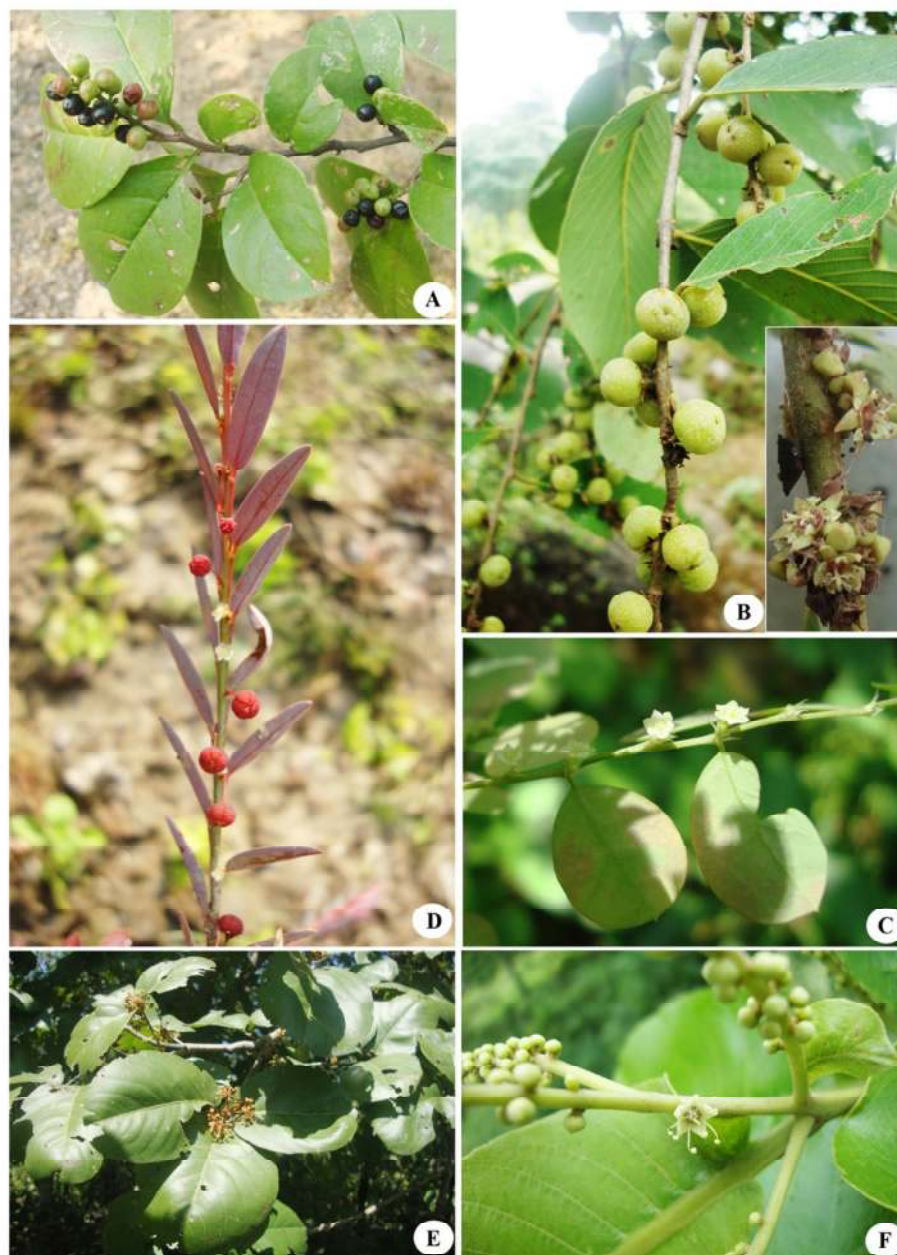
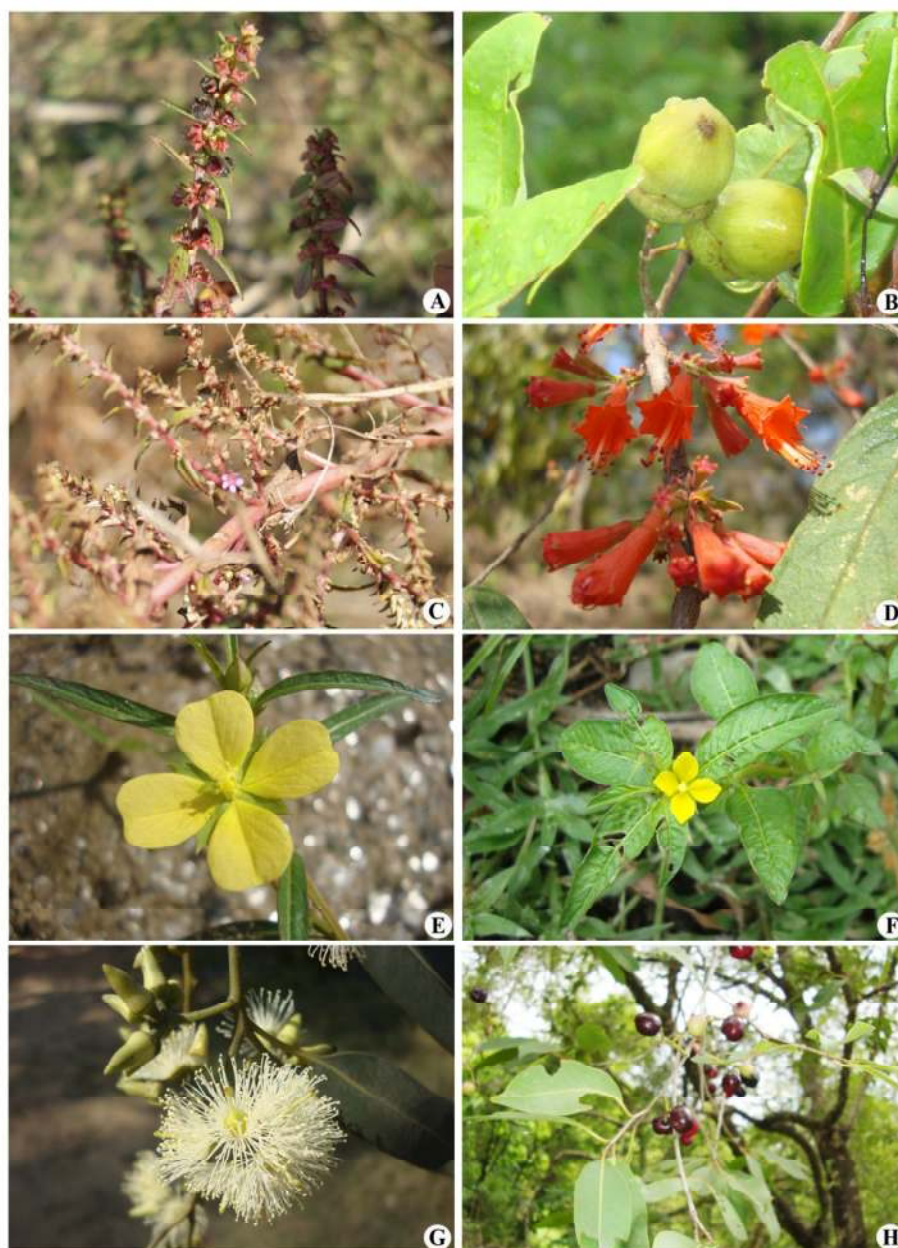


Plate 32. A. *Antidesma acidum* Retz.; B. *Bridelia retusa* (L.) Spreng.; inset: flowering-twig; C. *Phyllanthus airy-shawii* Jean F. Brunel & Jacq. Roux; D. *Phyllanthus virgatus* G. Forst.; E. *Terminalia anogeissiana* Gere & Boatwright; F. *Terminalia alata* B. Heyne ex Roth.

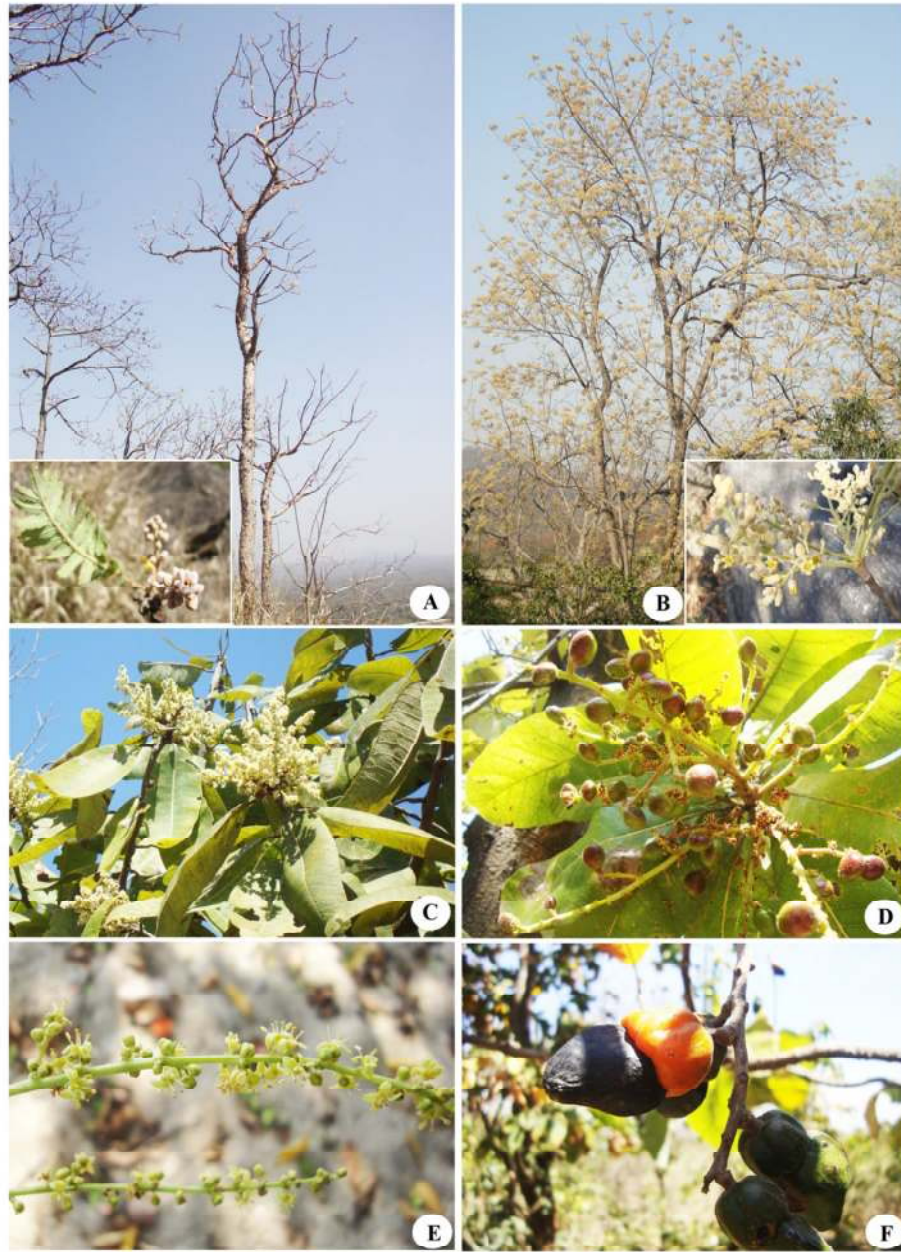


Plate 33. A. *Combretum roxburghii* Spreng.; B. *Terminalia alata* B. Heyne ex Roth; inset: fruiting-twig; C. *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.; D, E. *Terminalia bellirica* (Gaertn.) Roxb.; D. fruiting twig; E. fruit and seed; F. *Terminalia chebula* Retz.



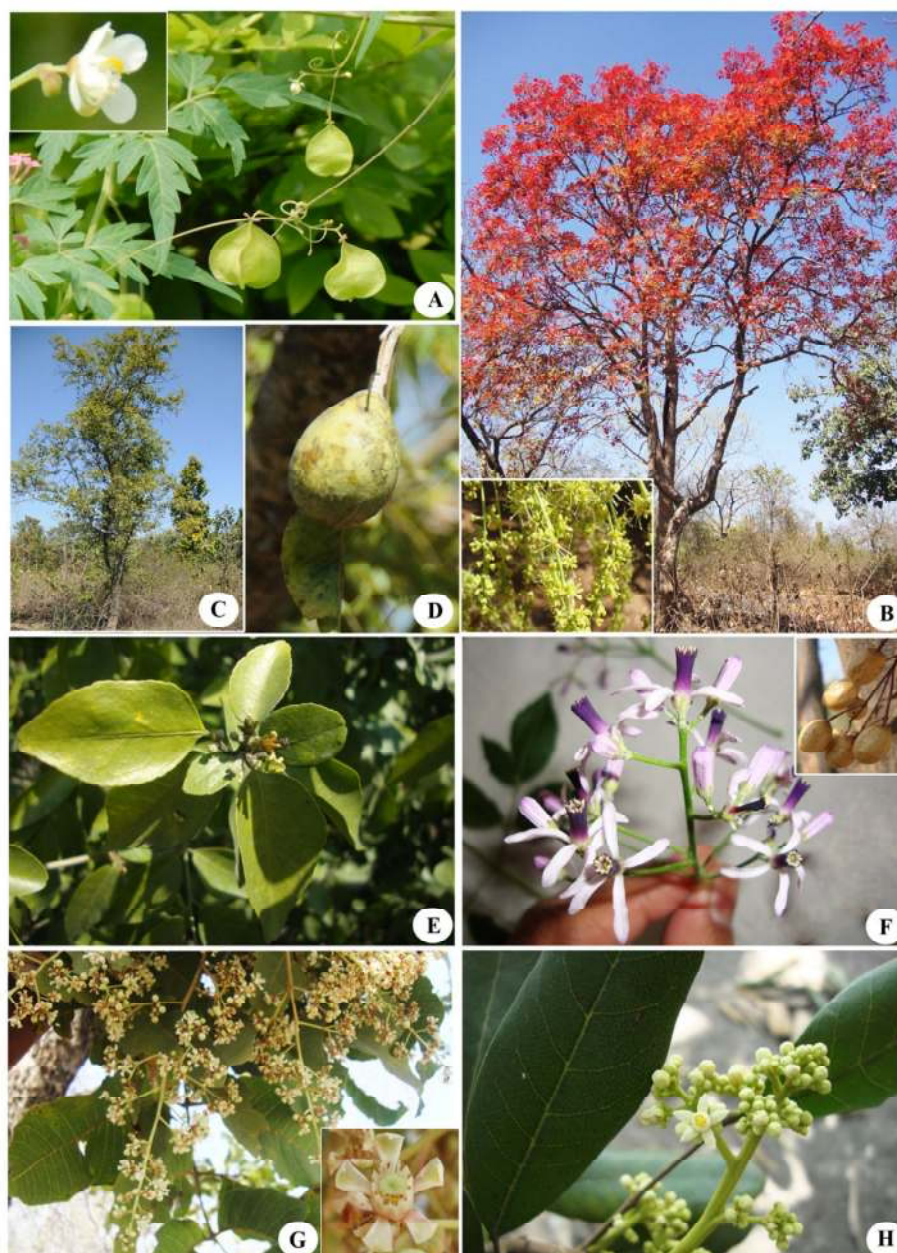


**Plate 34.** A. *Ammannia baccifera* L.; B. *Lagerstroemia parviflora* Roxb.; C. *Rotala densiflora* (Roth ex Roem. & Schult.) Koehne; D. *Woodfordia fruticosa* (L.) Kurz; E. *Ludwigia decurrens* Walter; F. *Ludwigia perennis* L.; G. *Eucalyptus tereticornis* Sm.; H. *Syzygium cumini* (L.) Skeels.

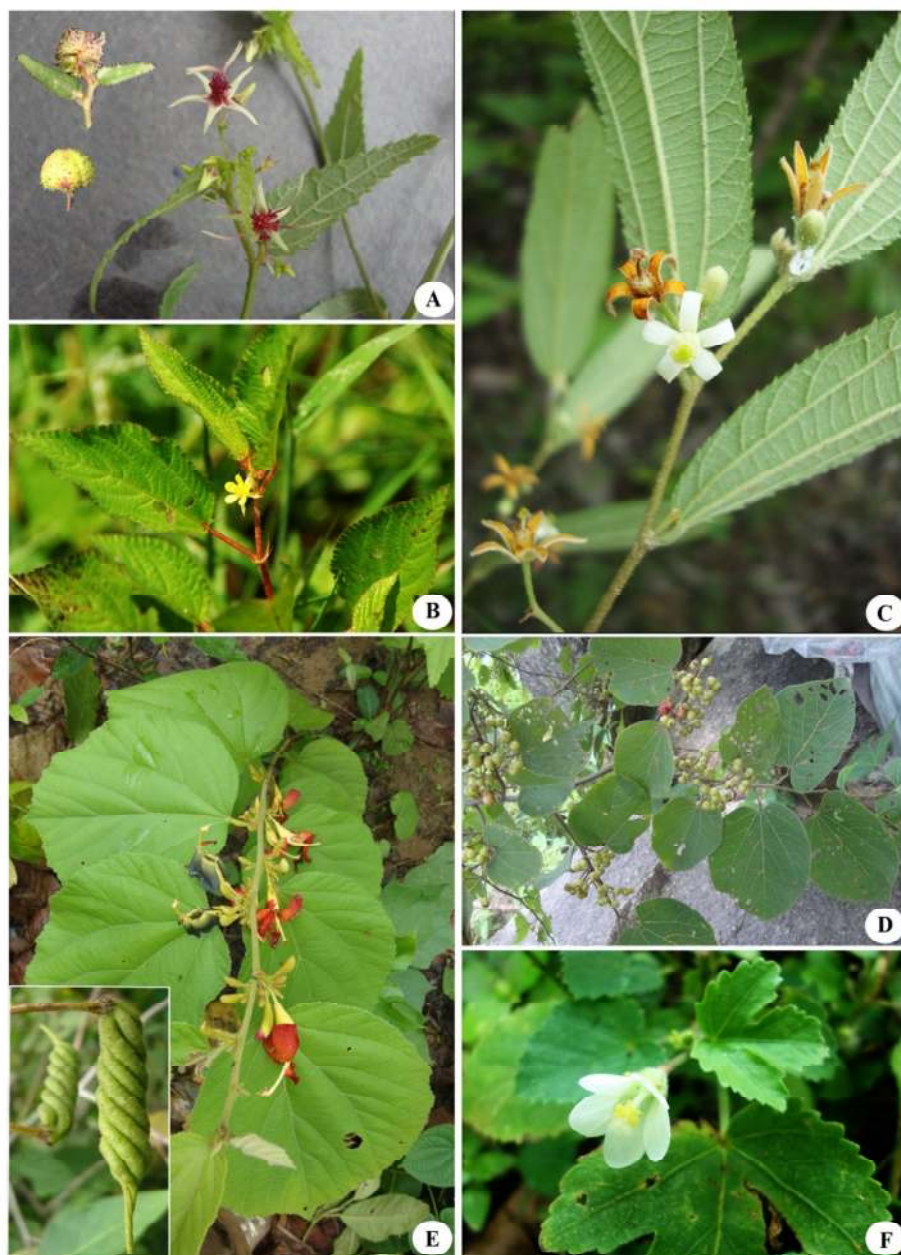


**Plate 35.** A. *Boswellia serrata* Roxb. ex Colebr.; inset: flowering-twig; B. *Garuga pinnata* Roxb.; inset: flowering-twig; C, D. *Buchanania cochinchinensis* (Lour.) M.R. Almeida; C. flowering-twig; D. fruiting-twig; E. *Lannea coromandelica* (Hout.) Merr.; F. *Semecarpus anacardium* L.f.



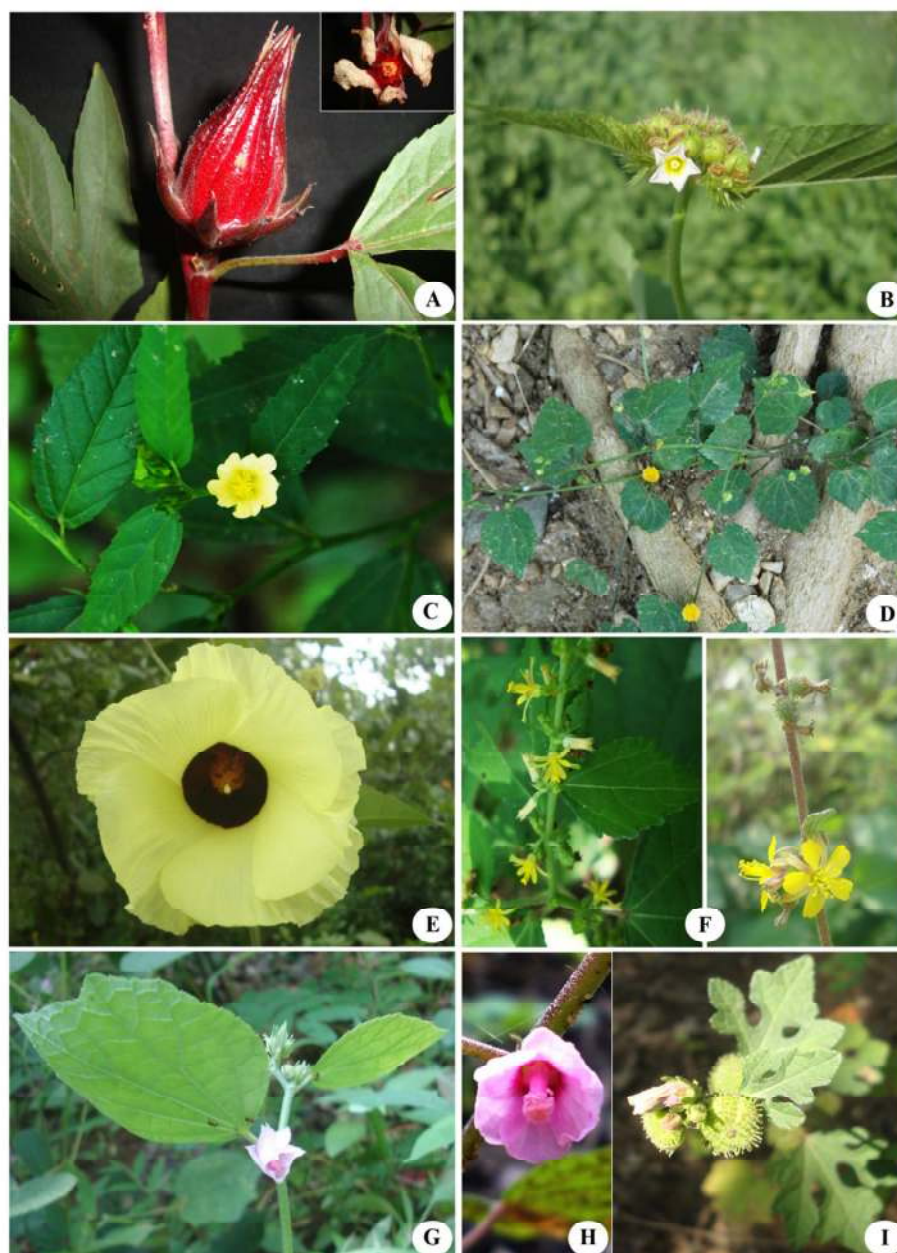


**Plate 36.** A. *Cardiospermum halicacabum* L.; inset: flower; B. *Schleicheria oleosa* (Lour.) Oken; inset: flowering-twig; C, D. *Aegle marmelos* (L.) Corrêa; C. habit; D. fruit; E. *Murraya paniculata* (L.) Jack.; F. *Melia azedarach* L.; inset: fruiting-twig; G. *Soymida febrifuga* (Roxb.) A. Juss.; inset: flower; H. *Walsura trifoliata* (A. Juss.) Harms.

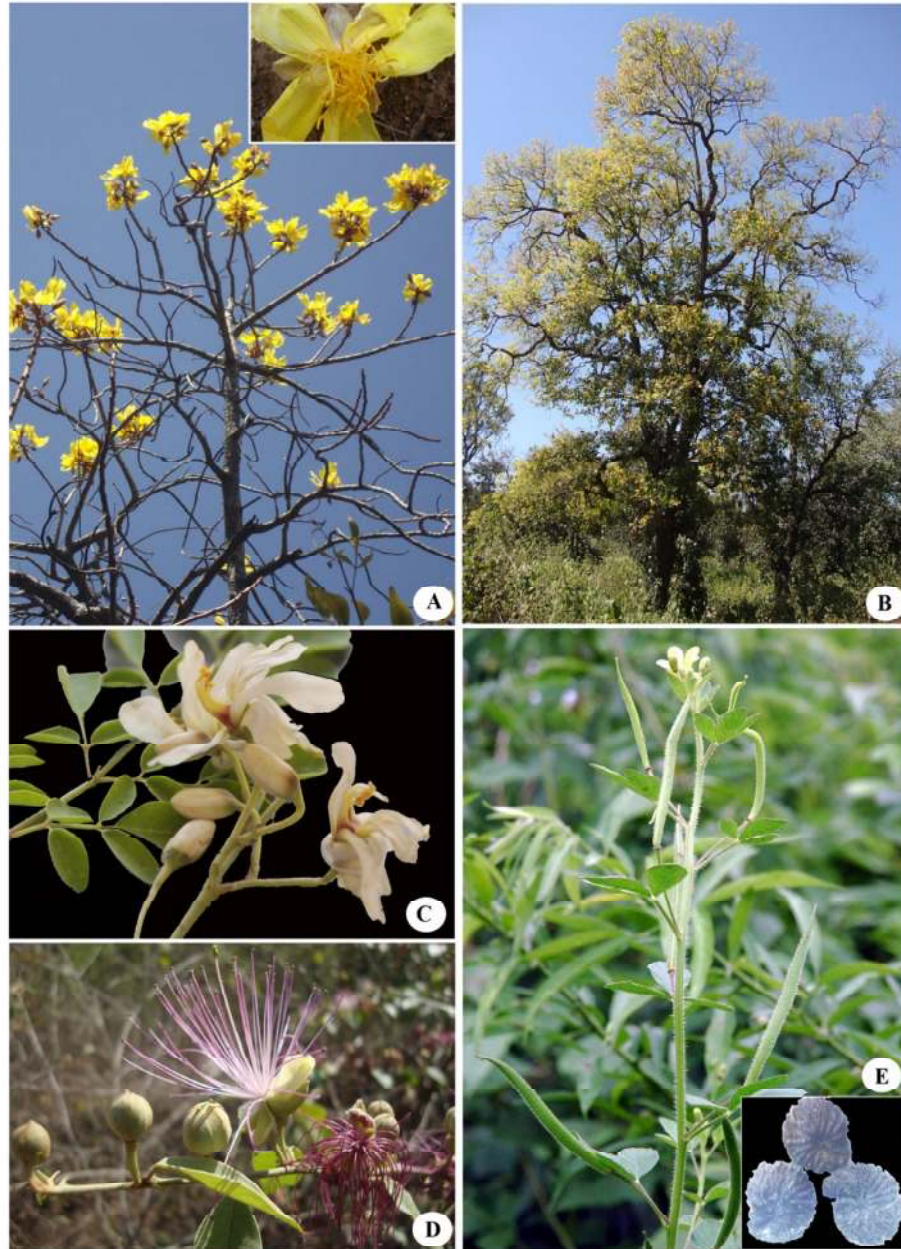


**Plate 37.** A. *Ayenia herbacea* (Roxb.) T.K.Paul; inset: fruit; B. *Corchorus olitorius* L.; C. *Grewia hirsuta* Vahl; D. *Grewia tiliifolia* Vahl; E. *Helicteres isora* L.; inset: fruits; F. *Hibiscus lobatus* (Murray) Kuntze.



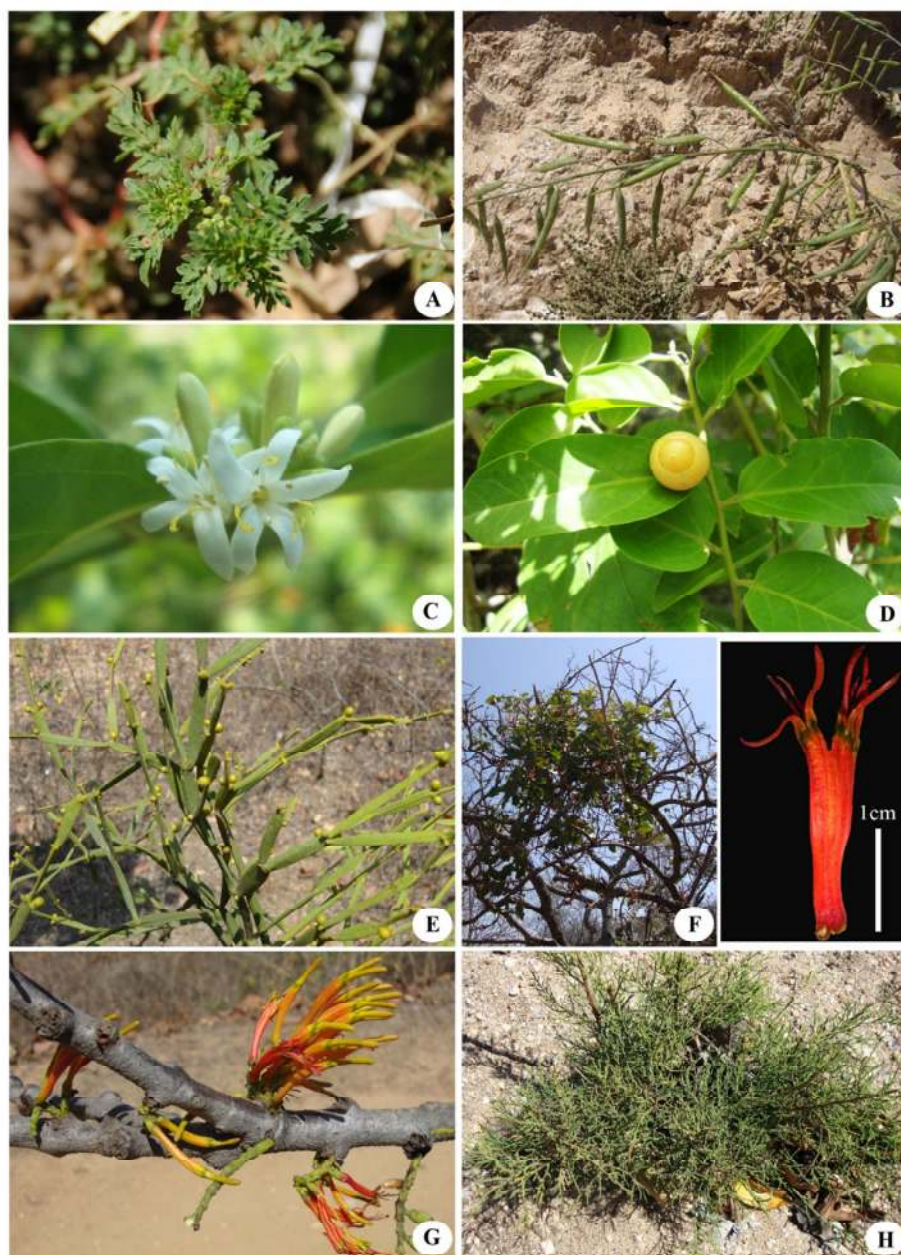


**Plate 38.** A. *Hibiscus sabdariffa* L.; inset: flower; B. *Melochia corchorifolia* L.; C. *Sida acuta* Burm.f.; D. *Sida cordata* (Burm.f.) Borss.Waalk.; E. *Azanza lampas* Alef.; F. *Triumfetta rhomboidea* Jacq.; G. *Urena lobata* L. subsp. *lobata*; H, I. *Urena sinuata* L. subsp. *sinuata* (L.) Borss.Waalk.; H: flower; I: Fruiting-twig.



**Plate 39.** A. *Cochlospermum religiosum* (L.) Alston; inset: flower; B. *Shorea robusta* Roxb. ex C.F. Gaertn.; C. *Moringa oleifera* Lam.; D. *Capparis zeylanica* L.; E. *Cleome viscosa* L.; inset: seeds.



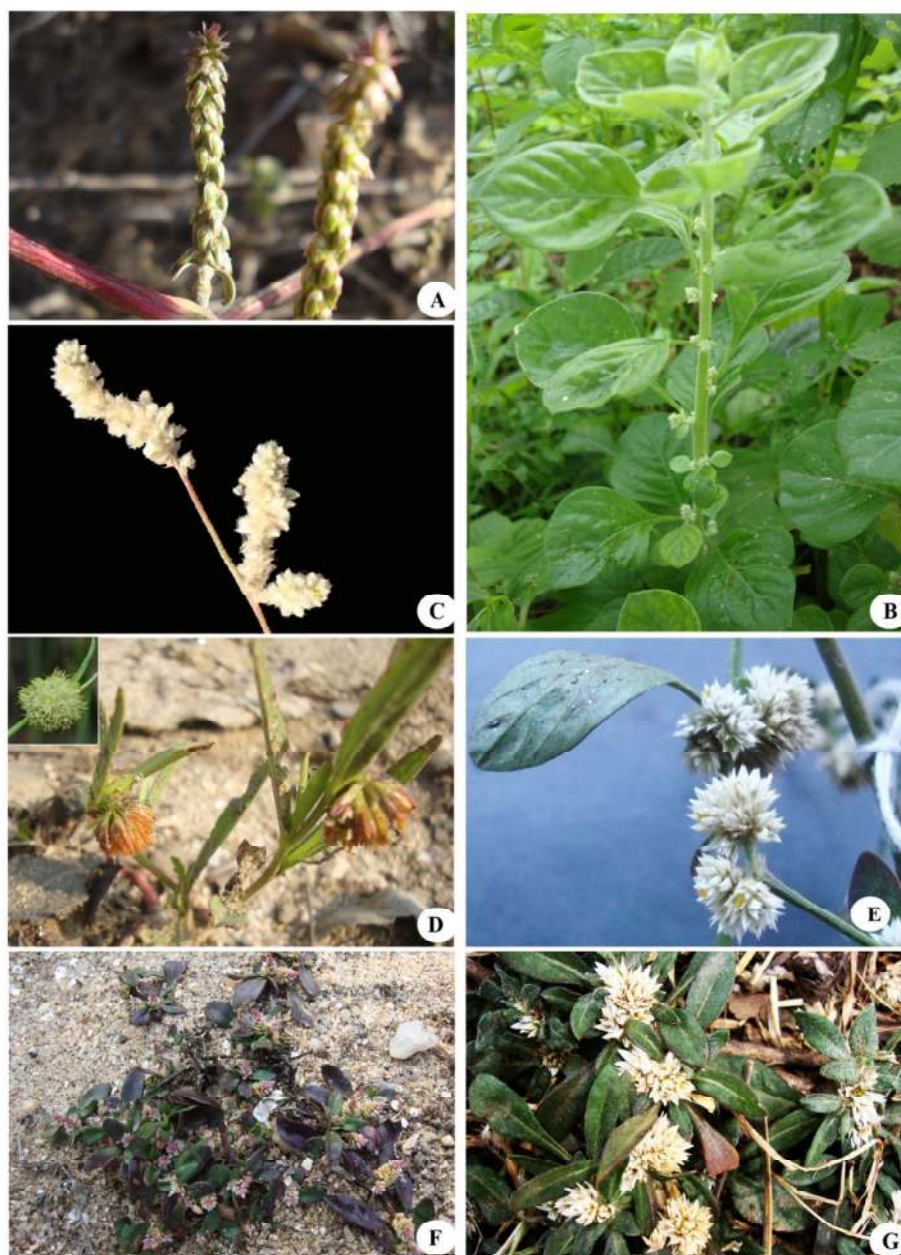


**Plate 40.** A. *Lepidium didymum* L.; B. *Raphanus sativus* L.; C, D. *Olax scandens* Roxb.; E. *Viscum articulatum* Burm.f.; F, G *Dendrophthoe falcata* (L.f.) Ettingsh.; F. Habit; inset: flower; G. Flowering-twig; H. *Tamarix ericoides* Rottler & Willd.

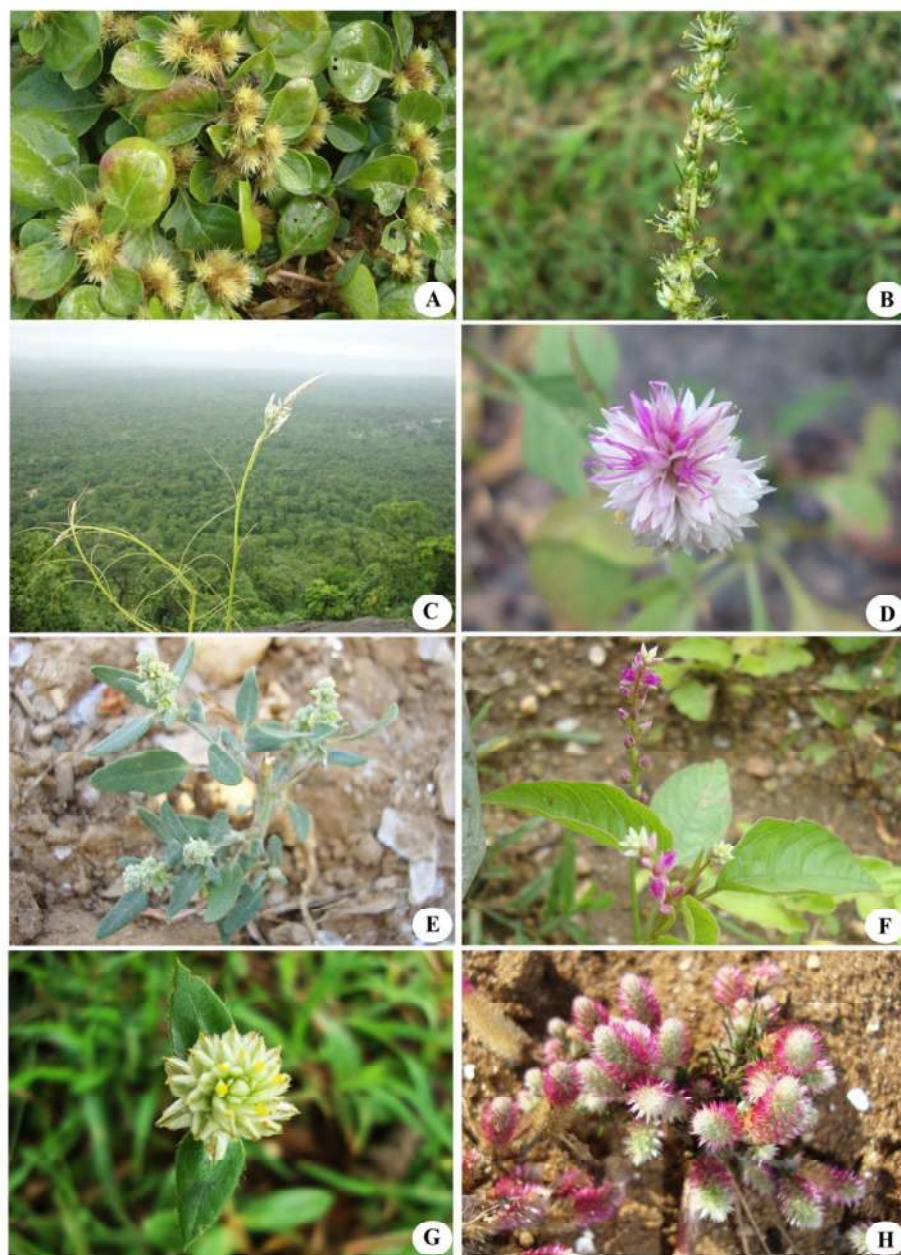


**Plate 41.** A. *Antigonon leptopus* Hook. & Arn.; B. *Persicaria hydropiper* (L.) Delarbre; inset: flowering-twig; C. *Polygonum plebeium* R. Br.; inset: flowering-twig; D, E. *Drosera burmanni* Vahl; D: habit; E. basal insect-trapping portion F. *Polycarpaea corymbosa* (L.) Lam.





**Plate 42.** A. *Achyranthes aspera* L.; B. *Aerva lanata* (L.) Juss. ex Schult.; C. *Aerva sanguinolenta* (L.) Blume; D. *Allmania nodiflora* (L.) R.Br. ex Wight E. *Alternanthera bettzickiana* (Regel) G. Nicholson; F. *Alternanthera ficoidea* (L.) P. Beauv.; G. *Alternanthera paronichyoides* A. St.-Hil.



**Plate 43.** A. *Alternanthera pungens* Kunth; B. *Amaranthus spinosus* L.; C., D. *Celosia argentea* L.; C. habit; D. inflorescence; E. *Chenopodium album* L.; F. *Digera muricata* (L.) Mart.; G. *Gomphrena celosioides* Mart.; H. *Trichuriella monsoniae* (L. f.) Bennet.



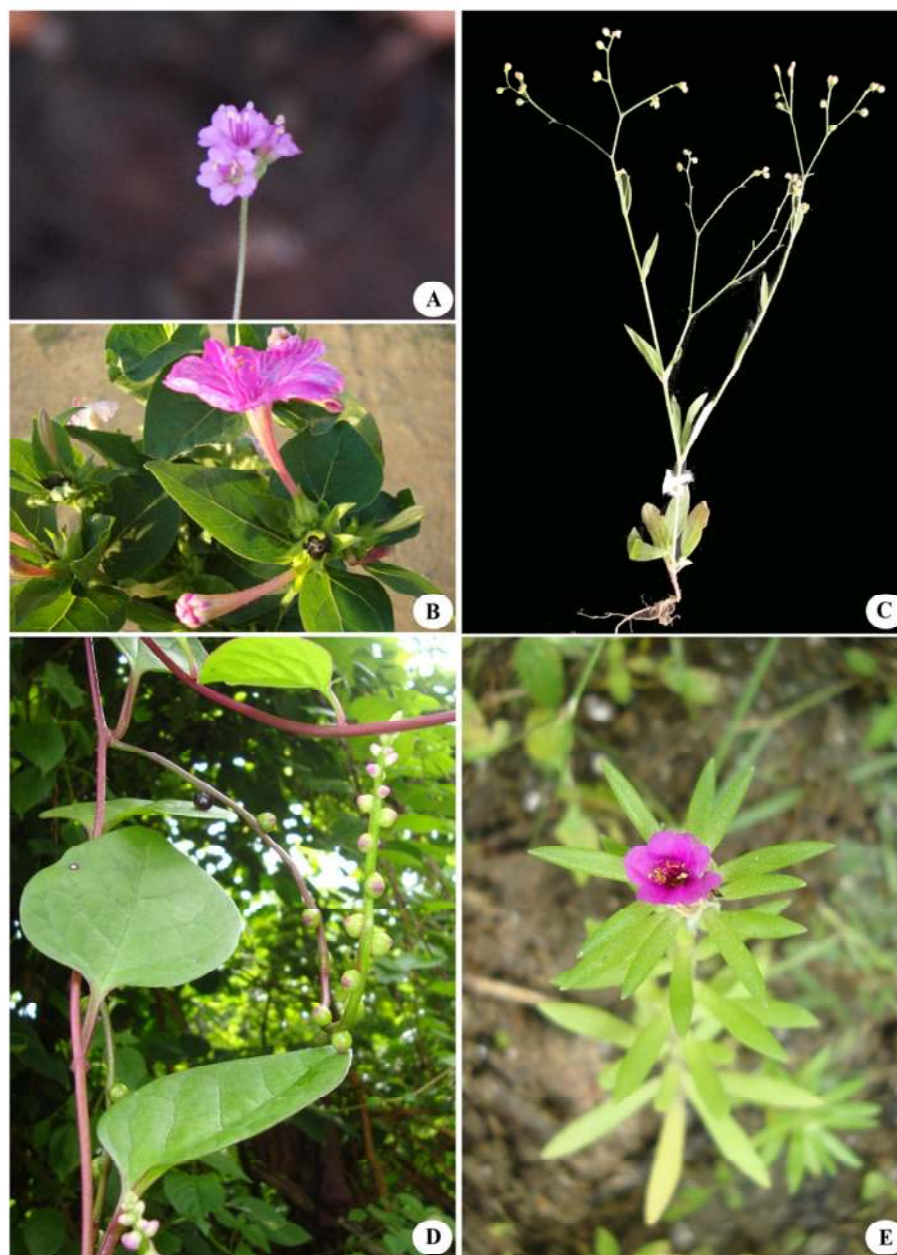
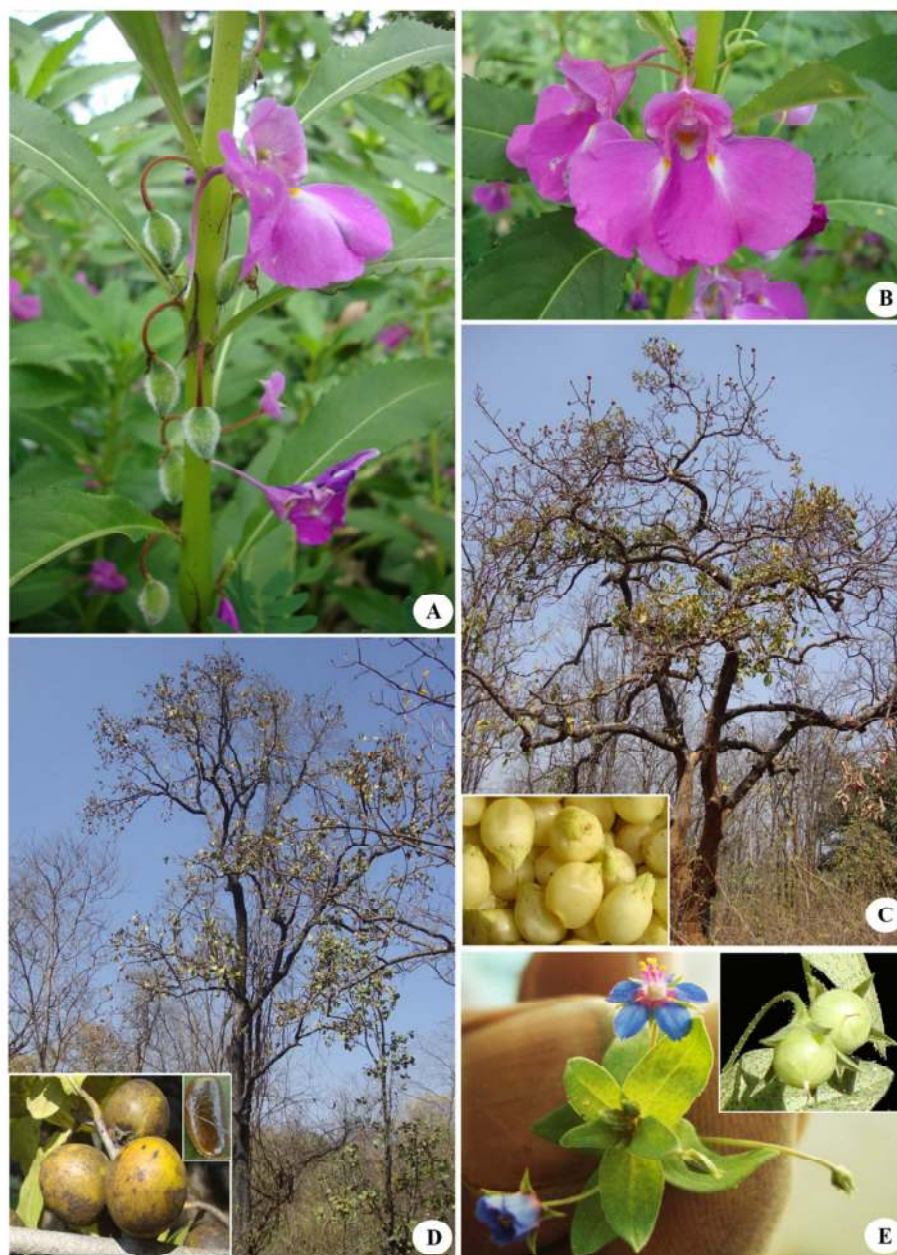


Plate 44. A. *Boerhaavia diffusa* L.; B. *Mirabilis jalapa* L.; C. *Mollugo pentaphylla* L.; D. *Basella alba* L.; E. *Portulaca pilosa* L.

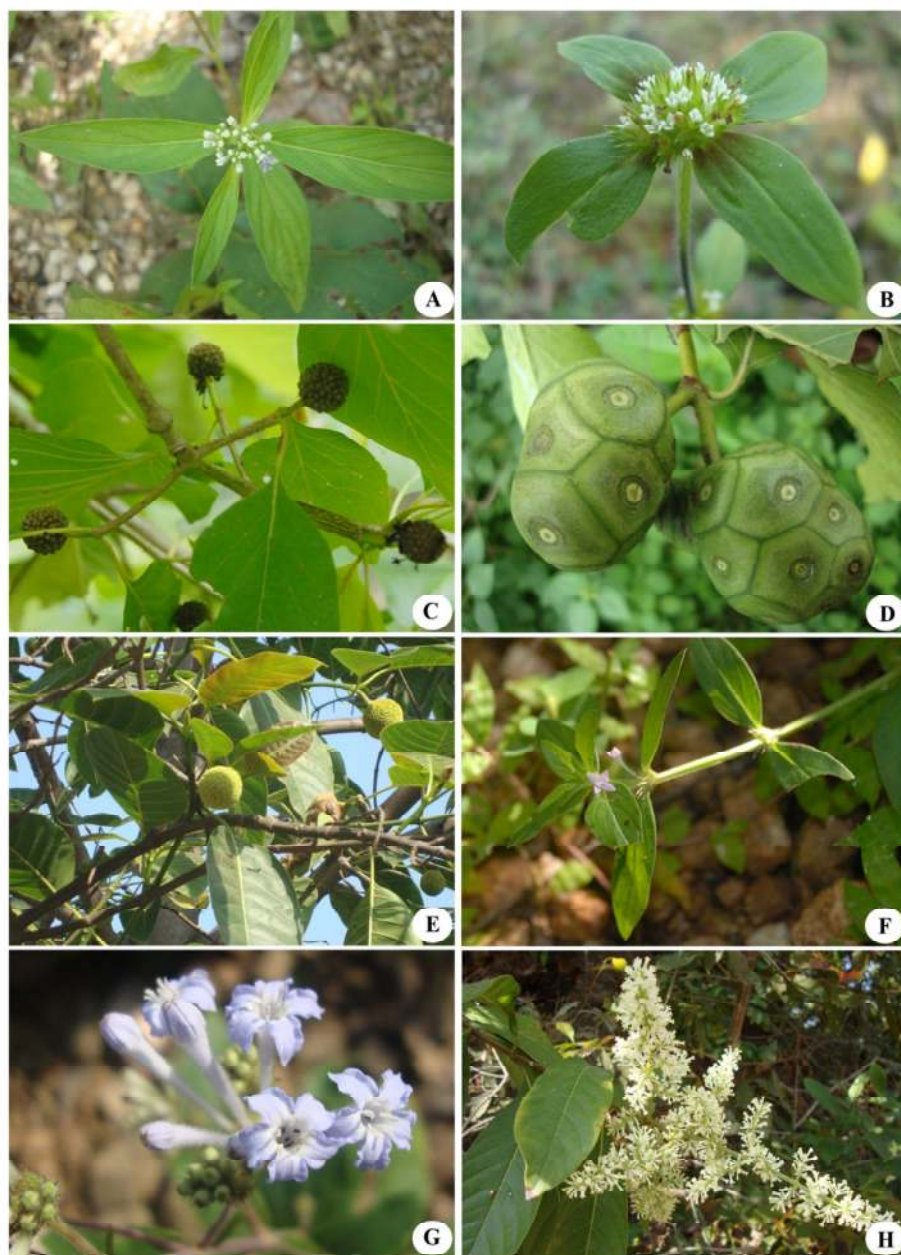


**Plate 45.** A, B. *Impatiens balsamina* L.; A. habit; B. flowering-twig; C. *Madhuca longifolia* var. *latifolia* (Roxb.) A. Chev.; inset flowers; D. *Diospyros melanoxylon* Roxb.; inset: fruiting-twig & seed; E. *Lysimachia arvensis* (L.) U.Manns & Anderb.; inset: fruits.



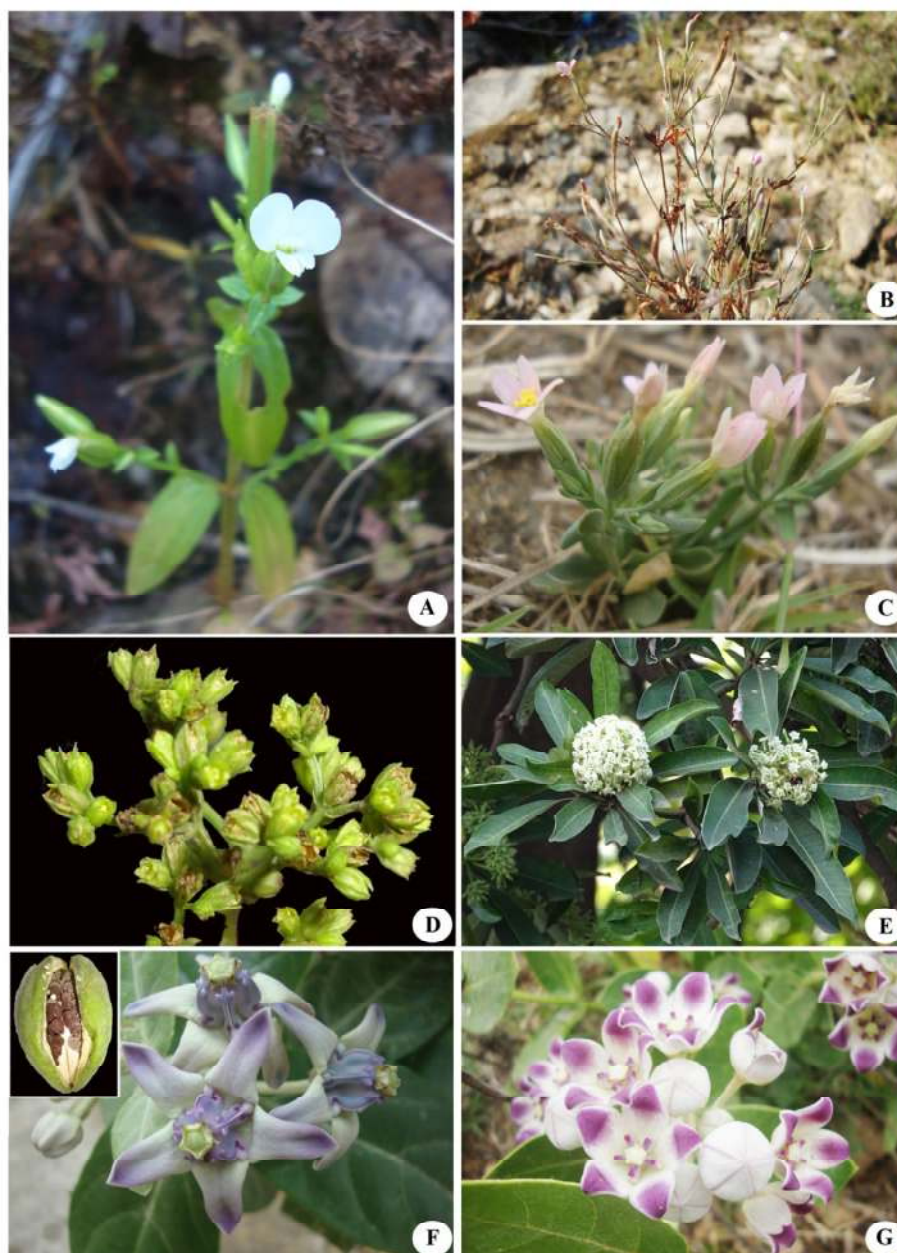


**Plate 46.** A. *Adina cordifolia* (Roxb.) Brandis; inset: inflorescence; B. *Catunaregam spinosa* (Thumb.) Tirveng.; C. *Debia ovatifolia* (Cav.) Neupane & N. Wikstr.; D. *Dentella repens* (L.) J.R. Forst. & G. Forst.; E. *Gardenia latifolia* Aiton; F. *Hymenodictyon orixense* (Roxb.) Mabb.; G. *Ixora pavetta* Andrews.

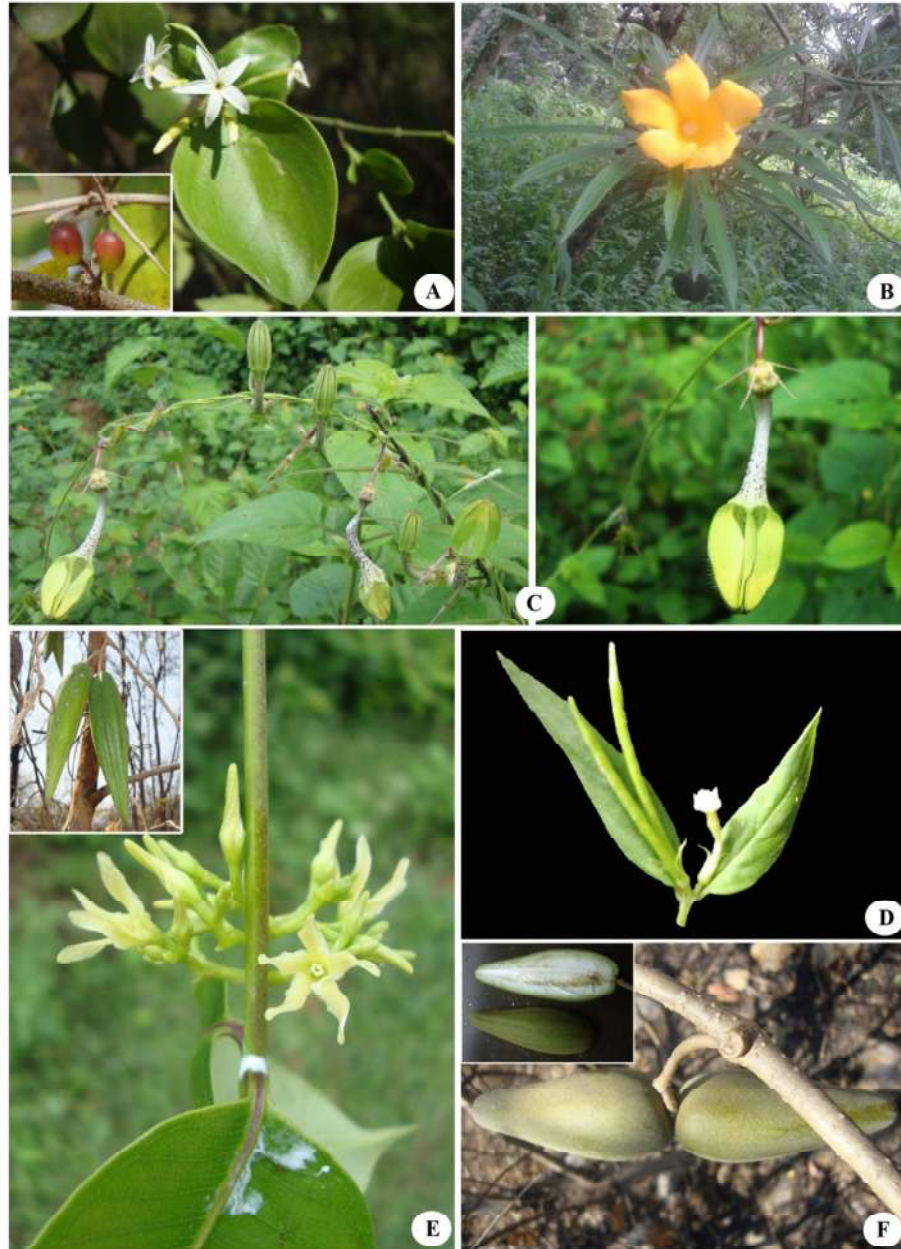


**Plate 47.** A. *Knoxia sumatrensis* (Retz.) DC.; B. *Mitracarpus hirtus* (L.) DC.; C. *Mitragyna parvifolia* (Roxb.) Korth.; D. *Morinda pubescens* Sm.; E. *Neolamarckia cadamba* (Roxb.) Bosser; F. *Spermacoce articularis* L.f.; G. *Spermadictyon suaveolens* Roxb.; H. *Wendlandia tinctoria* (Roxb.) DC.



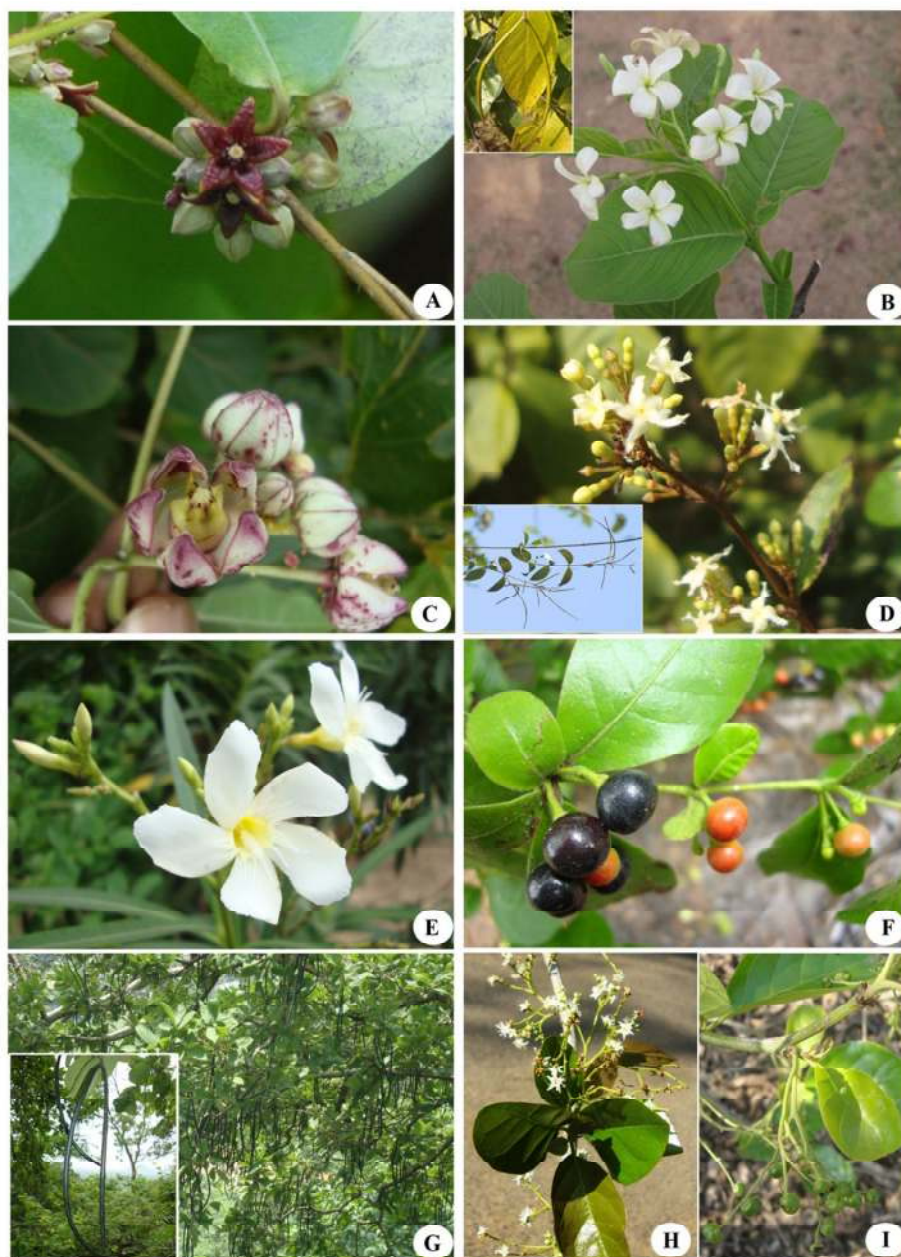


**Plate 48.** A. *Canscora alata* (Roth) Wall.; B. *Canscora diffusa* (Vahl) R. Br. ex Roem. & Schult.; C. *Centaurium pulchellum* (Sw.) Druce; D. *Mitrasacme prolifera* R.Br. E. *Alstonia scholaris* (L.) R. Br.; F. *Calotropis gigantea* (L.) W.T. Aiton; inset: fruit; G. *Calotropis procera* (Aiton) Dryand.

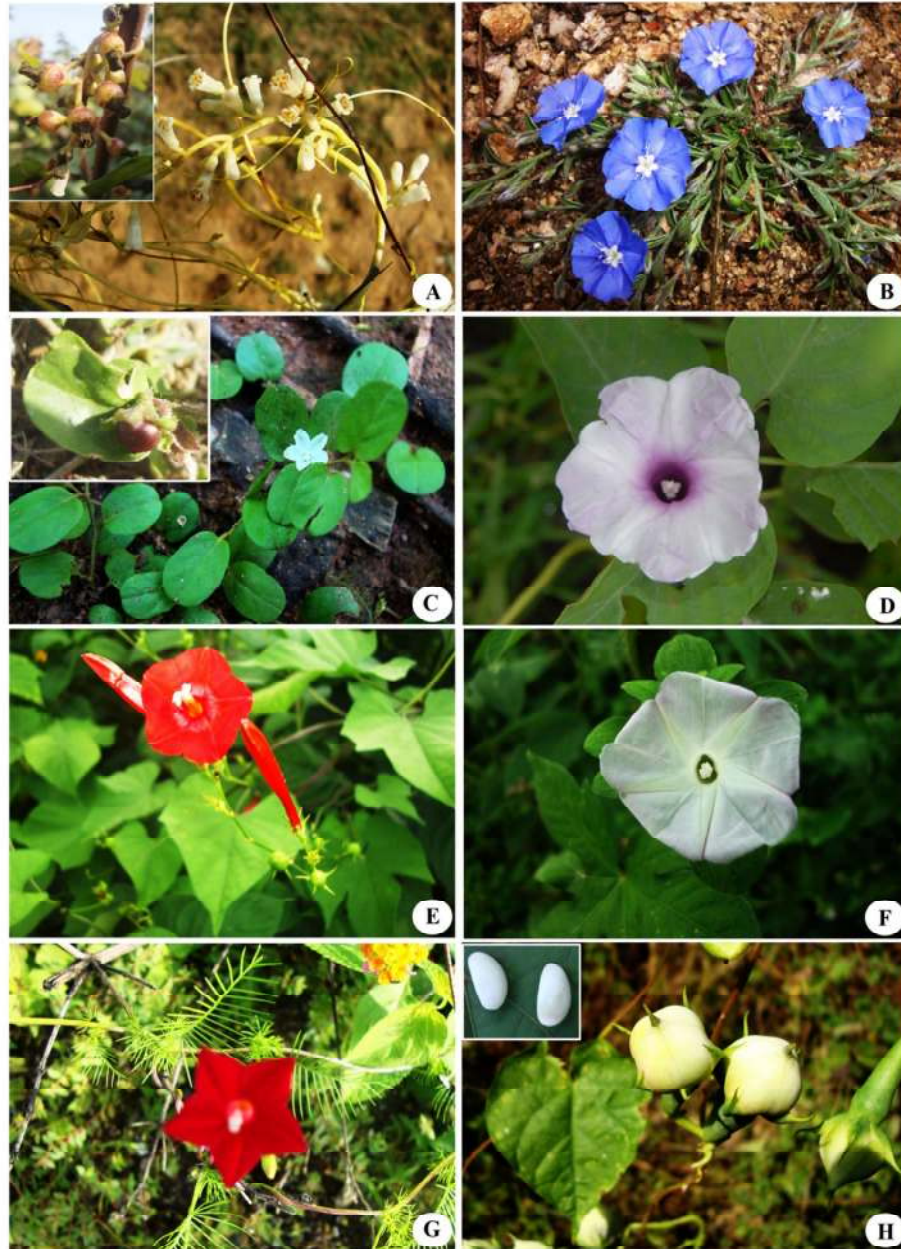


**Plate 49.** A. *Carissa carandas* L.; inset: fruit-twig; B. *Cascabela thevetia* (L.) Lippold; C. *Ceropegia hirsuta* Wight & Arn.; D. *Catharanthus pusillus* (Murr.) G. Don.; E. *Cryptolepis buchanani* Roem. & Schult.; inset: fruits; *Stephanotis volubilis* (L.f.) S.Reuss; inset: sliced fruit.



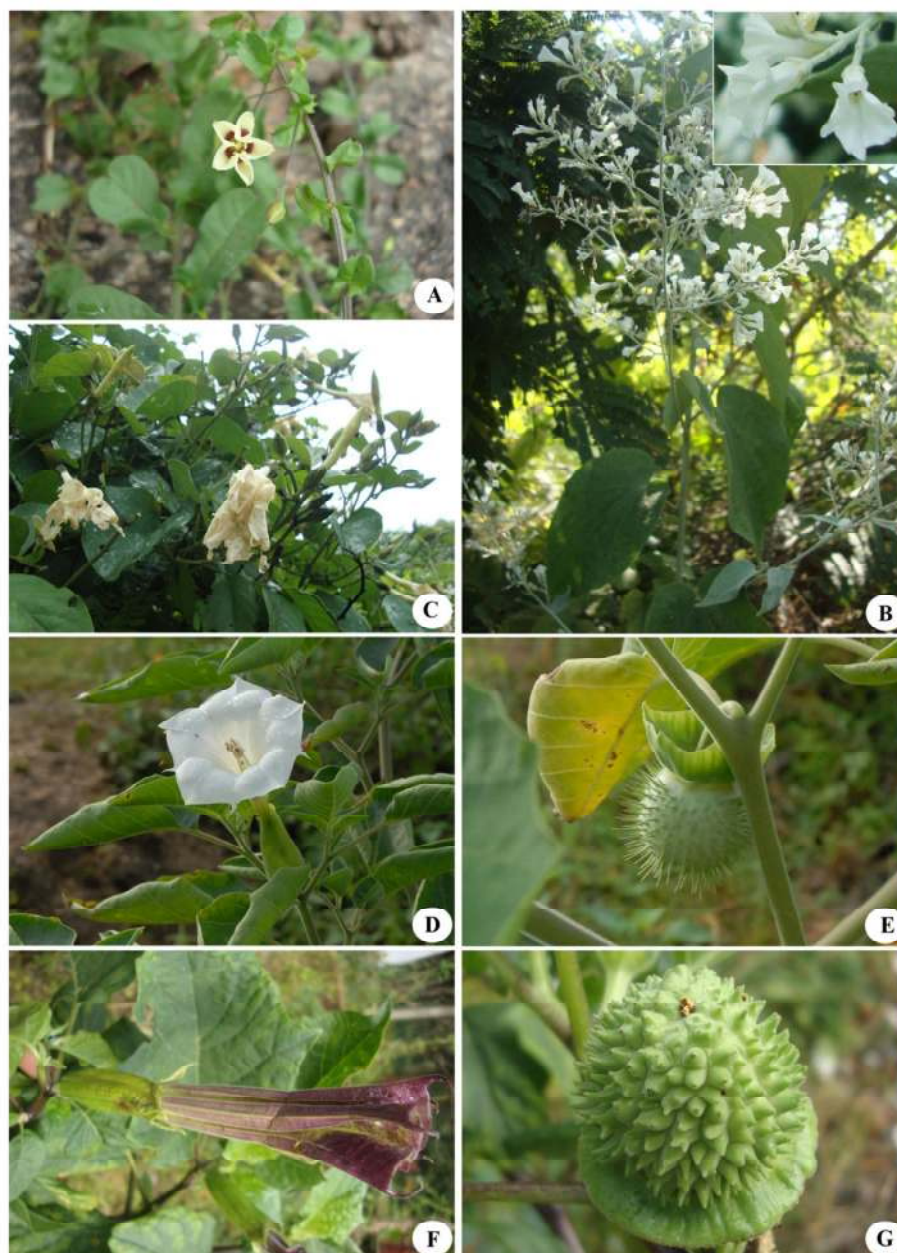


**Plate 50.** A. *Hemidesmus indicus* (L.) W.T. Aiton; B. *Holarrhena pubescens* Wall. ex G. Don; inset: fruits; C. *Cynanchum annularium* (Roxb.) Liede & Khanum; D. *Ichnocarpus frutescens* (L.) W.T. Aiton; inset: fruiting-twig; E. *Nerium oleander* L.; F. *Rauvolfia tetraphylla* L.; G. *Wrightia arborea* (Dennst.) Mabb.; inset: fruits; H, I. *Ehretia aspera* Willd.; H. flowering-twig; I. fruiting-twig.



**Plate 51.** A. *Cuscuta reflexa* Roxb.; inset: fruiting-twig; B. *Evolvulus alsinoides* (L.) L.; C. *Evolvulus nummularius* (L.) L.; inset: fruiting-twig; D. *Ipomoea carnea* Jacq.; E. *Ipomoea hederifolia* L.; F. *Ipomoea pes-tigridis* L.; G. *Ipomoea quamoclit* L.; H. *Ipomoea muricata* (L.) Jacq.; inset: seeds.





**Plate 52.** A. *Xenostegia tridentata* (L.) D.F. Austin & Staples; B. *Poranopsis paniculata* (Roxb.) Roberty; C. *Rivea hypocrateriformis* (Desr.) Choisy; D, E. *Datura innoxia* Mill.; D. flowering-twig; E. fruiting-twig; F, G. *Datura metel* L.; F. flowering-twig; G. fruit.

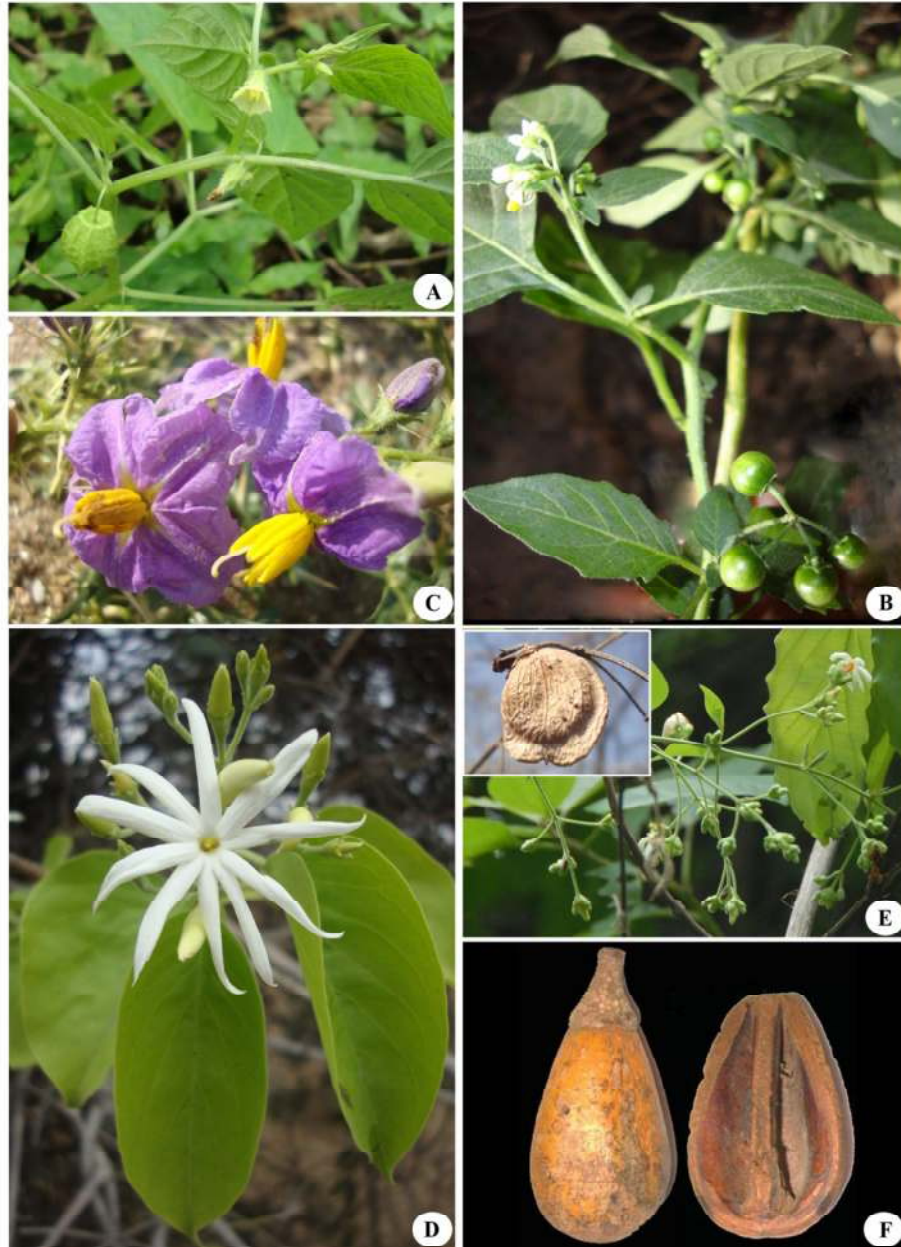
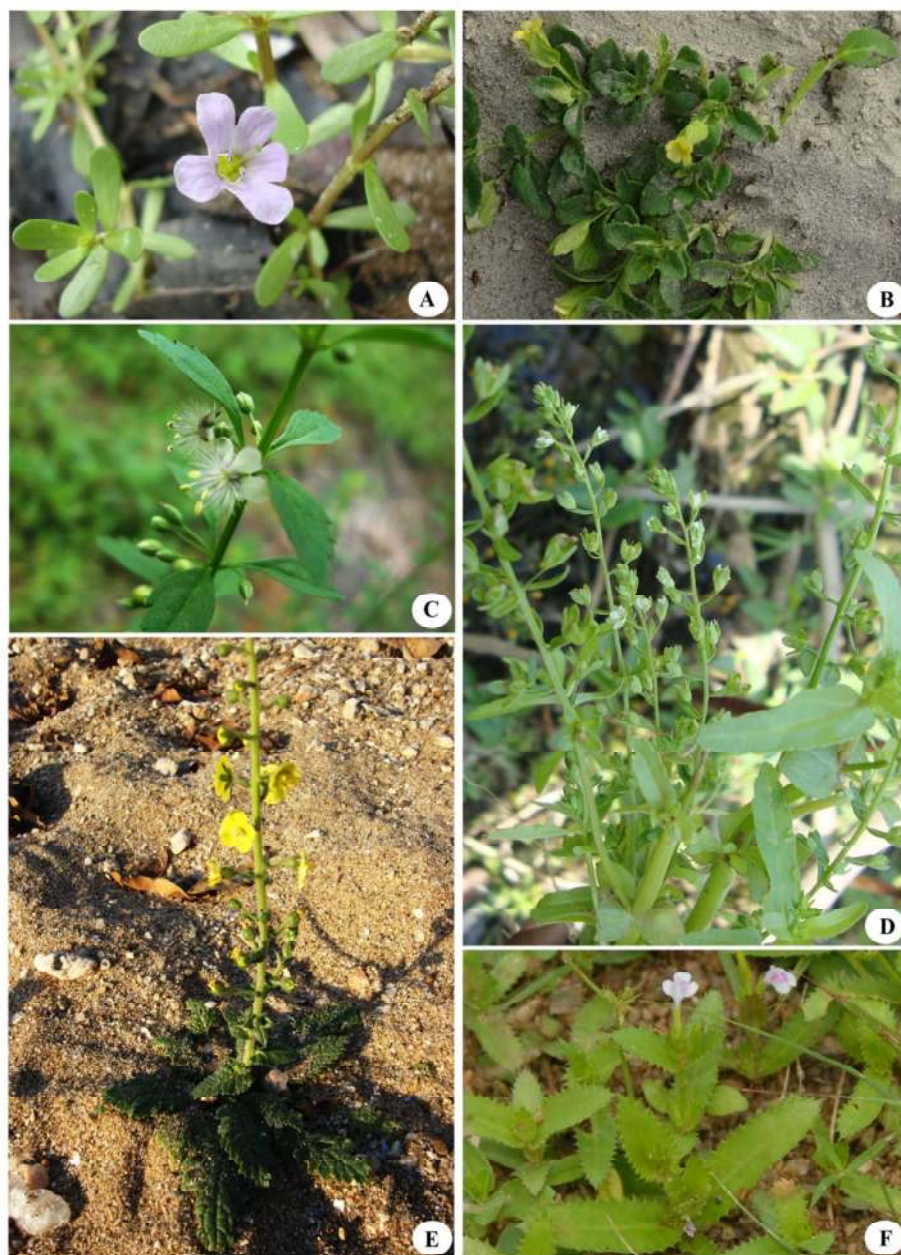


Plate 53. A. *Physalis angulata* L.; B. *Solanum americanum* Mill.; C. *Solanum virginianum* L.; D. *Jasminum arborescens* Roxb.; E. *Nyctanthes arbor-tristis* L.; inset: fruit; F. *Schrebera swietenioides* Roxb.





**Plate 54.** A. *Bacopa monnieri* (L.) Wettst.; B. *Mecardonia procumbens* (Mill.) Small; C. *Scoparia dulcis* L.; D. *Veronica anagaliis-aquatica* L.; E. *Verbascum coromandelianum* (Vahl) Hub.-Mor.; F. *Bonnaya ciliata* (Colsm.) Spreng.

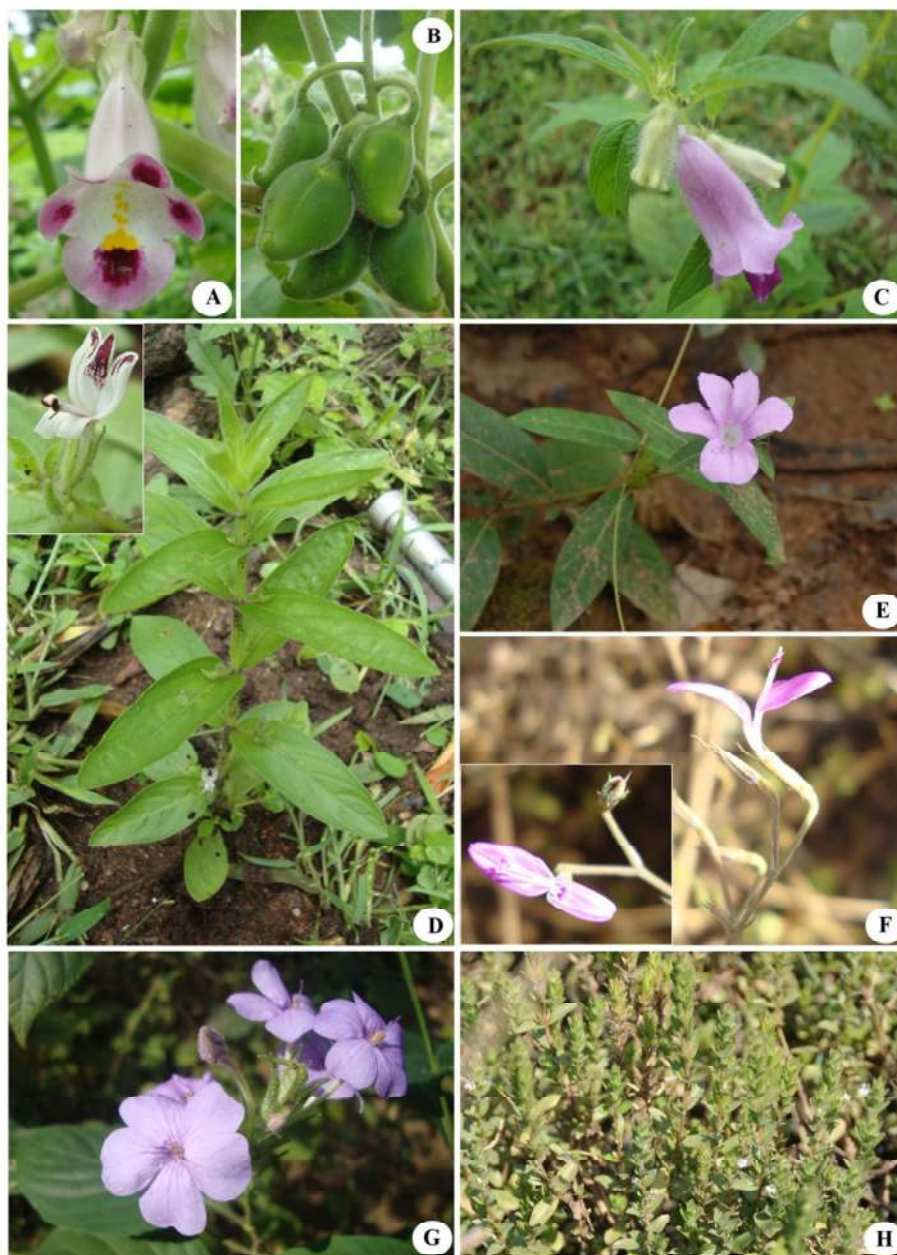
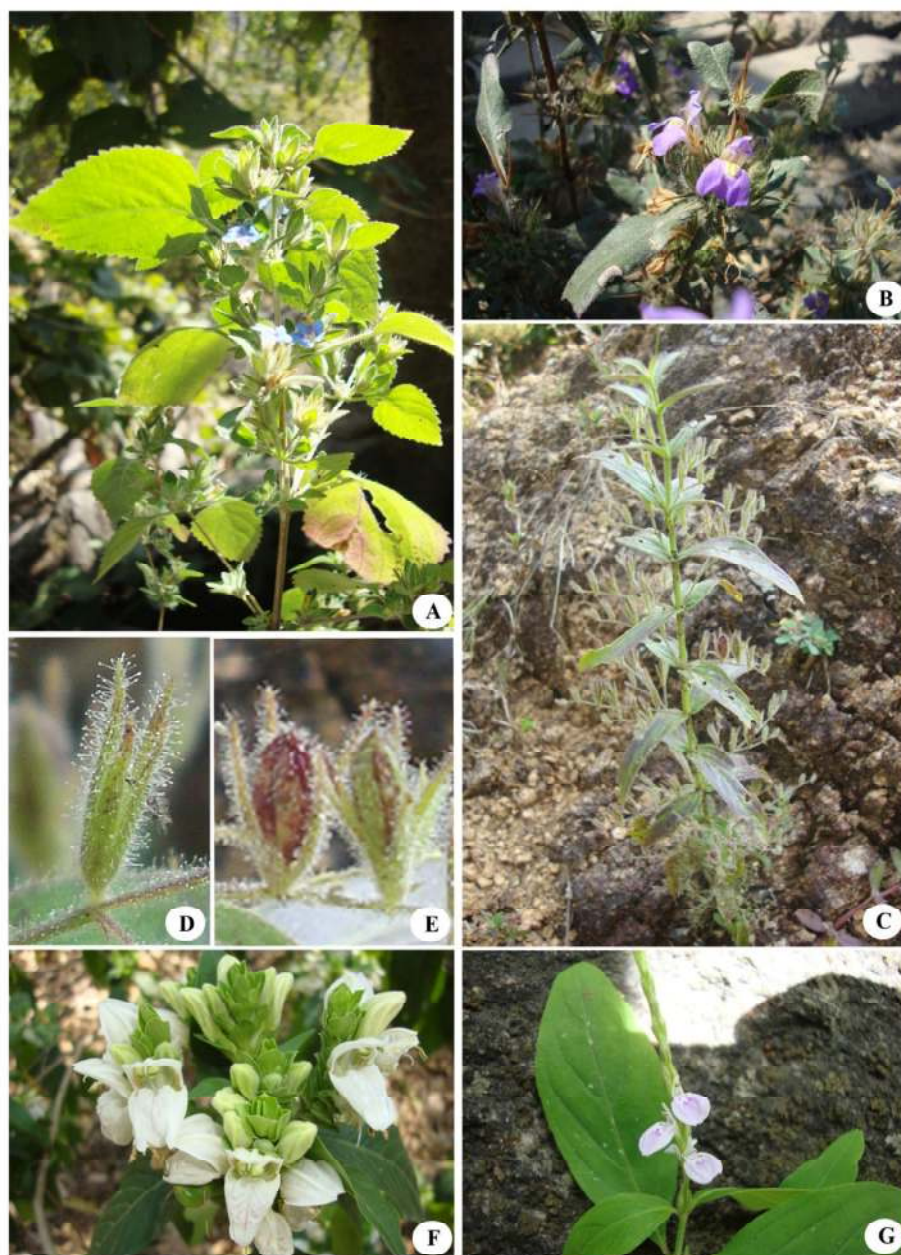


Plate 55. A, B. *Martynia annua* L.; A. flower; B. fruiting-twig; C. *Sesamum indicum* L.; D. *Andrographis echioides* (L.) Nees, inset. flower; E. *Barleria cristata* L.; F. *Dicliptera paniculata* (Forssk.) I.Darbysh; inset: flower; G. *Eranthemum pulchellum* Andrews; H. *Hygrophila polysperma* (Roxb.) T.Anderson.



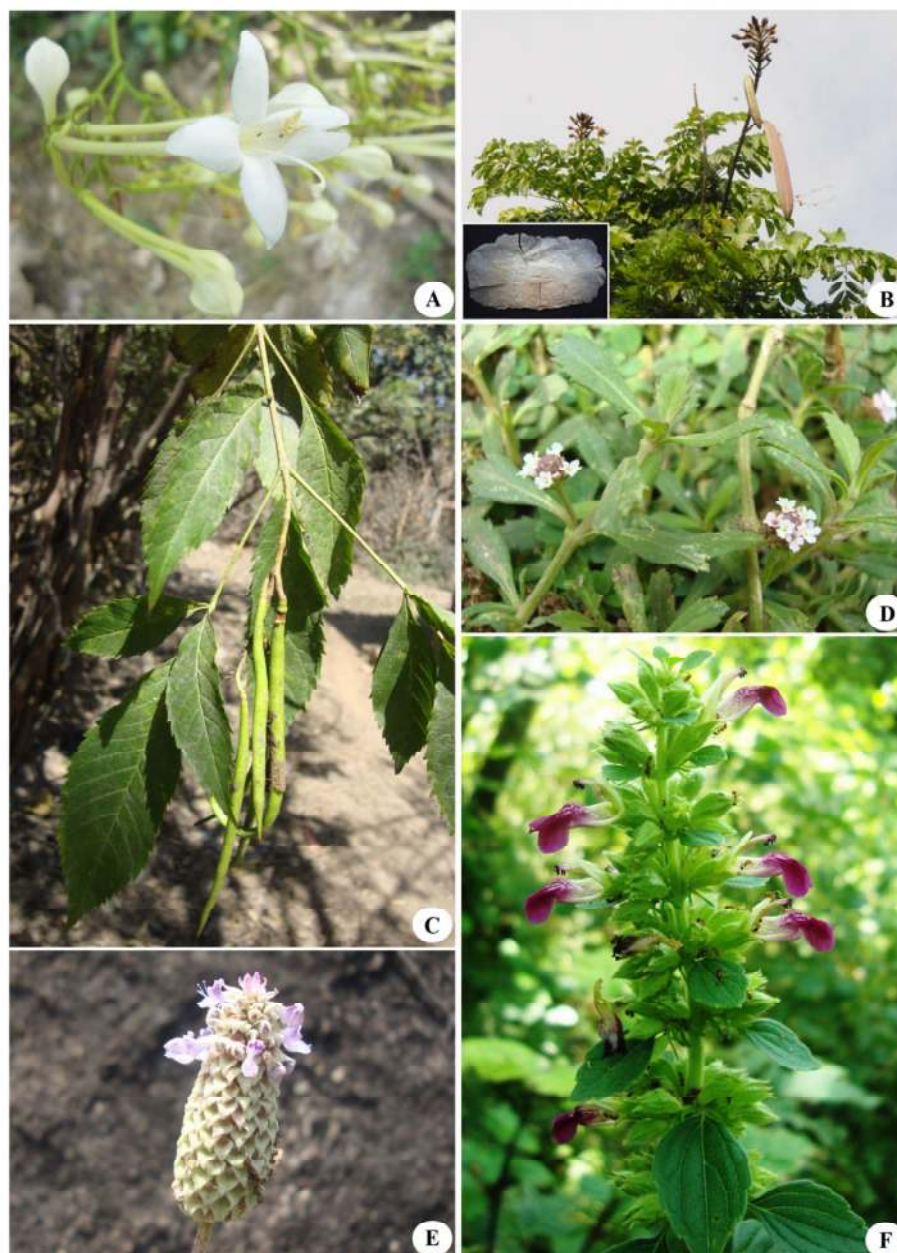


**Plate 56.** A. *Strobilanthes pavala* J.R.I.Wood; B. *Hygrophila auriculata* (Schumach.) Heine; C, D, E. *Andrographis longipedunculata* (Sreem.) L.H. Cramer; C. habit; D. fruit-bud; E. fruits; F. *Justicia adhatoda* L.; G. *Rostellularia diffusa* (Willd.) Nees

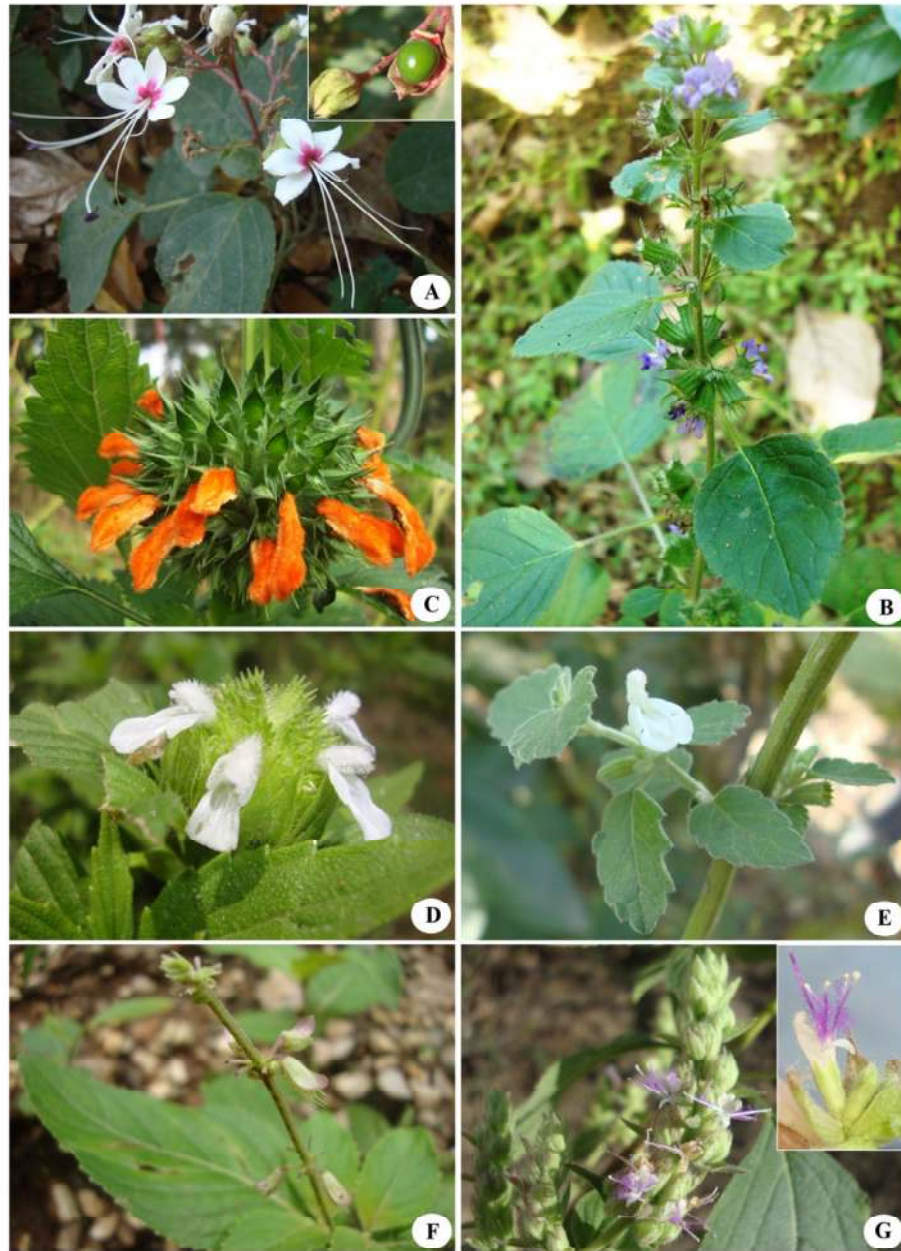


Plate 57. A. *Lepidagathis hamiltoniana* Wall. ex Nees; B. *Nelsonia canescens* (Lam.) Spreng.; inset: flower, C. *Ruellia sibua* (Nees) I.M.Turner, D. *Ruellia tuberosa* L., E. *Rungia pectinata* (L.) Nees.



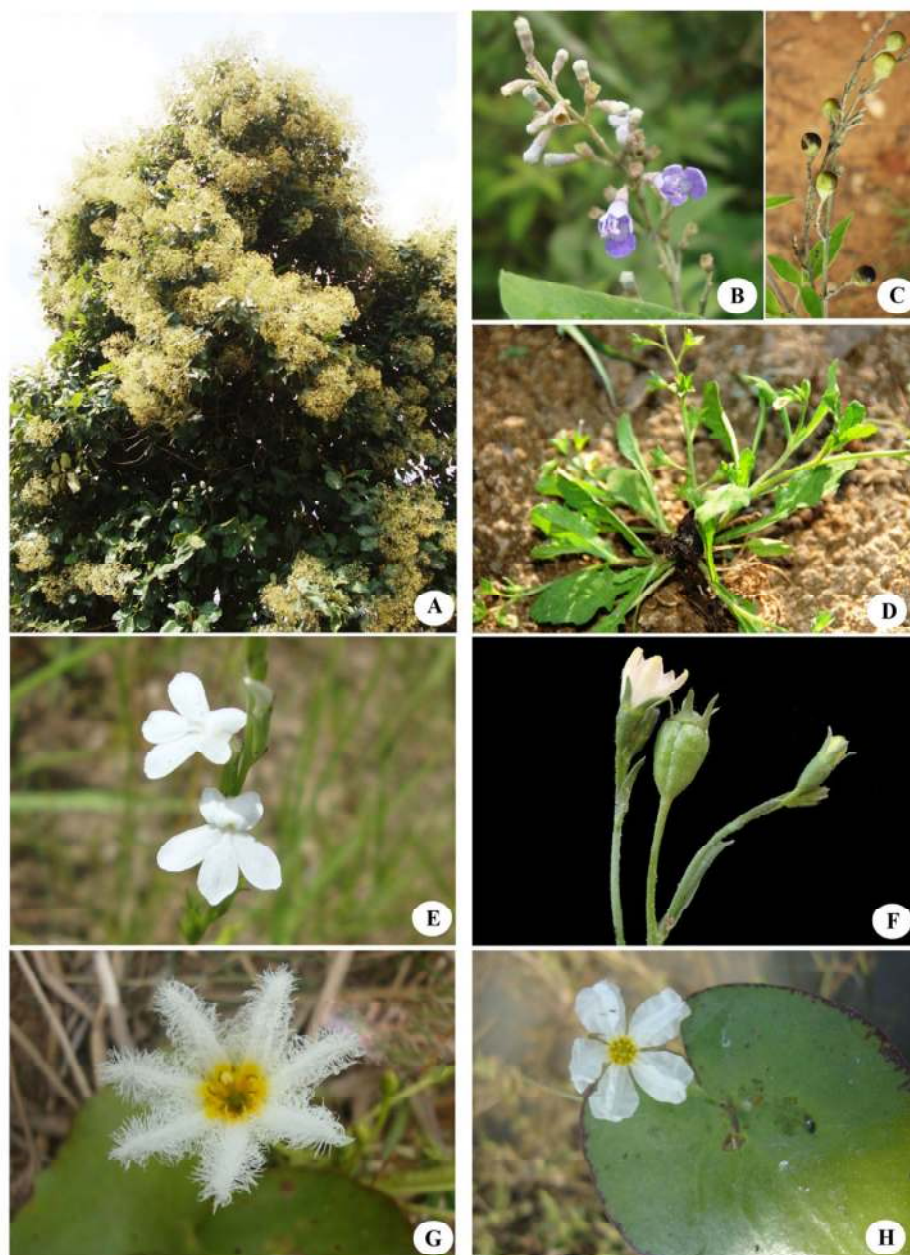


**Plate 58.** A. *Millingtonia hortensis* L.f.; B. *Oroxylum indicum* (L.) Vent.; inset: seed; C. *Tecoma stans* (L.) Juss. ex Kunth; D. *Phyla nodiflora* (L.) Greene; E. *Coleus strobilifer* (Roxb.) A.J.Paton; F. *Anisomeles indica* (L.) Kuntze.



**Plate 59.** A. *Clerodendrum infortunatum* L.; inset: fruiting-twig; B. *Mesosphaerum suaveolens* (L.) Kuntze; C. *Leonotis nepetifolia* (L.) R. Br.; D. *Leucas cephalotes* (Roth) Spreng.; E. *Leucas decedentata* (Willd.) Sm.; F. *Orthosiphon pallidus* Royle ex Benth.; G. *Pogostemon benghalensis* (Burm.f.) Kuntze; inset: flower.





**Plate 60.** A. *Tectona grandis* L.f.; B, C. *Vitex negundo* L.; B. flowering-twig; C. fruiting-twig; D. *Mazus pumilus* (Burm.f.) Steenis.; E. *Striga angustifolia* (D. Don) C.J. Saldanha, F. *Wahlenbergia marginata* (Thunb.) DC.; G. *Nymphoides indica* (L.) Kuntze; H. *Nymphoides hydrophyllum* (Lour.) Kuntze

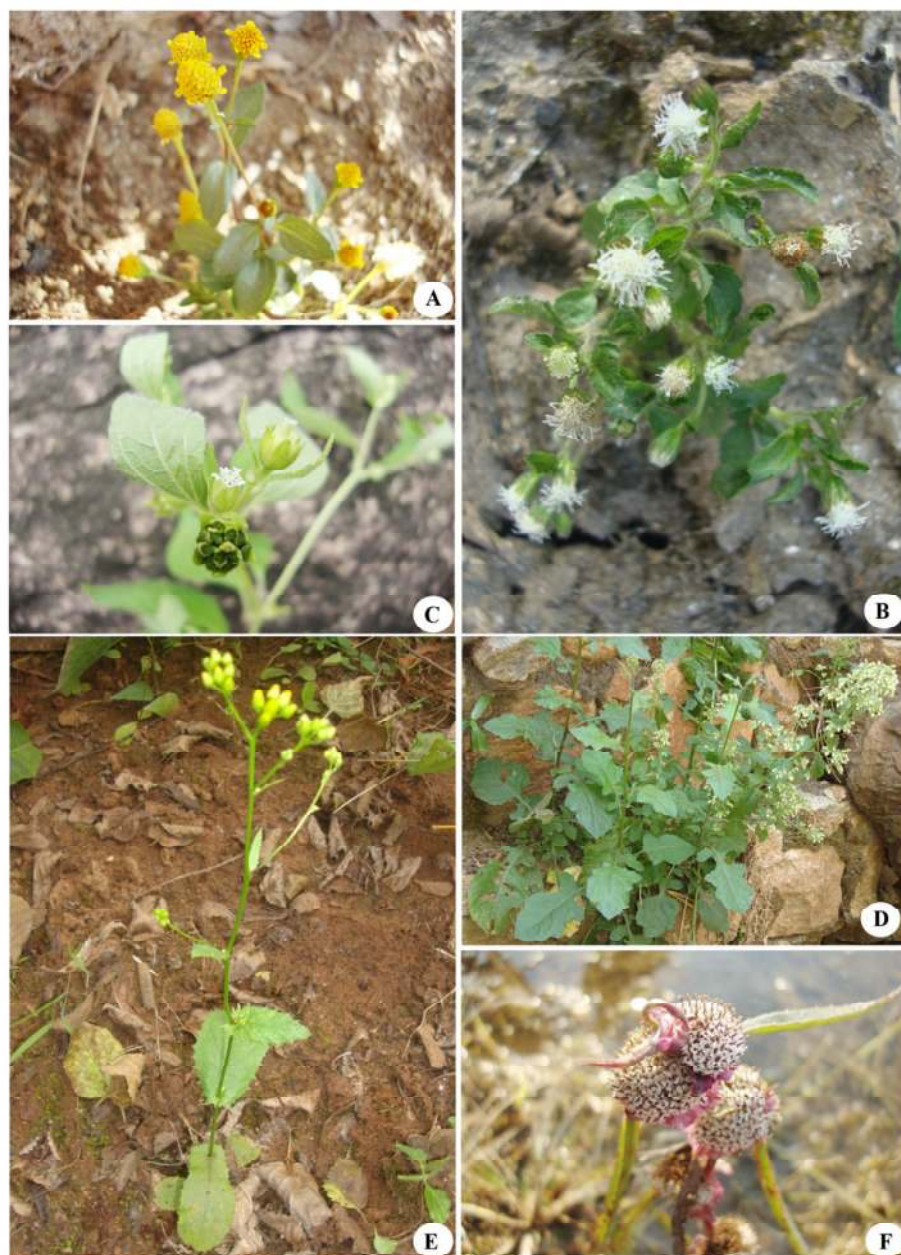


Plate 61. A. *Acmella paniculata* (Wall. ex DC.) R.K. Jansen; B. *Ageratum conyzoides* L.; C. *Blainvillea acmella* (L.) Philipson; D. *Blumea lacera* (Burm.f.) DC.; E. *Blumeopsis flava* (DC.) Gagnep.; F. *Caesulia axillaris* Roxb.



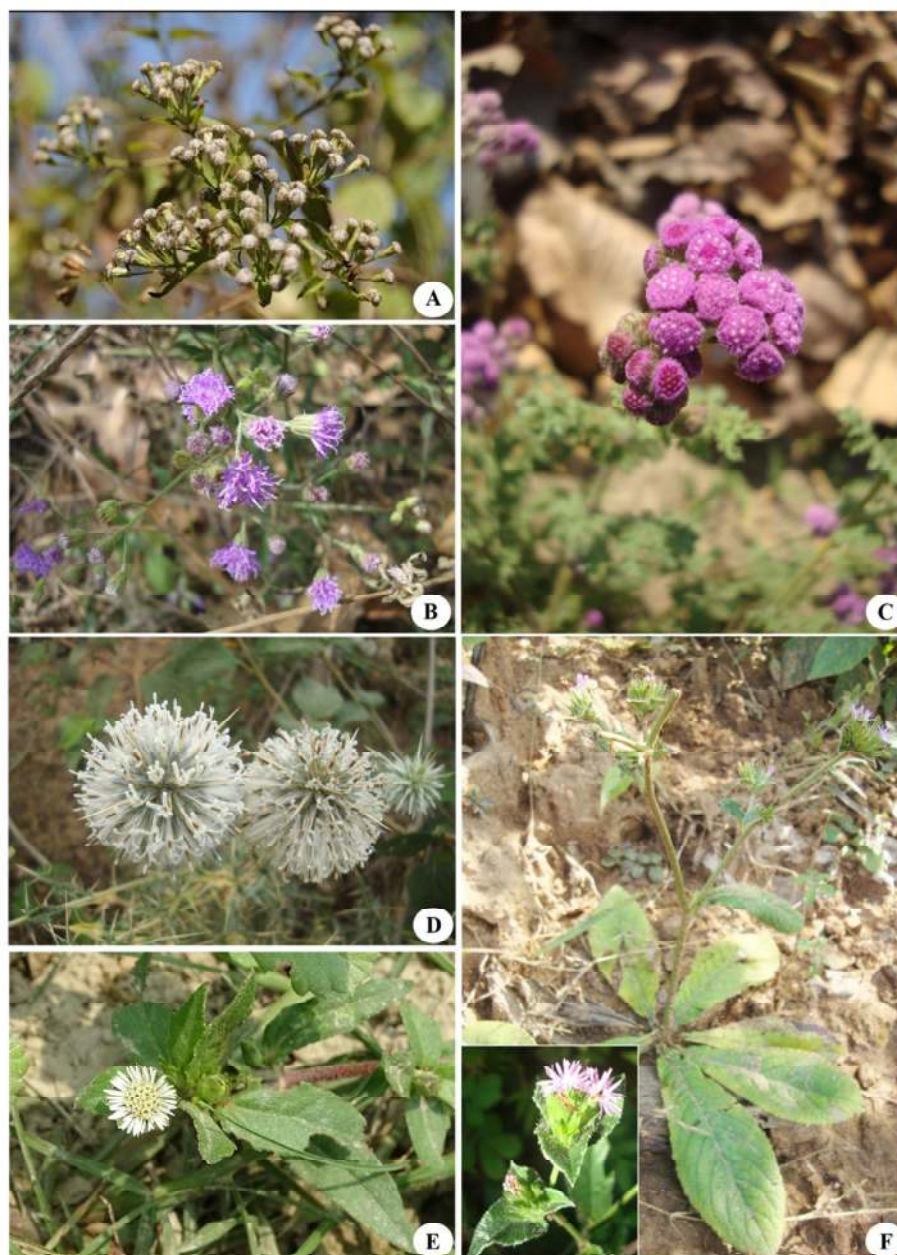


Plate 62. A. *Chromolaena odorata* (L.) R.M. King & H. Rob.; B. *Cyanthillium cinereum* (L.) H. Rob.; C. *Cyathocline purpurea* (Buch.-Ham. ex D. Don) Kuntze; D. *Echinops echinatus* Roxb.; E. *Eclipta prostrata* (L.) L.; F. *Elephantopus scaber* L.; inset: flowering-twig.

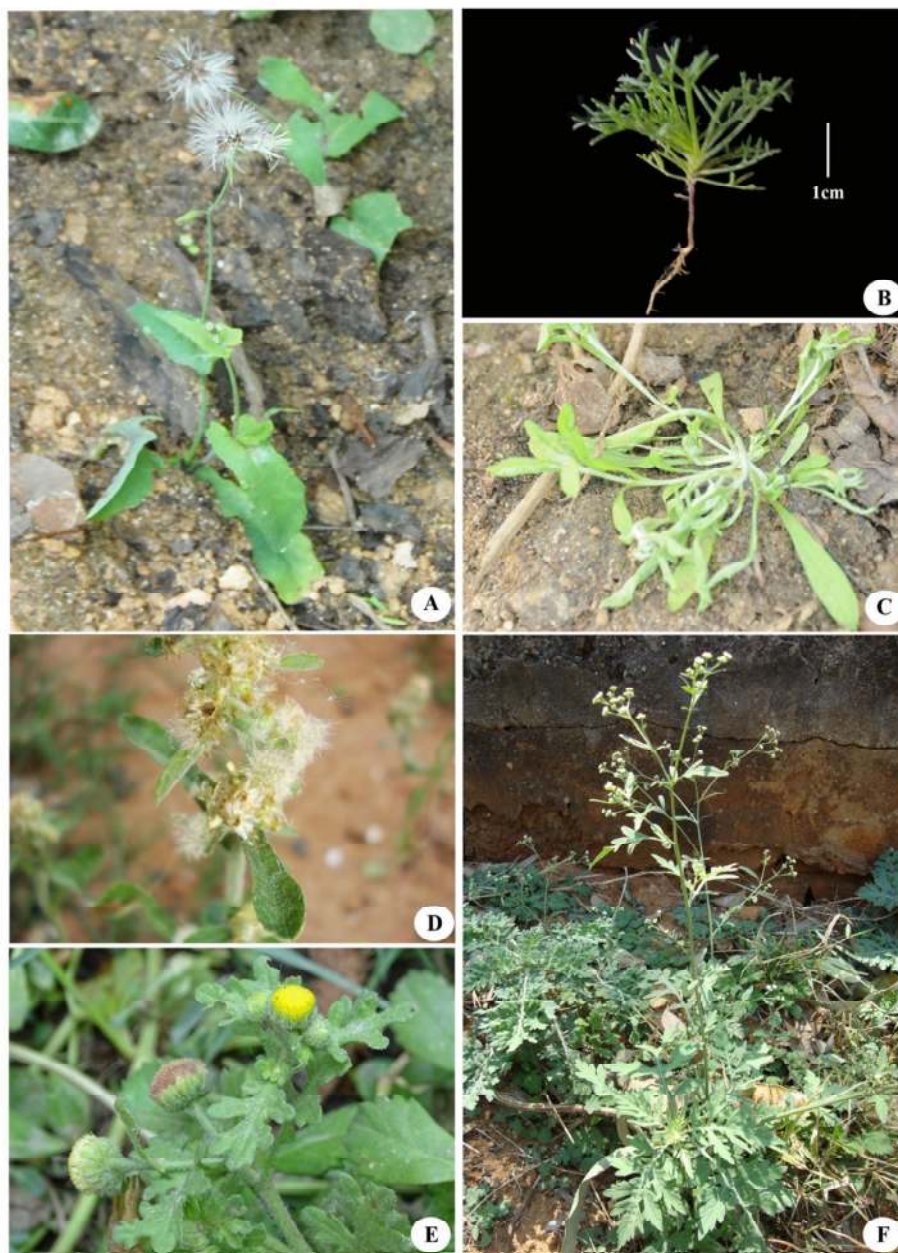


Plate 63. A. *Emilia sonchifolia* (L.) DC.; B. *Glossocardia bosvallia* (L.f.) DC.; C. *Gnaphalium polycaulon* Pers.; D. *Gamochaeta purpurea* (L.) Cabrera; E. *Grangea maderaspatana* (L.) Poir.; F. *Parthenium hysterophorus* L.



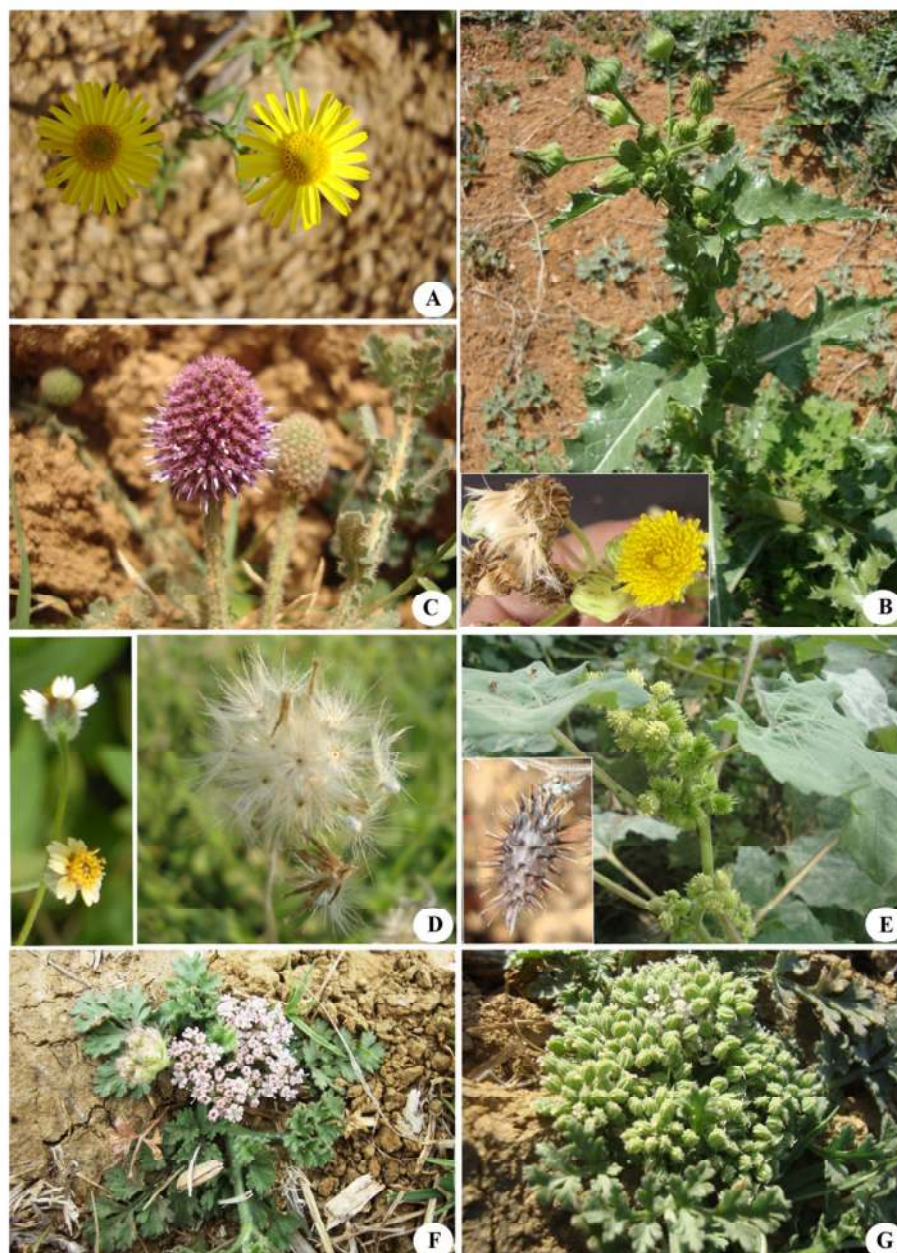


Plate 64. A. *Vicoa indica* (L.) DC.; B. *Sonchus asper* (L.) Hill; inset: flowering-twig; C. *Sphaeranthus indicus* L.; D. *Tridax procumbens* (L.) L.; inset: capitula; E. *Xanthium strumarium* L.; inset: fruit; F, G. *Trachyspermum ammi* (L.) Sprague.

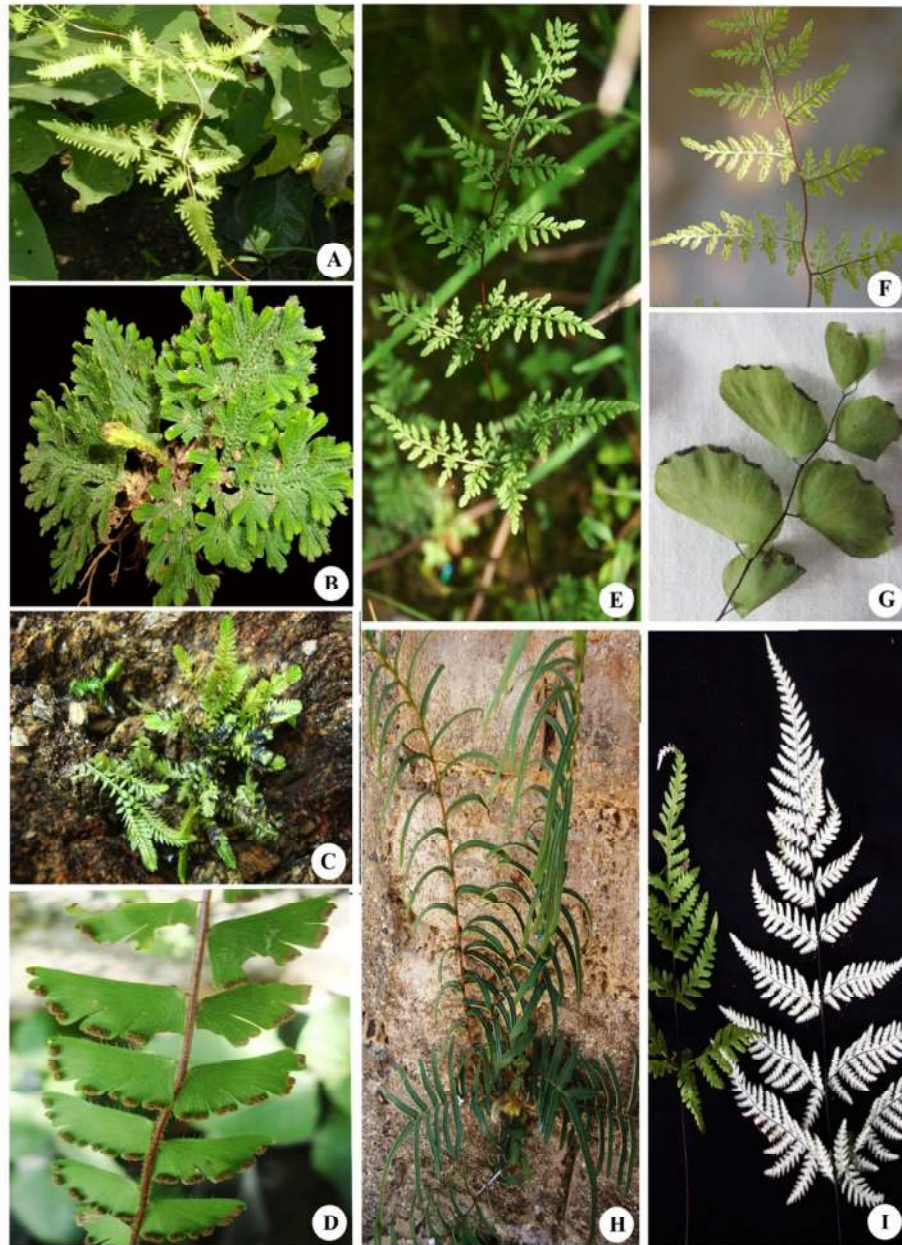


Plate 65. A. *Lygodium flexuosum* (L.) Sw.; B. *Selaginella bryopteris* (L.) Baker; C. *Selaginella vaginata* Spring; D. *Adiantum incisum* Forssk.; E, F. *Hemionitis tenuifolia* (Burm.f.) Christenh.; G. *Adiantum philippense* L.; H. *Pteris vittata* L.; I. *Hemionitis farinosa* (Forssk.) Christenh.





**Plate 66.** A. Illegal mica mining; B. Illegal mica mines; C. Felling of trees for fuel; D. Felling of trees to sell in market; E. Forest fire; F, G. Grazing in forest area.





**Plate 67.** A. Entrance gate of Koderma Wildlife Sanctuary at Taraghati; B. Watchtower at Koderma Reserve Forest; C. Forest personal along with BSI tour team at Range Forest Office; D. Dhawjadhari temple; E. Shiva temple at the top of Dhawjadhari Pahar; F. Christ Church built in 1912; G. Devotees visiting the Dhawjadhari Pahar temple during the Maha Shiva Ratari Mela; H. Mica quarry at Taraghati.



*“No field of knowledge is broader than Botany, nowhere else are the objects of study so numerous and so abundant. Nowhere so widely distributed and so diversified as in the Vegetable (Plant) Kingdom. No one has so many observations to follow as the botanist, for whom a hundred thousand observation are but few”.*

[Linnaeus (1738) “*Hortus Cliffortianus*”]

## INTRODUCTION

Plants are the primary producer and the most important component of global biodiversity which gives us oxygen to breathe and to sustain life. They provide us food, beverages, oils, spices, herbs, fibers, dyes, tannins, ornamentals, medicines, poisons, fuels and construction materials and constitute the main structure of our ecosystems and provide homes or habitats for the animals (Heywood & al., 2007). According to the “State of the World’s Plants Report” (Royal Botanic Gardens, Kew, 2023) there are approximately about 3,50,386 of vascular plants species are known to science. In India the number of angiosperms plants has been estimated which constitutes 22214 taxa and 83 gymnosperms, (Mao & al., 2024). The plants which are strictly endemic in Indian subcontinent comprises of 4381 species and infraspecific taxa of vascular plants belonging to 1007 genera and 176 families of which 4303 species and infraspecific taxa are angiosperms, 12 species of gymnosperms and 66 of pteridophytes. The two family viz., Poaceae and Orchidaceae has the largest and second largest number of endemic taxa in India (Singh & al., 2015). Taxonomy as a subject is very interesting and versatile, worthy of intense exploration, investigation and analysis of diversity of both flora and fauna from different habitats and ecosystem. It is the science of classifying plants into groups and identifying them from each other and one of the oldest disciplines in science. One of the primary functions of taxonomy is to provide information on the correct identity of plants and categorize them systematically. Taxonomy of plants and animals has, in fact inspired and guided the course of human civilization and advancement as well as various areas of biological research (Pandey & al., 2005). In order to increase our understanding of plant diversity, more collection is required (Prance 2001, 2005; Prather & al., 2004). Taxonomy is the mother of all branches of biology such as Agriculture, Anatomy, Biotechnology, Cytology, Ecology, Embryology, Forestry, Genetics, Horticulture, Palynology, Pharmacology, Phylogeny, or Physiology which provides the first basic necessary requirement, the correct identity of the organism to work with by the researcher (Balakrishnan, 2005). For so many years, taxonomy has been reduced to the level of an ‘esoteric art’ and the taxonomists were considered nothing more than just mere plant identifiers. However, the modern concept of taxonomy is based on synthetic sciences and the taxonomists have become a synthesizer who amalgamates all the relevant information from the fields of biological research revealing the ‘unity among diversity and diversity among unity’ in the biological world (Manilal, 1984). The multidimensional approach classification of living organism has helped to function as an effective mechanism for the storage of available information on the taxon for quick retrieval of data. The phylogeny study has revolutionized the process of investigation in character evolution, patterns and processes of diversification, historical biogeography, speciation, etc (Pandey & al., 2005). The plant kingdom have been classified since long in different classification systems (artificial, natural and phylogenetic) which are followed and practised throughout the world according to their needs and conveniences. The systematics and taxonomy approach of study has evolved in recent years with respect to theories, methodologies and strategies for more unified system and benefits to the end users at the global and regional levels. In order to establish a

consensus view of the classification of flowering plants an international group of flowering plant systematists was formed as Angiosperm Phylogeny Group (APG) to proposed a classification based on phylogenetic data sets in 1998. APG system is based on the phylogenetic principle of arranging taxa on the basis of established monophyly which relied on the synthesis of information from different disciplines like morphology, anatomy, embryology, phytochemistry and more strongly on molecular studies with reference to DNA sequences of two chloroplast genes (cpDNA; *atpB* and *rbcL*) and one gene coding for ribosomes (nuclear ribosomal 18s DNA) (Chase & al., 1993). As more datas were became available further versions APG II APG III and APG IV were published in 2003, 2009 and 2016 respectively. (APG I,1998; APG II, 2003; APG III, 2009 & APG IV, 2016). The taxonomic study not only help in proper categorizing of each species in correct order using their genetic resources but also caters the needs of required informations for meaningful conservation and sustainable use of biological diversity in different fields like conservation biology and bioprospecting for the benefits of human kind. Many important species were loss due to the habitat destruction and its fragile ecosysstem leading to genetic erosion of crop plant, medicinal, ornamental and other valuable plants. However the major scientific and technical advances in molecular biology and bioinformatics in recent years help to managed and organized the biological informations and data which have made taxonomy a useful tool for conservation of biodiversity (Pandey & al., 2005).

Floristic studies are taxonomic studies of a flora of a small or large region. They may range in extent from a compiled checklist of vascular plants of a small politically bounded area to a thorough taxonomic or bio-systematic analysis of the components of vascular flora of a continent. The variability of living organisms or the diversity of all living things depends on various biotic and abiotic factors such as rainfall, temperature, humidity, altitude, soil, geography and the presence of other species. For this reason, biodiversity is not evenly distributed and varies greatly across the world. The degree of diversity is more in the tropics which are abode for more than two thirds of earth's biological wealth than in the temperate regions. There are 17 mega-diversity countries found in the tropical regions of the world and India is one of them and ranked 10th among the plant rich countries of the world. The biologically rich regions in the world are recognized as biodiversity hotspots and there are 34 biodiversity hotspots in the world that cover 2.3% of the earth's land surface (Mittermeier & al., 2005). India harbours about 715,342 km<sup>2</sup> forest over which constitutes 21.76% of the total geographical cover (FSI, 2023) which consists of four biodiversity hotspots viz., Eastern Himalaya, Western Ghats, Indo-Burma and Sundaland which possessed a high level of endemism of plants. Over 50% of the world's plant species and 42% of all terrestrial vertebrate species are endemic to these hotspots regions, however, they are facing diverse threats and already had lost a good percentage of natural vegetation and the current rate of loss of forest cover is estimated around 2% annually (100,000 km<sup>2</sup> destroyed, another 100,000 km<sup>2</sup> degraded). An estimated of 34,000 plant species are threatened with extinction (Walter & Gillett, 1998) due to a considerable threat from a variety of anthropogenic related activities. It is estimated that the tropical forests will be reduced to 10–25% of their original extent by late 21st century (<http://conservationbiology404.blogspot.in/>). Sensing the seriousness of the threats of further losing of flora and fauna and its natural habitats the Convention on Biological Diversity (CBD, 1995) made all the Parties mandatory on their part to conserve the areas with rich biological diversity and prioritized in-situ conservation with special measures which includes the protected areas. There are about 1,30,000 protected areas, covering nearly 13% of the world's terrestrial surface, and over 6% of territorial marine areas (<http://www.cbd.int/protected/overview/>). In India, there are 1135 Protected areas, including 106



National Parks, 574 Wildlife Sanctuaries in which Koderma Wildlife Sanctuary is one of them, 145 Conservation Reserves and 310 Community Reserves covering a total area of **1,87,162.91** km<sup>2</sup> of geographical area constituting approximately 5.69 % ([http://www.wiienviis.nic.in/Database/Protected Area](http://www.wiienviis.nic.in/Database/Protected%20Area), 2025). Besides these, there are 18 Biosphere Reserves, 33 Elephant Reserves and 57 Tiger Reserves 7 Natural World Heritage sites and 89 Ramsar Wetland sites in India (<http://www.wii.gov.in> & <http://www.wiienviis.nic.in> 2025). The scientific research in the Wildlife Protected area is important for the better understanding of their ecosystems, functions, ecology and the status of the species diversity and their habitats. The information generated through scientific works in these areas will be useful in understanding the ecological processes for taking appropriate actions in conservation and management of both flora and fauna and their natural habitats. In this regard, the Botanical Survey of India (BSI) has given an adequate importance to the documentation of protected areas both in 11<sup>th</sup> plan and 12<sup>th</sup> plan and has been engaged in the studies of the vegetation/flora of many National Parks and Wildlife Sanctuaries in our country. The present study deals with the analysis of floristic diversity in **Koderma Wildlife Sanctuary** in the state of Jharkhand.

### **Jharkhand**

Jharkhand was formed on 20 November 2000 after the reorganization of the State of Bihar with two distinct regions the Chotanagpur and the Santal Parganas and lies between 22°00' and 24°37' N and 83°15' and 87°01' E with undulating tracts, hills and ridges ranging from 300 to 900 m, many rivers, valleys and basins and covers a total area of about 79,716 km<sup>2</sup> with a huge forest area of about 23,765 km<sup>2</sup> constituting 29.81% of the state total geography (FSI, 2023). Physiographically, the entire state is a plateau with the main rivers such as Damodar, Mayurakshi, Barakar, Koyal, Sankh, Son, Auranga, More, Karo, Bansloi, South Koel, Kharkai, Subamarekha, Ganga, Gumani and Batane flowing in the state. It is typically a tropical climate with hot wet summers and temperatures soar up to 42°C and mild winters and receive an annual rainfall of 1326 mm (Bhatt & Bhargava, 2005). Chotanagpur is one of the richest in minerals resources and the most industrialised regions of the country today. The region accounts for 35.5% of the country's known coal reserves, 90% of its cooking coal deposits, 40% of its copper, 22% of its iron ore, 90% of its mica and huge deposits of bauxite, quartz and ceramics. It is home to the largest steel plant in Bokaro, apart from Jamshedpur being practically the city of TISCO and TELCO (Bhatt & Bhargava, 2005). According to 2001 census 30 % of the total population are indigenous Adivasis with the Santhals as the largest community along with other important tribes such as Munda, Ho, Kharia and Oraon. Most of the tribal community inhabit in the mineral rich Chotanagpur plateau. They were nature worshippers before converting to more institutionalised religions like Christianity and Hinduism and today 17% of the tribal population practices Christianity. The tribal community rationalise the forces of nature by endowing objects of nature with supernatural qualities and worship them as manifestations of the Supreme Being (Bhatt & Bhargava, 2005). There are 11 Wildlife Sanctuaries including Koderma Wildlife Sanctuary, 1 National Park (about 2,182.15 km<sup>2</sup>) with Palamau as the only Tiger Reserve in the state covering an area of 1,026 km<sup>2</sup> (FSI, 2011) and 1 Elephant Reserve viz., East-Central Landscape (South-West Bengal-Jharkhand-Odisha) that covers an area of 4530 km<sup>2</sup>.

**Koderma Wildlife Sanctuary:** The Koderma Wildlife Sanctuary was notified as a Wildlife Sanctuary in the year 1981 (**Map 1 & 2**) and lies between 24°25' and 24°38' N Latitudes & 85°25' and 85°40' E Longitudes and spread over an area of 150.62 sq km., which falls in the bio-

geographical region of Deccan Peninsula in Chotanagpur Plateau Province. This Wildlife Sanctuary lies in the district of Koderma which was carved out from Hazaribagh region in 1994 that lies in the Chhotanagpur Plateau (**Map 2 & 3**). The northern part of the district is occupied by Koderma Reserve Forest. The drainage system in Koderma WLS is dependent upon rainfall. The main rivers tributaries in the Koderma wildlife sanctuary are Phutlaiya Nala, Dhanarjay Nadi and Dipluswa Nala, Khalaktambi Nala and Taraghati Nala remains dry during the dry period and there are lakes like Rheo Ghoghar dam and also the water reservoirs/check dams made by the forest department (**Plate 1**). The highest peak Debour Ghati with an elevation of 677 metre is found in Koderma district passing through Hazaribagh plateau boundary to both Jharkhand & Bihar (**Plate 2**). The annual average rainfall is 1125.1 mm with the mean temperature ranging from 10°C in winter to 40°C in summer. The soil in Koderma district are mainly four types depending upon physiography and lithology of the area with Yellow, Pale yellow and Pinkish catenary in high micaceous schist, Reddish yellow, Deep yellow and Greyish catenary soil, Hill and forest soil of steep slopes and high-dissected regions and Red yellow and light grey catenary soil (Narayan, 2013).

**VEGETATION:** Two major types of forests are found in the state of Jharkhand viz., Northern Tropical Dry Deciduous Forest (NTDDeF) or Dry Peninsular Sal Forest (DPSF) (**Plate 3E**) and Northern Dry Mixed Deciduous Forest (NDMDeF) (**Plate 3F**) (Champion & Seth, 1968). The Dry Peninsular Sal Forest (DPSF) is predominant with *Shorea robusta* (Sal) the state tree which is found both in the plains and in hilly tracts along with other tree species such as *Albizia procera*, *Bombax ceiba*, *Buchanania cochinchinensis*, *Butea monosperma* (state flower), *Cassia fistula*, *Diospyros melanoxylon*, *Lannea coromandelica*, *Madhuca longifolia* var. *latifolia*, *Semecarpus anacardium*, *Terminalia alata*, *Ziziphus mauritiana* etc. However, the dominant tree species in NDMDeF are *Aegle marmelos*, *Artocarpus lakoocha*, *Catunaregam spinosa*, *Oroxylum indicum*, *Shorea robusta*, *Syzygium cumini*, *Terminalia bellirica*, *Wendlandia tinctoria*, *Woodfordia fruticosa* etc. The common shrubs species in the forest are viz., *Indigofera cassioides*, *Clerodendrum infortunatum*, *Croton persimilis*, *Desmodium pulchellum*, *Flacourtia indica* ((NTDDeF)), *Catunaregam spinosa*, *Desmodium oojeinense*, *Flemingia chappar*, *Garuga pinnata*, *Haldina cordifolia* (NDMDeF). The ground vegetation includes *Cyperus difformis*, *Eragrostis tenella*, *Fimbristylis dichotoma*, *Hyptis suaveolens*, *Oplismenus burmannii*, *Pentanema indicum* and *Thespesia lampas* (NTDDeF), *Chrozophora rottleri*, *Commelina benghalensis*, *Curculigo orchioides*, *Nelsonia canescens*, *Phyllanthus airy-shawii*, *P. virgatus*, *P. urinaria* and *Cyathocline purpurea* (NDMDeF). The common stragglers, climbers and lianas found are *Combretum album*, *Cryptolepis dubia*, *Dioscorea bulbifera*, *Poranopsis paniculata*, *Smilax zeylanica*, *Ziziphus oenopolia* (NTDDeF), *Bauhinia vahlii* and *Millettia extensa* (NDMDeF).

**FAUNAL DIVERSITY:** The Sanctuary supports a variety of fauna. The Department of Forests and Environment, Jharkhand State documented the important mammals found in the Sanctuary they are the sloth bear, hyena, hare, neel-gai, sambhar, spotted deer, barking deer, hanuman langurs, rhesus monkeys, fox, jackal, mongooses, wild boars and bats; the important reptiles are Indian cobra, harhara or whip snake, rat snake. The Department of Forests and Environment, Jharkhand state also documented the avifauna of the Wildlife Sanctuary, which includes around 50 different bird species, some of the commonly found birds are Asian koel, blossom (plum-) headed parakeet, bulbul, cattle egret, cuckoo, drongo, eagle, hoopoe, house sparrow, Indian pond heron, myna, jungle crow, koel, owl, kingfisher, pigeon, quail, rose-ringed parakeet, wagtail,



woodpeckers, yellow-throated sparrow. The Sanctuary also supports many amphibians, insects and arachnids (**Plate 4 & 5**).

## PAST BOTANICAL WORK

The field study and collections of specimens of the flora of an area are the fundamental components of floristic study in which taxonomy as a subject plays an important role. Taxonomic studies are usually compiled in the form of floras that brings together and evaluate the nomenclature, distribution, ecology and utility of various species naturally occurring in a country or region (Heywood, 1984).

The history of Botany of Bihar and Jharkhand is more than a century old. A perusal of the literature reveals that Hooker (1848) was the first botanist who made sporadic collections in the Parasnath hills (the highest mountain in the province), Manbhum, Hazaribagh, Gaya, along the river Sone and Kymore Hills (Shahabad district). These collections helped in compilation of the flora of India with the first outcome published as *Flora Indica* (1885) which was later elaborated and revised as *The Flora of British India* (1872–1897) published in seven volumes. Anderson (1863) published an account on the flora of Bihar based on the collections of Hooker, Edgeworth and Thomson and also of his own. His catalogue includes 738 species, belonging to 473 genera under 110 Natural Orders. These were distributed into 3 classes as Dicotyledons (359 genera and 560 species) Monocotyledons (96 genera and 157 species) and Cryptogamae (18 genera and 21 species). The Natural Orders (family) with maximum number of genera and species in ascending order were Leguminosae, Poaceae, Asteraceae, Rubiaceae, Scrophulariaceae, Lamiaceae, Acanthaceae, Euphorbiaceae, Cyperaceae, Convolvulaceae, Malvaceae, Lythraceae, Urticaceae, Orchidaceae and Tiliaceae. Ball (1866, 1867a, and 1867b) made a study of the flora of Manbhum and Hazaribagh with particular reference to the food plants of the native peoples. Buchanan-Hamilton (1928) studied the vegetation of the districts of Bihar. Campbell (1866) had collected plants for over 30 years in Chotanagpur and is known for his noteworthy work “The Descriptive Catalogue of Economic products of Chutianagpur”. Wood (1906) did extensive work in Chotanagur plateau and published a book entitled “A forest flora of Chotanagpur” which also included Jaspur and Sarguja, now in Madhya Pradesh. But the most noteworthy and comprehensive study was done by Haines (1910) in Chotnagpur Plateau and published a book entitled, “A forest flora of Chotanagpur”. Haines (1921–25) added his own collections and findings and the earlier collections and brought out a comprehensive account of the plant wealth under the title “The Botany of Bihar & Orissa” in which 21 species have been recorded from the Koderma Forest. The species are *Croton oblongifolius* Roxb., *Walsura pisidia* Roxb., *Crotolaria mysorensis* Roth., *Rhynchosia minima* DC., *Rhynchosia rufescens* DC., *Phaseolus calcaratus* Roxb., *Caesalpinia coriaria* Willd., *Peucedanum nagpurens* Prain var *nagpuransis* Clarke, *Cordia* sp., *Rivea hypocyrtiformis* Chois., *Petalidium barlerioides* Nees, *Rhinacanthus communis* Nees, *Colebrookia oppositifolia* Sm., *Pennisetum pedicellatum* Trin, *Saccharum munja* Roxb., *Chrysopogon lancearius* (Hook. f.) Haines, *Cymbopogon gidarba* (Buch.-Ham. ex Steud.) A. Camus, *Rottboellia exaltata* L.f., *Dioscoria daemona* Roxb., *Dioscoria pentaphylla* L. and one Pteridophyte *Selaginella flaccida* Spring. Howard & al., (1922) studied the wheat of Bihar and Orissa. The medicinal plants and connected folk-lore of the Santhals were studied by Boddington (1927). Biswas (1934, 1935) gave an account of the vegetation of the vicinity of the Ranigunge and Jharia coal fields and Tindi in Hazaribagh district. Biswas & Sampathkumaran (1949) studied the flora of the Parasnath Hills. Haines work was further supplemented by

Mooney and Sanyal. Mooney (1937a, b, 1941, 1944, 1947 and 1950) collected extensively and added a number of species to the flora of Bihar and Orissa of Haines which culminated in his supplement. Mooney also referred to the plants earlier collected by P.K. Parija, D.B. Mukherjee, P. Misra, H. Patanaik, C.M. Basha and others in Orissa now housed at the Ravenshaw College, Cuttack. Mooney's most of the collections were made from Khalahandi, Jashpur-Surguja Pats, Bonai, Keonjhar and Lahara Hills. Mukherjee (1947 and 1956) studied the flora of Chotanagpur and the Parasnath hills and recorded some additions to the flora of Parasnath. Bressers (1951) published the botany of Ranchi district. Ara (1954, 1960 & 1966) made a study of the orchids of Chotanagpur and also the flora and fauna of the Hazaribagh National Park, the work was on ecological aspect. Srivastava (1954a,b, 1955a,b, 1956a,b, 1958 a,-g, 1959, 1961, 1964) made very comprehensive study of the vegetation of the districts in Bihar and also recently introduced aliens. Sanyal (1957) presented additional notes to the flora of Botany of Bihar and Orissa by Haines and the Supplement by Mooney. Sinha (1957) studied the plant wealth of Mithila in the Darbhanga district. Bharadwaja (1958) studied the grasses of Parasnath. Panigrahi (1966) studied the flora of Rajmahal Hills in Bihar (now Jharkhand). In his study 9 species and 1 genus appeared to be new records to the flora of Bihar. Thothathri & al., (1966) recorded *Arnebia hispidissima* DC. in Udaipur forest in Champaran district as a new record for Bihar. Kanodia & Malick (1966) collected *Begonia concanensis* A. .DC., *Anotis foetida* Benth. et Hook. f., *Physalis longifolis* Nutt., *Vanda caerulea* Griff. ex Lindl., *Ischaemum timorens* Kunth. and *Setaria pallide-fusca* Stapf & Hubb. from Ranchi and Hazaribagh district in South Bihar and reported these species for the first time from Bihar state. In addition a critical notes on *Pennisetum hordeoides* Steud. and *Chrysopogon serrulatus* Trin. have also been done by them. Paul (1966, 1967) studied on the weeds and the grasses of the rice field of the Bhagalpur district, Bihar. Banerjee & Banerjee (1967, 1968, 1969a, 1969b) gave an account of the flora of Udaipur forest of Champaran district in North Bihar and reported *Solanum khasianum* C.B. Clarke var *chatterjeenum* Sengupta and *Aspidopterys nutans* (Roxb.) Juss. from the area. Shah (1968) reported the flowering of bamboos viz., *Dendrocalamus hookeri* and *Dendrocalamus strictus* in Bihar state. Mishra (1969, 1970, 1971) and his associates worked on the flora of Darbhanga in Mithita, Bihar (vide Krishna 1977). Azam & al., (1969) did cytotaxonomical studies in grasses of Bihar. Mishra (1969, 1970 & 1971) studied the plants of Darbhanga. The revival of Boddington's work of medicinal plant-lore of the Santhal was provided by Jain & Tarafdar (1970). Meher-Homji (1971) studied the geography, climate and vegetation of Chotanagpur (covering extreme North-eastern part of Madhya Pradesh and South Bihar), in this work stress was laid on the forest flora and ecological peculiarities. Majumdar & Biswas (1971) described the vegetation of Chaibasa, Singhbhum district in North Bihar. Misra & Jha (1972), studied the floristic in Darbhanga. Maheshwari & Pandey (1973) studied the weed *Parthenium* sp. in Bihar state. Saxena (1974, 1976) added some plants to the flora of Orissa and provided some notes on the flora of Bihar & Orissa. The study of grasses by Jain & al., (1975) also included those from Bihar and Orissa. Krishna (1977) reviewed the floristic studies in Bihar & Orissa respectively and suggested measures to be considered in future. Krishna explored the districts of Palamau, Ranchi and Singhbhum in the late 1970s. Paul (1973, 1976, 1978, 1984 1990) and Paul & Prasad (1978) reported new records from Netarhat, Bihar. Biswas & Maheshwari (1978) studied the vegetation of Chaibasa and Singhbhum district of South Bihar. Varma (1981) studied the dicotyledons of the Bhagalpur district and brought out a comprehensive book the 'Flora of Bhagalpur- Dicotyledones' which describes 679 species belonging 440 genera under 110 families including, and it was found that Papilionaceae was the dominant family with 64 species followed by Compositae. Uniyal & Datta (1984) added some



grasses to the flora of Bihar and Orissa. The comprehensive dicotyledons flora of Patna was brought out by Singh (1986) in which he describes 674 species belonging 434 genera under 110 families including both wild and cultivated, and it was found that Fabaceae was the dominant family with 76 species. Bhattacharyya & Sarkar explored the Flora of West Champaran district, Bihar which describes 804 species belonging 488 genera under 119 families of dicot and 236 species belonging 144 genera under 27 families of monocot, and it was found that Poaceae was the dominant family followed by Leguminosae. Paria & Chattopadhyaya (2000, 2005) studied the *Flora of the Hazaribagh District, Bihar* (now Jharkhand) describes 972 species of Angiosperms belonging to 615 genera and 142 families of which 745 species of 478 genera of 114 families belonging to dicot and 227 species and 137 genera of 28 families belonging to Monocot, Leguminosae being dominant family. At that time the area of Koderma was also included in the Hazaribagh district. In this work, 118 species were mentioned from the Koderma. Singh & al., (2001) enumerated the species of Bihar and Jharkhand in the 'Flora of Bihar Analysis' and enumerated 2963 species belonging to 1151 genera and 186 families out of which 2106 species of 875 genera of 148 families belonging to dicot and 857 species and 276 genera of 38 families belonging to Monocot, Poaceae being dominant family followed by Fabaceae, in this work, 122 species have been recorded from Koderma. And two rare plants *Eulaliopsis binata* (Retz.) C.E. Hubb. (Poaceae) and *Viola macroceros* Bunge (Violaceae) have been reported to occur in Koderma. Sharma & Sarkar (2002), did comprehensive work on Palamu and brought out the 'Flora of Palamau District', Jharkhand and described 824 species of angiosperms belonging to 530 genera and 136 families of which 654 species of 427 genera of 110 families belonging to dicot and 170 species and 103 genera of 26 families belonging to Monocot, Poaceae being dominant family followed by Fabaceae. Ranjan (2014) explored the Parasnath area in Giridih district and has published the flora of the Parasnath Wildlife sanctuary which describes 586 taxa belonging to angiosperm under 367 genera and 102 families and reported Poaceae and Fabaceae as the dominant family. Verma and Pandey (2008) studied the floristic compositions of aquatic and semi-aquatic angiosperms of Ratu Maharaja Pond in Ranchi and recorded 32 aquatic and semi aquatic species under 22 families and 26 genera of which 16 species under 12 genera in 12 dicot families and 16 species under 14 genera in 10 monocot families respectively. Rahul and Jain (2014) documented the floristic compositions along the national highway of Dhanbad district and recorded 138 taxa belonging to angiosperm under 120 genera and 50 families and reported Fabaceae as the most dominant family along with other sub-families such as Malvaceae, Asteraceae, Amaranthaceae, Apocynaceae, Euphorbiaceae, Solanaceae and Verbenaceae. Siddique and Kumari (2016) surveyed and documented the tree species and its uses in Bokara district and recorded 49 species under 40 genera and 22 families.

## **PRESENT BOTANICAL WORK**

The floristic work in the past comprised of mostly in the state of Bihar of which the present Jharkhand state was a part of and the present work is an exclusive for the latter. Though the past literature revealed several works related to floristic documentation and analysis of the vegetations of different forest system in different parts of the Jharkhand state a comprehensive and systematic study in general and particularly in Koderma district and its Wildlife sanctuary is lacking and wanting. Koderma wildlife sanctuary is bordered to Gaya district of Bihar and comprises of hilly range of dry deciduous forest traversed by plenty of rivulets and harbours many important flora and fauna and very rich in mica deposits. Due to illegal mining of mica the forest vegetations and

the natural habitats of both flora and fauna had been disturbed and cause destructions to a large extent.

Therefore, the present study is an effort to investigate and analyse the total floristic composition of the Koderma Wildlife Sanctuary with the main objective of Taxonomic Study of Koderma Wildlife Sanctuary.

## MATERIALS AND METHODS

An extensive survey of literature was done related to the flora of Koderma and Chotanagpur from the published papers and floras prior to the explorations of KWLS. The plants which were exclusively collected from Koderma and their herbarium deposited in CAL by Haines were studied and indexed. Intensive botanical tour was made periodically with the duration of 15 to 20 days to Koderma Wildlife Sanctuary for consecutive five years i.e. 2010–2015. The plant specimens for every species were collected in three to four duplicates with flowers and fruits with an assigned field numbers tagged for each plant during the botanical explorations. The field details such as habitat, habit and height of the plant, colour and odour of the flowers and fruits associated with the plants and its distribution were noted in the field book. Photographs of the plants were taken with flowers and fruits along with the different types of vegetation in the sanctuary. The collected specimens were processed following the standard herbarium techniques (Fosberg & Sachet, 1965; Jain & Rao, 1977; Bridson & Forman, 1998). The specimens were identified using regional floras and also compared with authentic specimens deposited at CAL. Monographs, revisions and more recent literature were referred to for critical identification and name updating. Descriptions were made based on the fresh and old herbarium specimens housed at CAL. Illustrations were prepared for selected species. A set of voucher specimens duly labelled were deposited at CAL. (Plate 2)

## PLAN OF PRESENTATION

The plant families in the present study were arranged as per the Angiosperm Phylogeny Group (APG IV, 2016) system of classification. The bracketed key is presented to the families and each family with the number of genera and species and each genus with the number of species has given in sequential order as follows: Worldwide (Mabberley, 2008 & Christenhusz & Byng, 2016, LPWG, 2017); India- Flora of India (Rajendran & Daniel 2002; Ansari & Balakrishnan 1994, Ansari, 2008; Karthikeyan, 1999, 2000, Karthikeyan & al., 1989, 2009, Barua, 2010; Chaudhary & al., 2012; Sabu, 2006; Sanjappa, 1992; Renner & Pandey 2013; Santapau & Henry, 1973; Shendage & Yadav 2010; Singh, 2001, 2005, etc.) and Jharkhand (Singh & al., 2001) and Koderma Wildlife Sanctuary is based on the present study. Arrangements of alphabetical order with the genera under a family and the species under a genus have been made in the present study. The latest accepted botanical name, followed by basionym if any and relevant synonyms with detail citations have been provided for each taxon. The names of the authors are abbreviated according to ‘Authors of Plant Names’ (Brummitt & Powell, 1992) and IPNI (<http://www.ipni.org>); journal titles as per the ‘Botanico-Periodicum-Huntianum’ (Lawrence & al., 1968), BPH Supplementum I (Bridson, 1991) & BPH Supplementum II (Bridson, 2004) and the book titles were presented with reference to ‘Taxonomic Literature ed. 2nd’ (Stafleu & Cowan, 1976 – 1988) and its supplements (Stafleu & Mennega, 1992 – 2000; Dorr & Nicolson, 2008 – 2009). The nomenclatures of the plants were updated as per the current International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code, 2018 and McNeill & al., 2012) and in reference with the latest taxonomic literature. Nomenclatural citation



is followed by local vernacular name(s), if any. The details of the specimen examined along with habit, habitat, flowering and fruiting period and its distribution were given as per the Monographs, Revisions and Flora of India, Flora of China, World and local floras of India. The exact locations of the collected plants were given with GPS readings i.e. the coordinates along with elevation of the each plant collected.

#### STATISTICAL ANALYSIS OF THE TOTAL FLORA OF KODERMA WILDLIFE SANCTUARY

During the present botanical explorations in KWLS a total number of 634 field number comprising c. 1600 specimens have been collected and deposited at CAL. The flora of the Koderma Wildlife Sanctuary comprises of 437 taxa (including 429 species, and 5 varieties and 3 subspecies) in 328 genera belonging to 100 angiospermous families as per the APG IV system of classifications with other details were presented in the following tables below (**Table 1**). Besides, 8 pteridophyte species have been recorded from the study area.

**Table 1: Total Family in Koderma Wildlife Sanctuary (APG IV, 2016)**

| Sl. No. | FAMILY           | No. of Genera | No of Species | No. of Variety & subspecies | Total No of Taxa |
|---------|------------------|---------------|---------------|-----------------------------|------------------|
| 1.      | Nymphaeaceae     | 1             | 2             | -                           | 2                |
| 2.      | Annonaceae       | 1             | 1             | -                           | 1                |
| 3.      | Lauraceae        | 1             | 1             | -                           | 1                |
| 4.      | Araceae          | 2             | 2             | -                           | 2                |
| 5.      | Alismataceae     | 1             | 1             | -                           | 1                |
| 6.      | Hydrocharitaceae | 3             | 3             | -                           | 3                |
| 7.      | Potamogetonaceae | 1             | 1             | -                           | 1                |
| 8.      | Dioscoreaceae    | 1             | 3             | -                           | 3                |
| 9.      | Colchicaceae     | 2             | 2             | -                           | 2                |
| 10.     | Smilacaceae      | 1             | 1             | -                           | 1                |
| 11.     | Orchidaceae      | 3             | 3             | -                           | 3                |
| 12.     | Hypoxidaceae     | 1             | 1             | -                           | 1                |
| 13.     | Asparagaceae     | 3             | 3             | -                           | 3                |
| 14.     | Arecaceae        | 1             | 1             | -                           | 1                |
| 15.     | Commelinaceae    | 3             | 7             | -                           | 7                |
| 16.     | Pontederiaceae   | 1             | 1             | -                           | 1                |
| 17.     | Cannaceae        | 1             | 1             | -                           | 1                |
| 18.     | Costaceae        | 1             | 1             | -                           | 1                |
| 19.     | Zingiberaceae    | 2             | 2             | -                           | 2                |
| 20.     | Eriocaulaceae    | 1             | 1             | -                           | 1                |
| 21.     | Juncaceae        | 1             | 1             | -                           | 1                |
| 22.     | Cyperaceae       | 7             | 21            | -                           | 21               |
| 23.     | Poaceae          | 24            | 33            | -                           | 33               |
| 24.     | Papaveraceae     | 1             | 2             | -                           | 2                |

|     |                         |           |           |            |           |
|-----|-------------------------|-----------|-----------|------------|-----------|
| 25. | <b>Menispermaceae</b>   | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 26. | <b>Ranunculaceae</b>    | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 27. | <b>Vitaceae</b>         | <b>2</b>  | <b>3</b>  | -          | <b>3</b>  |
| 28. | <b>Zygophyllaceae</b>   | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 29. | <b>Leguminosae</b>      | <b>41</b> | <b>57</b> | <b>1+2</b> | <b>60</b> |
| 30. | <b>Polygalaceae</b>     | <b>1</b>  | <b>3</b>  | -          | <b>3</b>  |
| 31. | <b>Rosaceae</b>         | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 32. | <b>Rhamnaceae</b>       | <b>2</b>  | <b>4</b>  | -          | <b>4</b>  |
| 33. | <b>Ulmaceae</b>         | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 34. | <b>Moraceae</b>         | <b>3</b>  | <b>10</b> | -          | <b>10</b> |
| 35. | <b>Cucurbitaceae</b>    | <b>6</b>  | <b>9</b>  | -          | <b>9</b>  |
| 36. | <b>Celastraceae</b>     | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 37. | <b>Oxalidaceae</b>      | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 38. | <b>Putranjivaceae</b>   | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 39. | <b>Elatinaceae</b>      | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 40. | <b>Violaceae</b>        | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 41. | <b>Passifloraceae</b>   | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 42. | <b>Salicaceae</b>       | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 43. | <b>Euphorbiaceae</b>    | <b>7</b>  | <b>13</b> | -          | <b>13</b> |
| 44. | <b>Phyllanthaceae</b>   | <b>3</b>  | <b>5</b>  | -          | <b>5</b>  |
| 45. | <b>Combretaceae</b>     | <b>2</b>  | <b>6</b>  | -          | <b>6</b>  |
| 46. | <b>Lythraceae</b>       | <b>5</b>  | <b>4</b>  | <b>1</b>   | <b>5</b>  |
| 47. | <b>Onagraceae</b>       | <b>1</b>  | <b>2</b>  | -          | <b>2</b>  |
| 48. | <b>Myrtaceae</b>        | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 49. | <b>Burseraceae</b>      | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 50. | <b>Anacardiaceae</b>    | <b>5</b>  | <b>5</b>  | -          | <b>5</b>  |
| 51. | <b>Sapindaceae</b>      | <b>3</b>  | <b>3</b>  | -          | <b>3</b>  |
| 52. | <b>Rutaceae</b>         | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 53. | <b>Simaroubaceae</b>    | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 54. | <b>Meliaceae</b>        | <b>4</b>  | <b>4</b>  | -          | <b>4</b>  |
| 55. | <b>Malvaceae</b>        | <b>12</b> | <b>14</b> | <b>1+1</b> | <b>16</b> |
| 56. | <b>Bixaceae</b>         | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 57. | <b>Dipterocarpaceae</b> | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 58. | <b>Moringaceae</b>      | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 59. | <b>Capparaceae</b>      | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 60. | <b>Cleomaceae</b>       | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 61. | <b>Brassicaceae</b>     | <b>2</b>  | <b>2</b>  | -          | <b>2</b>  |
| 62. | <b>Olacaceae</b>        | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 63. | <b>Santalaceae</b>      | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 64. | <b>Loranthaceae</b>     | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 65. | <b>Tamaricaceae</b>     | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 66. | <b>Polygonaceae</b>     | <b>3</b>  | <b>3</b>  | -          | <b>3</b>  |
| 67. | <b>Droseraceae</b>      | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |
| 68. | <b>Caryophyllaceae</b>  | <b>1</b>  | <b>1</b>  | -          | <b>1</b>  |



|      |                         |            |            |            |            |
|------|-------------------------|------------|------------|------------|------------|
| 69.  | <b>Amaranthaceae</b>    | <b>10</b>  | <b>14</b>  | -          | <b>14</b>  |
| 70.  | <b>Nyctaginaceae</b>    | <b>2</b>   | <b>2</b>   | -          | <b>2</b>   |
| 71.  | <b>Molluginaceae</b>    | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 72.  | <b>Basellaceae</b>      | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 73.  | <b>Portulacaceae</b>    | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 74.  | <b>Balsaminaceae</b>    | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 75.  | <b>Sapotaceae</b>       | <b>1</b>   | -          | <b>1</b>   | <b>1</b>   |
| 76.  | <b>Ebenaceae</b>        | <b>1</b>   | -          | <b>1</b>   | <b>1</b>   |
| 77.  | <b>Primulaceae</b>      | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 78.  | <b>Rubiaceae</b>        | <b>16</b>  | <b>17</b>  | -          | <b>17</b>  |
| 79.  | <b>Gentianaceae</b>     | <b>2</b>   | <b>3</b>   | -          | <b>3</b>   |
| 80.  | <b>Loganiaceae</b>      | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 81.  | <b>Apocynaceae</b>      | <b>15</b>  | <b>17</b>  | -          | <b>17</b>  |
| 82.  | <b>Boraginaceae</b>     | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 83.  | <b>Convolvulaceae</b>   | <b>6</b>   | <b>11</b>  | -          | <b>11</b>  |
| 84.  | <b>Solanaceae</b>       | <b>3</b>   | <b>5</b>   | -          | <b>5</b>   |
| 85.  | <b>Oleaceae</b>         | <b>3</b>   | <b>3</b>   | -          | <b>3</b>   |
| 86.  | <b>Plantaginaceae</b>   | <b>4</b>   | <b>4</b>   | -          | <b>4</b>   |
| 87.  | <b>Scrophulariaceae</b> | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 88.  | <b>Linderniaceae</b>    | <b>3</b>   | <b>3</b>   | -          | <b>3</b>   |
| 89.  | <b>Martyniaceae</b>     | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 90.  | <b>Pedaliaceae</b>      | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 91.  | <b>Acanthaceae</b>      | <b>12</b>  | <b>15</b>  | -          | <b>15</b>  |
| 92.  | <b>Bignoniaceae</b>     | <b>4</b>   | <b>4</b>   | -          | <b>4</b>   |
| 93.  | <b>Verbenaceae</b>      | <b>2</b>   | <b>2</b>   | -          | <b>2</b>   |
| 94.  | <b>Lamiaceae</b>        | <b>11</b>  | <b>12</b>  | -          | <b>12</b>  |
| 95.  | <b>Mazaceae</b>         | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 96.  | <b>Orobanchaceae</b>    | <b>1</b>   | <b>1</b>   | -          | <b>1</b>   |
| 97.  | <b>Campanulaceae</b>    | <b>2</b>   | <b>2</b>   | -          | <b>2</b>   |
| 98.  | <b>Menyanthaceae</b>    | <b>1</b>   | <b>2</b>   | -          | <b>2</b>   |
| 99.  | <b>Asteraceae</b>       | <b>24</b>  | <b>24</b>  | -          | <b>24</b>  |
| 100. | <b>Apiaceae</b>         | <b>2</b>   | <b>2</b>   | -          | <b>2</b>   |
|      | <b>Total</b>            | <b>328</b> | <b>429</b> | <b>5+3</b> | <b>437</b> |

## DISCUSSION

The taxonomic study of the flora of Koderma Wildlife Sanctuary (KWLS) reveals 437 taxa including 5 varieties and 3 subspecies of angiosperms under 328 genera belonging to 100 families and collected a total number of a total number of comprising c. 1600 specimens and 634 field number have been deposited at CAL for future reference. Apart from the plant species, five varieties were recorded in the present study viz., *Crotalaria prostrata* var. *levis* Haines, *Malva parviflora* L. var. *microcarpa* (Pers.) Loscos, *Madhuca longifolia* (L.) J.F. Macbr. var. *latifolia* (Roxb.) A. Chev., *Trapa natans* L. var. *bispinosa* (Roxb.) Makino., *Diospyros melanoxylon* Roxb., var. *melanoxylon* V. Singh and three subspecies viz. *Mimosa rubicaulis* subsp. *himalayana* (Gamble) H.Ohashi, *Vachellia nilotica* subsp. *indica* (Benth.) Kyal. & Boatwr. and

*Urena lobata* subsp. *sinuata* (L.) Borss.Waalk. Besides the angiosperms, 8 pteridophytes were recorded from the forest of KWLS, viz., *Lygodium flexuosum* (L.) Sw., *Selaginella bryopteris* (L.) Baker., *Selaginella vaginata* Spring., *Adiantum incisum* Forssk., *Adiantum phillense* L., *Hemionitis tenuifolia* (Burm.f.) Christenh., *Hemionitis farinosa* (Forssk.) Christenh., and *Pteris vittata* L. The present investigation recorded Leguminosae Juss. one of the most dominant angiosperm families comprising 41 genera, 57 species, 2 subspecies and 1 variety. The circumscription of the four subfamilies namely, Cercidoideae, Detarioideae, Caesalpinioideae and Papilionoideae have been presented as per the latest taxonomic literature. The Papilionoideae recorded highest with 26 genera, 34 species and 1 varieties; Cercidoideae, 3 genera, 5 species and Detarioideae, 1 genera, 1 species and Caesalpinioideae, 11 genera, 16 species, 2 subspecies.

The other 11 dominant families with more than 10 taxa are Leguminosae (41 genera and 60 taxa); Poaceae (24 genera and 33 spp.); Asteraceae (24 genera and 24 spp.); Cyperaceae (7 genera, 21 spp.); Rubiaceae (16 genera and 17 spp.); Apocynaceae (15 genera and 17 spp.); Malvaceae (11 genera and 16 taxa); Acanthaceae (12 genera and 15 spp.); Amaranthaceae (10 genera and 14 spp.); Euphorbiaceae (7 genera, 13 spp.); Lamiaceae (11 genera and 12 spp.); Convolvulaceae (6 genera, 11 spp.) and Moraceae (3 genera, 10 spp.) (**Diagram 1**). The genera *Cyperus* and *Ficus* are the genus which has the maximum of 10 and 7 species each respectively. A comparative study of the floras of the past and the present shows a similar trend to a large extent with respect to the most dominant families and floristic diversity. The two families viz., Poaceae and Leguminosae was recorded as the most dominant families in the early taxonomic studies in ‘Forest Flora of Chotanagpur’ (Haines, 1910) and ‘The Botany of Bihar & Orissa’ (Haines, 1921–1925). Similarly, the recent past works in ‘Flora of Bihar Analysis’ (Singh & al., 2001), ‘Flora of Hazaribagh, Bihar’ (Paria & Chattopadhyaya, 2000–2005) and ‘Flora of India’ (Karthikeyan, 2000) which reported Leguminosae as the most dominant family followed by Poaceae reflects a similar result with the present study in KWLS. Apart from the two most common dominant families (Leguminosae and Poaceae) the other families such as Asteraceae, Cyperaceae, Rubiaceae, Acanthaceae, Amaranthaceae and Euphorbiaceae exhibits a similar status of dominance though differ in ranking from one to the other (**Table 2**). An analysis on the composition of the flora habit reveals with a maximum of 231 herbaceous taxa which constitute 54% of flora including 33 taxa of grasses (8%), 21 taxa of sedges (5%) and 1 taxon of rush (0.2%)], 96 tree taxa (21%), 58 taxa of climbers (13%), 45 taxa of shrubs (10%) and a minimum of 7 taxa of undershrubs (2%) (**Diagram 2**). Haines (1921–1925) in ‘Botany of Bihar & Orissa’ mentioned 21 species recorded from the Koderma forest, however, majority of the stated species (16 angiosperms and one pteridophyte) was unfounded and couldn’t be collected from the KWLS forest in the present investigations which includes the following species viz., *Walsura pisdia* Roxb., *Crotolaria mysorensis* Roth., *Rhynchosia minima* DC., *Rhynchosia rufescens* DC., *Phaseolus calcaratus* Roxb., *Caesalpinia coriaria* Willd., *Peucedanum nagpurens* Prain var *nagpuransis* Clarke, *Cordia* sp., *Petalidium barlerioides* Nees, *Rhinacanthus communis* Nees, *Colebrookia oppositifolia* Sm., *Saccharum munja* Roxb., *Chrysopogon lancearius* (Hook. f.) Haines, *Cymbopogon gidarba* (Buch.-Ham. ex Steud.) A. Camus, *Rottboellia exaltata* L.f., *Dioscoria daemona* Roxb. and a pteridophyte plant *Selaginella flaccida* Spring. The absence of those species collected by Haines in KWLS forest suggest either the natural habitat had been destroyed in due course of time due to anthropogenic activities for various development projects or the collections was made from other parts of the Koderma district but not from the KWLS forest.



In the present investigation some new and interesting informations were recorded from the floristic and taxonomic study such as rediscovery of plant, new distribution, endemic plants and rare plants in and from the Koderma Wildlife Sanctuary.

**Table 2: A Comparison of Distribution of Families between the Study Area and Earlier Published Floras**

| Sl No. | Flora of India (Karthikeyan 2000) | A Forest Flora of Chota Nagpur (Haines, 1910) | The Botany of Bihar & Orissa (Haines, 1921–1925) | Flora of Bihar Analysis (Singh & al., 2001) | Flora of Hazaribagh, Bihar Paria & Chattopadhyaya (2000 – 2005) | Flora of Koderma Wildlife Sanctuary (present study APG IV) |
|--------|-----------------------------------|-----------------------------------------------|--------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------|
| 1.     | Poaceae                           | Poaceae                                       | Poaceae                                          | Leguminosae (Fabaceae)                      | Leguminosae                                                     | Leguminosae (Fabaceae)                                     |
| 2.     | Orchidaceae                       | Leguminosae (Fabaceae)                        | Leguminosae (Fabaceae)                           | Poaceae                                     | Poaceae                                                         | Poaceae                                                    |
| 3.     | Leguminosae (Fabaceae)            | Cyperaceae                                    | Cyperaceae                                       | Euphorbiaceae                               | Asteraceae                                                      | Asteraceae                                                 |
| 4.     | Asteraceae                        | Orchidaceae                                   | Euphorbiaceae                                    | Orchidaceae                                 | Cyperaceae                                                      | Cyperaceae                                                 |
| 5.     | Rubiaceae                         | Asteraceae                                    | Asteraceae                                       | Acanthaceae                                 | Euphorbiaceae                                                   | Rubiaceae                                                  |
| 6.     | Cyperaceae                        | Euphorbiaceae                                 | Acanthaceae                                      | Rubiaceae                                   | Rubiaceae                                                       | Apocynaceae                                                |
| 7.     | Euphorbiaceae                     | Acanthaceae                                   | Rubiaceae                                        | Lamiaceae                                   | Acanthaceae                                                     | Malvaceae                                                  |
| 8.     | Acanthaceae                       | Rubiaceae                                     | Lamiaceae                                        | Asteraceae                                  | Scrophulariaceae                                                | Acanthaceae                                                |
| 9.     | Lamiaceae                         | Scrophulariaceae                              | Scrophulariaceae                                 | Scrophulariaceae                            | Caesalpiniaceae                                                 | Amaranthaceae                                              |
| 10.    | Rosaceae                          | Lamiaceae                                     | Convolvulaceae                                   | Convolvulaceae                              | Malvaceae                                                       | Euphorbiaceae                                              |

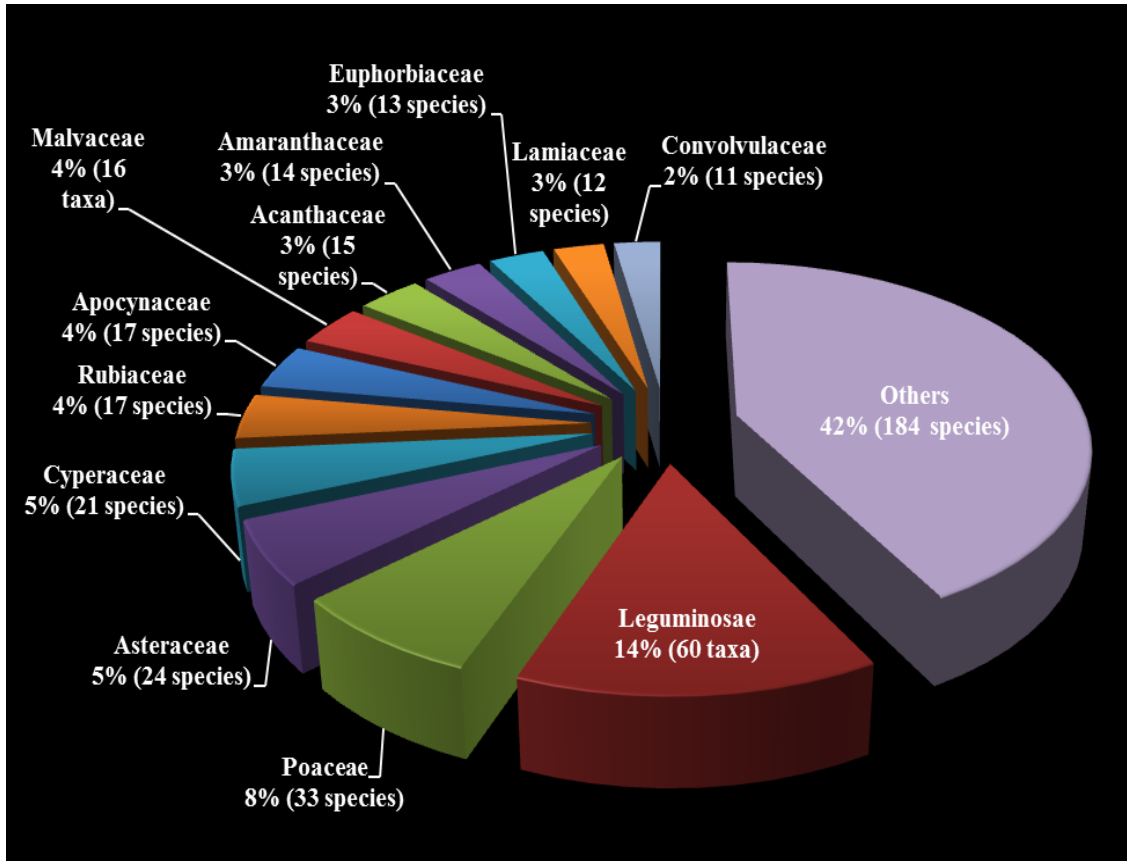


Diagram 1. Dominant families of Koderma Wildlife Sanctuary

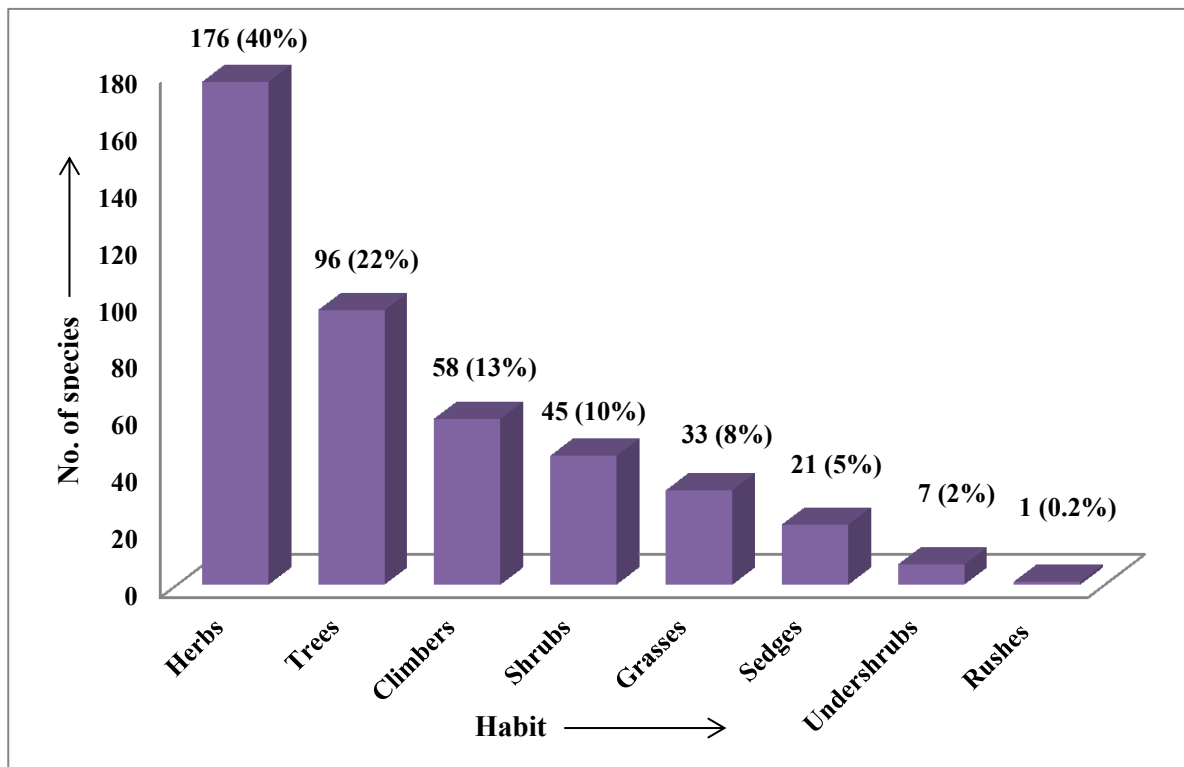


Diagram 2. Composition of Plant habits of Koderma Wildlife Sanctuary



**Rediscovery of Plant:** During the present study the plant **Crotalaria prostrata** var. **levis** Haines, has been rediscovered and collected after a gap of about 100 years after its first type collection was made by Haines in 1922 with very few population recorded in the shaddy grassland in Koderma NRF area (near Forest Range Office).

**New Reports from Jharkhand:** **Malva parviflora** L. var. **microcarpa** (Pers.) Loscos belonging to the family Malvaceae was collected from the damp or water-logged places in Phoolwaria area of Koderma forest during botanical explorations. The plant is native to Mediterranean region and was first reported for India from Rajasthan by Paul (1987) and more recently from West Bengal along the railway tracts of Howrah and on the open slopes of Hoogly river bank by Mandal & al. (2012), also **Ludwigia decurrens** Walter is addition to the angiospermic flora of Jharkhand state from KWLS.

**Endemic Plants of India in KWLS:** During the present study six Indian endemic plants was collected from KWLS. The plant **Boswellia serrata** Roxb. (Burseraceae) endemic to Peninsular India was collected from KWLS which are commonly found in the dry deciduous forest on hills. **Byttneria herbacea** Roxb., (Malvaceae) was collected from the dry deciduous areas of the KWLS forest which was observed in many localities though in less number. The plant is usually found in the state of Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Nagaland, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. Though the plant **Chrysopogon hamiltonii** (Hook.f.) Haines (Poaceae) was mentioned as endemic to Munger, Bihar (Singh & al., 2001), this species was collected during the present study from the hill slopes of Dhawjadhari Pahar, KWLS forest. **Andrographis longipedunculata** (Sreem.) L.H. Cramer (Acanthaceae) is endemic to Peninsula India (Kartikeyan & al 2009.) and reported in other states like Maharashtra, Tamil Nadu, Andra Pradesh, Karnataka, Gujarat and Rajasthan. The plant was observed with an extended distribution to eastern region as well and collected from the present study. On the other hand the two endemic plants to India were collected from KWLS in the present investigation. **Cynotis cuculata** (Roth) Kunth (Commelinaceae) was collected from the marshy area of Rheo Ghoghar dam, Chattarbar forest, KWLS though the species is reported to grow along the cultivated weeds and barren fields which is states to be common in Deccan peninsular India to Gujarat, East coast of India and Maharashtra and occurs in other states as well (Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh and Rajasthan). Lastly the plant **Glossocardia bosvallea** (L.f.) DC. (Asteraceae) an endemic plant to India was collected from the rocky hill slopes in the dry deciduous forest of Rishi Dhurwasa Pahar, KWLS.

**Rare Species in KWLS:** The four rare species which are found in KWLS forest which are found to be very few in population and confined to a very restricted locality were collected viz., **Habaneria plantaginea** Lindl. (Orchidaceae) a terrestrial orchid, **Drosera burmannai** Vahl (Droseraceae) an insectivorous plant, **Striga angustifolia** (Orobanchaceae) a root parasitic and **Ceropegia hirsuta** Wight & Arn. (Apocynaceae) a beautiful climber from the present floristic study. KWLS also has an interesting tree **Bombax ceiba** L. in Teliya Reserve Forest, which bears invariably only bright yellow-coloured flowers, which is an unusual phenomenon, as this species usually produces red-coloured flowers elsewhere. The rare occurrence of flowering in *Dendrocalamus strictus* (Roxb.) Nees was also recorded during the present study. Also an interesting character of **Pueraria tuberosa** (Roxb. ex Willd.) DC (Leguminosae: Papilionoideae) with two roundish bracteoles/epicalyx like measuring about c. 2 × 2 mm attached on opposite side at the base of the calyx was observed which can be mark as the characteristic features of the

species in the present study which was not reported and described in any of the published literature.

The present investigation reveals the forest flora of Koderma Wildlife Sanctuary is rich in vegetation and harbours several important plant species which are endemic to the country and is a natural habitat for the rediscovery species of **Crotalaria prostrata** var. **levis** Haines, nearly after a gap of 100 years and the first ever reported species of **Malva parvifolia** L. var. **microcarpa** (Pers.) Loscos for the state.

The Koderma Wildlife Sanctuary is not only the natural habitats of the recorded plants of the present study but also a home for the animals as well and support the ecosystem and its functions. The biodiversity of the forest is the primary source of livelihood especially for the Birhore community and others residing within and on the periphery of the wildlife sanctuary. Apart from the flora and fauna the KWLS is rich in mica deposits, Koderma is known as “Mica city of India” and illegal mining by the local people is rampant which disturbed the forest vegetations to a large extent. Though the forest is rich in vegetations and housed many important plant species as described here it faces a major threats from various quarters such as illegal mica mining, felling of trees, forest fire, poaching, invasion of alien species and illegal poaching and conversion/encroachment of forest areas for cultivation are some of the major threats to the flora and fauna of the Sanctuary (**Plate 66**).

Illegal mica mining leads to fragmentation of habitat and the resultant fallow land is immediately colonised by the invasive species such as *Lantana camara*, *Argemone mexicana*, *Argemone ochroleuca*, *Acmella paniculata*, *Chromolaena odorata*, *Hyptis suaveolens* and *Parthenium hysterophorus*.

The trees like *Boswellia serrata*, *Buchanania cochinchinensis* and *Shorea robusta* are illegally felled in large number by the local for fuel, firewood and timber and also for thatching and fencing purposes.

In the present study it was observed during the period February–March, the local people set fire to clear the ground vegetation so as to ease their collections of ‘mahua’ flowers (*Madhuca longifolia* var. *latifolia*), for illicit distilling of country liquor (mahua).

Cattle-grazing has been another serious problem posing an immense pressure on the ground vegetation of the Sanctuary. *Achyranthes aspera*, *Acmella paniculata*, *Ageratum conyzoides*, *Alternanthera* spp., *Caesulia axillaris*, *Chromolaena odorata*, *Cyathocline purpurea*, *Hyptis suaveolens*, *Lantana camara*, *Parthenium hysterophorus*, *Sida acuta*, *Sonchus asper* and *Tridax procumbens* are some of the important alien invasive species found naturalized and competing with the native species in the Wildlife Sanctuary. Similarly, the freshwater lakes and ponds in the sanctuary are entirely invaded by *Eichhornia crassipes* and *Spirodela polyrrhiza*. The menace of *Lantana camara* in the forest of KWLS can be controlled by implementing the cut rootstock method coupled with weeding of saplings found under the trees that are perched by birds and subsequent restoration of weed-free landscapes devised by Love & al., (2009). All these invasive weeds need to be controlled preferably through biocontrol methods and their spread has to be checked and monitored regularly.

Illegal hunting of wild animals by tribal communities, and human interference mostly due to tourism also posed a serious threat to the biodiversity of the Sanctuary. The sanctuary is also thronged by thousands of pilgrims, worshipers and visitors every year during Shivratri in the month of February or March for worshipping the Lord Siva in a temple at the Dhawjadhari Pahar top (**Plate 67**). During this period the wildlife get disturbed by the visitors. Certain steps have to be taken to sustainably solve the problem and no damage is done to the wildlife sanctuary.



A periodic monitoring by the personnel of the Department of Forests and Environment, Jharkhand State and implementation of proper and effective conservation measures and strategies are necessary to protect and conserve the existing biodiversity of the Koderma Wildlife Sanctuary. Furthermore, the department of Forests and Environment, Jharkhand State as well as the NGOs should take initiatives to create awareness by educating the local communities about the importance of conserving the flora and fauna and sustainable utilization of NTFPs (Non Timber Forest Produces) that are used as medicines and other ethnobotanical purposes for the posterity and for the generations to come and involve them in conservation activities. In order to preserve the biodiversity and its genetic resources from further damages a periodic monitoring and implementations of proper and effective conservation measures and strategies by the managing authority as well as the NGOs is paramount to protect and conserve the existing biodiversity of the Koderma Wildlife Sanctuary. On the other hand creating community awareness about the biodiversity and its importance for their survival and imparting the knowledge of sustainable uses of the forest products will be helpful for preserving the genetic resources available in the wildlife sanctuary. It is imperative to have the detail data or informations to undertake any meaningful projects for better management and development in any field. The present study highlights the flora of Jharkhand state which provides the basic informations about the plant treasure of Koderma Wildlife Sanctuary forest which can be utilized by the forest personals, policy makers, botanists, ecologists, students, agriculturists, pharmaceutical companies and plant conservationists/environmentalist for better management in future to derived maximum benefits to humanity.

## Systematic Enumeration of the Species

### KEY TO THE FAMILIES (ANGIOSPERMS)

- 1a. Leaves usually isobilateral and parallel-veined; flowers usually 3-merous; cotyledon 1      1
- 1b. Leaves usually dorsiventral and reticulately veined; flowers 4 or 5- and rarely  
3-merous; cotyledons 2      21
- 2a. Floral bracts and perianth lobes usually with more or less white papillose hairs; seed coat  
cells usually with ribbon-like appendages      **20. Eriocaulaceae**
- 2b. Floral bracts and perianth lobes without papillose hairs; seeds not as above      3
- 3a. Perianth reduced to a scale/bristles or absent      4
- 3b. Perianth well-developed      6
- 4a. Inflorescences subtended by a leafy spathe; fruit a berry or utricle      **4. Araceae**
- 4b. Inflorescences not subtended by a leafy spathe; fruit a nut or caryopsis      5
- 5a. Culms cylindrical with nodes and internodes; leaves with open sheaths; florets  
usually subtended by lemma and palea; ligulate      **23. Poaceae**
- 5b. Culms trigonous, without nodes and internodes; leaves with closed sheaths; florets  
not subtended by lemma and palea; not ligulate      **22. Cyperaceae**
- 6a. Ovary superior (except *Agave* in Asparagaceae)      7
- 6b. Ovary inferior      15
- 7a. Plants usually aquatic      8
- 7b. Plants not aquatic      10
- 8a. Stamens 6–9; ovules many      9
- 8b. Stamens 4; ovule solitary      **7. Potamogetonaceae**
- 9a. Ovary 1-loculed; fruit a follicle      **5. Alismataceae**
- 9b. Ovary 3-loculed; fruit a capsule      **16. Pontederiaceae**
- 10a. Trees; leaves forming a terminal crown and palmati-, pinnati- or pedatisect and more  
than 2 m long      **14. Arecaceae**
- 10b. Herbs, shrubs or climbers; leaves not forming a terminal crown and not  
palmati or pinnatisect and less than 2 m long      11
- 11a. Fruits usually berry      **10. Smilacaceae**
- 11b. Fruits usually capsule (except *Asparagus* of Asparagaceae)      12
- 12a. Leaves septate      **21. Juncaceae**
- 12b. Leaves not septate      13
- 13a. Filaments usually bearded      **15. Commelinaceae**
- 13b. Filaments not bearded      14
- 14a. Flowers in racemes, spikes or panicles      **13. Asparagaceae**
- 14b. Flowers solitary or a few in corymbs      **9. Colchicaceae**
- 15a. Ovules minute, seeds inconspicuous      16
- 15b. Ovules large, seeds conspicuous      17
- 16a. Plants aquatic; median petal not produced into labellum; stamens and styles  
separate; pollen free      **6. Hydrocharitaceae**
- 16b. Plants terrestrial or epiphytic; median petal produced into a labellum; stamens and  
styles united into a column; pollen in pollinia      **11. Orchidaceae**
- 17a. Plants climbing; fruits winged      **8. Dioscoreaceae**
- 17b. Plants erect herb, undershrub or shrubs; fruits not winged      18
- 18a. Leaves caulescent; flowers zygomorphic      19



|                                                                                                   |                            |
|---------------------------------------------------------------------------------------------------|----------------------------|
| 18b. Leaves acaulescent; flowers actinomorphic                                                    | <b>12. Hypoxidaceae</b>    |
| 19a. Sepals united; anthers 2-celled                                                              | 20                         |
| 19b. Sepals free; anthers 1-celled                                                                | <b>17. Cannaceae</b>       |
| 20a. Plants aromatic; flowers yellow; staminodes present                                          | <b>19. Zingiberaceae</b>   |
| 20b. Plants non-aromatic; flowers white; staminodes absent                                        | <b>8. Costaceae</b>        |
| 21a. Perianth dichlamydeous or heterochlamydeous                                                  | 22                         |
| 21b. Perianth monochlamydeous or homochlamydeous                                                  | 89                         |
| 22a. Petals free                                                                                  | 23                         |
| 22b. Petals united at base                                                                        | 65                         |
| 23a. Calyx generally not united; stamens hypogynous; ovary superior                               | 24                         |
| 23b. Calyx generally united; stamens peri- or epigynous; ovary inferior, rarely superior          | 55                         |
| 24a. Sepals usually distinct, free from ovary; disk absent                                        | 25                         |
| 24b. Sepals either distinct or united free or adnate to ovary; disk usually present               | 42                         |
| 25a. Carpels usually free                                                                         | 26                         |
| 25b. Carpels united                                                                               | 29                         |
| 26a. Plants terrestrial                                                                           | 27                         |
| 26b. Plants aquatic                                                                               | <b>1. Nymphaeaceae</b>     |
| 27a. Trees; fruits a berry                                                                        | <b>2. Annonaceae</b>       |
| 27b. Herbs or climbers; fruits other than berry                                                   | 28                         |
| 28a. Herbs; leaves compound; styles feathery; fruits an achene                                    | <b>26. Ranunculaceae</b>   |
| 28b. Climbers; leaves simple; styles not feathery; fruits a drupe                                 | <b>25. Menispermaceae</b>  |
| 29a. Ovary 1-loculed; placentation parietal                                                       | 30                         |
| 29b. Ovary 2 to many-loculed, if 1-loculed then placentation free central                         | 37                         |
| 30a. Leaves and fruits prickly                                                                    | <b>24. Papaveraceae</b>    |
| 30b. Leaves and fruits not prickly                                                                | 31                         |
| 31a. Herbs                                                                                        | 32                         |
| 31b. Climber, shrubs or trees                                                                     | 35                         |
| 32a. Flowers zygomorphic; fruits subglobose                                                       | <b>40. Violaceae</b>       |
| 32b. Flowers actinomorphic; fruits subterete                                                      | 33                         |
| 33a. Leaves sheathing or amplexicaul, scale-like on oldest stems and on branchlets; seeds plumose | <b>65. Tamaricaceae</b>    |
| 33b. Leaves not sheathing or scale-like, well-developed; seeds not as above                       | 34                         |
| 34a. Sepals unequal; fruits a silique; seeds ovoid without clefts                                 | <b>61. Brassicaceae</b>    |
| 34b. Sepals equal; fruits a capsule; seeds reniform with clefts                                   | <b>60. Cleomaceae</b>      |
| 35a. Armed; leaves entire; flowers other than yellow; seeds not woolly                            | 36                         |
| 35b. Unarmed; leaves lobed; flowers yellow; seeds woolly                                          | <b>56. Bixaceae</b>        |
| 36a. Leaf margins entire; gynophores present                                                      | <b>59. Capparaceae</b>     |
| 36b. Leaf serrulate or crenate; gynophores present                                                | <b>42. Salicaceae</b>      |
| 37a. Corolla zygomorphic; ovary 2-loculed                                                         | <b>30. Polygalaceae</b>    |
| 37b. Corolla actinomorphic; ovary other than 2-loculed                                            | 38                         |
| 38a. Ovary 1-loculed; placentation free central                                                   | 39                         |
| 38b. Ovary 3–5 or many-loculed; placentation axile                                                | 40                         |
| 39a. Leaves linear or elliptic-spathulate; sepals 5; stamens 2–5                                  | <b>68. Caryophyllaceae</b> |
| 39b. Leaves not linear; sepals 2; stamens 8–many                                                  | <b>73. Portulacaceae</b>   |
| 40a. Sepals imbricate                                                                             | 41                         |
| 40b. Sepals valvate                                                                               | <b>55. Malvaceae</b>       |

|                                                                       |                             |
|-----------------------------------------------------------------------|-----------------------------|
| 41a. Trees; fruits winged; seeds solitary                             | <b>57. Dipterocarpaceae</b> |
| 41b. Herbs; fruits not winged; seeds many                             | <b>39. Elatinaceae</b>      |
| 42a. Placentation axile                                               | 42                          |
| 42b. Placentation parietal                                            | <b>58. Moringaceae</b>      |
| 43a. Androecium obdiplostemonous or diplostemonous; ovules pendulous  | 44                          |
| 43b. Androecium haplostemonous; ovules erect                          | 53                          |
| 44a. Flowers 4 or 5-merous; androecium diplostemonous                 | 45                          |
| 44b. Flowers always 5-merous; androecium obdiplostemonous             | 47                          |
| 45a. Climbers or scandent large shrubs                                | <b>62. Olacaceae</b>        |
| 45b. Erect shrubs or trees (except <i>Cardiospermum</i> )             | 46                          |
| 46a. Ovules 1 or 2 per locule, on axile placenta                      | <b>51. Sapindaceae</b>      |
| 46b. Ovules 1-per locule, on sub-basal funicle                        | <b>50. Anacardiaceae</b>    |
| 47a. Herbs                                                            | 48                          |
| 47b. Trees                                                            | 49                          |
| 48a. Leaves simple; corolla spurred; stamens 5                        | <b>74. Balsaminaceae</b>    |
| 48b. Leaves compound; corolla not spurred; stamens 10                 | <b>37. Oxalidaceae</b>      |
| 49a. Leaves 2-foliolate                                               | <b>28. Zygophyllaceae</b>   |
| 49b. Leaves other than 2-foliolate                                    | 50                          |
| 50a. Fruits samaras                                                   | <b>53. Simaroubaceae</b>    |
| 50b. Fruits other than samaras                                        | 51                          |
| 51a. Leaves with numerous minute pellucid gland dots                  | <b>52. Rutaceae</b>         |
| 51b. Leaves without gland dots                                        | 52                          |
| 52a. Fruits a berry                                                   | <b>54. Meliaceae</b>        |
| 52b. Fruits other than berry                                          | <b>49. Burseraceae</b>      |
| 53a. Fruits a berry                                                   | <b>27. Vitaceae</b>         |
| 53b. Fruits a drupe or capsule or winged nut                          | 54                          |
| 54a. Stamens alternate to petal                                       | <b>36. Celastraceae</b>     |
| 54b. Stamens opposite petals                                          | <b>32. Rhamnaceae</b>       |
| 55a. Stamens often twice or more than the number of petals            | 56                          |
| 55b. Stamens not as above                                             | 62                          |
| 56a. Placentation usually parietal                                    | 57                          |
| 56b. Placentation usually axile                                       | 59                          |
| 57a. Stamens numerous; carpels many                                   | <b>31. Rosaceae</b>         |
| 57b. Stamens definite; carpels solitary                               | 57                          |
| 58a. Fruits a pod                                                     | <b>29. Leguminosae</b>      |
| 58b. Fruits a capsule or follicle                                     | <b>67. Droseraceae</b>      |
| 59a. Stamens many, usually more than 20                               | <b>48. Myrtaceae</b>        |
| 59b. Stamens up to 10                                                 | 60                          |
| 60a. Fruit a drupe                                                    | <b>45. Combretaceae</b>     |
| 60b. Fruit a capsule                                                  | 61                          |
| 61a. Ovary superior                                                   | <b>46. Lythraceae</b>       |
| 61b. Ovary inferior                                                   | <b>47. Onagraceae</b>       |
| 62a. Plants tendrillar; ovules usually on parietal placenta           | 64                          |
| 62b. Plants not tendrillar; ovules usually on axile or basal placenta | 63                          |
| 63a. Fruit a capsule; seeds many                                      | <b>71. Molluginaceae</b>    |
| 63b. Fruit a cremocarp; seeds 1 or 2                                  | <b>100. Apiaceae</b>        |



|                                                                                                                    |                             |
|--------------------------------------------------------------------------------------------------------------------|-----------------------------|
| 64a. Stamens 3; ovary inferior; fruit a pepo                                                                       | <b>35. Cucurbitaceae</b>    |
| 64b. Stamens 4 or 5; ovary superior; fruit a capsule or berry                                                      | <b>41. Passifloraceae</b>   |
| 65a. Ovary inferior                                                                                                | 66                          |
| 65b. Ovary superior                                                                                                | 68                          |
| 66a. Stipules present, interpetiolar                                                                               | <b>78. Rubiaceae</b>        |
| 66b. Stipules absent                                                                                               | 67                          |
| 67a. Inflorescence a capitulum; calyx reduced to pappus; fruit an achene                                           | <b>99. Compositae</b>       |
| 67b. Inflorescence other than a capitulum; calyx well-developed; fruit a capsule                                   | <b>97. Campanulaceae</b>    |
| 68a. Carpels more than 2                                                                                           | 69                          |
| 68b. Carpels 2                                                                                                     | 70                          |
| 69a. Plants monoecious; flowers ebracteate                                                                         | <b>75. Sapotaceae</b>       |
| 69b. Plants dioecious; flowers bracteate                                                                           | <b>76. Ebenaceae</b>        |
| 70a. Corolla actinomorphic                                                                                         | 71                          |
| 70b. Corolla zygomorphic                                                                                           | 79                          |
| 71a. Leaves opposite                                                                                               | 72                          |
| 71b. Leaves alternate or rarely absent                                                                             | 75                          |
| 72a. Stamens 2                                                                                                     | <b>85. Oleaceae</b>         |
| 72b. Stamens 4 or 5                                                                                                | 73                          |
| 73a. Stamens 4, unequal and different in shape                                                                     | <b>80. Loganiaceae</b>      |
| 73b. Stamens 4 or 5, if 4 then didynamous or equal in size                                                         | 74                          |
| 74a. Plants laticiferous                                                                                           | <b>81. Apocynaceae</b>      |
| 74b. Plants not laticiferous                                                                                       | 75                          |
| 75a. Placentation free central; stamens opposite petals                                                            | <b>77. Primulaceae</b>      |
| 75b. Placentation parietal; stamens alternate with petals                                                          | <b>79. Gentianaceae</b>     |
| 76a. Plants aquatic                                                                                                | <b>98. Menyanthaceae</b>    |
| 76b. Plants terrestrial                                                                                            | 77                          |
| 77a. Branchlets usually scabrous with strigose or sericeous hairs                                                  | <b>82. Boraginaceae</b>     |
| 77b. Branchlets neither scabrous nor with strigose or sericeous hairs                                              | 78                          |
| 78a. Ovules 1 or 2 per locule                                                                                      | <b>83. Convolvulaceae</b>   |
| 78b. Ovules numerous                                                                                               | <b>84. Solanaceae</b>       |
| 79a. Ovules more than 4                                                                                            | 80                          |
| 79b. Ovules 4                                                                                                      | 88                          |
| 80a. Moist marshy or aquatic plants or near the shady localities (except <i>Scoparia</i> occasionally terrestrial) | 81                          |
| 80b. Terrestrial                                                                                                   | 85                          |
| 81a. Plant root parasitic                                                                                          | <b>96. Orobanchaceae</b>    |
| 81b. Plant not root parasitic                                                                                      | 82                          |
| 82a. Corolla 2-lipped                                                                                              | <b>88. Linderniaceae</b>    |
| 82b. Corolla not 2-lipped                                                                                          | 83                          |
| 83a. Filaments bearded                                                                                             | <b>87. Scrophulariaceae</b> |
| 83b. Filaments not bearded                                                                                         | 84                          |
| 84a. Fruit dehiscent, septicidal capsule                                                                           | <b>86. Plantaginaceae</b>   |
| 84b. Fruit indehiscent                                                                                             | <b>95. Mazaceae</b>         |
| 85a. Trees; fruit a capsule                                                                                        | <b>92. Bignoniaceae</b>     |
| 85b. Herbs or shrubs; fruit other than a capsule                                                                   | 86                          |

|                                                                       |                           |
|-----------------------------------------------------------------------|---------------------------|
| 86a. Fruit a drupe                                                    | 87                        |
| 86b. Fruit a capsule                                                  | <b>91. Acanthaceae</b>    |
| 87a. Stamens 4; drupes spiny along angles, not beaked                 | <b>90. Pedaliaceae</b>    |
| 87b. Stamens 2; drupes not spiny with 2 curved beaks                  | <b>89. Martyniaceae</b>   |
| 88a. Calyx bilabiate; style gynobasic; ovary 4-lobed                  | <b>94. Lamiaceae</b>      |
| 88b. Calyx not bilabiate; style terminal; ovary entire                | <b>93. Verbenaceae</b>    |
| 89a. Plants parasitic or semi-parasitic                               | 90                        |
| 89b. Plants not parasitic                                             | 92                        |
| 90a. Plants hemiparasitic with haustoria; leaves present              | <b>64. Loranthaceae</b>   |
| 90b. Plants parasitic without haustoria; leaves absent or rudimentary | 91                        |
| 91a. Plant twining, monoecious; fruit a drupe                         | <b>3. Lauraceae</b>       |
| 91b. Plant not twining, dioecious; fruit a berry                      | <b>63. Santalaceae</b>    |
| 92a. Flowers bisexual (except <i>Amaranthus</i> of Amaranthaceae)     | 93                        |
| 92b. Flowers unisexual                                                | 96                        |
| 93a. Perianth lobes plicate; fruit an anthocarp                       | <b>70. Nyctaginaceae</b>  |
| 93b. Perianth lobes not plicate; fruit other than anthocarp           | 94                        |
| 94a. Twining shrubs                                                   | <b>72. Basellaceae</b>    |
| 94b. Erect, straggling or prostrate herbs                             | 95                        |
| 95a. Stipules present, ochraceous                                     | <b>66. Polygonaceae</b>   |
| 95b. Stipules absent                                                  | <b>69. Amaranthaceae</b>  |
| 96a. Ovary usually 3-locular                                          | 97                        |
| 96b. Ovary 1- or 2-locular                                            | 99                        |
| 97a. Plants usually laticiferous                                      | <b>43. Euphorbiaceae</b>  |
| 97b. Plants not laticiferous                                          | 98                        |
| 98a. Plants monoecious or dioecious; styles or style-arms slender     | <b>44. Phyllanthaceae</b> |
| 98b. Plants usually dioecious; styles much dilated                    | <b>38. Putranjivaceae</b> |
| 99a. Inflorescence usually a syconium                                 | <b>34. Moraceae</b>       |
| 99b. Inflorescence not syconium                                       | <b>33. Ulmaceae</b>       |

### 1. NYMPHAEACEAE Salisb., nom. cons.

Cosmopolitan, 5 genera and c. 95 species; 2 genera and 7 species in India.

#### NYMPHAEA L., nom. cons.

Cosmopolitan, c. 60 species, 6 in India, 3 in Jharkhand and 2 in KWLS.

#### Key to species

1a. Petals white; filaments of inner stamens without purplish band outside; anthers yellow

**1. N. pubescens**

1b. Petals bright pink; filaments of inner stamens with a purplish band outside; anthers red

**2. N. rubra**

**1. *Nymphaea pubescens*** Willd., Sp. Pl. 2: 1154. 1799; R.L. Mitra in B.D. Sharma & al., Fl. India 1: 431. 1993; N.P. Singh & al., Fl. Bihar: 33. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 66. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 1: 65. 2000. *Nymphaea lotus* auct. non L. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 114. 1872, p.p. *Nymphaea lotus* var. *pubescens* (Willd.) Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 114. 1872; Haines, Bot. Bihar Orissa: 21. 1921.

**Plate 6A**



Vern. Name: *Koka* (Hindi).

Herb, floating; rhizomes usually producing slender stolons. Leaves simple, broadly ovate-elliptic, ovate-elliptic or orbicular, 15.5–26 × 13–24 cm, sagittate to deeply cordate at base, sharply sinuately spinous-dentate at margins, rounded at apex, glabrous; petioles and pedicels very long. Flowers 8–11 cm across, emergent. Sepals usually ovate-lanceolate or elliptic-oblong, 2.5–4(–8) × 1–1.5(–2.5) cm, puberulous. Petals 10–25, linear-oblongate or linear-elliptic, 2–4(–7) × 1–1.5(–2.5) cm, white. Stamens 25(–70), in 3 rows, 1.5–2.5(–3.5) cm long, white-yellow. Ovary 12–15(–22)-loculed; stigmatic appendages linear or oblong, c. 1 cm long, inflexed, yellow. Berries 2.2–4 cm across. Seeds ellipsoid, c. 1.5 × 1 mm, with longitudinal ridges.

*Fl. & Fr.*: September – February.

*Habitat*: Freshwater ponds and lakes.

*Distribution*: KWLS: Pond near Lokai road; common. INDIA: Throughout the plains. WORLD: Cambodia, China, Indonesia, Laos, Malaysia, Myanmar, New Guinea, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Pond near Lokai road, 399 m, 24°29'01.4" N, 85°36'52.9" E, 28th September 2013, *Shyam Biswa* 54174.

**2. *Nymphaea rubra*** Roxb. ex Salisb., *Parad. Lond.* i. sub t. 14. 1808; Roxb. ex Andrews, *Bot. Repos.* 8(104): t. 503. 1808; R.L. Mitra in B.D. Sharma & al., *Fl. India* 1: 432. 1993; N.P. Singh & al., *Fl. Bihar*: 33. 2001. *Nymphaea lotus* L. var. *rubra* (Roxb.) Haines, *Bot. Bihar Orissa*: 21. 1921. *Nymphaea lotus* sensu Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 114. 1872, p.p. non L. 1753.

#### Plate 6B

Herb, floating, rhizome corm or nodular. Leaves simple, ovate-elliptic or orbicular, 7.5–17 × 6–24 cm, deeply cordate and slightly peltate at base, dentate at margins, rounded at apex, floating shiny above, pubescent beneath, strongly veined; veins repeatedly bifurcate; young ones dark red both above and beneath, turning greenish above with age. Flowers solitary, emergent, 5.5–6.2 × 5–14 cm. Sepals 4, elliptic-oblong, c. 6.5 × 2.5 cm, inserted at base of the torus, obtuse at apex. Petals 16–25, in spiral, lanceolate or elliptic-lanceolate, 5.5–6.2 × 1–2 cm, the uppermost being almost superior, the inner gradually passing into stamens, bright pink. Stamens 25–80, to 2.5 cm long; filaments of inner stamens with a dark purplish band near base; connective of the anthers not at all or very slightly produced beyond the cells. Ovary 10–27, usually 19–21-loculed; stigmatic rays clubbed. Berries spongy, maturing under water and irregularly breaking up.

*Fl. & Fr.*: September – February.

*Habitat*: Freshwater ponds and lakes.

*Distribution*: KWLS: Bon Kali, Pipra Tan, Chattarbar; common. INDIA: Throughout plains. WORLD: Cambodia, Indonesia, Malaysia, Philippines and Vietnam.

*Specimen examined*: Bon Kali, Pipra Tan, Chattarbar, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 54176.

## 2. ANNONACEAE Juss., nom. cons.

Tropical regions, 123 genera and c. 2100 species; 24 genera c. 120 species in India.

### ANNONA L.

America and Africa, 137 species, 3 in India, 2 in Jharkhand and 1 in KWLS.

**Annona squamosa** L., Sp. Pl. 1: 537. 1753; Hook.f. & Thomson in Hook .f, Fl. Brit. India 1: 78. 1872; Haines, Forest Fl. Chota Nagpur: 145. 1910 & Bot. Bihar Orissa: 9. 1921; Debika Mitra in B.D. Sharma & al., Fl. India 1: 207. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 58. 2000; N.P. Singh & al., Fl. Bihar: 27. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 58. 2002.; Ranjan, Fl. Parasnath Wildlife Sanct.:30.2014. **Plate 6C**

Vern. Names: *Saripha* (Hindi); *Sitaphal*.

Tree, *c.* 5 m high; branches lenticellate. Leaves simple, alternate, exstipulate, lanceolate or oblong-lanceolate, 3.5–7.2 × 1.4–3.2 cm, cuneate or tapering at base, entire at margins, acute or obtuse at apex, glabrous; petioles 0.5–1cm long, glabrous. Flowers solitary, axillary, 2–2.5 cm long, drooping; pedicels 1.5–1.8 cm long, glabrous. Petals narrowly oblong, triquetrous with concave base, 2–2.5 × 0.5–0.7 cm, yellowish green. Carpels aggregated on torus, 1-ovuled. Fruit an aggregated ripe carpels, ovoid or globose, 5–9 cm across, greenish; areoles rounded. Seeds smooth, *c.* 1.4 × 0.8 cm, blackish.

*Fl. & Fr.*: March – September.

*Habitat*: Cultivated and escaped.

*Distribution*: KWLS: Near the Meghatari village. INDIA: Throughout. WORLD: Native to tropical America and West Indies.

*Specimen examined*: Near the Meghatari village, 212 m, 24°35'23.8" N, 85°35'05.8" E, 12th September 2010, *Shyam Biswa* 49613.

### 3. LAURACEAE Juss., nom. cons.

Tropical and subtropical regions, 52 genera and *c.* 2550 species; 17 genera and 212 species in India.

#### CASSYTHA Osbeck

Old World, tropical regions, 23 species, 3 in India, 1 in Jharkhand.

**Cassytha filiformis** L., Sp. Pl. 1: 35. 1753; Hook.f., Fl. Brit. India 5: 188. 1886; Haines, Forest Fl. Chota Nagpur: 154. 1910 & Bot. Bihar Orissa: 798. 1924; N.P. Singh & al., Fl. Bihar: 442. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 535. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.:189. 2014. **Plate 6D**

Twining leafless parasite, forming web over bushes and on trees. Stems terete, ribbed, adhering to host by haustoria, young parts puberulous or nearly glabrous, green. Leaves reduced to minute scales or absent. Inflorescences spikes, 1–5 cm long; bracts deciduous; bracteoles 3, rounded, ciliate, small. Perianth 6 (3 + 3), free, unequal, obtuse at apex; outer lobes ovate-orbicular, *c.* 1.2 mm long, ciliate; inner lobes obovate, *c.* 2.5 mm long. Stamens 9 in 3 whorls; outer 2 whorls eglandular, introrse; 3rd inner whorl glandular, extrorse; anthers 2-celled, *c.* 1.5 mm long; staminodes in 4th whorl, sessile. Ovary globose; style short; stigma capitate. Drupes globose, 5–8 mm wide, crowned with succulent perianth tube or segments, smooth. Seed 1, globose.

*Fl. & Fr.*: November – December.

*Habitat*: Parasite on the Trees branches.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; rare. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012 *Shyam Biswa* 54099.



#### 4. ARACEAE Juss., nom. cons.

Mostly tropical and subtropical regions with a few in temperate regions, c. 105 genera and c. 3250 species; 29 genera and 126 species in India.

##### Key to genera

- 1a. Terrestrial, rhizome tuberous; spathe with spadix differentiated into female flowers zone, zone of sterile male flowers and male flowers zone **1. Colocasia**
- 1b. Aquatic floating, roots fibrous; spathe not differentiated into spadix, 2-lipped, male and female flowers in marginal clefts, enclosed together in a small transitory spathe **2. Spirodella**

#### 1. COLOCASIA Schott, nom. cons.

Tropical Asia, 7 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

**Colocasia esculenta** (L.) Schott, Schott & Endl., Melet. Bot.: 18. 1832; N.P. Singh & al., Fl. Bihar: 545. 2001. *Arum esculentum* L., Sp. Pl. 2: 965. 1753. *Colocasia antiquorum* Schott in Schott & Endl., Melet. Bot.: 18. 1832; Hook.f., Fl. Brit. India 6: 523. 1893; Haines, Forest Fl. Chota Nagpur: 551. 1910 & Bot. Bihar Orissa: 867. 1924. **Plate 6E**

Vern. Names: *Arvi*, *Kachalu* (Hindi); *Geduo Sag* (Birhore).

Herb, to 1 m high; rhizomes tuberous, vertical to horizontal. Leaves simple, basal, oblong-ovate to suborbicular, 9–40 × 6–30 cm, cordate at base, broadly and shortly cuspidate at apex, shallowly (sinus 1–4 cm), dull, glaucous; petioles 25–80 cm, spongy and filled with air spaces, green; peduncles 16–26 cm long. Spathe: tube 3–5 × 1.2–1.5 cm, green; blade narrowly lanceolate, acuminate at apex, lower part open, 10–19 × 2–5 cm, yellowish-orange. Spadix: female part 1.2–3.5 cm long; zone of sterile male flowers 1.2–2 cm long; male part 4.5–6.5 cm long; synandria 0.7–1 mm across; appendix 1.5–4.5 × c. 0.2 cm, rough. Ovaries 1–3 mm wide, 1-locular; ovules 36–67; stigma broadly peltate, c. 0.6 mm wide.

*Fl. & Fr.*: August – December.

*Habitat*: Moist localities near settlements, also as an escape.

*Distribution*: KWLS: Dhodhakola, near Birhore Tola, Safinalwa; common. INDIA: Almost throughout. WORLD: Widely cultivated usually near farmhouses or in water fields; also naturalized or perhaps native in wet places in forests, valleys, swamps, wastelands, and at watersides.

*Specimen examined*: Dhodhakola, near Birhore Tola, Safinalwa, 380 m, 24°33'15.1" N, 85°39'37.9" E, 27th February 2012, *Shyam Biswa* 54006.

#### 2. SPIRODELA Schleid.

Cosmopolitan 3 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Spirodela polyrhiza** (L.) Schleid., Linnaea 13: 392. 1839; N.P. Singh & al., Fl. Bihar: 550. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 628. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 958. 2005. *Lemna polyrhiza* L., Sp. Pl. 2: 970. 1753; Hook.f., Fl. Brit. India 6: 557. 1893; Haines, Bot. Bihar Orissa: 874. 1924. **Plate 6F**

Herb, free-floating on stagnant ponds; roots 5–20 in clusters, usually from the swollen portion beneath the fronds. Fronds asymmetrical, herbaceous, flat, orbicular, orbicular-obovate or obovate, 7–8 × 5–6 mm, rounded at base, entire at margins, obtuse to rounded at apex, green above, purplish or reddish beneath, very faintly 7-veined above, distinctly inflated with a 2-lobed

prophyllum at base. Slit of the budding pouch lateral to the margin of the frond, remaining attached to the parent by a slender stipe. Flowers rarely produced, enclosed in spathe. Spathe 2-lipped, male and female flowers in marginal clefts, enclosed together in a small transitory spathe. Male of 2-stamens maturing one after the other; 1–4 ovules in pistillate flowers.

*Fl. & Fr.*: September – March.

*Habitat*: Ponds and lakes.

*Distribution*: KWLS: Pond near Koderma village; common. INDIA: Almost throughout. WORLD: Sub-cosmopolitan.

*Specimen examined*: Pond near Koderma village, 401 m, 24°28'46.5" N, 85°35'57.3" E, 27th March 2013, *Shyam Biswa* 54116.

## 5. ALISMATACEAE Vent., nom. cons.

Cosmopolitan, 14 genera and c. 100 species; 6 genera 14 species in India.

### BUTOMOPSIS Kunth

Old World Tropical regions, monotypic.

**Butomopsis latifolia** (D. Don) Kunth, Enum. Pl. 3: 165. 1841; N.P. Singh & al., Fl. Bihar: 552. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 630. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 921. 2005. *Butomus latifolius* D. Don, Prodr. Fl. Nepal.: 22. 1825. *Butomus lanceolatus* Roxb., Fl. Ind. 2: 315. 1832. *Butomopsis lanceolata* (Roxb.) Kunth, Enum. Pl. 3: 165. 1841; Hook.f., Fl. Brit. India 6: 562. 1893; Mooney, Suppl. Bot. Bihar Orissa: 140. 1950.

### Plate 6G

Aquatic herb, annual or perennial, scapigerous, 15–35 cm high. Stems angular, glabrous. Leaves simple, radical, linear, spatulate or oblong-lanceolate, 6–19 × 0.2–2.6 cm, tapering or attenuate at base, entire at margins, acute or rounded at apex, glabrous, glaucous; petioles 5–15 cm long. Inflorescence a scape, usually longer than the leaves; peduncles 5–25 cm long, stout, terminating in an umbel of 4–12 flowers; pedicels variable in length, 2–6 cm long, elongated in fruit; bracts triangular-lanceolate, 1–1.5 cm long, decreasing in size inwards, scarious, reticulate-veined. Sepals 3, broadly elliptic-obovate, 4–6 × 2.5–3.5 mm, herbaceous, scarious at margins, rounded or slightly emarginate at apex, persistent. Petals 3, obovate, 5–6 × 2.5–4 mm, white, ephemeral. Stamens 6–9, c. 6 mm long; filaments 2–3 mm long; anthers oblong. Carpels 6–9, whorled on a flat receptacle, sessile, shortly connate below, 1-loculed; ovules many, parietal; style short; stigma slightly decurrent. Follicles 6–9, tapering into a short beak, 7–9 × 2.5–3 mm; seeds many, oblong or globular, c. 0.5 mm long with a central channel, shining, light golden brown.

*Fl. & Fr.*: August – February.

*Habitat*: Temporary pools.

*Distribution*: KWLS: Jeetia Dam, Chattarbar; common. INDIA: Throughout. WORLD: Bangladesh, China, Indonesia (Java), Laos, Myanmar, Nepal, North Africa, North Australia, Thailand and Vietnam.

*Specimen examined*: Jeetia Dam, Chattarbar, 375 m, 24°28'36.5" N, 85°32'20.5" E, 28th February 2012, *Shyam Biswa* 54015.

## 6. HYDROCHARITACEAE Juss., nom. cons.

Cosmopolitan, 18 genera and c. 120 species; 9 genera and c. 18 species in India.

### Key to genera

- |                                                                                                        |                       |
|--------------------------------------------------------------------------------------------------------|-----------------------|
| 1a. Leaves all basal                                                                                   | 2                     |
| 1b. Leaves cauline, in whorls on stem                                                                  | <b>1. Hydrilla</b>    |
| 2a. Leaves linear; peduncles of female spathes spirally coiled                                         | <b>3. Vallisneria</b> |
| 2b. Leaves with expanded lanceolate to suborbicular blades; peduncles of female spathes usually winged | <b>2. Ottelia</b>     |

### 1. HYDRILLA Rich.

Old World, monotypic.

**Hydrilla verticillata** (L.f.) Royle, Ill. Bot. Himal.: t. 376. 1839; Hook.f., Fl. Brit. India 5: 659. 1888; Haines, Bot. Bihar Orissa: 852. 1922; N.P. Singh & al., Fl. Bihar: 485. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 587. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 926. 2005. *Serpicula verticillata* L.f., Suppl. Pl.: 416. 1782.

### Plate 7A

Vern. Name: *Senwar* (Hindi).

Herb, aquatic, submerged, dioecious or sometimes monoecious. Stems branched, producing filiform roots from lower nodes. Leaves simple, in whorls of 3–8, variable in shape, sessile, linear to lanceolate or ovate, 1.5–10 × 1–3.5 mm, obtuse to acute at base, serrulate at margins, acute or apiculate at apex. Flowers unisexual, borne singly in leaf axils. Male flowers very shortly pedicellate, enclosed in subglobose, c. 1 mm wide, spathe with apical knob and corona of setae, opening to release flower which floats to surface; outer perianth lobes 3, ovate, convex, imbricate; inner lobes 3, narrower. Stamens 3. Female flowers: spathe tubular, c. 4 mm long, apex bifid; outer perianth lobes 3, narrowly oblanceolate; inner lobes 3, narrower, transparent. Ovary cylindric, enclosed within a spathe, prolonged upwards into a filiform tube to 2.8 cm long, 1-loculed; styles 3; ovules a few to 6. Fruits cylindric, to 7 mm long. Seeds c. 2 mm long, brown.

*Fl. & Fr.*: February – March.

*Habitat*: Freshwater shallow ponds or lakes.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Throughout. WORLD: Australia, China, Europe, Indonesia, Japan, Malaysia and Philippines.

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49897.

### 2. OTTELIA Pers.

Tropical and subtropical regions, especially Old World, 21 species and 1 in India.

**Ottelia alismoides** (L.) Pers., Syn. Pl. 1: 400. 1805; Hook.f., Fl. Brit. India 5: 662. 1888; Haines, Bot. Bihar Orissa: 855. 1922; N.P. Singh & al., Fl. Bihar: 486. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 588. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 929. 2005. *Stratiotes alismoides* L., Sp. Pl. 1: 535. 1753.

### Plate 7B

Herb, aquatic, submerged and emergent; roots fibrous. Leaves simple, basal, ovate to suborbicular, 4–9 × 3.5–8 cm, truncate, cuneate or cordate at base, entire at margins, rounded at apex, thin, glabrous, with 5–7 arching longitudinal veins; petioles triangular, to 25 cm long. Flowers c. 3 mm wide, arising from spathe, which encloses ovary. Spathe tubular, bifid, 2.5–4 ×



1.5–3 cm, normally with 3–6 wavy wings. Flowers sessile, bisexual. Perianth lobes 6; outer lobes 3, linear to narrowly oblong, persistent; inner lobes 3, obovate, *c.* 1 × 1.5 cm, white. Stamens 6; filaments *c.* 5 mm long; anthers linear, basifixed. Ovary oblong to narrowly ellipsoid, to 4 cm long, tapering above into a stout beak; styles 6. Fruits oblong, 3–4 × 1.2–2 cm, 6-valved or winged. Seeds fusiform, 1–2 mm long.

*Fl. & Fr.*: November – February.

*Habitat*: Ponds, lakes or temporary pools.

*Distribution*: KWLS: Jeetia Dam, Chattarbar; not common. INDIA: Almost throughout. WORLD: Africa, Australia, Cambodia, China, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Sri Lanka, Thailand and Vietnam; introduced in North America

*Specimen examined*: Jeetia Dam, Chattarbar, 375 m, 24°28'36.5" N, 85°32'20.5" E, 28th February 2012, *Shyam Biswa* 54014.

### 3. VALLISNERIA L.

Tropical, subtropical and temperate regions, 2–6 species, 3 in India and 1 in Jharkhand.

**Vallisneria spiralis** L., Sp. Pl. 2: 1015. 1753; Hook.f., Fl. Brit. India 5: 660. 1888; Haines, Bot. Bihar Orissa: 853. 1922; N.P. Singh & al., Fl. Bihar: 486. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 589. 2002.

**Plate 7C**

Herb, submerged, stoloniferous with fibrous roots. Leaves simple, basal, sessile, linear, linear-oblong or ribbon-shaped, 2–6 × 0.3–0.6 cm, obtuse or truncate at base, faintly denticulate to entire at margins, obtuse to acute at apex, longitudinally brown-black-striped, purplish or pinkish green. Male spathes oblong, *c.* 5 mm long; peduncles 2–3 cm long. Male flowers pedicellate; sepals unequal, recurved; stamen solitary by fusion, or 2, erect. Female spathe 1–2 cm long, enveloping the ovary to more than half its length, bilobed at apex, peduncles filiform, longer to nearly as long as leaves, spirally coiled in fruits. Female flower: solitary; perianth lobes ovate-oblong, 1.5–4 × 1–2 mm, obtuse at apex, persistent; ovary 1.5–2.5 cm long; styles 3, bifid, alternating with scarious and rudimentary petals; stigmas hairy. Fruits to 12 cm long, greenish yellow. Seeds many, fusiform to cylindric, 1.5–3 mm long.

*Fl. & Fr.*: February – April.

*Habitat*: Shallow ponds and lakes.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; occasional. INDIA: Almost throughout. WORLD: South Europe, West Asia to Indo-Pakistan subcontinent.

*Specimens examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49894; near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.2" N, 85°33'00.2" E, 3rd April 2013, *Shyam Biswa* 54152.

### 7. POTAMOGETONACEAE Bercht. & J. Presl, nom. cons.

Cosmopolitan, 7 genera and *c.* 115 species; 1 genus and *c.* 18 species in India.

#### POTAMOGETON L.

Cosmopolitan, *c.* 100 species, 18 in India, 4 in Jharkhand and 1 in KWLS.

**Potamogeton nodosus** Poir. in Lam., Encycl. Suppl. 4: 535. 1816; N.P. Singh & al., Fl. Bihar: 554. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 632. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 936. 2005. *Potamogeton indicus* sensu Hook.f., Fl. Brit. India 6: 565. 1893, non Roxb., 1893; Haines, Bot. Bihar Orissa: 847. 1924. **Plate 7D**

Herb, aquatic, perennial, rhizomatous with creeping rootstocks. Stems, simple or sparsely branched. Leaves simple, opposite, mostly floating, heterophyllous, lanceolate-oblong or elliptic-lanceolate, 3.5–10 × 2–4 cm, cuneate to rounded at base, entire at margins, obtuse to acute at apex, coriaceous, shiny above; petioles 2.5–9 cm long. Stipules, free, lanceolate, 2–6 cm long, amplexicaul, keeled. Peduncles 3–6 cm long. Spikes cylindric, 2–4 × 0.5–1 cm. Flowers 4–5 mm across, ebractate, 4-merous, on a lateral peduncle, densely packed without space between the whorls, greenish or dark pinkish; spikes rising above the surface of water from a membranous spathe or sheath. Perianth 1.5–2 mm long, including the claws; limb 4-lobed; lobes suborbicular, concave, 1–1.5 mm across, valvate. Stamens sessile on perianth, didymous with a cell on each side of the claw, extrose; anthers c. 1 mm long. Carpels 4, sessile, subsessile or decurrent, 1-loculed, 1-ovuled; stigma persistent. Drupelets 4, obliquely obovoid, 3–4 × 2–2.5 mm, shortly beaked, usually with 3 wavy keels, coriaceous or spongy.

*Fl. & Fr.*: February – April.

*Habitat*: Ponds and lakes.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Throughout the plains, Sikkim Himalayas and Andamans. WORLD: Africa, Southwest Asia, Europe, North and South America, Pacific Islands; Bangladesh, China, Indonesia, Japan, Kazakhstan, Myanmar, Nepal, New Guinea, Pakistan, Russia, Sri Lanka, Tajikistan, Thailand, Turkmenistan, Uzbekistan, Vietnam.

*Specimens examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33' 00.0" E, 26th February 2012, *Shyam Biswa* 49881; Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.2" N, 85°33'00.2" E, 3rd April 2013, *Shyam Biswa* 54154.

## 8. DIOSCOREACEAE R. Br., nom. cons.

Tropical and subtropical regions, 3 genera and c. 630 species; 3 genera and 33 species in India.

### DIOSCOREA L., nom. cons.

Tropical and subtropical regions, 616 species, 30 in India, 13 in Jharkhand and 3 in KWLS.

#### Key to Species

- |                                                                                                                                  |                          |
|----------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1a. Stems prickled on lower internodes; leaves 3–5-foliolate                                                                     | <b>3. D. pentaphylla</b> |
| 1b. Stems not prickled on lower internodes; leaves simple                                                                        | <b>2</b>                 |
| 2a. Stems bulbiferous; leaves 7–9-veined, sagittate at base; capsules ovate-oblong, olive green; seeds winged at base only       | <b>1. D. bulbifera</b>   |
| 2b. Stems not bulbiferous; leaves rounded at base, 3–5-veined; capsules obovate-suborbicular, dark green; seeds winged all round | <b>2. D. glabra</b>      |

**1. Dioscorea bulbifera** L., Sp. Pl. 2: 1033. 1753; Haines, Bot. Bihar Orissa: 1122. 1924; N.P. Singh & al., Fl. Bihar: 522. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 602. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1183. 2005; Ranjan, Fl. Parasnath

Wildlife Sanct.:213. 2014. *Dioscorea sativa* Thunb., Fl. Jap.: 151. 1784, non L. 1753; Hook.f., Fl. Brit. India 6: 295. 1892.

**Plate 7E**

Vern. Name: *Geethi*.

Climber, tuberous; tubers globose or elongate, large. Stems bulbiferous in nodes or leaf-axils; bulbils warted. Leaves simple, opposite and alternate, broadly ovate, 3–6 × 5–7 cm, cordate or sagittate at base, entire at margins, acuminate at apex, variable in size, glaucous beneath, prominently 8 or 9-veined at base; petioles 2–3.2 cm long. Male inflorescence: spikes borne in fascicles on elongated axillary axis, sometimes in groups of 4–6 in axils of main stem; spikes 4–15 cm long, slender; flowers solitary, sessile; bracts lanceolate, acuminate, shorter than flowers, membranous. Male flowers 2–5 × c. 4 cm; bracts cup-shaped, one long one short, ovate, c. 1 mm long, acute at apex, glabrous. Perianth, erect, 6-lobed; lobes more or less free, linear-lanceolate, c. 2 × 0.5 mm, subacute, whitish in bud, becoming green, pinkish or purple with numerous pink or purplish dots when mature. Stamens 6; filaments c. 0.5 mm long; anthers c. 0.5 mm long, didymous; pistillodes 3-lobed. Female spikes axillary in groups of 2–5, flowers overlapping. Female flowers: perianths similar to male, white, sweet-smelling; staminodes 6. Ovary triquetrous; styles 3, very short; stigmas 3, c. 0.8 mm long. Capsules reflexed, oblong-elliptic 1.8–2.4 × 1–1.5 cm, subtruncate at apex; wings 6–7 mm wide. Seeds winged at base; wings oblong, c. 8 × 4 mm.

*Fl. & Fr.*: September – February.

*Habitat*: Dry deciduous and Sal forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; common. INDIA: Eastern and Peninsular India and Himalayas. WORLD: Africa, Bhutan, Cambodia, China, Japan, Korea, Madagascar, Myanmar, Oceania, Thailand, Vietnam and also introduced to the New World.

*Specimens examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49561; Dhodhakola forest, 367 m, 24°33'33.4" N, 85°39'21.7" E, 28th September 2013, *Shyam Biswa* 54191.

**2. *Dioscorea glabra*** Roxb., Fl. Ind. 3: 804. 1832; Hook.f., Fl. Brit. India 6: 294. 1892; Haines, Bot. Bihar Orissa: 1119. 1924; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 603. 2002. *Dioscorea nummularia* Roxb., Fl. Ind.: 3803. 1832, non Lam.; Haines, Forest Fl. Chota Nagpur: 529. 1910.

**Plate 7F**

Vern. Name: *Pita alu* (Hindi).

Climber, leafless when fruiting; tubers stalked, elongate, to 50 × 4 cm, white. Stems terete, glabrous, not bulbiferous. Leaves simple, opposite, upper oblong-elliptic to narrowly ovate, 6–12 × 3.2–7 cm, truncate or very shallowly cordate at base, entire at margins, cuspidate or acuminate at apex; lower leaves larger, to 16.5 × 9.5 cm, cordate with rounded basal lobes; petioles shorter than to almost equalling blade. Male inflorescence: spikes in groups of 4–7 on slender axis; axis single or paired in axils, 9–31 cm long; spikes slender, to 2 cm long; flowers distant, sessile; bracts minute. Male flowers: petals and sepals erect; sepals triangular-ovate, 1.2–1.5 × 1.1–1.2 mm, narrowly scarious at margins, brown; petals oblanceolate, 1.3–1.5 × c. 0.7 mm, thick; anthers c. 0.3 mm long, about equalling filaments. Female spikes single or paired, bearing flowers throughout. Female flowers like male; style c. 0.2 mm long. Capsules triangular or 3-winged,



1.5–2.5 × 3–3.5 cm along with the wings, shallowly retuse at apex, glossy, bright whitish green. Seeds 2 in each locule, roundish, 1.5–1.7 × 1.6–1.8 cm, surrounded by light brownish wing.

*Fl. & Fr.*: September – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Lokai forest; occasional. INDIA: Peninsular & East India, Himalaya. WORLD: Bhutan, Cambodia, China, Indonesia, Laos, Malaysia, Myanmar, Nepal, Thailand and Vietnam.

*Specimen examined*: Lokai forest, 391 m, 24°29'02.9" N, 85°37'04.4" E, 28th February 2011, *Shyam Biswa* 53902.

**3. *Dioscorea pentaphylla* L.**, Sp. Pl. 2: 1032. 1753; Hook.f., Fl. Brit. India 6: 289. 1892; Haines, Bot. Bihar Orissa: 1123. 1924; N.P. Singh & al., Fl. Bihar: 524. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 604. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1184. 2005. *Dioscorea jacquemontii* Hook.f., Fl. Brit. India 6: 290. 1892.

#### Plate 7G

Vern. Names: *Kantaalu* (Hindi); *Khania kanda* (Kharwari).

Climber, tuberous; tubers elongated to globose-pyriform, covered by short bristly roots. Stems densely prickled on lower internodes, glabrescent; bulbils many, globose-ellipsoid, brown. Leaves compound, 3–5-foliolate, pubescent beneath; petioles 1.5–5.5 cm long, prickled; leaflets broadly oblanceolate-obovate, 3–8 × 1–4 cm; middle one largest, obtuse or rounded at base, entire at margins, shortly acuminate at apex. Male flowers pale-greenish, fragrant, in a shortly pedunculate raceme of *c.* 3 cm long; bracts and bracteoles near apex of pedicels. Outer perianth lobes lanceolate, *c.* 1 mm long; inner ones rather broader and blunt. Stamens 3, perfect; anthers subsessile; staminodes 3, minute. Pistillodes 3-lobed. Female flowers in axillary spikes; spikes 5–12 cm long, pendulous, pubescent. Capsules oblong, 2–2.4 cm long, subtruncate at base, with rounded angles near apex, more or less black when ripe, 3-winged; wings 6–7 mm wide. Seeds oblong, *c.* 3 × 4 mm, basally winged; wings 1–1.3 × 0.5–0.6 cm.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests, on the hills.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; common. INDIA: Throughout. WORLD: South and Southeast Asia.

*Specimens examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49562; Dengra Pahar, near RIT institute, Chattarbar, 419 m, 24°27'58.8" N, 85°34'23.2" E, 13th August 2011, *Shyam Biswa* 49790.

### 9. COLCHICACEAE DC., nom. cons.

Australia, South Africa to West Europe and West Asia, North America, *c.* 15 genera and *c.* 255 species; 5 genera and 13 species in India

#### Key to genera

1a. Herbs; leaves linear, acute at apex; perianth lobes entire

**1. *Iphigenia***

1b. Climbers; leaves ovate to lanceolate, cochleate or tendrillar at apex; perianth lobes wavy at margins

**2. *Gloriosa***

1. **IPHIGENIA** Kunth nom. cons.

Old World Tropics, 12 species, 6 in India and 1 in Jharkhand.

**Iphigenia indica** (L.) A. Gray ex Kunth, Enum. Pl. 4: 213. 1843; Hook.f., Fl. Brit. India 6: 357. 1892; Haines, Bot. Bihar Orissa: 1097. 1924; N.P. Singh & al., Fl. Bihar: 529. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1168. 2005. *Melanthium indicum* L., Mant. Pl. 226. 1771.

**Plate 8A**

Herb, 20–40 cm high; corms globose. Stems flexuous, leafy. Leaves simple, basal, linear, 9–41 × 0.4–0.7 cm, sheathing and clasping at base, entire at margins, acute at apex, glabrous, midrib prominent, with many parallel veins. Flowers 1–3, axillary and terminal; bracts linear, 1.5–2.5 cm long; pedicels 0.5–1 cm long. Perianth lobes 6, linear to narrowly oblanceolate, 7–10 × 0.7–1 mm, purplish, stellately spreading, deciduous. Stamens 6, 2–3 mm long; anthers *c.* 1 mm long, dorsifixed, versatile. Ovary sessile, 3-loculed; styles linear, connate at base; stigmatic lobes recurved; ovules many in each locule. Capsules obovoid to oblong, 1.5–1.8 × 0.5–0.8 cm, glossy, brownish. Seeds subglobose, brown.

*Fl. & Fr.*: September – November.

*Habitat*: Shade localities in dry deciduous forests.

*Distribution*: KWLS: Koderma NRF, near the Phulwarwaria jungle; not common. INDIA: Almost throughout. WORLD: Australia, Cambodia, China, Indonesia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Koderma NRF, near Phulwarwaria jungle, 390 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49538.

2. **GLORIOSA** L.

Old World tropical regions, 10–18 species and 1 in India.

**Gloriosa superba** L., Sp. Pl. 1: 305. 1753; Hook.f., Fl. Brit. India 6: 358. 1892; Haines, Bot. Bihar Orissa: 1093. 1924; N.P. Singh & al., Fl. Bihar: 528. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 607. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1167. 2005.

**Fig. 1; Plate 8B & C**

Vern. Names: *Karihari, Langali* (Hindi); *Seyar, Siyar Phool*.

Climber; rhizomes tuberous. Stems branched, glabrous. Leaves simple, alternate, whorled, ovate to lanceolate, 9–14 × 1–3 cm, rounded or amplexicaul at base, entire at margins, cochleate or tendrilled at apex; venation finely parallelodromous, from base to apex, glabrous. Flowers solitary or in a corymb, large, long- pedicelled. Perianth lobes 6, oblong-lanceolate, 6–8 × 0.5–0.7 cm, tapering at ends, wavy at margins, bright yellowish orange or scarlet-yellowish. Stamens 6, free, inserted at the base of perianth lobes; filaments 4.5–5.5 cm long, glabrous; anthers 1–1.2 cm long, dorsifixed, dehiscing by longitudinal slits. Ovary 3-loculed; ovules many per locule; style to 5 cm long, apically 3-lobed; stigmatic lobes 5–6 mm long. Capsules oblongoid, 3–5.5 × 1–2.5 cm, smooth, green. Seeds many, dorsally compressed, subglobose, 3.5–4 mm across, warty.

*Fl. & Fr.*: September – October.

*Habitat*: Open localities in jungle.



**Fig 1. *Gloriosa superba* L.:** a. flowering twig; b. petal; c. stamen; d. carpel; e. fruit.



*Distribution:* KWLS: Phulwarwaria jungle, Koderma NRF; common. INDIA: Throughout. WORLD: Cambodia, China, Indonesia, Laos, Malaya, Malaysia, Myanmar, Nepal, Sri Lanka, South and tropical Africa, Thailand and Vietnam.

*Specimen examined:* Near Phulwarwaria jungle, Koderma NRF, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49545.

#### 10. SMILACACEAE Vent., nom. cons.

Tropical and sub-tropical regions, 2 genera and *c.* 360 species; 2 genera and 33 species in India.

##### SMILAX L.

Tropical and temperate regions, *c.* 350 species, 24 in India, 9 in Jharkhand and 1 in KWLS.

**Smilax zeylanica** L., Sp. Pl. 2: 1029. 1753; Hook.f., Fl. Brit. India 6: 309. 1892; Haines, Forest Fl. Chota Nagpur: 520. 1910 & Bot. Bihar Orissa: 1087. 1924; N.P. Singh & al., Fl. Bihar: 530. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1180. 2005. **Plate 8D**

Climber. Stems woody, prickly; branches slender, more or less 4-angled with few prickles; branchlets often zig-zag. Leaves simple, alternate, elliptic, ovate-oblong or orbicular, 6–16.5 × 3–13.5 cm, rounded or subcordate at base and decurrent on petiole, entire at margins, acute to acuminate at apex; veins palmate 7–9, glabrous; petioles 0.5–2 cm long, jointed in the middle, narrowly sheathing at base, but not auricled. Umbels solitary or 2 or 3, many-flowered; peduncles 1.5–2 cm long, bracteate at base; pedicels slender, 5–7 mm long. Staminate flowers: pedicels 5–10 mm long; tepals 6, pale green; inner 3 linear, 7–10 × 1–2 mm, outer broader; filaments 7–8 mm long, pale green, anthers *c.* 1.5 mm long, white. Pistillate flowers: tepals lanceolate, *c.* 4 × 1.5 mm, pale green; ovary trigonous; stigmas *c.* 1 mm long, flattened on upper surface, papillose, greenish-yellow; staminodes 6, awl-like, 1–1.2 mm long. Berries orbicular or obovoid, 6–10 mm across, glossy, smooth, green turns red to blackish when ripe, loosely packed. Seeds 1–3, biconvex.

*Fl. & Fr.:* August – April.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Lokai forest; very common. INDIA: Throughout on hill tops. WORLD: Tropical Asia.

*Specimen examined:* Lokai forest, 390 m, 24°29'18.7" N, 85°35'50.1" E, 10th August 2011, *Shyam Biswa* 49771.

#### 11. ORCHIDACEAE Juss., nom. cons.

Cosmopolitan, 779 genera and *c.* 22500 species; 184 genera 1229 species in India.

##### Key to species

- |                                                                                                                                                                                |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 1a. Plants epiphytic; velamen present                                                                                                                                          | <b>3. Vanda</b>     |
| 1b. Plants terrestrials; velamen absent                                                                                                                                        | <b>2</b>            |
| 2a. Underground stem a chain of tubers; lip spleen-shaped, slightly recurved at tip, not spurred; pollinia softly granular or in small masses, held together by viscid threads | <b>1. Eulophia</b>  |
| 2b. Underground stem not in a chain of tubers; lip usually 3-lobed, always spurred at base; pollinia waxy, 1–4 in each cell                                                    | <b>2. Habenaria</b> |

## 1. **EULOPHIA** R.Br.

Tropical regions, *c.* 250 species, *c.* 30 in India and *c.* 10 in Jharkhand.

**Eulophia picta** (R.Br.) Ormerod, Checkl. Papuasian Orchids 293. 2017. *Geodorum densiflorum* (Lam.) Schltr., Repert. Spec. Nov. Regni Veg. Beih. 4: 259. 1919; N.P. Singh & al., Fl. Bihar: 493. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 592. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1188. 2005. *Limodorum densiflorum* Lam, Encycl. 3: 516. 1792. *Geodorum purpureum* R. Br. in Aiton, Hort. Kew., ed. 2, 5: 207. 1813; Hook.f., Fl. Brit. India 6: 16. 1890. *Geodorum dilatatum* auct. non R. Br. 1813; Hook.f., Fl. Brit. India 6: 17. 1890; Haines, Bot. Bihar Orissa: 1170. 1922; Mooney, Suppl. Bot. Bihar Orissa: 211. 1950.

### Plate 8E

Herb, terrestrial; roots with chain of roundish tubers with concentric circular rings. Leaves simple, basal, lanceolate, 14–29 × 4–7.2 cm, attenuate at base, entire at margins, acute at apex, glabrous, shiny above with prominent parallel veins. Scape solitary from rootstock, sheathed, 20–24 cm long, ribbed; bracts 3–4 × 0.5–1 cm. Flowers crowded in decurved racemes with narrow membranous bracts. Sepals acute at apex, 3–5-veined, green; dorsal sepal oblong, 1–1.2 cm long; lateral sepal 1–1.2 cm long. Petals 1.1–1.2 cm long, rather broader, white; lip spleen-shaped, 1.5–1.3 cm long, slightly recurved at tip, white and pink-veined and yellow, quite smooth veins ending in irregular small tubercles. Column short; anther 2-celled, appendaged after dehiscence by the persistent detached faces of the cells; pollinia 2, broad foveolate, sessile or subsessile on a broad strap or gland. Capsules tapering with 6 prominent ridges, 2.5–3 × 1–1.5 cm, smooth, greenish.

*Fl. & Fr.*: July – August.

*Habitat*: On shady places in dry deciduous mixed forests.

*Distribution*: KWLS: Taraghati forest, near sanctuary gate; rare. INDIA: Peninsular India. WORLD: Australia, Cambodia, China, Indonesia, Japan (Ryukyu Islands), Laos, Malaysia, Myanmar, New Guinea, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Taraghati forest, near sanctuary gate, 316 m, 24°32'13.5" N, 85°34'59.5" E, 18th August 2011, *Shyam Biswa* 49831.

## 2. **HABENARIA** Willd.

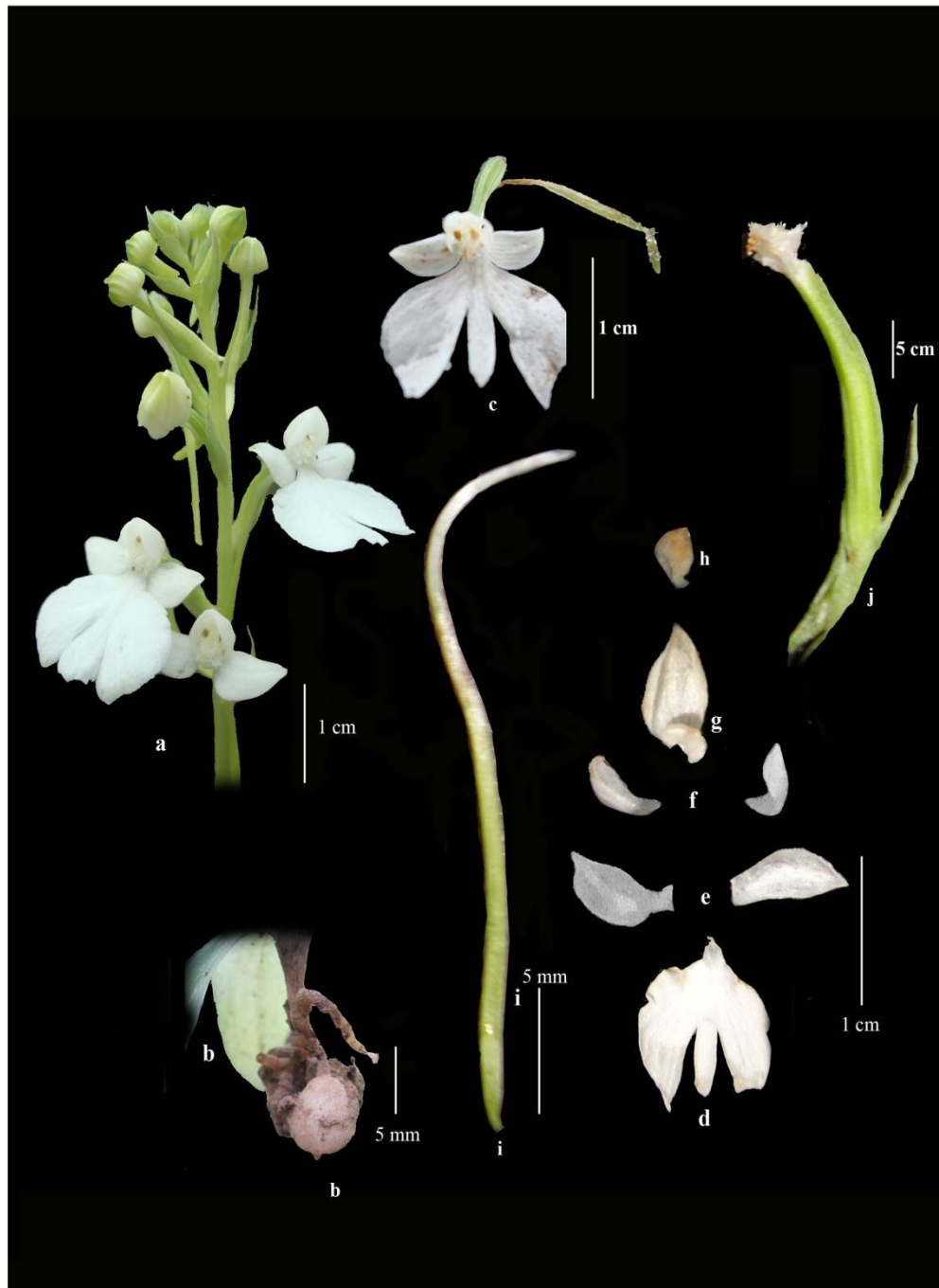
Pantropical and subtropical, *c.* 600 species, *c.* 100 in India, 13 in Jharkhand and 1 in KWLS.

**Habenaria plantaginea** Lindl., Gen. Sp. Orchid. Pl.: 323. 1835; Hook.f., Fl. Brit. India 6: 141. 1890; Haines, Bot. Bihar Orissa: 1155. 1924; N.P. Singh & al., Fl. Bihar: 495. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 206. 2014.

### Fig.2; Plate 8F

Herb, terrestrial, tuberous. Leaves 2–5 (rarely to 7), basal, oblong or elliptic-oblong, 4.5–8.5 × 1.5–3.3 cm, glossy, fleshy. Scape slender, 10–30 cm long with lax spike of white flowers. Lateral sepals mostly spreading or reflexed, falcate, *c.* 5 × 3 mm; dorsal sepal cucullate (hood-shaped), *c.* 5 mm long. Petal 2-partite with often filiform segments; lip usually 3-lobed always spurred at base, side-lobe semi-ovate, *c.* 1 × 1.1 cm, acute at apex, open, midlobe linear, *c.* 1 × 0.2 cm; spur *c.* 2.5 cm long. Anther tubes short upcurved; pollinia 2, with long caudicles enclosed in tubes. Ovary beaked about half as long as spur, slender; bracts about half as long as ovary. Capsules fusiform with short slender beak.

*Fl. & Fr.*: September – October.



**Fig. 2.** *Habenaria plantaginea* Lindl.: a. flowering shoot; b. tuber; c. flower; d-h. dissected part of the flower; h. androceium; i. spur; j. gynoecium.



*Habitat*: Shady places in dry deciduous forests.

*Distribution*: KWLS: Dhodhakhola forest; Taraghati forest; rare. INDIA: Almost throughout. WORLD: Lesser Sunda Island (Timor) and Myanmar.

*Specimen examined*: Dhodhakhola forest, 367 m, 24°34'33.6" N, 85°39'21.7" E, 6th September 2010, *Shyam Biswa* 49580; Taraghati forest, 320 m, 24°32'32.1" N, 85°35'06.0" E, 27th September 2013, *Shyam Biswa* 54199.

### 3. **VANDA** Jones ex R. Br.

Himalaya to Australia, 46 species, 12 in India, 3 in Jharkhand and 1 in KWLS.

**Vanda tessellata** (Roxb.) Hook. ex G. Don in Loud., Hort. Brit.: 372. 1830; Haines, Bot. Bihar Orissa: 1181. 1924; N.P. Singh & al., Fl. Bihar: 504. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 594. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1190. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 209. 2014. *Epidendrum tessellatum* Roxb., Pl. Coromandel 1: 34, t. 42. 1795. *Vanda roxburghii* R. Br., Bot. Reg. 6: t. 506. 1820; Hook.f., Fl. Brit. India 6: 52. 1890.

**Plate 8G**

Vern. Names: *Banda* (Hindi); *Parjiwe*.

Herb, epiphytic; roots hanging with velamen. Stems fleshy, terete, glabrous. Leaves sessile, simple, complicate, premorse, linear, folded, 6–22 × 0.5–2 cm; base covering the stem, entire at margins, acute or tapering at apex, parallel-veined, thick-fleshy, glabrous. Inflorescence a simple, axillary raceme. Flowers tessellated, bisexual, 4–5 cm across; pedicels 3–4 cm long. Dorsal sepal 1, obovate, 2–2.5 × 0.5–0.8 cm, clawed, wavy at margins, tessellate, yellowish with brown spots; lateral sepals 2, obovate, c. 2 × 0.5 cm, clawed, wavy at margins, tessellate, yellowish with brown spots; lateral petals 2, obovate, 2–2.5 × 0.6–0.8 cm, clawed, wavy at margins, tessellate, yellowish with brown spots; lip 5–10 mm long, white and violet, midlobe with dilated truncate, 2-lobed tip; spur conical. Column c. 5 mm long, stout with scarcely produced foot, whitish; anthers 2-celled; rostellum obscure; pollinia 2, didymous, subglobose or obovoid with broad, flat, geniculate caudicle and rather large gland. Capsules club-shaped, 4.8–8.5 cm long, ribbed, green turning brownish when mature.

*Fl. & Fr.*: April – September.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Way to Basraon forest; moderately common. INDIA: Almost throughout. WORLD: Indochina.

*Specimen examined*: Way to Basraon forest, 337 m, 24°34'33.6" N, 85°38'34.0" E, 6th September 2010, *Shyam Biswa* 49578.

## 12. **HYPOXIDACEAE** R. Br., nom. cons.

Southern Hemisphere to Tropical Africa Mountains and North America,  
9 genera and c. 120 species; 3 genera and 9 species in India.

### **CURCULIGO** Gaertn.

Tropical regions, c. 20 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

**Curculigo orchioides** Gaertn., Fruct. Sem. Pl. 1: 63, t. 16. 1788; Hook.f., Fl. Brit. India 6: 279. 1892; Haines, Bot. Bihar Orissa: 1112. 1924; Mooney, Suppl. Bot. Bihar Orissa: 203. 1950; N.P.

Singh & al., Fl. Bihar: 519. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 599. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1166. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 212. 2014.

**Plate 9A**

Vern. Name: *Kalamusali* (Hindi).

Herb, to 25 cm high; rootstock a tuberous or elongated cylindrical rhizomes covered with remains of old leaves. Leaves simple, basal, sessile or narrowed into a short petiole, linear-lanceolate or lanceolate-oblong to elliptic, 10–23.5 × 1.2–2.6 cm, attenuate or tapering at base, entire, long-ciliate at margins, acute or narrowly acuminate at apex, glabrous or with a few long hair on veins beneath; petioles to 2.5 cm long. Leaf-sheaths persistent. Scapes 2–3 cm long, sheathed with bracts; bracts lanceolate, acuminate, 1.5–6 × 0.2–0.8 cm, spathaceous, whitish. Perianth lobes 6, lanceolate-oblong, 5–6 × 1.5–2 mm, acute at apex, pilose outside, bright yellow. Stamens 6, adnate to base of perianth; anthers dorsifixed, green or yellow, 2-celled. Ovary narrowly oblongoid, c. 4 mm long, densely hairy, 3-loculed; ovules 2 or more in each locule; style stout; stigma linear, 3-cleft. Berries subfusiform, 1.5–2 cm long, with a short beak, hairy at apex. Seeds subglobose or ellipsoid, c. 2.5 mm long, beaked, shiny, dark brown or black.

*Fl. & Fr.*: May – September.

*Habitat*: Shade and moist localities in dry deciduous forest.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; common. INDIA: Andaman and Nicobar Islands, Peninsular and Northeast India and subtropical Himalayas. WORLD: Tropical and subtropical Asia to West Pacific.

*Specimen examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49563.

### 13. ASPARAGACEAE Juss., nom. cons.

Sub-cosmopolitan, 153 genera and c. 2500 species; 28 genera and c. 100 species in India.

#### Key to genera

- 1a. Shrubby woody; leaves with spine; radical flowers borne on naked scapes, flowers with superior often gamophyllous petaloid perianth, sometimes with a corona **1. Agave**
- 1b. Herb or climbing shrubs; leaves simple without spine sometimes reduced to scales/cladode; perianth petaloid or sepaloid **2**
- 2a. Climbing usually prickly shrubs; leaves not evident, cladodes acicular; fruit berry globose or lobed not winged **2. Asparagus**
- 2b. Herbs, not prickly; leaves evident, linear-lanceolate; fruit a capsule 3-winged **3. Chlorophytum**

#### 1. AGAVE L.

Southern United States to West Panama, Caribbean and Venezuela, 221 species, c. 6 in India, 5 in Jharkhand (2 cultivated) and 1 in KWLS.

**Agave americana** L., Sp. Pl. 1: 323. 1753; Haines, For. Fl. Chota Nagpur: 526. 1910 & Bot. Bihar Orissa 1104. 1924; N.P. Singh & al., Fl. Bihar: 520. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1172. 2005.

**Plate 9B**

Vern. Name: *Siju*.

Shrub, pole to 5 m high, hidden by thick leaf bases. Leaves simple, basal, linear-lanceolate, 42–150 × 3–12 cm; widest just above the middle, truncate at base, curved spine, upward spine reddish at margin, apical and terminal spine 1.5–2 cm dark brown at apex parallel veined, thick fleshy, glabrous, sessile. Flowers, in pairs with a subsidiary bud laterally developed at a different level. Tepals linear lanceolate, pale amber tint, cup herbaceous, anthers much exerted, Ovary smooth, cylindric longer than perianth, style very faintly lobed. Capsules rather turgid, oblong cylinderoc tip rounded. Seeds black shining.

*Fl. & Fr.*: July – November.

*Habitat*: Dry deciduous forests and scrub forests.

*Distribution*: KWLS: Chittarpur forest; occational. INDIA: WORLD: Native to tropical America, widely cultivated.

*Specimen examined*: Chittarpur forest, 333 m, 24°32'02.2" N, 85°34'47.0" E, 22nd November 2012, *Shyam Biswa*, 54078.

## 2. ASPARAGUS L.

Old World, Europe and Africa to North Australia, c. 120 species, c. 20 in India, 2 Jharkhand and 1 in KWLS.

**Asparagus racemosus** Willd., Sp. Pl., ed. 4. 2: 152. 1799; Hook.f., Fl. Brit. India 6: 316. 1862; Haines, Bot. Bihar Orissa: 1089. 1924; N.P. Singh & al., Fl. Bihar: 526. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 606. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1161. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 214. 2014.

### Fig. 3; Plate 9C & D

Vern. Name: *Satavar* (Hindi).

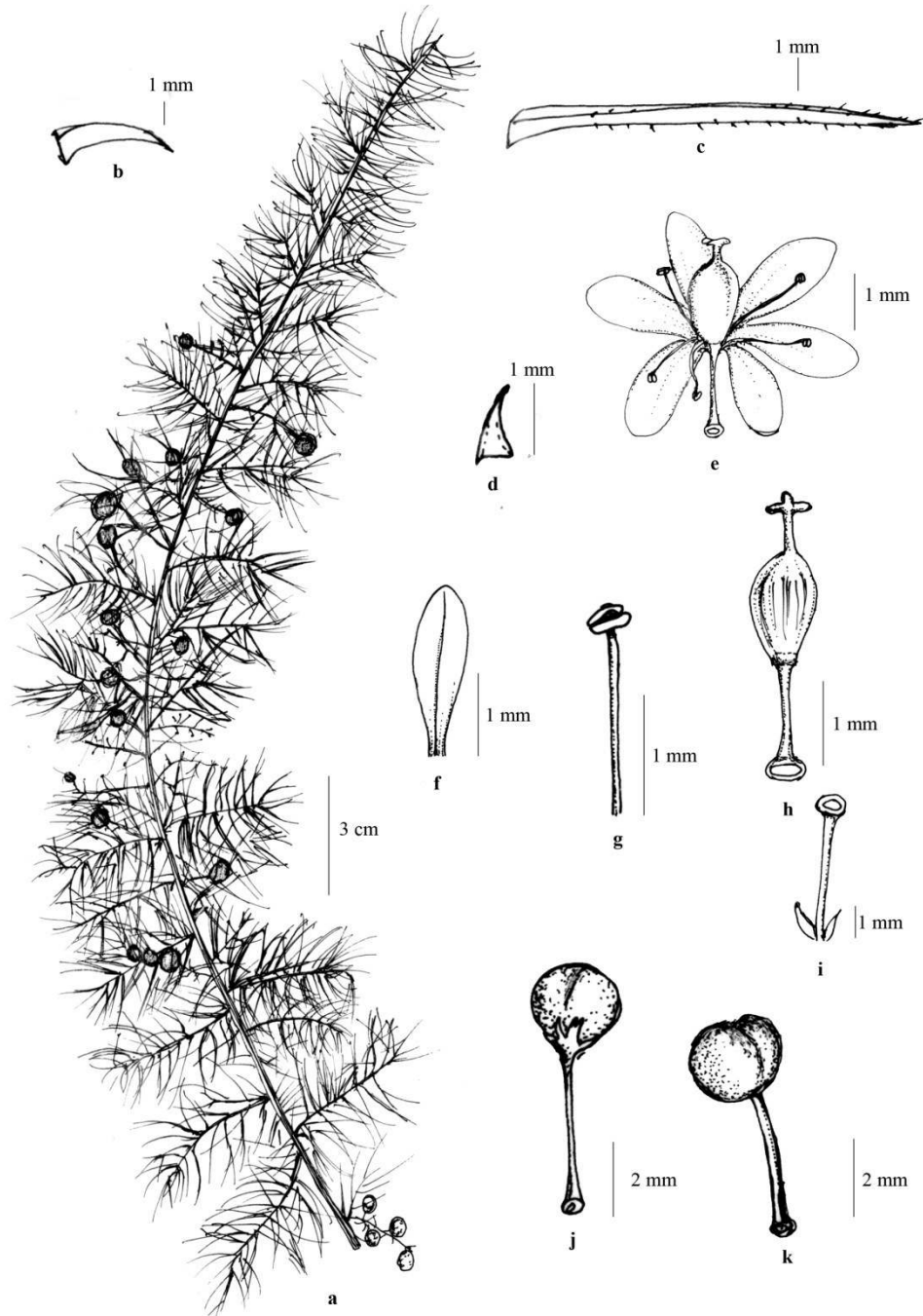
Scandent. Stems with strong reflexed thorns, 5–7 mm long, reddish. Leaves reduced to minute scales, c. 1 mm, often spinescent. Cladodes acicular and 3-quetrous, falcate 0.8–1.5 cm long truncate at base, finely or minutely serrate at margins, finely acuminate at apex. Inflorescence racemes, 1.5–3 cm long bracts c. 1 mm long. Flowers small, axillary, bisexual, racemed on jointed pedicel, 4–5 mm in diameter white, fragrant; pedicels jointed c. 1 + 4–5 mm; bracteoles lanceolate or spatulate, c. 1mm long. Perianth petaloid 6, narrowly oblanceolate or lanceolate, c. 2 × 0.8–1 mm, white. Stamens 6, filaments 1.5–2 mm long, free; anthers round or oblong, c. 0.2 mm. Ovary obovoid, 1–1.5 × c. 1 mm,; style c. 0.5 mm; stigma 3-fid., Berry globose or lobed 4–5 mm in diameter, glossy, turns blackish with age, 1–2-seeded; seed somewhat globose, black.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF near the Phulwarwaria jungle; not very common.INDIA: Throughout the plains and in the dry hills of the lower Himalayas. WORLD: Africa, Australia, Bhutan, China, Malaysia, Myanmar, Nepal, and Pakistan.





**Fig. 3.** *Asparagus racemosus* Willd.: a. fruiting twig; b. thorn; c. cladode; d. bract; e. flower; f. petal; g. stamen; h. carpel; i. pedicel; j, k. berry.

*Specimens examined:* Koderma NRF near the Phulwarwaria jungle, 393m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010 *Shyam Biswa* 49540; Lokai forest, 390 m, 24°29'18.7" N, 85°35'50.1" E, 10th August 2011, *Shyam Biswa* 49772.

### 3. **CHLOROPHYTUM** Ker Gawl.

Old World Tropical and subtropical regions, 198 species, 17 in India, 5 in Jharkhand and 1 in KWLS.

**Chlorophytum arundinaceum** Baker, J. Linn. Soc., Bot. 15: 323. 1876; Hook.f., Fl. Brit. India 6: 333. 1892; Haines, Bot. Bihar Orissa: 1098. 1924; Mooney, Suppl. Bot. Bihar Orissa: 203. 1950; N.P. Singh & al., Fl. Bihar: 527. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 606. 202; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1162. 2005. **Plate 9E**

Herb 50–60 cm high, scape solitary, roots fibrous with thick cylindrical tubers at the ends. Leaves simple, basal, suberect, linear-lanceolate, 36–58 × 3.5–4 cm; broad amplexicaul, attenuate at base, entire at margin, long acuminate to apex, with prominent raised parallel veins. Inflorescence terminal dense flowered racemes or contracted panicles. Flowers white with lanceolate-acuminate bracts 1–1.2 cm long and overtopping the shortly pedicelled buds. Pedicel 8–10 mm, jointed in the middle or slightly below the middle. Tepals oblong-lanceolate, c. 1cm long, white. Anthers as long as or longer than the filaments, straight, green to yellow. Capsule 1–3 at each node, roundish 5–7 × 7–12 mm, 3-winged. Seeds roundish 3.5–4 mm, blackish compressed turgid, minutely tessellate or punctuate.

*Fl. & Fr.:* August – November.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Khalaktambi forest; rare. INDIA: Almost throughout. WORLD: Myanmar and Nepal.

*Specimen examined:* Khalaktambi forest, 370 m, 24°30'29.0" N, 85°35'10.1" E, 12th August 2011, *Shyam Biswa* 49783.

### 14. **ARECACEAE** Bercht. & J. Presl, nom. cons. (=PALMAE Juss. nom. cons.)

Tropical and Sub-tropical regions, 189 genera and 2400 species; 24 genera 94 species in India.

#### **PHOENIX** L.

Tropical and sub-tropical regions, 13 species, 7 in India, 4 in Jharkhand and 1 KWLS.

**Phoenix sylvestris** (L.) Roxb., Fl. Ind. 3: 787. 1882; Becc. & Hook.f. in Hook.f., Fl. Brit. India 6: 425. 1892; Haines, Bot. Bihar Orissa: 881. 1924; N.P. Singh & al., Fl. Bihar: 541. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 622. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 945. 2005. *Elate sylvestris* L., Sp. Pl. 2: 1189. 1753.

**Plate 9F**

Vern. Name: *Khajur* (Hindi).

Tree robust. Trunk rough, covered with petiolar bases. Leaves 2–4 m long, lower ones arching; petioles spinescent; leaflets in several fascicles, 15–45 × 2–3 cm, narrowed at base, acuminate and spinescent at apex, greyish green; spines on petioles to 10 cm long. Male flowers white, scented. Spadix 6–90 cm long, erect; branches filiform. Spathes 30–40 cm long, scurfy, separating into 2 boat-shaped valves. Flowers numerous, angular, oblique, 6–8 mm long. Calyx

cup-shaped with 3 short rounded lobes. Petals 3 or 4 times as long as the calyx, concave, warted outside. Filaments very short, free; anthers linear. Female flowers: Spadix and spathe as in male; fruiting peduncles short, *c.* 15 cm long. Flowers distant, roundish. Calyx cup-shaped, obsoletely 3-lobed. Petals 3, very broad, convolutedly imbricate. Staminodes 3 or 4. Fruiting spadix *c.* 65 cm long, much compressed, golden orange. Drupes terete, 2.5–3 cm long, orange to reddish brown; pericarp very scanty, sweet. Seeds oblongoid, 2–2.5 cm long, rounded at ends, pale brown; fruiting peduncles 20–75 cm long, terminating in large branches of spadices.

*Fl. & Fr.*: February – June.

*Habitat*: In open areas and cultivated.

*Distribution*: KWLS: Lokai forest; very common. INDIA: Throughout. WORLD: Myanmar.

*Specimen examined*: Lokai forest, 385 m, 24°29'02.9" N, 85°37'04.4" E, 28th February 2011, Shyam Biswa 49643.

## 15. COMMELINACEAE Mirb., nom. cons.

Tropical to subtemperate regions, *c.* 40 genera and *c.* 600 species; 14 genera and *c.* 90 species in India.

### Key to genera

- |                                                                                      |                     |
|--------------------------------------------------------------------------------------|---------------------|
| 1a. Cymes panicled, naked                                                            | <b>3. Murdannia</b> |
| 1b. Cymes simple, subtended by spathe                                                | <b>2</b>            |
| 2a. Bracts spathaceous; petals free; fertile stamens 3; filaments glabrous           | <b>1. Commelina</b> |
| 2b. Bracts foliaceous; petals united into a tube; fertile stamens 6; filaments hairy | <b>2. Cynotis</b>   |

### 1. COMMELINA L.

Tropical and subtropical regions, *c.* 170 species, 23 in India, 7 in Jharkhand and 2 in KWLS.

### Key to species

- |                                                                                                                                                                   |                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1a. Leaves petiolate; sheaths long-ciliate at mouth; spathes 1–3 together, conical in form, 1–1.5 long                                                            | <b>1. C. benghalensis</b> |
| 1b. Leaves sessile, sheath short or without ciliate at mouth; spathe single, stalked, terminal on main and lateral branches, spathes ovate, <i>c.</i> 2.8 cm long | <b>2. C. suffruticosa</b> |

**1. Commelina benghalensis** L., Sp. Pl. 1: 41. 1753; Hook.f., Fl. Brit. India 6: 370. 1892; Haines, Forest Fl. Chota Nagpur: 535. 1910 & Bot. Bihar Orissa: 1077. 1924; Mooney, Suppl. Bot. Bihar Orissa: 199. 1950; N.P. Singh & al., Fl. Bihar: 532. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 612. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 964. 2005.

### Plate 10A

Vern. Name: *Kanchara* (Hindi).

Herb, perennial, decumbent or ascending. Stems creeping and rooting below, glabrous. Leaves simple, alternate, sessile, ovate or elliptic-ovate, 4–7 × 2.3–4.8 cm, rounded, subtruncate or subacute and slightly oblique at base, entire or ciliate at margins, obtuse or rounded at apex, subglabrous; petioles 4–5 mm long; sheaths with an oblique, long-ciliate at mouth, 1–1.5 cm long. Spathes 1–3 together, conical, subsessile, auricled at base on one side, 1–1.5 × 1.5–2 cm, hairy outside. Inflorescence a 2-nate cyme; upper branch 2 or 3-flowered; lower ones usually 1, rarely 2-flowered, sometimes 0; peduncles 1–1.5 cm long; pedicels 3–4 mm long. Sepals 3, unequal; outer one ovate-lanceolate, 3–3.2 × 1.3–1.5 mm; inner ones suborbicular, *c.* 3.2 mm



across. Petals 3, *c.* 4 × 4.5 mm, bluish; larger ones broadly ovate; smaller one shallowly notched, *c.* 2.5 × 1.5 mm. Stamens 3, perfect, to 3.5 mm long; staminodes 2 or 3; filaments filiform, often bearded with joint hairs; anthers oblong. Cleistogamous flowers ovoid, 4–6 mm long. Capsules short-stalked, trigonous, *c.* 6 × 4 mm, membranous, 3-loculed, 3-valved; 2 anterior locules larger, 2-seeded each, dehiscent; posterior locule smaller, 1-seeded, tardily dehiscent. Seeds subquadrate to oblongoid, 2–3 mm long, rugose, closely pitted, brown.

*Fl. & Fr.*: September – November.

*Habitat*: On the shady places of dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure forest, Koderma NRF; abundant. INDIA: Throughout. WORLD: Africa, China, Japan and Malesia.

*Specimen examined*: Inside the enclosure forest, Koderma NRF, 8th September 2010, 388 m, 24°29'18.7" N, 85°35'50.1" E, *Shyam Biswa* 53911.

**2. *Commelina suffruticosa*** Blume, Enum. Pl. Jav. 1: 3. 1827; Hook.f., Fl. Brit. India 6: 374. 1892; Haines, Forest Fl. Chota Nagpur: 535. 1910 & Bot. Bihar Orissa: 1078. 1924; Mooney, Suppl. Bot. Bihar Orissa: 199. 1950; N.P. Singh & al., Fl. Bihar: 533. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 616. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 216. 2014.

**Plate 10B**

Herb, 20–45 cm high, with fleshy rhizomes. Stems thickened at nodes, glabrous. Leaves sessile, simple, alternate, lanceolate, 7–15.2 × 2.5–4 cm, unequal at base, entire at margins, acuminate at apex, with 4 or 5 parallel prominent veins, glabrous; sheath cylindric, 2–3.5 cm long, shortly hairy all over, mouth shortly ciliate. Spathe single, stalked, terminal on main and lateral branches, subtended by leaf-like bracts with persistent membranous sheaths, ovate, *c.* 2.8 × 1.2 cm, conduplicate, acute; pedicels sharply recurved and thickened in fruits. Sepals 3, Petals usually white, 2-clawed (claw *c.* 2 mm, blade *c.* 3mm). Stamens 3, perfect; filaments *c.* 4.5 mm long; anthers oblong, subequal, *c.* 1.5 mm long. Ovary minute, *c.* 0.5 mm; style *c.* 1.5 mm long, recurved. Capsules retuse, compressed, 4.5–6.5 × 6–7.5 mm, 2-loculed. Seeds oblongoid, 3.5–4 × *c.* 2 mm, with large pits, light brown or yellowish.

*Fl. & Fr.*: August – September.

*Habitat*: Damp shady areas near village.

*Distribution*: KWLS: Dhodhakola forest; abundant. INDIA: Throughout. WORLD: Africa, China, Japan and Malesia.

*Specimen examined*: Dhodhakola forest, 386 m, 24°33'41.6" N, 85°40'00.3" E, 17th August 2011, *Shyam Biswa* 49829.

**2. CYANOTIS D. Don, nom. cons.**

Old World tropical regions, *c.* 56 species, 16 in India, 4 in Jharkhand and 3 in KWLS.

**Key to species**

- 1a. Flowers clustered in the leaf sheaths, enclosed in the falcate obtuse and apiculate imbricating bracts **2. *C. cristata***
- 1b. Flowers solitary in the leaf sheaths, not enclosed in imbricating bracts **2**
- 2a. Flowers sessile without a corolla tube, 1 or 2 in all axils, almost included in the sheath pouch **3. *C. cuculata***

2b. Flowers with short corolla tube, extending from the leaf sheath; sheath pouch

Absent

### 1. *C. axillaris*

**1. *Cyanotis axillaris* (L.) D. Don ex Sweet**, Hort. Brit.: 430. 1826; Hook.f., Fl. Brit. India 6: 388. 1892. *Tonningia axillaris* (L.) Kuntze, Revis. Gen. Pl. 2: 722. 1891; N.P. Singh & al., Fl. Bihar: 536. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 618. 2002. *Commelina axillaris* L., Sp. Pl. 1: 42. 1753; Hook.f., Fl. Brit. India 6: 388. 1892; Haines, Bot. Bihar Orissa: 1081. 1924. *Amischophacelus axillaris* (L.) R.S. Rao & Kammathy, J. Linn. Soc., Bot. 59: 306. 1966; Paria & Chattopadhyay, Fl. Hazaribagh 2: 961. 2005; Nandikar & Gurav, Taiwania 59: 295. 2014.

#### Plate 10C

Herb, subsucculent, creeping and rooting; roots fibrous. Stems ribbed, with spreading branches, glabrous. Leaves simple, alternate, linear-lanceolate, 2.5–11 × 0.5–0.8 cm, sheathing at base, entire at margins, acute at apex, glabrous; sheath or ochreate stipule not bearded, tubular, glabrous. Flowers in the leaf sheath in axillary short fascicles, trimerous 1.5–1.8 cm across. Calyx split about half-way into 3 narrow hyaline or greenish segments, keeled in fruits. Corolla tube very slender, c. 5 mm long; lobes ovate, 8–10 × 6–8 mm, glabrous, white or violet. Stamens 6; filaments with long bluish jointed hairs, clavate at tips; anthers oblong, c. 0.8 mm long, bright yellow. Ovary 3-loculed; style filiform, spiral, clavate above. Capsules ellipsoid, 3–6 × 1.5–2.5 mm. Seeds ovoid to ellipsoid, c. 2 × 1.5 mm, coarsely pitted, shining, dark brown.

*Fl. & Fr.*: August – January.

*Habitat*: Marshy localities near ponds.

*Distribution*: KWLS: Dhodhakola forest; near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Throughout. WORLD: Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam and Oceania.

*Specimens examined*: Dhodhakola forest, 17th August 2011, 390 m, 24°33'14.6" N, 85°39'41.4" E, *Shyam Biswa* 49825; near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 54106.

**2. *Cyanotis cristata* (L.) D. Don**, Prodr. Fl. Nepal.: 46. 1825; Hook.f., Fl. Brit India 6: 385. 1892; Haines, Bot. Bihar Orissa: 1081. 1924; N.P. Singh & al., Fl. Bihar: 533. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 616. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 967. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 217. 2014; Nandikar & Gurav, Taiwania 59: 299. 2014. *Commelina cristata* L., Sp. Pl. 1: 42. 1753.

#### Plate 10D

Herb, 20–35 cm high; roots fibrous. Stems erect, branched, ribbed, glabrous. Leaves simple, alternate, ovate-oblong or oblong-lanceolate, 2.5–8 × 1–2.4 cm, sheathing at base, entire at margins, acute at apex, glabrous; sheaths without beard. Flowers clustered in the leaf sheaths, usually 2-seriate, secund, on the stout curved rachis of axillary and terminal cymes and enclosed in the biseriate bracts; bracts falcate, obtuse and apiculate, imbricate, 6–10 × 5–8 mm, pubescent. Flowers 5–7 mm long. Sepals linear-oblong, c. 5 × 1–1.5 mm, acute at apex, hairy on outer surface. Petals bluish. Stamens 6; filaments bearded, clavate below the tip; anthers c. 1 mm long. Capsules columnar, trigonous, c. 5 × 3 mm, slightly hairy. Seeds 2 in each locule, one above the other, conic-oblong, c. 2–2.5 × 1–1.5 mm, truncate at their extremity, pitted, light yellowish brown.

*Fl. & Fr.*: August – October.

*Habitat*: Grasslands.

*Distribution*: KWLS: Near the enclosure, Koderma NRF; occasional. INDIA: Throughout. WORLD: Bhutan, Cambodia, China, Indonesia, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Near the enclosure, Koderma NRF, 11th August 2011, 410 m, 24°28'58.1" N, 85°35'03.0" E, *Shyam Biswa* 49776.

**3. *Cyanotis cucullata*** (Roth) Kunth, Enum. Pl. 4: 107. 1843; Hook.f., Fl. Brit. India 6: 389. 1892. *Tradescantia cucullata* Roth, Nov. Pl. Sp.: 189. 1821. *Tonningia cucullata* (Roth) Kuntze, Revis. Gen. Pl. 2: 722. 1891. *Amischophacelus cucullata* (Roth) R.S. Rao & Kammathy, J. Linn. Soc., Bot. 59: 306. 1966; Paria & Chattopadhyay, Fl. Hazaribagh 2: 962. 2005. *Cyanotis axillaris* (L.) Sweet var. *cucullata* (Roth) Nandikar & Gurav, Taiwania 59: 297. 2014.

**Fig. 4; Plate 10E & F**

Herb, erect, suberect or decumbent, 10–30 cm high; branches usually from the basal regions, rooting at lower nodes, glabrous. Leaves simple, sessile, linear-lanceolate or narrowly linear, 1–3 × 0.2–0.4 cm, sheathing at base, entire at margins, acute at apex, glabrous, succulent, recurved, green purplish, especially purplish on margins and on veins; sheaths cucullate or globosely inflated. Flowers sessile, 1 or 2 in all axils, almost included in the sheath pouch. Corolla 3–4 mm across, bluish or violet-blue. Stamens 6; filaments densely bearded with long blue hairs, *c.* 2 mm long; anthers *c.* 1 mm long, bright yellow. Style blue with colourless 2-lipped stigma. Capsules trigonous, obovoid, *c.* 5.5 × 2.5 mm, 3-horned at the top with a central depression, included or slightly protruding from the sheath pouch. Seeds ovoid to ellipsoid, 2–2.5 × 1–1.5 mm, pitted.

*Fl. & Fr.*: November – December.

*Habitat*: Marshy places or near ponds and lakes.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; not common. INDIA: Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan. **Endemic.**

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 29th November 2012, 379 m, 24°27'50.0" N, 85°33'00.0" E, *Shyam Biswa* 54106.

*Note*: As per IUCN Red List Categories and Criteria, version 3.1 (2001) it has been assessed as a Least Concern species, as it is widespread in the country. The plant has been introduced in Antigua and Barbados.

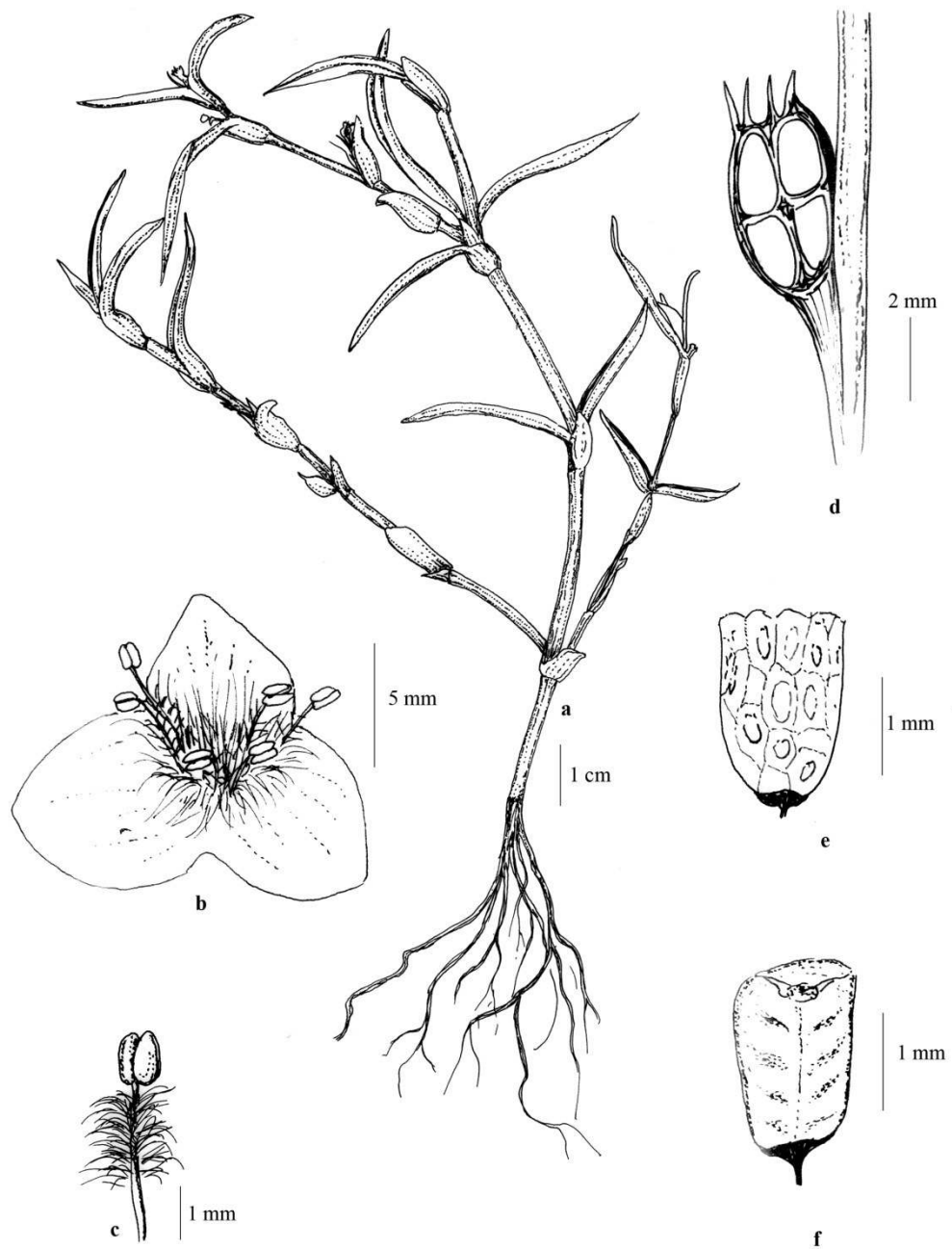
**3. MURDANNIA** Royle, nom. cons.

Tropical and subtropical regions, *c.* 50 species, 22 species in India, 6 species in Jharkhand and 2 in KWLS.

**Key to species**

- 1a. Leaves oblong to linear-lanceolate, less than 4 cm long; ovules and seeds 3–7 in each locule, less than 4 cm long; seeds not rugose, punctate **2. *M. spicata***
- 1b. Leaves linear, 2.5–7.5 cm long; ovules and seeds 2 in each locule; seeds rugose **1. *M. nudiflora***





**Fig. 4.** *Cyanotis cucullata* (Roth) Kunth: a. habit; b. flower; c. stamen; d. fruiting twig; e.,f. fruit.

**1. *Murdannia nudiflora* (L.)** Brenan, Kew Bull. 7(2): 189. 1952; N.P. Singh & al., Fl. Bihar: 535. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 617. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 969. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 217. 2014; Nandikar & Gurav, Phytodiversity 2(1): 85. 2015. *Commelina nudiflora* L., Sp. Pl. 1: 41. 1753, p.p.; Mooney, Suppl. Bot. Bihar Orissa: 199. 1950. *Aneilema nudiflorum* Wall. ex Hook.f., Fl. Brit. India 6: 378. 1892; Haines, Bot. Bihar Orissa: 1080. 1924.

**Fig. 5; Plate 10G**

Vern. Name: *Kanshura* (Hindi).

Herb, 5–35 cm high; roots fibrous. Stems branching from base, slender; branches decumbent, rooting at nodes. Leaves simple, sessile, linear-lanceolate, rarely ovate-lanceolate or linear, 2.5–7.5 × 0.5–1 cm, ochreate-rounded at base, entire at margins, acute or mucronate or slightly acuminate at apex, glabrous; sheaths with strongly ciliate margins and mouth, 6–10 mm long, hairy. Flowers a few, in terminal or leaf-opposed cymes, small, light purplish pink; peduncles 1.5–5 cm long, marked with scars of fallen bracts; pedicels 3–5 mm long; bracts ovate, 2.5–3.5 mm long, obtuse at apex, not-spathaceous, membranous; pedicels 3.5–5 cm long. Sepals 3, ovate-oblong, 2.5–3 × 1.8–2 mm, obtuse at apex, membranous. Petals 3, equal, obovate or suborbicular, 3.5–4 × 2.5–2.7 mm, purplish pink. Stamens 2 or 3, fertile with bearded filaments; staminodes 3 or 4. Ovary sessile, 3-loculed; 2-ovuled in 2 locules and 1-ovuled in one locule; style c. 1.5 mm long; stigma simple. Capsules broadly oblong-ellipsoid, c. 4 × 3 mm, mucronate, each locule with 2 seeds. Seeds subtriangular, c. 3 × 1 mm, truncate at their common end, rounded at the other end, yellowish brown.

*Fl. & Fr.*: August – September.

*Habitat*: Near moist and shade places.

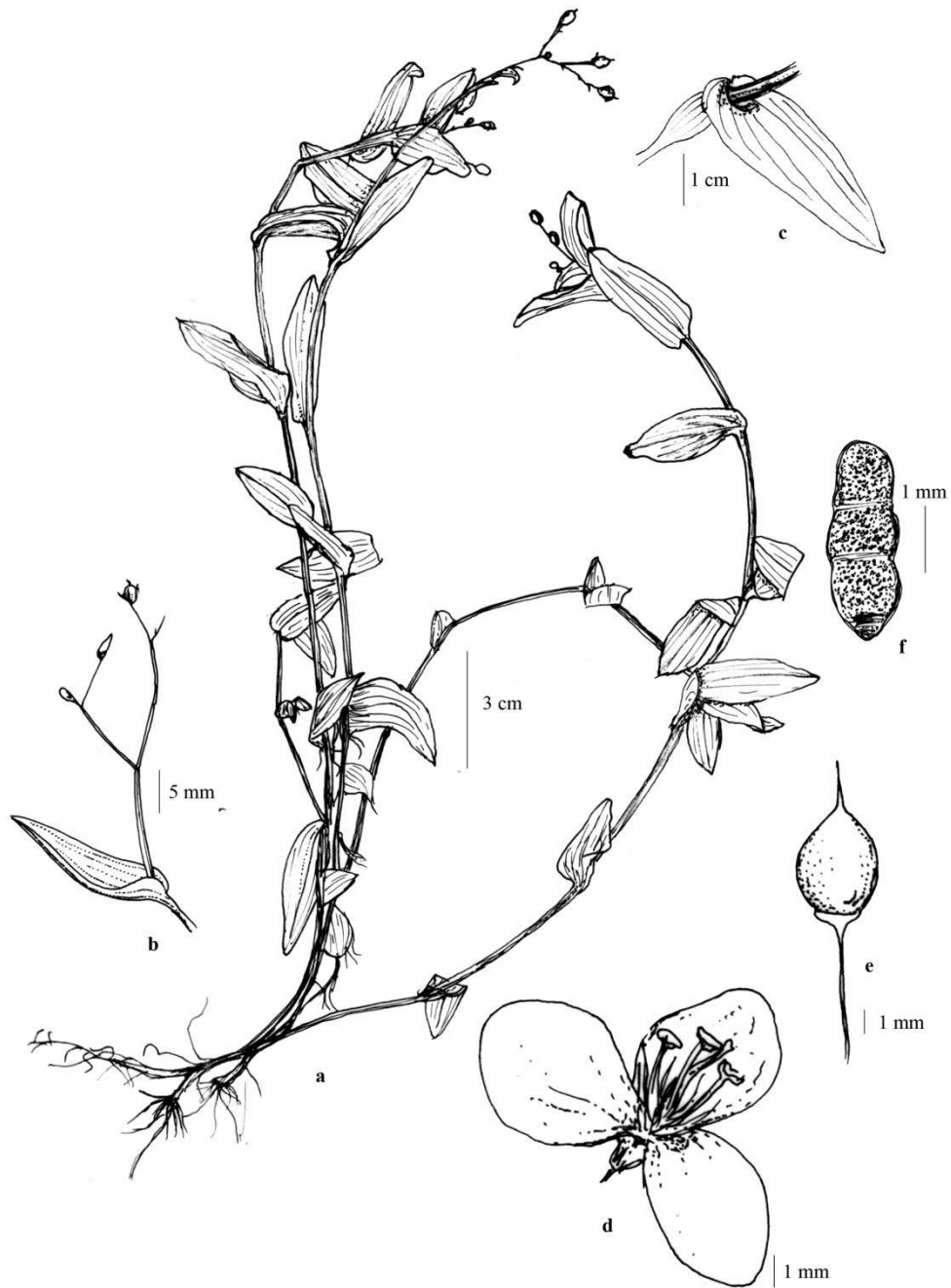
*Distribution*: KWLS: At the base of Dhawjadhari Pahar and Dhodhakola forest; common. INDIA: Throughout. WORLD: Tropical Asia to Malaysia; naturalized in West Africa, Southeastern United States and the West Indies to Brazil.

*Specimens examined*: At the base of Dhawjadhari Pahar, 4th September 2010, 390 m, 24°29'06.6" N, 85°35'49.8" E, *Shyam Biswa* 49556; Dhodhakola forest, 380 m, 24°33'15.1" N, 85°39'37.9" E, 17th August 2011, *Shyam Biswa* 49824.

**2. *Murdannia spirata* (L.)** G. Brückn. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 15a: 173. 1930; N.P. Singh & al., Fl. Bihar: 535. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 617. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 970. 2005; Nandikar & Gurav, Phytodiversity 2(1): 92. 2015. *Commelina spirata* L., Mant. Pl. 2: 176. 1771. *Aneilema spiratum* (L.) R. Br., Prodr.: 271. 1810, nom. inval.; Hook.f., Fl. Brit. India 6: 377. 1892; Haines, Bot. Bihar Orissa: 1079. 1924.

**Plate 10H**

Herb, 20–30 cm high, procumbent or ascending. Stems branched. Leaves sessile, simple, alternate, oblong or linear-lanceolate, 1.5–3.8 × 0.8–1.2 cm, amplexicaul or cordate at base, entire at margins, acute at apex, glabrous; veins prominent; sheaths c. 2 mm long, ciliate. Inflorescence axillary and terminal panicle; rachis filiform, often zig zag. Flowers trimerous, violet; bracts minute, persistent; pedicels 5–7 mm long. Sepals elliptic to oblong-elliptic, 2–4 mm long, brownish. Petals obovate to orbicular, 4–6 mm long, blue. Stamens 3; filaments bearded; anthers elliptic; staminodes 3. Ovary ovoid; stigma simple. Capsules oblongoid or ovoid-ellipsoid, c. 3



**Fig. 5.** *Murdannia nudiflora* (L.) Brenan: a. habit; b. flowering twig; c. leaf; d. flower; e. fruit; f. seed.



mm long, acutely trigonous, mucronate or shortly beaked, glabrous; seeds 3–7 per locule. Seeds cuboid or trapezoidal,  $c. 1 \times 1$  mm, shining, punctate, yellowish brown.

*Fl. & Fr.*: September – January.

*Habitat*: Shade localities in dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; not common. INDIA: Throughout. WORLD: Indomalesia to Pacific Islands (Samoa).

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49518.

## 16. PONTEDERIACEAE Kunth, nom. cons.

Tropical and subtropical regions to a few in North Temperate regions, 9 genera and *c.* 35 species and 2 genera 3 species in India.

### PONTEDERIA L.

Canada to Argentina 6 species, 2 in India, 1 in Jharkhand.

***Pontederia vaginalis*** Burm.f., Fl. Ind.: 80. 1768. *Monochoria vaginalis* (Burm.f.) C. Presl ex Kunth, Enum. Pl. 4: 134. 1843; Hook.f., Fl. Brit India 6: 363. 1892; N.P. Singh & al., Fl. Bihar: 513. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1157. 2005. **Plate 11A**

Herb, floating and rooted; rootstock short, creeping, clothed with leaf-sheaths. Leaves simple, basal rosette or on shortly decumbent stem, ovate to ovate-lanceolate,  $3-7.5 \times 0.5-3$  cm, shallowly to deeply cordate, sometimes rounded at base, entire at margins, acute to acuminate at apex; petioles 4–11 cm long, petioles and stipules membranous at margins; stipules 0.5–2 cm long. Scapes 3–15 cm long. Inflorescence sub-umbellate to racemose, erect at first, strongly deflexed in fruit; upper spathe membranous, shorter than inflorescence; lower spathe leaf-like, conspicuously exceeding inflorescence; pedicels short. Perianth 6-lobed; lobes distinct, 7–12 mm long, persistent, blue. Stamens 6, adnate to base of perianth lobes; anthers basifixed; smaller anthers 5, 1–1.2 mm long on simple filaments; larger one 2–2.5 mm long on a filament toothed on one side. Ovary ellipsoid,  $2-2.5 \times 1.5-1.8$  mm; style filiform, 3–3.5 mm long; stigma shortly 2 or 3-lobed. Capsules ellipsoid,  $5-10 \times 4-5$  mm. Seeds oblong,  $c. 10 \times 0.4$  mm, longitudinally ribbed, pale brown with a darker tip.

*Fl. & Fr.*: July – November.

*Habitat*: Ditches, marshes and shallow ponds or temporary pool.

*Distribution*: KWLS: Near Rishi Dhurwasha Pahar, Meghatari; common. INDIA: North-east India. WORLD: Africa, Australia, Bhutan, Cambodia, China, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Russia (Siberia), Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Near Rishi Dhurwasha Pahar, Meghatari, 226 m, 24°35'24.54" N, 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 49816.

## 17. CANNACEAE Juss., nom. cons.

Tropical and subtropical regions, 1 genus and 8–10 species; and 3 species in India.

### CANNA L.

Tropical regions, 8–10 species, 3 in India, 1 in Jharkhand.

**Canna indica** L., Sp. Pl. 1: 1. 1753; N.P. Singh & al., Fl. Bihar: 516. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 598. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1153. 2005. *Canna indica* var. *orientalis* (Roscoe) Baker in Hook.f., Fl. Brit. India 6: 260. 1892; Haines, Bot. Bihar Orissa: 1147. 1924.

**Plate 11B**

Shrub, 1–3 m high; rhizome fleshy. Stems terete, stout, glabrous. Leaf-sheath glabrous, green or purple. Leaves simple, alternate, ovate-oblong to oblong, 11–40 × 5–15 cm, obtuse to narrowly cuneate at base, entire at margins, acute to acuminate at apex, glabrous. Inflorescence a raceme of cincinni. Flowers 1 or 2 per cincinnus; bracts ovate, 1–1.5 cm long, persistent. Flowers 3–4.5 cm long; pedicels 0.2–1 cm long. Sepals lanceolate, 0.8–1.5 cm long, pale purplish green. Corolla red to orange; tube 0.5–1.5 cm long; lobes erect, lanceolate to narrowly oblong, 3–4.5 cm long. Staminodes 2 (or 3), erect, oblanceolate, 4–5.5 cm long, orange-red at base, emarginate at apex; labellum (lower staminode) lanceolate, c. 4.5 cm long, revolute at margins, emarginate and red at apex, sometimes with orange spots. Stamens with reddish orange filament, lanceolate, c. 4 cm long; anthers c. 9 mm long. Ovary globose, c. 6 mm, warty, green; style narrow, c. 6 cm long, base adnate to staminode column, red. Capsules ellipsoid to nearly globose, 1.5–3 × 1.5–2.5 cm, trigonal, muricate. Seeds globose, c. 5 mm, smooth, shiny, black.

*Fl. & Fr.*: October – December.

*Habitat*: Near hedges and on damp waste land.

*Distribution*: KWLS: Near NH 31, Chattarbar; common. INDIA: Almost throughout, grown as an ornamental, also found as an escape. WORLD: Native to tropical America, and cultivated throughout the tropical regions.

*Specimen examined*: Near NH 31, Chattarbar, 375 m, 24°28'36.5" N, 85°32'20.5" E, 29th November 2012, *Shyam Biswa* 54110.

## 18. COSTACEAE Nakai

Tropical regions, 7 genera and c. 143 species; 2 genera and 7 species in India.

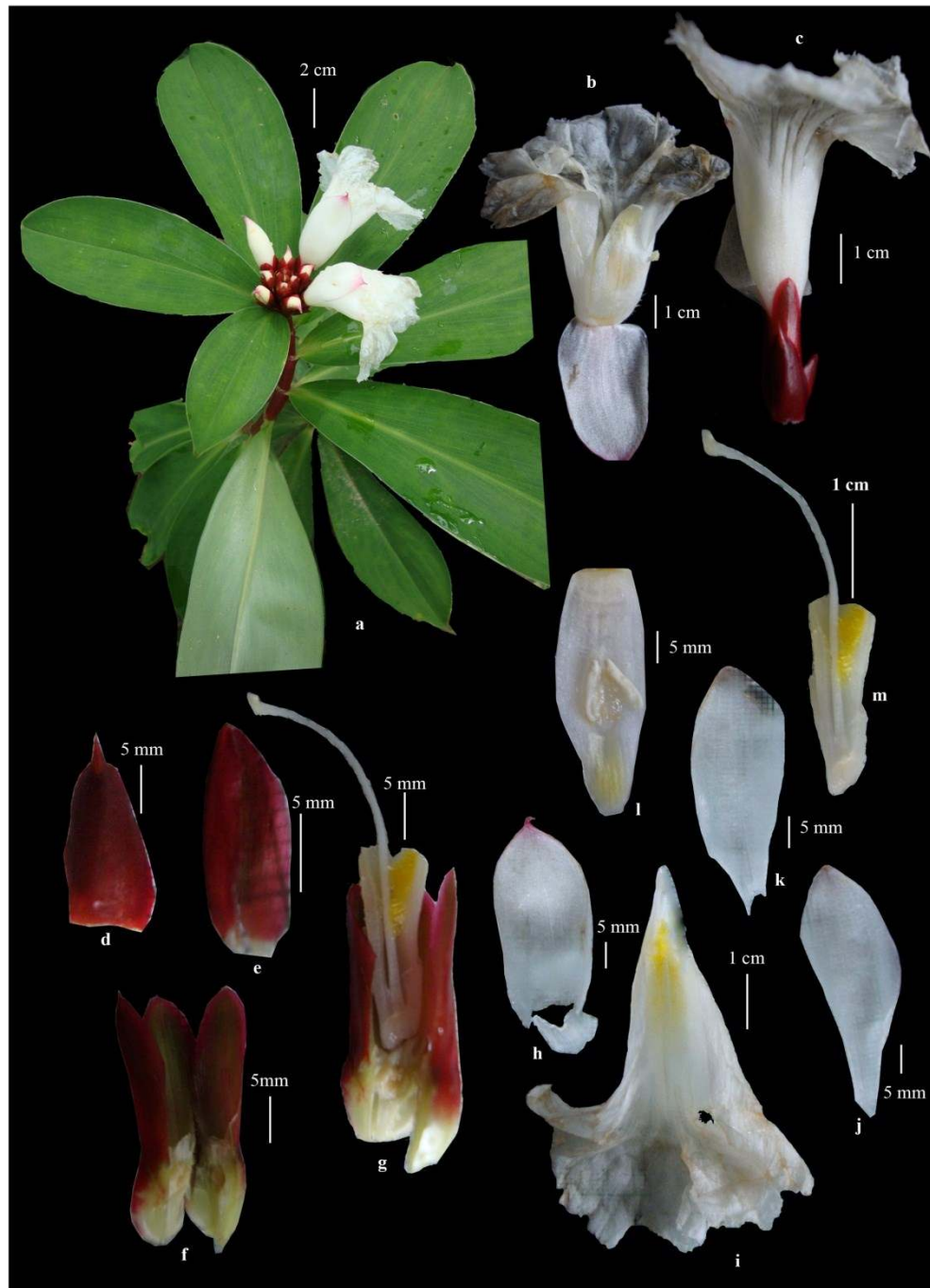
### HELLENIA Willd.

Tropical and subtropical Asia and Queensland, 5 species, 1 in India.

**Hellenia speciosa** (J.Koenig ex Sm.) S.R. Dutta, Pleione 7(1): 228. 2013. *Banksea speciosa* J.Koenig, Retz. Obs. iii. 75. 1783. *Costus speciosus* (J. König) Sm., Trans. Linn. Soc. London 1: 249. 1791; Baker in Hook.f., Fl. Brit. India 6: 249. 1892; Haines, Forest Fl. Chota Nagpur: 544. 1910 & Bot. Bihar Orissa: 1145. 1924; Mooney, Suppl. Bot. Bihar Orissa: 205. 1950; N.P. Singh & al., Fl. Bihar: 514. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 596. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1152. 2005; Sabu, Zingiberac. Costac. S. India: 259, f. 70. 2006; Ranjan, Fl. Parasnath Wildlife Sanct.: 211. 2014. *Cheilocostus speciosus* (J. König) C.D. Specht, Taxon 55: 159. 2006.

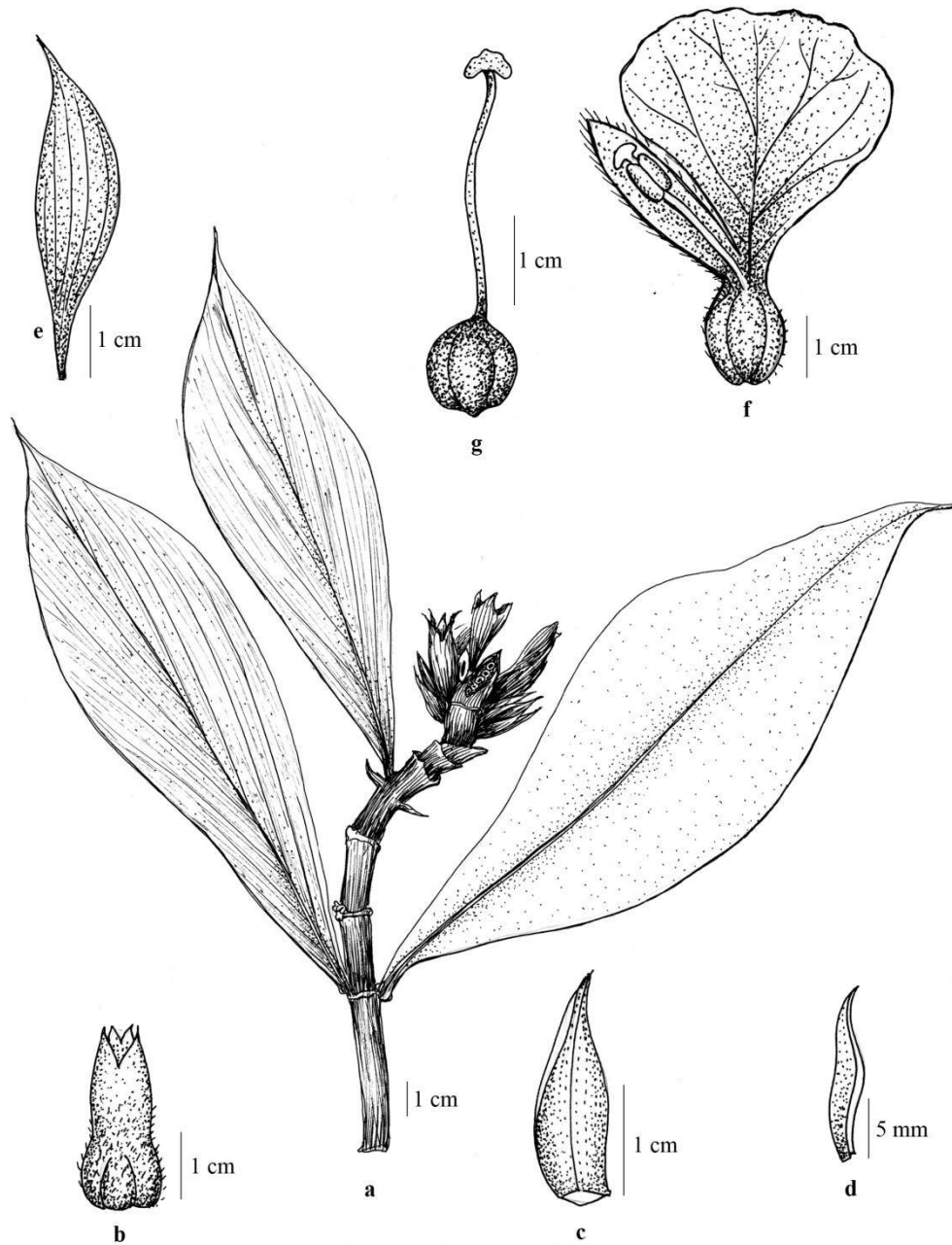
**Fig. 6, 7; Plate 11C**

Herb or shrub, perennial, to 2 m high, tuberous. Stems terete, unbranched, reddish green. Leaves simple, alternate, or one row in spiral, elliptic-oblong or elliptic-obovate, 5.5–20 × 2.5–6 cm, attenuate to narrowly rounded at base, entire at margins, acuminate at apex, glabrous or appressed-hairy above, silky beneath; ligule absent; sheaths coriaceous, upper internodes reddish; petioles 4–8 mm long. Inflorescence a spike, subglobose or ovoid, but elongating with age, 3–5 cm long; bracts ovate, c. 1.5 cm long, acute at apex, with a narrow subapical protuberance, red;



**Fig. 6. *Hellenia speciosa* (J.Koenig ex Sm.) S.R. Dutta:** a. flowering shoot; b.,c. flower; d.,e.,f. calyx; g. calyx and gynoecium; h.,i.,j.,k. corolla; l. stamen; m. carpel.





**Fig. 7. *Hellenia speciosa* (J.Koenig ex Sm.) S.R. Dutta:** a. flowering shoot; b. calyx; c.,d.,e. sepals; f. petal, stamen and carpel; g. carpel.

bracteoles keeled, 1.5–2.5 cm long, red. Calyx funnel-shaped, 2.5–3 cm long, leathery, 3-lobed or toothed, red. Corolla tubular, distally 3-lobed; lobes oblong-elliptic,  $4\text{--}4.5 \times 1.5\text{--}2$  cm, imbricate in bud, white or red at apex. Labellum trumpet-shaped,  $7\text{--}8 \times 6\text{--}7$  cm, apex toothed and crisped, with edges overlapping, margin incurved, white. Stamen 1, petaloid, urceolate,  $3\text{--}3.5 \times 1\text{--}1.5$  cm, pubescent, yellow at apex; anther lobes linear, *c.* 1 cm long. Ovary 3-loculed; ovules many in each locule; style filiform, 2.5–3 long; stigma funnelform. Capsules globose, to 3 cm, crowned with persistent calyx, red. Seeds globose, *c.* 3 mm, black.

*Fl.*: August – September; *Fr.*: September – February.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Taraghati forest, near the Sanctuary gate; common. INDIA: Throughout. WORLD: Throughout Asia, New Guinea and Australia; naturalized in Mauritius, Réunion, Hawaii, Central America, West Indies It is also cultivated and naturalized in the Neotropical regions.

*Specimen examined*: Taraghati forest near the Sanctuary gate, 330 m,  $24^{\circ}32'12.5''$  N,  $85^{\circ}34'5.4''$  E, 18th August 2011, *Shyam Biswa* 49832.

## 19. ZINGIBERACEAE Martinov, nom. cons.

Tropical regions, especially Indomalesia, 50 genera and 1600 species; *c.* 21 genera *c.* 200 species in India.

### Key to genera

1a. Ovary 1-loculed, placentas parietal

1. **Globba**

1b. Ovary 3-loculed, placentas axial

2. **Zingiber**

### 1. GLOBBA L.

East Asia, Indomalesia, 35 species, 17 in India, 7 in Jharkhand and 1 in KWLS.

**Globba marantina** L., Mant. Pl. 2: 170. 1771; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 595. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1148. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:210. 2014. *Globba bulbifera* Roxb., Asiat. Res. 11: 358. 1810; Baker in Hook.f., Fl. Brit. India 6: 206. 1890; Haines, Bot. Bihar Orissa 1130. 1924; N.P. Singh & al., Fl. Bihar: 509. 2001.

**Plate 11D**

Herb 30–60 cm high. Stems often inclined with spreading distichous leaves, the lowest sheath often purple. Leaves simple, basal, lanceolate, elliptic to oblong-lanceolate,  $12.5\text{--}24 \times 4\text{--}6.5$  cm, sheathing or attenuate at base, entire at margins, acute to acuminate at apex, ending in a long straight or slightly twisted tail, shortly pubescent beneath. Bulbils erect, globose-oblong. Bracts rhomboid-ovate, 1–2.5 cm long, broad at base, acute at apex. Flowers yellow in the axils of large folded sub-persistent bracts in simple spikes 5–10 cm long, the lower bracts usually bearing a solitary bulbil in place of a flower. Flowers *c.* 2.5 cm long, including the stamen. Petals and staminodes reflexed. Dorsal petal boat-shaped *c.* 5 mm long, lateral similar, rather smaller. Lateral staminodes petaloid, oblong, *c.* 1.2 cm long. Lip dependent from the column, *c.* 8 mm long, oblong but gradually wider towards tip (oblong-trapezoid) with 2 oblique lobes and base 2-clawed. Filament strongly arched as in the others, anther with 2 large spreading lateral wings cut nearly to the base into 2 triangular segments, larger *c.* 4 mm long. Ovary often 3-locular at base. Capsules oblong, rugose. Seeds globose, pale-brown, pubescent, seated on a cupular-lobed aril.

*Fl. & Fr.*: August – October.

*Habitat*: On the shades of Dry deciduous mixed forests.

*Distribution*: KWLS: Lokai forest; common. INDIA: Almost throughout. WORLD: China to Tropical Asia, Queensland.

*Specimen examined*: Lokai forest, 390 m, 24°29'18.7" N, 85°35'50.1" E, 10th August 2011, Shyam Biswa 49774.

## 2. ZINGIBER Boehm.

Indomalesia to East Asia & Tropical Australia, c. 100 species, 18 in India, 7 in Jharkhand and 1 in KWLS.

**Zingiber capitatum** Roxb., Asiat. Res. 11: 348. 1810; Baker in Hook.f., Fl. Brit. India 6: 248. 1892; Haines, Forest Fl. Chota Nagpur: 543. 1910 & Bot. Bihar Orissa 1144. 1924; N.P. Singh & al., Fl. Bihar: 512. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1150. 2005. **Plate 11E**

Herb 0.9–1.2 m high, root bulbous. Stem leafy, ribbed, glabrous. Leaves simple, alternate, linear-lanceolate to linear, sessile, 21–45 × 1–2.5 cm, sheathing at base, entire at margins tapering or acuminate at apex, usually shortly pubescent beneath (at least near midrib) glabrous above; ligule 1–2 mm, puberulous. Inflorescence terminal, erect, sessile, narrowly elliptic, 10–20 cm; bracts each subtending a single flower and bracteole, ovate, 3–5 cm, coriaceous, green with narrow brown margin. Calyx c. 1 cm. Corolla yellow, tube equalling bract. Lip yellow, c. 1 cm wide, 3-lobed, mid-lobe orbicular, shallowly emarginate, laterals (staminodes) oblong. Lateral staminodes adnate to lip thus forming a 3-lobed structure. Stamen pale yellow c. 1 cm long. Stigma scarcely wider than style. Stigma scarcely wider than style, ciliate-margined. Capsules elliptic, c. 2 cm, bright red.

*Fl. & Fr.*: August – October.

*Habitat*: On the shades of Dry deciduous mixed forests.

*Distribution*: KWLS: Tara tan, Khalaktambi forest. INDIA: . WORLD: Himalaya to Eastern India.

*Specimen examined*: Tara tan, Khalaktambi forest, 370 m, 24°30'29.0" N, 85°35'09.8" E, 12th August 2011, Shyam Biswa 49781.

## 20. ERIOCAULACEAE Martinov, nom. cons.

Tropical and subtropical regions, few temperate regions, 11 genera and c. 1100 species; 1 genus and c. 70 species in India.

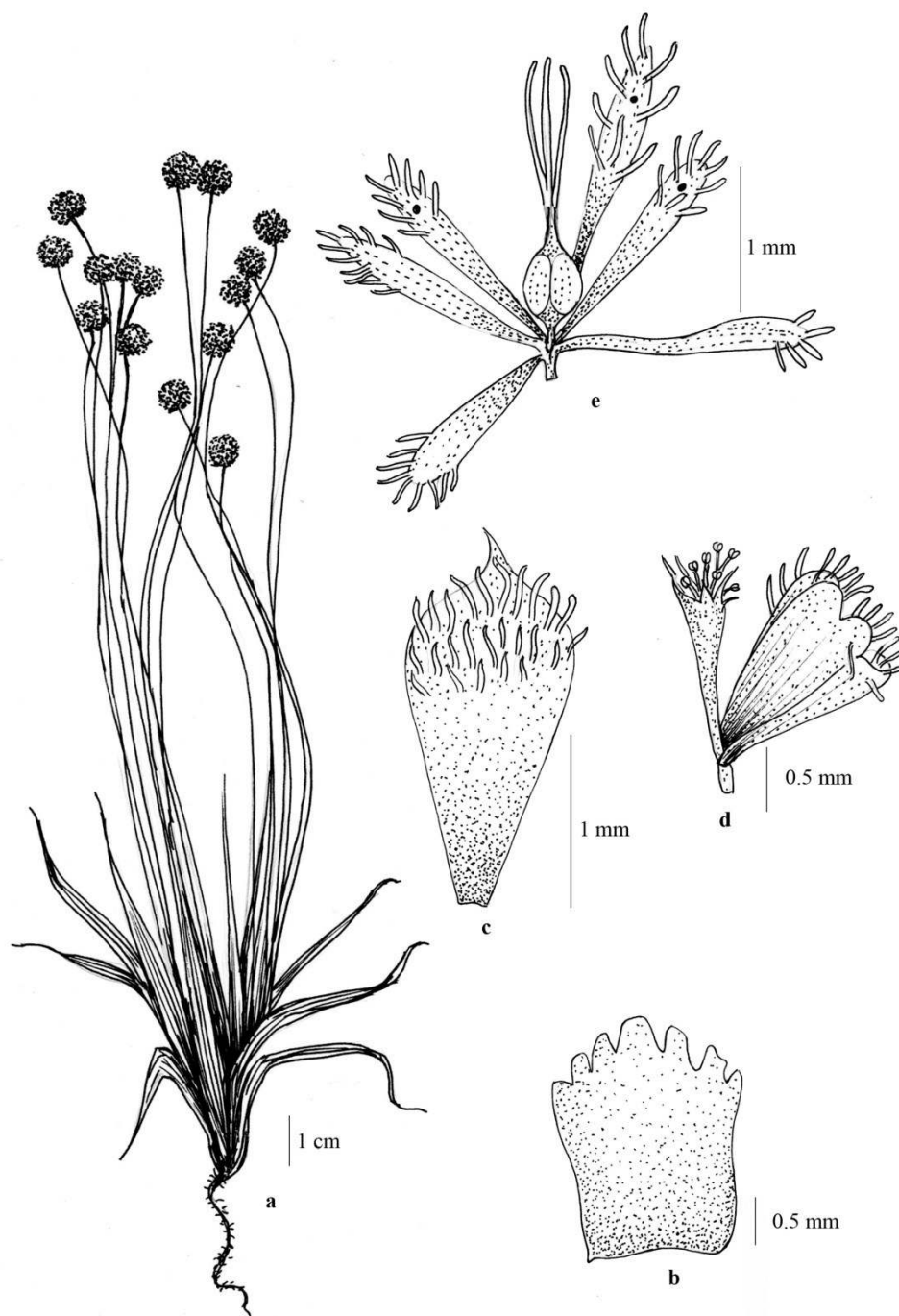
### ERIOCAULON L.

Tropical and subtropical regions, c. 400 species 80 in India, 12 in Jharkhand and 1 in KWLS.

**Eriocaulon quinquangulare** L., Sp. Pl. 1: 87. 1753; Hook.f., Fl. Brit. India 6: 582. 1893; Mooney, Suppl. Bot. Bihar: 198. 1950; R. Ansari & N.P. Balakr., Eriocaul. India: 104. f. 42. 1994. *Eriocaulon argenteum* Mart., Wall., Pl. Asiat. Rar. 3: 28. 1832. N.P. Singh & al., Fl. Bihar: 557. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 635. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 974. 2005; Haines, Bot. Bihar Orissa: 1068. 1924.

**Fig. 8; Plate 11F**





**Fig. 8.** *Eriocaulon quinquangulare* L.: a. habit; b. involucral bract; c. floral bract; d. male flower; e. female flower.

Herb 6–15 cm high, on wet ground. Leaves simple, radical forming a tuft or rosette, linear or lanceolate,  $1.5\text{--}5 \times 0.2\text{--}0.5$  cm, tapering at base, entire at margins, acute at apex, glabrous. Heads globose or ovoid  $2\text{--}9 \times 2\text{--}6$  mm, grey or white, intruded at base; receptacle globose or columnar covered with fine villi; peduncles few or densely crowded 5–15 cm long, glabrous; sheaths 2–4 cm long, usually turning purple on drying; involuncral bracts pale concave reflexed, oblong-oblancheolate or broadly obcuneate  $c. 1.5 \times 1$  mm; floral bracts hyaline 2 mm long broadly obcuneate shortly pubescent in upper half suddenly cuspidate. Male flowers: subsessile, sepals connate into a 3-lobed spathe, hoary towards apex, black; petals 3, subequal with a black gland in each, hoary; stamens 6; anthers black. Female flowers: shortly pedicelled or subsessile, narrowly linear-clavate, hairy in upper half; sepals 3, spatulate, hoary towards apex, black; petals 3, unequal, spatulate with a black gland in each, hoary; ovary stalked, ovoid or globose; style 3-fid. Seeds ovoid or oblong,  $c. 0.4 \times 0.2$  mm; cells of seed coat transversely elongated; appendages 2–4, rectangular or ribbon-like arising from transverse radial walls.

*Fl. & Fr.*: February – April.

*Habitat*: At river bank and near pond and lakes.

*Distribution*: KWLS: Panbasa Nala, Lokai forest; Near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Almost throughout. WORLD: South Asia

*Specimens examined*: Panbasa Nala, Lokai forest, 382 m,  $24^{\circ}28'57.6''$  N,  $85^{\circ}37'20.5''$  E, 24th February 2012, *Shyam Biswa* 49863; Near Rheio Ghoghar Dam, Chattarbar, 379m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E, 26th February 2012, *Shyam Biswa* 49890 & 54169, 2nd April 2013.

## 21. JUNCACEAE Juss., nom. cons.

Temperate and cold tropical mountainous regions, 7 genera and  $c. 430$  species; 2 genera 53 species in India.

### JUNCUS L.

Cosmopolitan,  $c. 310$  species, 28 in India, 1 in Jharkhand.

**Juncus articulatus** L., Sp. Pl. 1: 327. 1753. *Juncus lampocarpus* Ehrh. ex Hoffm., Deutschl. Fl. Bot. Taschenb. 3: 166. 1800; Hook.f., Fl. Brit. India 6: 395. 1892. **Plate 11G**

Herb, 5–20 cm high, with fibrous roots. Stems stiff, erect, reddish green at base. Leaves simple, linear or tubular,  $2\text{--}5 \times 0.2\text{--}0.3$  cm, entire at margins, gradually tapering into an acute apex, septate; sheaths slightly inflated, auricled, acute, free parts  $c. 2 \times 1$  mm, membranous, pale brown. Inflorescence terminal, branched, with 6–20-flowered capitula, subtended by a bract; bract stiff, erect, leaf-like, to 2 cm long; bracts of main inflorescence branches oblong, aristate or sometimes trifid, ribbed, straw-coloured. Tepals lanceolate, subequal or inner longer, 3–4 mm long, membranous at margins, pale brown. Stamens 6, shorter than tepals; filaments  $c. 1.5$  mm long, flat, whitish; anthers oblong,  $c. 0.5$  mm long, cream-coloured. Ovary ovoid, tapering into a beak, to 2 mm long; style  $c. 0.2$  mm long; stigmatic lobes spreading,  $c. 0.9$  mm long. Capsules oblong-ovoid or ellipsoid, strongly trigonous,  $3\text{--}4 \times 1.5\text{--}2$  mm, usually contracted abruptly into a short beak, conspicuously exceeding the perianth, brownish to greenish, many seeded. Seeds ovoid or ellipsoid, brownish,  $c. 0.5$  mm long, yellowish.

*Fl. & Fr.*: March – April.

*Habitat*: Moist and marshy localities near river.

*Distribution:* KWLS: Near Phutlaiya Nala; common. INDIA: Eastern Himalayas, Western Ghats, Meghalaya, Punjab, West Bengal. WORLD: Africa, Afghanistan, Bhutan, Europe, Mongolia, Nepal, North America, Pakistan, Russia and Vietnam.

*Specimen examined:* Near Phutlaiya Nala, 380 m, 24°33'08.8" N, 85°38'31.0" E, 5th March 2011, *Shyam Biswa* 49684.

## 22. CYPERACEAE Juss., nom. cons.

Cosmopolitan, especially temperate regions, 92 genera and *c.* 4450 species; 38 genera and *c.* 545 species in India.

### Key to genera

- |                                                                                                                                    |                          |
|------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1a. Fl. glumes all distichous; bristles always                                                                                     | <b>3. Cyperus</b>        |
| 1b. Flowering glumes many spirally arranged or sometimes lower only sub-distichous; bristles often present                         | 2                        |
| 2a. Flowers with a perianth of hypogynous scales or bristles or of both                                                            | 3                        |
| 2b. Flowers without a perianth of hypogynous scales or bristles                                                                    | 5                        |
| 3a. Perianth consists of bristles only                                                                                             | 4                        |
| 3b. Perianth consists of scales (in <i>Fuirena</i> often bristles also found)                                                      | <b>6. Fuirena</b>        |
| 4a. Inflorescence reduced to a single terminal spike; style articulated with the ovary; nut even if beaked not with a constriction | <b>4. Eleocharis</b>     |
| 4b. Inflor. a head; style continuous with the ovary nut even if beaked not with a constriction                                     | <b>7. Schoenoplectus</b> |
| 5a. Leaves glabrous; style persistent flat and hairy, or if deciduous not leaving a prominent button on the nut                    | 6                        |
| 5b. Leaves fine hairs; style linear glabrous, deciduous and leaving a button on the nut                                            | <b>2. Bulbostylis</b>    |
| 6a. Single spikelet in a terminal inflorescence                                                                                    | <b>1. Abildgaardia</b>   |
| 6b. Multiple spikelets in a terminal inflorescence                                                                                 | <b>5. Fimbristylis</b>   |

### 1. ABILDGAARDIA Vahl

15 Tropical and subtropical regions, *c.* 15 species, 1 in India.

**Abildgaardia ovata** (Burm.f.) Kral, Sida 4(2): 72. 1971. *Carex ovata* Burm.f., Fl. Ind. (N. L. Burman): 194. 1768. *Fimbristylis monostachyos* (L.) Hassk., Pl. Jav. Rar.: 61. 1848, 'monostachya'; C.B. Clarke in Hook.f., Fl. Brit. India 6: 649. 1893; Haines, Bot. Bihar Orissa: 917. 1924. *Fimbristylis ovata* (Burm.f.) J.Kern, Blumea 15: 126. 1967; N.P. Singh & al., Fl. Bihar: 573. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 651. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.:224. 2014.

Perennial herb, 10–30 cm high, with fibrous roots. Stems densely tufted slightly swollen at base, strongly ribbed. Leaves simple, filiform, *c.* 15 × 0.1 cm, entire at margins, acute with very few hairs or not at apex, flat or inrolled; sheaths to 4.5 cm long, stramineous; ligule absent. Inflorescence terminal, usually solitary or with 1 or 2 spikelets later; involucre bracts 1–3, not overtopping, 0.7–1 cm long. Flowers bisexual. Spikelets solitary (or to 3), terminal, ovate-lanceolate, 5–6 × *c.* 3 mm, compressed in the lower half, subterete in the upper half, sometimes twisted, stramineous; rachilla winged; bracts setaceous. Glumes distichous below, subspiral later,



broadly ovate-oblong, 4.5–6 mm long, keeled, mucronate at apex, 3–5-veined. Stamens 3; filaments flat, to 4 mm long, hyaline; anthers linear-oblong, apiculate, to 1.5 mm long. Ovary oblong, *c.* 1 mm long; style 3-fid, *c.* 3 mm long, trigonous, pyramidal at base, hyaline at margins, stigmas 3, 1–1.5 mm long, papillate. Nuts pyriform, obtusely trigonous, almost truncate and umbonate at apex, 1.5–2.5 × 1.5–2 mm, muricate except on the narrow base, stramineous.

*Fl. & Fr.*: September – November.

*Habitat*: In Damp under the Dry deciduous forests.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 390 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49554.

## 2. **BULBOSTYLIS** Kunth, nom. cons.

Tropical and subtropical regions, *c.* 100 species, 5 in India, 3 in Jharkhand and 1 in KWLS.

**Bulbostylis barbata** (Rottb.) C.B. Clarke in Hook.f., Fl. Brit. India 6: 651. 1893; Haines, Bot. Bihar Orissa: 923. 1924; Mooney, Suppl. Bot. Bihar Orissa: 149. 1950; N.P. Singh & al., Fl. Bihar: 559. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 637. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 980. 2005. *Scirpus barbatus* Rottb., Descr. Pl. Rar. 27. 1772 & Descr. Icon. Rar. Pl.: 52, t. 17, f. 4. 1773.

### Plate 12A

Annual, 5–20 cm high, with fibrous roots. Culms very slender, sulcate, smooth, glabrous, with white dots. Leaves simple, capillary to very slender, 0.5–2 × *c.* 0.1 cm, entire at margins, acute at apex, glabrous or scabrous beneath towards apex; sheaths membranous, stramineous to brownish when dry; ligule absent; orifice white-hyaline, usually with long white hairs; leaves at times reduced to sheaths. Inflorescence a terminal head of (1–)2–20 sessile spikelets, sub-spherical in later stage, 5–10 mm across. Involucral bracts 1–3, shorter to much longer than the inflorescence, dilated at base, 5–25 mm long, usually scabrous outside. Spikelets ovoid to ovoid-lanceolate, subacute at apex, angular, 3–7 × 1–1.7 mm, with few florets. Glumes ovate, ciliolate, mucronate, mucro usually excurved, 1.5–2 × *c.* 1 mm, membranous, usually puberulous on outer surface, strongly keeled in green, brownish. Stamen 1; filament elongated, 0.5–1 mm; anther linear-oblong, *c.* 0.8 mm long. Ovary obovate, 0.5–0.6 × 0.4–0.5 mm; style *c.* 1.5 mm long; stigmas 3, shorter than style, hairy. Nuts triquetrous, broadly obovoid, smooth, 0.6–0.8 × *c.* 0.5 mm, stramineous, finely reticulate with minute isodiametric cells in many rows.

*Fl. & Fr.*: September – November.

*Habitat*: On sandy soil in open areas.

*Distribution*: KWLS: near the Phulwarwaria jungle, Koderma NRF; common. INDIA: Throughout. WORLD: Widely distributed in subtropical regions of the Old World and southern USA.

*Specimen examined*: Koderma NRF, near the Phulwarwaria jungle, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49535.

## 3. **CYPERUS** L.

Cosmopolitan, *c.* 600 species, *c.* 70 in India, 28 in Jharkhand and 10 in KWLS.

**Key to species**

- 1a. Fl. glumes all distichous; bristles always 2
- 1b. Flowering glumes many spirally arranged or sometimes lower only sub-distichous; bristles often present **7. C. neochinensis**
- 2a. Glumes many; rhachilla of spikelet persistent 3
- 2b. Glumes often few. rhachilla of spikelet deciduous leaving a disk above the empty glumes; Stigmas 2; spikelets always in capitate spikes **1. C. brevifolius**
- 3a. Stigmas 2, nut not at all 3-gonous 4
- 3b. Stigmas 3, nut more or less 3-gonous 5
- 4a. Nut with longitudinally oblong epidermal cells, wrinkled, wavy, often with white broken transverse lines **5. C. diaphanus**
- 4b. Nut with isodiametric epidermal cells, punctulate or finely reticulate **9. C. sanguinolentus**
- 5a. Rachilla of spikelets deciduous **3. C. cyperoides**
- 5b. Rachilla of spikelets persistent 6
- 6a. Styles 2-fid **6. C. michelianus**
- 6b. Styles 3-fid 7
- 7a. Spikelets spicately arranged on elongated rachis 8
- 7b. Spikelets digitately or capitately arranged on reduced rachis 9
- 8a. Rachilla of spikelets winged **2. C. compressus**
- 8b. Rachilla of spikelets winged **8. C. pangorei**
- 9a. Spike globose nut obovoid brown **4. C. difformis**
- 9b. Spike digitate nut subglobose white **10. C. tenuispica**

**1. *Cyperus brevifolius*** (Rottb.) Hassk., Cat. Hort. Bogor 24. 1844; Ranjan, Fl. Parasnath Wildlife Sanct.: 220. 2014. *Kyllinga brevifolia* Rottb., Descr. Icon. Rar. Pl.: 13. t. 4. fig. 3. 1773; C.B. Clarke in Hook.f. Fl. Brit. India 6: 588. 1893; Haines, Bot. Bihar Orissa 907. 1924; N.P. Singh & al., Fl. Bihar: 576. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1009. 2005.

Perennial herb, 5–30 cm high, rhizome horizontally creeping. Stems distantly or closely arranged in a row, triquetrous, smooth. Leaves simple, usually well developed, radical or subradical, narrowly linear, 2–20 × 0.1–0.3 cm usually shorter than stems, entire at margins, gradually acuminate at apex, wide; sheaths membranous, brownish or purplish, lowest 1 or 2 bladeless. Inflorescence a terminal, globose or ovoid head, 4–10 × 5–8 mm, greenish, ultimately stramineous, rarely with 1 or 2 smaller heads from the base, densely bearing numerous spikelets. Involucral bracts 3–4, leafy, unequal in size; lowest 2–10 cm long; often erect. Spikelets strongly compressed, elliptic-oblong or oblong-lanceolate, 2–3.5 × c. 1 mm, 1-flowered. Glumes elliptic-ovate to boat-shaped, membranous; first glume 0.5–1 mm long; second c. 1 mm; third and fourth mucronate at apex, 2.5–3.5 mm long, strongly compressed, acutely keeled, with 2–3-veined sides; keel usually spinulose. Stamens 1–2; filaments c. 2 mm long; anthers linear, c. 0.5 mm long. Style c. 1 mm long; stigmas 2, c. 1 mm long. Nut biconvex, laterally compressed, obovate or elliptic, 1–1.5 × 0.5–0.8 mm, apiculate at apex, ultimately brownish.

*Fl. & Fr.*: September – November.

*Habitat*: On the sandy gravel places on open dry deciduous forests and Near the lake or Moist places.

*Distribution:* KWLS: Muglamaram forest; Near the Phulwarwaria jungle, Koderma NRF; very common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined:* Muglamaram forest 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49514; Near the Phulwarwaria jungle, Koderma NRF, 4th September 2010, 390m, 24°29'06.6"N, 85°35'49.8"E *Shyam Biswa* 49534; Near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 2nd March 2012 54028 & 54030.

2. ***Cyperus compressus* L.**, Sp. Pl. 1: 46. 1753; C.B. Clarke in Hook.f, Fl. Brit. India 6: 605. 1893; Haines, Bot. Bihar Orissa: 896. 1924. Mooney, Suppl. Bot. Bihar Orissa: 144. 1950; N.P. Singh & al., Fl. Bihar: 563. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 641. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 986. 2005. **Plate 12B**

Annual, 6–20 cm high, with fibrous roots. Culms triquetrous, smooth, striate, glabrous. Leaves simple, linear, 4–12 × 0.1–0.3 cm, flat or folded, entire at margins, gradually narrowed to an acute apex, glabrous, usually scabrous on the margins towards apex; sheaths striate, brownish towards base. Inflorescence simple, open, at times reduced to a single cluster of spikelets. Involucral bracts 3–5, lower ones overtopping the inflorescence, up to 12 cm long. Rays to 5, patent, 1.5–5 cm long. Spikes broadly ovoid, with 4–12 spikelets subdigitately on a short axis, 2–5 cm across. Spikelets patent or spreading, strongly compressed, oblong-lanceolate to linear, 1–1.5 × 2–3 mm, subacute at apex, usually yellowish-green; rachilla flexuous, with caducous wings. Glumes ovate, 1.5–3 × 1.5–2 mm, hyaline at margins, acute and mucronate at apex, mucro 1–1.5 mm long, often slightly excurved, keeled, veins prominent on both sides, somewhat rigid, green. Stamens 3; filaments *c.* 1 mm long; anthers linear-oblong, *c.* 0.5 mm long, with slightly produced connective appendage. Style *c.* 1 mm long; stigmas 3, linear, *c.* 1 mm long. Nuts trigonous, broadly obovoid, often slightly oblique, obtuse, minutely apiculate at apex, 1.2–1.4 × *c.* 1 mm, light brown.

*Fl. & Fr.:* September – December.

*Habitat:* Marshy localities.

*Distribution:* KWLS: Muglamaram forest; common. INDIA: Throughout. WORLD: Widely distributed in tropical, subtropical and temperate regions of the whole world.

*Specimen examined:* Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49510.

3. ***Cyperus cyperoides* (L.) Kuntze**, Revis. Gen. Pl. 3(3): 333. 1898; Mooney, Suppl. Bot. Bihar Orissa: 146. 1950. *Scirpus cyperoides* L., Mant. Pl. Altera 181. 1771. *Kyllinga sumatrensis* Retz., Observ. Bot. 4: 13. 1786. *Mariscus sieberianus* Nees, Linnaea 9: 286. 1834; Haines, Bot. Bihar Orissa: 909. 1924. *Mariscus sumatrensis* (Retz.) Raynal, Adansonia 15: 110. 1975; N.P. Singh & al., Fl. Bihar: 579. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1014. 2005.

Perennial herb, 20–50 cm high, with short woody rhizome. Stems solitary or up to a few closely arranged, erect, rigid, triquetrous, smooth. Leaves simple, linear, 8–21 × 0.1–0.3 cm gradually long-attenuate at apex; sheaths reddish-brown at base. Inflorescence simple. Involucral bracts 5–8, leaf-like, lower ones much overtopping the inflorescence; lowest up to 20 cm long. Rays 3–12, slender, patent, straight, *c.* 5 cm long, smooth. Spikes cylindrical, 1.5–2 cm long not attenuate to base, 6–8 mm broad, densely bearing numerous spikelets. Spikelets suberect, linear, or linear-lanceolate, 1.5–2 × 0.5–0.8 mm, acute at apex, obliquely erect in early stage, later spreading at right angle to the rachis, lower ones often reflexed. maturing 1 or 2 nuts; rachilla wings, hyaline.



Glumes 4–5, membranous, oblong-ovate to oblonglanceolate,  $3-4 \times 0.5-1$  mm, subacute at apex faintly many-veined; keel 3-veined. Stamens 3: filaments *c.* 3 mm long; anthers linear-oblong, *c.* 0.5 mm long. Style 0.5–1 mm long, stigmas 3, longer than style *c.* 2 mm long. Nut trigonous, linear-oblong,  $1.5-2 \times c. 0.5$  mm, apiculate at apex, straw-coloured, minutely punctate.

*Fl. & Fr.*: August – September.

*Habitat*: On moist places and under the grassland canopy of dry deciduous forests.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; not common. INDIA: Throughout. WORLD: Tropical and subtropical regions of Asia, Africa and Australia.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 394 m,  $24^{\circ}29'06.6''$  N,  $85^{\circ}35'49.8''$  E, 4th September 2010, *Shyam Biswa* 53917.

4. **Cyperus difformis** L., in Torner, Cent. Pl. II: 6. 1756; C.B. Clarke in Hook.f., Fl. Brit. India 6: 599. 1893; Haines, Bot. Bihar Orissa 893. 1924. Mooney, Suppl. Bot. Bihar Orissa: 144. 1950; N.P. Singh & al., Fl. Bihar: 563. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 644. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 988. 2005. **Plate 12C**

Annual herb, 10–20 cm high, with reddish, fibrous roots. Stems tufted, erect, acutely triquetrous, smooth. Leaves simple, linear,  $3-5 \times 0.1-0.3$  cm, entire at margins, gradually tapering to an acute at apex, smooth; sheaths stramineous to pale brown. Inflorescence simple or compound, usually lax, 2–4 cm long, at times congested in a globose cluster of spikelets. Involucral bracts 2 or 3; lower 2 much overtopping the inflorescence; lowest up to 5 cm long. Primary rays 3–9, 1–5 cm long, smooth. Spikes dense, globose, 5–20 mm across, bearing numerous spikelets, greenish, brownish or blackish. Spikelets stellately arranged, compressed, linear, linear-oblong or oblong-ovate,  $1.5-4 \times 1-1.5$  mm, obtuse at apex, 8–30-flowered; rachilla persistent, wingless, with *c.* 2 mm long internodes. Glumes very small, membranous, somewhat loosely arranged, orbicular or broadly obovate,  $0.8-1 \times 0.3-0.5$  mm obtuse or slightly emarginate at apex, keeled; keel greenish, faintly 3-veined; sides veinless, often purplish-brown, with whitish hyaline margins. Stamens 2; filaments elongate *c.* 0.2 mm; anthers very small, oblong, *c.* 0.1 mm long. Style short, *c.* 0.1 mm long; stigmas 3, slightly longer than style. Nut triquetrous, elliptic-obovoid, minutely apiculate, shortly stipitate, nearly equalling the glume,  $0.8-1 \times 0.3-0.5$  mm, light brownish.

*Fl. & Fr.*: December – February.

*Habitat*: Near the lake / pond on grassland or on wet places.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; very common. INDIA: Throughout. WORLD: Widely distributed in the tropical and subtropical regions of the old world.

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E, 26th February 2012, *Shyam Biswa* 49895.

5. **Cyperus diaphanus** Schrad. ex Schult, Mant. 2: 477. 1824. *Pycneus latespicatus* (Boeck.) C.B. Clarke in Hook.f. Fl. Brit. India 6: 590. 1893; Haines, Bot. Bihar Orissa 904. 1924. *Pycneus diaphanus* (Schrad. ex Roem. & Schult.) S.S. Hooper & T. Koyama, J. Jap. Bot. 51(10): 316. 1976; N.P. Singh & al., Fl. Bihar: 579. 2001. **Plate 13F**

Annual herb, 10–35 cm high with fibrous roots. Stems trigonous, smooth. Leaves simple, linear,  $6-17 \times 0.1-0.2$  cm, ciliate at margins, gradually narrowed to apex, glabrous. Inflorescence usually simple, often contracted and reduced to a single head, at times with 2–3 rays. Involucral bracts 2–3, patent, lowest much longer than inflorescence. Spikelets strongly compressed, oblong-elliptic  $8-20 \times 3-5$  mm with almost parallel margins, subobtuse at apex, keeled; rachilla

wingless, persistent. Glumes ovate,  $2.5-3 \times c. 2$  mm, truncate at base, obtuse and muticous at apex. with somewhat undulate margins; keel 3-veined, green. Stamens 2; filaments up to  $c. 2$  mm long, flexuous or twisted; anthers oblong to linear-oblong,  $c. 0.5$  mm long. Ovary obovate  $c. 1$  mm, whitish flacky; style  $c. 1$  mm long; stigmas 2,  $c. 1$  mm, whip-like. Nut laterally compressed, biconvex, broadly obovate,  $1-1.2 \times c. 1$  mm, apiculate at apex, transverse wrinkles, scaly surface, blackish

*Fl. & Fr.*: August – November.

*Habitat*: Near the lake or Moist places.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; rare. INDIA: Peninsular India, East and North East India. WORLD: Central Asia, Malesia.

*Specimen examined*: Rheio Ghoghar Dam, Chattarbar, 379 m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E, 29th November 2012, *Shyam Biswa* 53912.

*Note.*: Observed the two filament flexuous or twisted not straight.

**6. *Cyperus michelianus* (L.) Delile, Descr. Egypte, Hist. Nat. 2(Mém.): 50. 1813. *Scirpus michelianus* L., Sp. Pl. 1: 52. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 6: 662. 1893; N.P. Singh & al., Fl. Bihar: 585. 2001.**

**Plate 12D**

Annual herb, 5–10 cm high, with fibrous roots. Stems densely tufted, erect or patent, often pulvinate, trigonous, smooth. Leaves simple, linear,  $1-3 \times 0.1-0.2$  cm, scabrid on the margins in the upper part, narrowed to apex, flat; basal sheaths reddish-brown. Inflorescence a contracted lobed head of several dense glomerules of spikelets, triangular-ovoid or subglobose, 4–8 mm across. Involucral bracts 2–7, patent, all overtopping the inflorescence, up to 3 cm long, dilated at base. Spikelets strongly compressed, often twisted, ovate to ovate-lanceolate,  $c. 2 \times 0.5$  mm, whitish-green to stramineous; rachilla slightly flexuous, wingless. Glumes distichous, often looks irregular due to the twisting of rachilla, membranous, lanceolate, acute or short-mucronate at apex, keeled,  $c. 2 \times 0.5$  mm, pale whitish, subtranslucent; keel greenish, often spinulose. Stamens 1 or 2, filaments elongated  $c. 1$  mm, hyaline; anthers linear,  $c. 0.4$  mm long. Style  $c. 0.5$  mm long; stigmas 2,  $c. 0.5$  mm long. Nut trigonous, oblong or elliptic-oblong,  $c. 1 \times 0.3$  mm, pale brown, minutely punctulate.

*Fl. & Fr.*: April – May.

*Habitat*: Near the moist soil, near the ponds or in open areas.

*Distribution*: KWLS: Inderwa, Chittarpur; occasional; INDIA: Throughout. WORLD: Widely distributed in South and South-East Asia, Mediterranean region, Africa and Australia.

*Specimen examined*: Inderwa, Chittarpur, 333 m,  $24^{\circ}32'02.2''$  N,  $85^{\circ}34'47.0''$  E, 2nd April 2013, *Shyam Biswa* 54146.

**7. *Cyperus neochinensis* (Tang & F.T.Wang) Bauters, Phytotaxa 166(1): 21. 2014. *Lipocarpha squarrosa* (L.) Goetgh, Wageningen Agr. Univ. Pap. 89(1): 71. 1989. *Rikliella squarrosa* (L.) J. Raynal in Adansonia sér. 2, 13(2): 154. 1973; N.P. Singh & al., Fl. Bihar: 582. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1019. 2005. *Scirpus squarrosus* L., Mant. Pl. Altera 181. 1771; C.B. Clarke in Hook.f., Fl. Brit. India 6: 663. 1893; Haines, Bot. Bihar Orissa 925. 1924. Mooney, Suppl. Bot. Bihar Orissa: 150. 1950.**

**Plate 13E**

Annual herb, 8–10 cm high, with fibrous roots,. Stems tufted, slender, obtuse-angular or flattened, smooth. Leaves simple shorter than stem, filiform, linear,  $0.5-2.5 \times c. 0.1$  cm, entire at margins, acute at apex, slender, glabrous, smooth; ligule absent; sheaths up to 1 cm long;

lowermost leaves reduced to bladeless sheaths. Inflorescence a pseudolateral, squarrose head of 2–3 spikelets. Involucral bracts 1–3, leaf-like, dilated at base; lowest erect, up to 1 cm long; other bracts if present much shorter, not erect. Spikelets sessile, strongly squarrose, ovoid to subcylindrical, terete, obtuse at apex,  $2-5 \times 2-3$  mm, densely many-flowered. Glumes membranous, obovate-rhomboid,  $1.8-3 \times 0.3-0.5$  mm (including the mucro). narrowed to a long recurved 1–1.5 mm long mucro, glabrous. Stamen 1 or 2; filament elongate *c.* 0.5 mm long; anther oblong, 0.2–0.4 mm long. Ovary oblong *c.* 0.4 mm long; style very short, inconspicuous; stigmas 3, short, *c.* 0.1 mm long. Nut trigonous, oblong or oblong-obovate, *c.*  $0.5 \times 0.2$  mm, minutely papillose, blackish with dots.

*Fl. & Fr.*: November – January.

*Habitat*: Near the river or on dried up river beds.

*Distribution*: KWLS: Near Dhanarjay Nadi; not common. WORLD: South and South-East Asia (Sri Lanka, China, Thailand, Malesia). INDIA: Throughout.

*Specimen examined*: Near Dhanarjay Nadi, 189 m,  $24^{\circ}34'58.1''$ N,  $85^{\circ}35'21.4''$  E, 27th November 2012, *Shyam Biswa* 53913.

**8. *Cyperus pangorei*** Rottb., Descr. Icon. Rar. Pl. 31; Prog. 18. 1773; Mooney, Suppl. Bot. Bihar Orissa: 145. 1950; N.P. Singh & al., Fl. Bihar: 566. 2001. non *Cyperus corymbosus* Rottb. var. *pangorei* (Rottb.) C.B. Clarke in Hook.f. Fl. Brit. India 6: 612. 1893. *Cyperus tegetum* Roxb., Fl. Ind. 1: 208. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 6: 613. 1893; Haines, Bot. Bihar Orissa 900. 1924.

Perennial herb, 90–150 cm high, with creeping rhizome. Rhizome stout, woody, clothed with brownish scales; roots thick, usually branched into blackish fibrous hairs. Stems usually in a row along the creeping rhizome or subtufted, erect, trigonous to triquetrous towards apex, narrowed to apex, ribbed with fine striation/veins. Leaves simple, usually reduced to 2–4 subphyllus sheaths surrounding the basal portion of the stem, 12 cm long blades; sheaths long, brownish to purplish-brown towards base, uppermost up to 30 cm long. Inflorescence compound, lax,  $10-20 \times 6-15$  cm. Involucral bracts 3–5, patent, usually much overtopping the inflorescence,  $15-30 \times 0.1-0.6$  cm long. Primary rays short, up to 4 cm long, ending in coymb-like spikes of 4–10 spikelets, with smooth rachis. Spikelets spicately arranged, compressed, linear, subacute at apex,  $2-3 \times 0.1-0.15$  cm, usually reddish, 12–30-flowered; rachilla straight, winged, with *c.* 1 mm long internodes; wings lanceolate, reddish-brown. Glumes membranous, somewhat loosely to closely imbricate, oblong to somewhat oblong-lanceolate, *c.*  $3 \times 1$  mm, hardly keeled, 5-veined on the obtuse back; sides veinless, usually reddish-brown. Stamens 3; filaments up to 0.2 mm long; anthers linear, 0.8–1 mm long. Style *c.* 0.5 mm long; stigmas 3, longer than style *c.* 2 mm long. Nut trigonous, oblong or oblong-obovoid,  $1-1.5 \times 0.3-0.5$  mm, minutely apiculate at apex, yellowish-brown to blackish-brown.

*Fl. & Fr.*: September – January.

*Habitat*: Near the bank of the river.

*Distribution*: KWLS: Phutlaiya Nala; localized. INDIA: Throughout. WORLD: Sri Lanka, Pakistan, Nepal, Myanmar; cultivated in Mauritius.

*Specimen examined*: Phutlaiya Nala, 337 m,  $24^{\circ}34'33.4''$  N,  $85^{\circ}39'21.7''$  E, 6th September 2010, *Shyam Biswa* 49583.



*Note:* Observed the spikelets generally with male and female florets intermixed or with male floret towards apex/ upper part and female florets towards base/ lower part.

9. **Cyperus sanguinolentus** Vahl, Enum. Pl. 2: 351. 1805. Mooney, Suppl. Bot. Bihar Orissa: 145. 1950; N.P. Singh & al., Fl. Bihar: 581. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 650. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1018. 2005. *Pycreus sanguinolentus* (Vahl) Nees ex C.B. Clarke in Hook.f, Fl. Brit. India 6: 590. 1893; Haines, Bot. Bihar Orissa 904. 1924.

**Fig. 9**

Annual or perennial herb 5–60 cm high, with short rhizome,; stolons absent. Stems tufted, slender, trigonous, decumbent at base, smooth, with 1–4 nodes at base from which roots and branches arise; basal portion covered with stramineous or brownish sheaths. Leaves simple, linear, 3–8 × 0.1–0.4 cm, entire at margins, gradually narrow acute at apex, wide, scabrid on the margins towards apex. Inflorescence simple, usually with 1–5 rays, often congested to a cluster of few spikelets. Involucral bracts 3–5: lower ones overtopping the inflorescence. Spikes ovoid to broadly ovoid, with 3–18 spikelets on a short rachis. Spikelets compressed, ovate to oblong-lanceolate, 5–10 × 2–3.5 mm, subacute at apex, reddish-brown or marron, 10-30-flowered; rachilla wingless, persistent. Glumes membranous, keeled, ovate to broadly ovate, 1.5–2 × c. 1.5 mm obtuse and muticous at apex, keel 3–5-veined, green; sides veinless, ferrugineous to reddish-brown, usually furrowed in the centre. Stamens 2 or 3; filaments elongate 1.5–2 mm; anthers linear-oblong, c. 0.5 mm long. Ovary obovate c. 1mm long; style, filiform c. 1 mm long; stigmas 2, bifurcate shorter than to as long as the style c. 1 mm long, nut laterally compressed, biconvex, broadly obovate to orbicular, apiculate at apex, 1–1.2 × 0.8-1 mm, brownish to black when mature.

*Fl. & Fr.:* November – February.

*Habitat:* Near the lake or moist places.

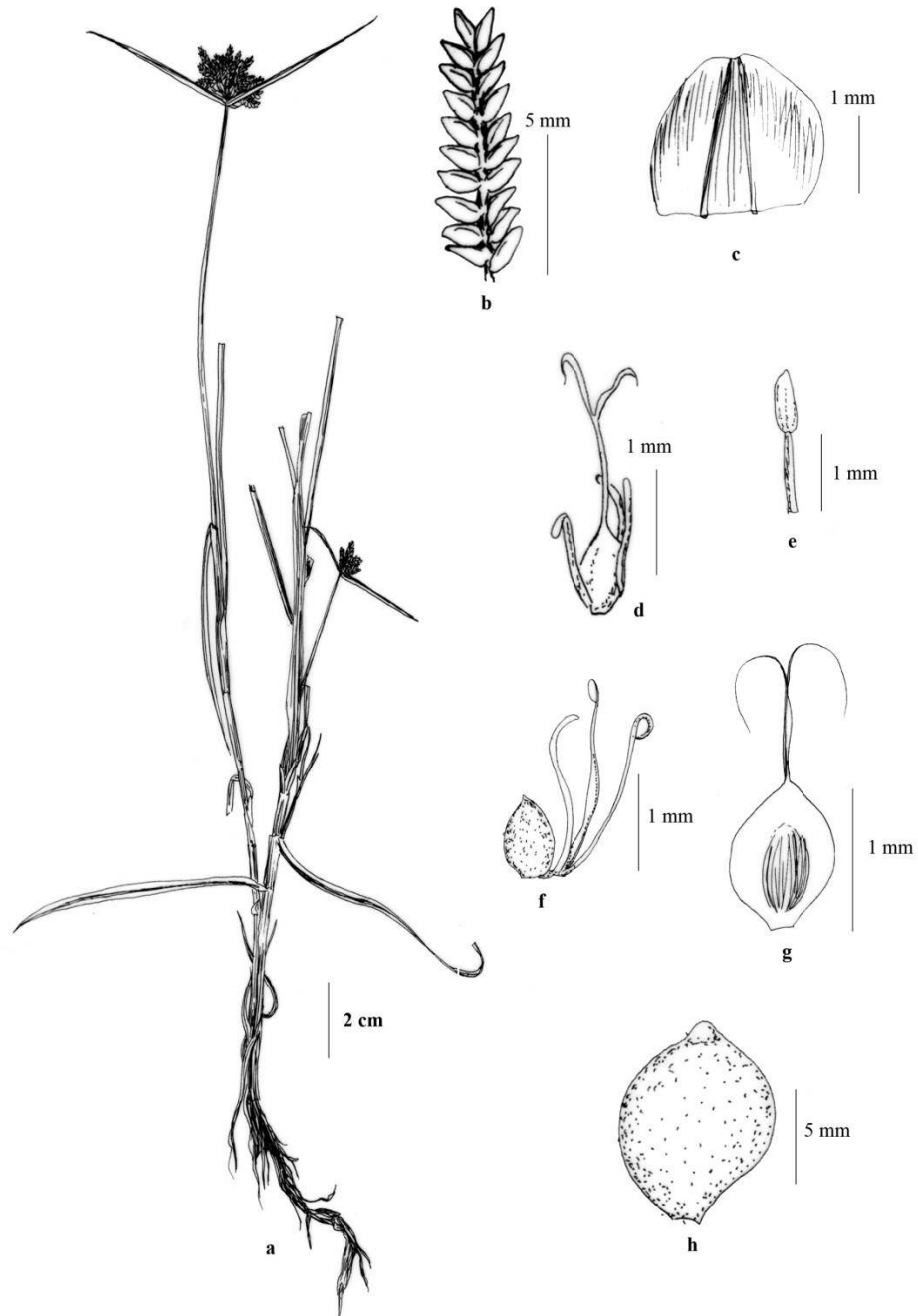
*Distribution:* KWLS: Rheio Ghoghar Dam, Chattarbar; few. INDIA: Throughout. WORLD: Widely distributed in subtropical parts of Central and Eastern Asia, to Japan, tropical Africa and Australia.

*Specimen examined:* Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 54107.

10. **Cyperus tenuispica** Steud., Syn. Pl. Glumac. 2(7): 11. 1854; N.P. Singh & al., Fl. Bihar: 568. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 997. 2005. *Cyperus flavidus* C.B. Clarke, J. Linn. Soc., Bot. 21: 122, t. 3, f. 25. 1884 & in Hook.f., Fl. Brit. India 6: 600. 1893, non Retz., 1789; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 644. 2002.

**Plate 12E**

Annual herb, 8–20 cm high, with reddish, fibrous roots. Stems tufted, trigonous, smooth. Leaves simple, linear, c. 15 × 2–5cm long, gradually narrowed to an acute apex, smooth or scabrid on the upper margins; sheaths scarious, stramineous to reddish-brown, lower ones bladeless. Inflorescence compound or decompound, relatively large, lax, 2–17 cm across. Involucral bracts 2–3, longest usually overtopping the inflorescence 1–6.5 × 0.5–2 mm. Primary rays 5–17, suberect to patent, unequal, slender up to 10 cm long; secondary rays up to 2 cm long. Spikelets digitate, in clusters of 3–9, flattened, linear-oblong, subacute at apex, 3–8 × 1–1.5 mm. Rachilla wingless, persistent, with c. 0.5 mm long internodes. Glumes subloosely arranged exposing part



**Fig. 9.** *Cyperus sanguinolentus* Vahl: a. habit; b. spike; c. glume; d. stamens and pistil; e. stamen; f. ovary and stamen; g. pistil; h. nut.

of rachilla and mature nuts, membranous, ovate to oblong-ovate, obtuse and slightly recurved at apex, 0.8–1 × 0.5–0.8 mm, slightly keeled towards apex; keel greenish, 3-veined, midvein excurved as a minute mucro; sides veinless, hyaline or purplish-lineolate. Stamen I; filament 0.2–0.3 mm long; anther oblong, *c.* 0.5 mm long, with smooth connective appendage. Style *c.* 0.5 mm long; stigmas 3, *c.* 0.5 mm long. Nut obtusely trigonous, broadly obovoid to subglobose, 0.3–0.5 × *c.* 0.2 mm, distinctly stipitate, very minutely apiculate, densely and minutely tuberculate/punctate.

*Fl. & Fr.*: February – March.

*Habitat*: On damp places of dry deciduous forests.

*Distribution*: KWLS: Lokai forest; few.

INDIA: Throughout. WORLD: Widely distributed in Sri Lanka, Nepal, China, Malesia, South Japan, tropical Africa and tropical Australia.

*Specimen examined*: Lokai forest, 382 m, 24°28'57.6" N, 85°37'20.5" E, 24th February 2012, *Shyam Biswa* 49865.

#### 4. **ELEOCHARIS** R. Br.

Cosmopolitan *c.* 200 species, 14 in India, 8 in Jharkhand and 1 in KWLS.

**Eleocharis geniculata** (L.) Roem. & Schult., Syst. Veg. 2: 150. 1817; N.P. Singh & al., Fl. Bihar: 569. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 998. 2005. *Scirpus geniculatus* L., Sp. Pl. 1:48. 1753. *Eleocharis capitata* (L.) R.Br., Prodr. Fl. Nov. Holland. 225. 1810; C.B. Clarke in Hook.f. Fl. Brit. India 6: 627. 1893; Haines, Bot. Bihar Orissa 913. 1924; Mooney, Suppl. Bot. Bihar Orissa: 147. 1950.

#### Plate 12F

Annual herb, 3–16 cm high, root fibrous. Stems tufted, slender, erect or reflexed, angular-sulcate base pinkish. Sheaths membranous, 1–4 cm long, truncate-oblique at mouth, acute to attenuate at apex, usually purplish- brown towards base; blades 0 or minute tip. Spikelets broadly ovoid, oblong-ovoid or hemispherical, obtuse at apex, 4–5 × 3–4 mm, brownish, many-flowered. Glumes membranous, tightly imbricate even during fruiting, elliptic-oblong, *c.* 2 × 1 mm obtuse at apex, without keel, often with few reddish-brown steaks. Perianth bristles 4–7, *c.* 1 mm long, retrorsely, scabrid. Stamens 2 or 3; filaments elongate, *c.* 2 mm long; anthers oblong, 0.8–1 mm long, connective appendage very minute, apiculate. Ovary obovate, *c.* 0.5 mm long; style *c.* 1 mm long, 2 stigmas slender, *c.* 1 mm long, slightly plumose like or cilliate. Nut obovoid, biconvex, *c.* 1 × 0.5–0.6 mm, shining blackish-brown, smooth; persistent style base minute, conical; persistent perianth bristles brownish, exceeding the nut.

*Fl. & Fr.*: November – December.

*Habitat*: Near the lake or damp places.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; occasional. INDIA: Peninsular India, East and North-East India. WORLD: Throughout the subtropical parts of old and new world.

*Specimen examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 53914.

*Note*: Stigma slightly plumose like or cilliate

#### 5. **FIMBRISTYLIS** Vahl, nom. cons.

Subtropical regions, *c.* 300 species, 115 in India, 22 in Jharkhand and 6 in KWLS.



## Key to species

- |                                                                         |                              |
|-------------------------------------------------------------------------|------------------------------|
| 1a. Style 3-fid                                                         | 2                            |
| 1b. Style 2-fid                                                         | 3                            |
| 2a. Style hairy; glumes acute, mucronate; rachchilla winged             | <b>5. F. quinquangularis</b> |
| 2b. Style glabrous; glumes obtuse, not mucronate; rachchilla not winged | <b>4. F. littoralis</b>      |
| 3a. Spikelets few often 1–3                                             | <b>6. F. schoenoides</b>     |
| 3b. Spikelets many                                                      | 4                            |
| 4a. Nut conspicuously longitudinally striate trabeculate                | <b>3. F. dichotoma</b>       |
| 4b. Nut smooth reticulate                                               | 5                            |
| 5a. Annuals, style dorsifventrally flattened fimbriate above            | <b>1. F. aestivalis</b>      |
| 5b. Perennnial style weakly flattened not fimbriate                     | <b>2. F. cymosa</b>          |

**1. *Fimbristylis aestivalis* (Retz.) Vahl**, Enum. Pl. 2: 288. 1805; C.B. Clarke in Hook.f., Fl. Brit. India 6: 637. 1893, p.p.; Haines, Bot. Bihar Orissa: 920. 1924; Mooney, Suppl. Bot. Bihar Orissa: 149. 1950; N.P. Singh & al., Fl. Bihar: 570. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 650. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1001. 2005.

## Fig. 10; Plate 12G

Annual herb, 3–20 cm high, roots fibrous. Stems densely tufted, slender, angular. Leaves simple, linear to filiform 4–6 × 0.1–0.2 cm, sheath at base entire at margins; acuminate at apex, flat or canaliculated, glabrous beneath, above slightly pubescent; sheaths 0.3–0.5 mm wide, stramineous or ferrugineous, soft-hairy; ligule a dense fringe of short hairs. Inflorescences compound, loose, 1–7 cm long; involucre bracts *c.* 6, similar to leaves, lower 1 or 2 usually shorter than inflorescences. Primary rays filiform, obliquely patent, *c.* 5 cm long. Flowers bisexual. Spikelets solitary, ovoid-oblong 3–7 × 1–1.5 mm, angular, densely many-flowered; rachilla narrowly winged. Glumes spiral, ovate, mucronulate, 1.2–1.5 × 0.8–1 mm, lineolate, ferrugineous, keeled; keels 3-veined with a prominent midvein, green. Stamen 1; filament elongate to 0.4 mm; anther oblong, 0.3–0.6 mm long. Ovary oblong, *c.* 0.2 mm long, shortly stipitate; style 0.5–0.8 mm long, flat, dilated at base, ciliate except at base; stigmas 2, shorter than style. Nuts biconvex, ellipsoid or obovoid, umbonulate, *c.* 0.5 × 0.5 mm, smooth, shining, stramineous.

*Fl. & Fr.*: November – February.

*Habitat*: Near the lake or damp places.

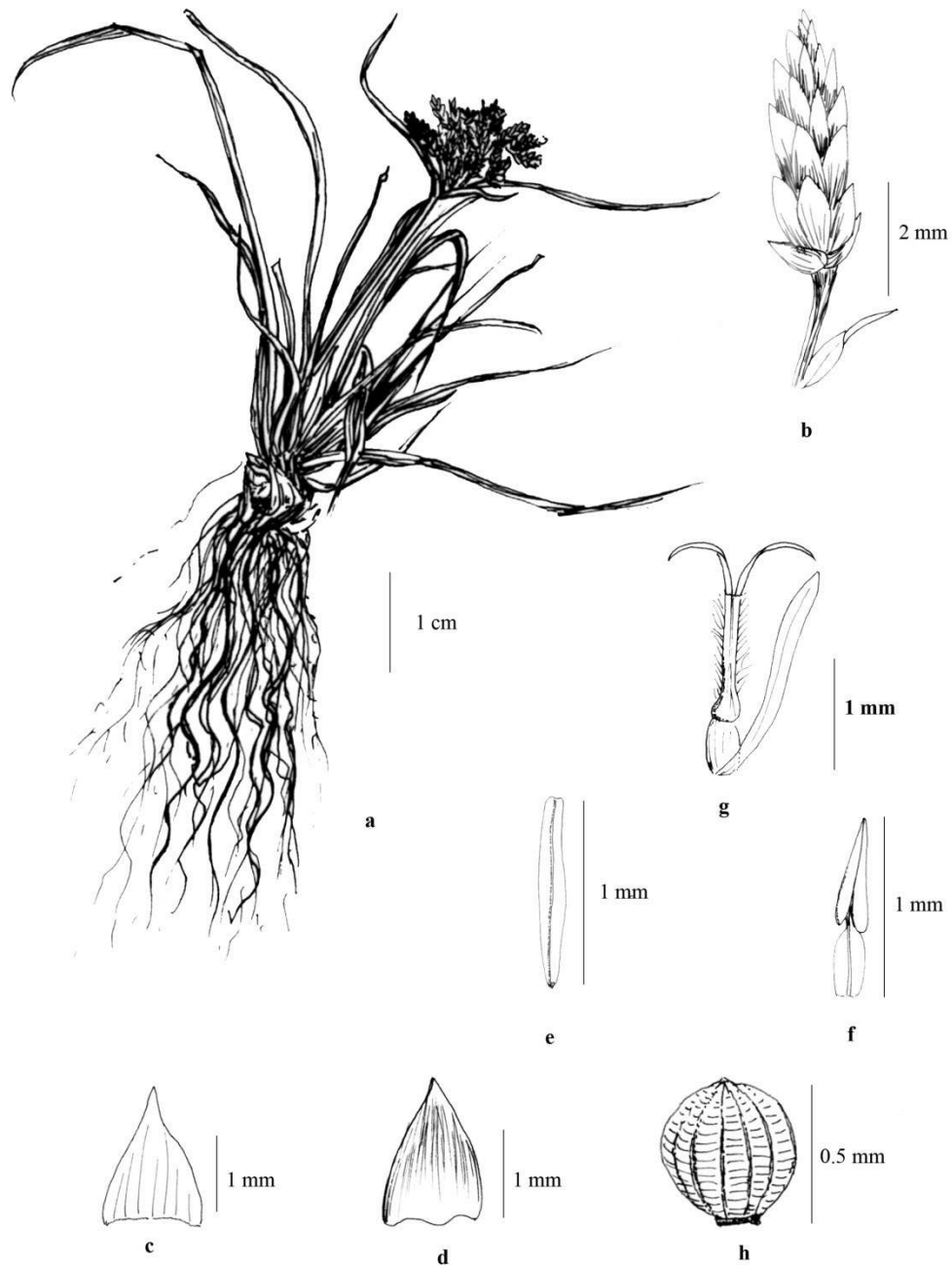
*Distribution*: KWLS: Pipra tan, Chattarbar common. INDIA: Throughout. WORLD: South to East and Southeast Asia and Tropical Australia.

*Specimen examined*: Pipra tan Chattarbar, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, Shyam Biswa 53916.

**2. *Fimbristylis cymosa* R. Br.**, Prodr. Fl. Nov. Holland. 228. 1810. *Fimbristylis spathacea* Roth, Nov. Pl. Sp. 24. 1821; C.B. Clarke in Hook.f., Fl. Brit. India 6: 640. 1893; Haines, Bot. Bihar Orissa 922. 1924.

## Plate 12H

Annual or perennial herb, 5–40 cm high; rhizomes short. Stems densely tufted, slender, sometimes setaceous, obtusely trigonous, base in crispate covered by brownish sheath. Leaves simple flat or slightly conduplicate, linear, filiform, 2–3 roundish or roundish folded inwards, 2–



**Fig. 10.** *Fimbristylis aestivalis* (Retz.) Vahl: a. habit; b. spikelet; c.,d. glume; e.,f. stamen; g. pistil and stamen; h. nut.

35 cm long, gradually acuminate, nearly as long as stem, inflorescences capitate, consisting of usually 3 (rarely 1, 4 or 5) sessile, dense spikes; central spike subglobose,  $5-8 \times 4-6$  cm; lateral ones globose, smaller; involucre bracts 3 or 4, spreading or reflexed, to 10 cm long. Flowers bisexual. Spikelets oblong,  $1.6-2 \times 0.6-0.7$  mm, compressed, pale green. Glumes spiral, broadly ovate, obtuse, slightly notched or minutely apiculate at apex,  $1.5-1.8 \times 1-1.4$  mm, faintly keeled, scarious towards margins. Stamens usually 2, maturing at different times; filaments flat, elongate to 1 mm long; anthers linear-oblong, *c.* 0.5 mm long, connective minutely apiculate. Ovary oblong, *c.* 0.5 mm long; style glabrous, *c.* 0.7 mm long, dilated at base; stigmas 2, *c.* 1 mm long, minutely ciliate. Nuts globose or oblong,  $0.5-1 \times c. 0.5$  mm, laterally compressed, brownish.

*Fl. & Fr.*: October – February.

*Habitat*: Near the lake or moist places.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Andaman & Nicobar Islands, Eastern and Western Peninsular India. WORLD: Pantropical.

*Specimen examined*: Near Dhanarjay Nadi, Meghatari, 189 m,  $24^{\circ}34'58.1''$  N,  $85^{\circ}35'21.4''$  E, 2nd March 2012, *Shyam Biswa* 54031.

**3. *Fimbristylis dichotoma* (L.) Vahl**, Enum. Pl. 2: 287. 1805, excl. var.; C.B. Clarke in Hook.f., Fl. Brit. India 6: 635. 1893; Haines, Bot. Bihar Orissa: 920. 1924; Mooney, Suppl. Bot. Bihar Orissa: 149. 1950; N.P. Singh & al., Fl. Bihar: 571. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 650. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1003. 2005. *Scirpus dichotomus* L., Sp. Pl. 1: 50. 1753. *Scirpus diphyllus* Retz., Observ. Bot. 5: 15. 1789. *Fimbristylis diphylla* (Retz.) Vahl, Enum. Pl. 2: 289. 1805; C.B. Clarke in Hook.f., Fl. Brit. India 6: 636. 1893; Haines, Bot. Bihar Orissa: 920. 1924.

Annual or perennial herb, 10–60 cm high, fibrous or short rhizomatous. Stems slender to rather stout, angular, compressed especially below inflorescence, striate, glabrous or pilose. Leaves simple, basal,  $3-45 \times 1.5-5$  mm, entire and scabrid at margins in upper parts, abruptly acuminate at apex, glabrous or more or less pubescent, green or glaucous; ligule absent. Inflorescences simple to decompound, *c.* 20 cm long; involucre bracts 2–5, much shorter to somewhat longer than inflorescences. Primary rays obliquely patent, *c.* 10 cm long. Flowers bisexual. Spikelets ovoid or oblong-ovoid,  $5-6 \times 2-3$  mm, densely many-flowered. Glumes chartaceous, spiral, broadly ovate to oblong-ovate,  $2-2.5 \times 1-1.5$  mm, keeled, glabrous, dark brown; keel protruding above the apex as a mucro sparsely hairy above. Stamens 2; filaments elongate to 2–2.5 mm long; anthers oblong-lanceolate, apiculate at apex, *c.* 0.5 mm long. Ovary oblong, *c.* 0.5 mm long, stipitate; style flat, 1–1.5 mm long, slightly dilated at base, ciliate at margin; stigmas 2, tapering towards apex, 0.5–1.5 mm long, curled inwards. Nuts obovoid, biconvex, shortly stipitate,  $1-1.2 \times 0.8-1$  mm, conspicuously trabeculate by 5–10 longitudinal ribs on either face, glistening white to stramineous.

*Fl. & Fr.*: May – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; very common. INDIA: Throughout. WORLD: Throughout the subtropical parts of the world. One of the most widely distributed species. South and East Asia.



*Specimen examined:* Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49516.

**4. *Fimbristylis littoralis*** Gaudich. in Freyc., Voy. Uranie, Bot. 413. 1829; N.P. Singh & al., Fl. Bihar: 572. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 223. 2014. *Fimbristylis miliacea* sensu Vahl, Enum. Pl. 2: 287. 1806 (non *Scirpus miliaceus* L.); Clarke in Hook.f., Fl. Brit. India 6: 644. 1894.

**Plate 13A**

Annuals herb, 10–60 cm high, with fibrous roots. Stems tufted, glabrous, usually 4-angled. Leaves simple, linear, 5–40 × 0.1–0.2 cm, gradually narrowed to an acuminate apex, glabrous; sheaths covering basal portion of the stem, with a very short appendage-like blade, up to 15 cm long, ligule absent; orifice membranous, smooth, glabrous. Inflorescence compound or decompound, with many to numerous spikelets, 2–2.5 mm long. Involucral bracts 3–5, much shorter than inflorescence. Primary rays few to several angled, longest up to 3 cm. Spikelets solitary, globose, or subglobose, terete, obtuse at apex, 2–3 mm across, densely many-flowered, brownish; rachilla not winged. Glumes spiral, membranous, boat-shaped, ovate, 1–2 × c. 0.5 mm, obtuse and muticous at apex, faintly keeled, usually with a brown streak on both sides of the keel, hyaline towards margins. Stamens 2; filaments flat, hyaline, elongate 0.3–0.8 mm; anthers oblong, 0.2–0.5 mm long, orange coloured. Ovary oblong, c. 0.3–0.5 mm long; style triquetrous, c. 0.5 mm long, brownish, ciliolate towards apex; stigmas 3, 0.5–0.8 mm long, ciliolate, hairy. Nut trigonous, obovoid, 0.5–0.8 × c. 0.5 mm, verruculose, faintly stipitate, yellowish straw coloured.

*Fl. & Fr.:* October – February.

*Habitat:* Near the lake or damp places.

*Distribution:* KWLS: Panbasa nadi, Lokai jungle; few. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined:* Panbasa nadi, Lokai jungle, 382 m, 24°28'57.6" N, 85°37'20.5" E, 24th February 2012, *Shyam Biswa* 49864.

**5. *Fimbristylis quinquangularis*** (Vahl) Kunth, Enum. Pl. 2: 229. 1837; C.B. Clarke in Hook.f., Fl. Brit. India 6: 644. 1893; Haines, Bot. Bihar Orissa 915. 1924; Mooney, Suppl. Bot. Bihar Orissa: 148. 1950; N.P. Singh & al., Fl. Bihar: 573. 2001. *Scirpus miliaceus* L., Syst. Nat. ed. 10. 2: 868. 1759. *Fimbristylis miliacea* (L.) Vahl, Enum. Pl. 2: 287. 1805, *quoad basion.*; C.B. Clarke in Hook.f. Fl. Brit. India 6: 644. 1893; Haines, Bot. Bihar Orissa 915. 1924; N.P. Singh & al., Fl. Bihar: 572. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1006. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:224. 2014. *Scirpus quinquangularis* Vahl, Enum. Pl. 2: 279. 1805.

**Plate 13B**

Annual herb, 10–20 cm high, with fibrous roots, stems densely tufted, erect, winged above embraced at base by the large leaf sheaths. Leaves simple, basal, 5–19 × 0.1–0.4 cm, entire at margins gradually tapering to an acute apex, parallel many veined sheaths papery, 1–5 cm long; ligule absent; orifice membranous, glabrous. Upper leaves reduced to sheaths or with very short blades. Inflorescence compound to decompound umbel, with numerous spikelets, 2–8 cm long; branches of umbel winged or triquetrous, glabrous. Involucral bracts 3–6, much shorter than inflorescence, lowest 0.6–3.5 cm long. Primary rays few to many, compressed, sulcate, upto 5 cm long, usually scabrid. Spikelets solitary, oval or sub-globose, 2–4 × 1–2 mm, brownish, many-

flowered, central sessile and 2–5 lateral with slender pedicels on the final branches of the umbel; rachilla prominently winged. Glumes membranous, spiral, broadly ovate, *c.* 1.7 × 1.5 mm obtuse and apiculate at apex, keeled, with a brown streak on both sides of the keel, hyaline towards margins. Stamens 1 or 2; filament flat, hyaline, elongate 0.5–0.8 mm long; anther oblong, acute at apex, *c.* 0.5 mm long. Ovary oblong, *c.* 0.4 mm long; style trigonous, *c.* 0.5 mm long pyramidally thickened at base; stigmas 3, 0.5–1 mm long, minutely ciliate. Nut obtusely trigonous, broadly obovoid to subglobose, 0.8–1 × 0.5–0.6 mm, verruculose, minutely transversely striate; minutely verrucose, whitish-yellow.

*Fl. & Fr.*: November – January.

*Habitat*: Near the lake or Moist places.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; rare. INDIA: Throughout. WORLD: Sri Lanka, South China, Formosa, Malesia, tropical Africa, tropical Australia.

*Specimen examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 53915.

**6. *Fimbristylis schoenoides* (Retz.) Vahl**, Enum. Pl. Obs. 2: 286. 1805; C.B. Clarke in Hook.f. Fl. Brit. India 6: 634. 1893, *p.p.*; Haines, Bot. Bihar Orissa 918. 1924; Mooney, Suppl. Bot. Bihar Orissa: 149. 1950; N.P. Singh & al., Fl. Bihar: 573. 2001. *Scirpus schoenoides* Retz, Observ. Bot. 5: 14. 1788.

#### Plate 13C

Annuals or perennial herb 5–35 cm high, with or without a short rhizome. Stems densely tufted, smooth, very slender, striate-sulcate. Leaves simple, filiform, 3–25 × *c.* 0.5 cm; sheaths 2–5 cm long; ligule a fringe of short hairs. Inflorescence usually a solitary, terminal spikelet, often proliferates into 1–2 peduncled spikelets; peduncle 2.5–27 cm long, ribbed, glabrous. Involucral bracts usually glume-like, ovate or triangular, *c.* 2 × 1 mm, apiculate, often leafy. Spikelets ovoid, 4–6 × 3–5 mm, many-flowered. Glumes spiral, membranous, broadly ovate, *c.* 3.5 × 2 mm, apiculate at apex, prominently keeled, with brown spots towards centre. Stamens 3; filaments *c.* 3 mm long, anthers oblong, *c.* 1 mm long, mucronate. Ovary obovate, 0.5–1 mm long; style *c.* 1 mm long, dilated at base, ciliate in the upper half; stigmas 2 bifid, *c.* 0.5 mm long, brownish. Nut biconvex, obovate 1.5–2 × 1 mm, whitish to straw coloured, smooth.

*Fl. & Fr.*: October – November.

*Habitat*: Near the lake or damp and marshy places.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; common. INDIA: Throughout. WORLD: Sri Lanka, China, Malesia, Thailand, Formosa, and tropical Australia.

*Specimen examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 54097.

#### 6. **FUIRENA** Rottb.

Subtropical regions, *c.* 30 species, 6 in India, 2 in Jharkhand and 1 in KWLS.

***Fuirena ciliaris* (L.) Roxb.**, Fl. Ind. 1: 184. 1820; N.P. Singh & al., Fl. Bihar: 575. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 653. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1008. 2005. *Scirpus ciliaris* L., Mant. Pl. 182. 1771. *Fuirena glomerata* Lam, Tabl. Encycl. 1: 150. 1791; C.B. Clarke in Hook.f. Fl. Brit. India 6: 666. 1893; Haines, Bot. Bihar Orissa 928. 1924.

#### Plate 13D

Annual herb, 10–25 cm high with fibrous roots. Stems tufted, obtuse-angular, striate-sulcate, pubescent. Leaves linear-lanceolate,  $1-5 \times 0.1-0.5$  cm, entire and ciliate at margins, acute at apex, pubescent throughout, hair whitish *c.* 0.5 mm long; ligule very prominent, 2–3 mm long; sheaths striate, pubescent. Inflorescence usually a terminal cluster along with 1 or 2 peduncled clusters from the upper axils, often a terminal cluster only; each cluster, 0.6–3 cm across, bearing 3–13 spikelets; peduncles pubescent. Bracts leaf-like, shorter than or overtopping the inflorescence. Spikelets ovoid or oblong-ellipsoid, subacute at apex,  $5-10 \times 3-5$  mm, squarrose, densely pubescent. Glumes membranous, oblong-obovate or obovate, obtuse at apex,  $1.5-2 \times 1-1.5$  mm (excluding a 1 mm long, bristly awn), pubescent throughout outside, pilose in the centre; costa 3-veined. Perianth biseriate; bristles 3, usually shorter than nut, at times as long as the nut, scaberrulous to smooth; scales subquadrate, cordate at base, 3-dentate at apex (with the central teeth largest), distinctly clawed, long-stipitate at base, *c.*  $1 \times 0.6$  mm (including the claw and the stipe), glabrous or minutely hairy at apex. Stamens 3; filaments elongate up to 0.5–1 mm; anthers oblong, *c.* 0.4 mm long. Style *c.* 1.5 mm long; stigmas 3, slightly shorter than style. Nut triquetrous, obovate in outline, cuneate towards base, narrowed to a beak at apex,  $0.5-1 \times 0.6$  mm (including the beak), smooth, stramineous.

*Fl. & Fr.*: January – February .

*Habitat*: On Moist places or Near the Nallas/ drain of dry deciduous forests.

*Distribution*: KWLS: Lokai forest near Birhore Tola; not common. INDIA: Throughout the subtropical parts. WORLD: Tropics of the old world; throughout South-East Asia, tropical Africa and Australia.

*Specimen examined*: Lokai forest near Birhore Tola, 382 m,  $24^{\circ}28'57.6''$  N,  $85^{\circ}37'20.5''$  E, 24th February 2012, *Shyam Biswa* 49866.

*Note*: Observed two types of florets, the lower floret and the upper floret; the lower florets having stamens or looks like staminodes *c.* 2 mm long hyaline the upper florets having 3 stamens prominent *c.* 1 mm long and the carpel of lower florets slightly longer.

## 7. SCHOENOPLECTIELLA Lye

Cosmopolitan, *c.* 77 species, *c.* 15 in India, 8 in Jharkhand and 1 in KWLS.

**Schoenoplectiella lateriflora** (J.F. Gmel.) Lye, *Lidia* 6(1): 25. 2003. *Schoenoplectus lateriflorus* (J.F.Gmel.) Lye, *Bot. Not.* 124 (2): 290. 1971; N.P. Singh & al., *Fl. Bihar*: 583. 2001. *Scirpus lateriflorus* J.F. Gmel, *Syst. Nat.* ed. 13. 2(1): 127. 1791. *Scirpus supinus* Roxb., *Fl. Ind.* (Carey & Wallich ed.) 1: 219. 1820, *non* L., 1753. *Scirpus supinus* var. *uninodis* auct. *non* (Del.) Asch. & Schweinf, 1887; C.B. Clarke in *Hook.f. Fl. Brit. India* 6: 656. 1893; Haines, *Bot. Bihar Orissa* 925. 1924.

### Plate 13G

Annual herb, 10–40 cm high, with fibrous roots. Stems tufted, narrow to slender, obtusely triangular, smooth, glabrous, with 1 or 2 nodes above the base. Leaves simple, reduced to 1 or 2 sheaths, mucronate or with a short blade at apex, *c.* 10 cm long, often with a solitary female flower from the axil with a very long trifid style. Inflorescence pseudolateral, usually corymbose, some times head-like, with 2–10 spikelets. Rays up to 4, longest up to 3 cm long. Involucral bract 1 or 2; the lower erect, continuous to and looks like the stem, ventrally sulcate, always shorter than stem, 2–15 cm long; second bract, if present much shorter, up to 4 cm long. Spikelets clustered on rays or on the stem, oblong-ovoid, acute at apex, angular,  $4-8 \times 2-3$  mm, densely



many-flowered. Glumes membranous, broadly ovate,  $2-2.5 \times c. 1$  mm, mucronate at apex, strongly keeled, brownish variegated on sides, very minutely ciliolate at margins; keel 3-veined. Perianth bristles absent. Stamens 3; filaments elongate up to 2 mm; anthers oblong,  $c. 0.5$  mm long, with a prominent bristly connective appendage at apex. Ovary obovoid  $c. 1$  mm long; style  $c. 0.6-1$  mm long; stigmas 3,  $0.5-1$  mm long. Nut trigonous, broadly obovoid, shortly apiculate,  $c. 1.2 \times 1$  mm, conspicuously transversely wavy-ridged, light yellowish-white, turns reddish-blackish, glossy.

*Fl. & Fr.*: November – February.

*Habitat*: Near the lake or Marshy places.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; very common. INDIA: Throughout (except North-West). South and South-East Asia (India to China, Malesia & Formosa) and Australia.

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E, 26th February 2012, *Shyam Biswa* 49883; Rheio Ghoghar Dam, Chattarbar, 379m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E 29th November 2012, *Shyam Biswa* 54108.

### 23. POACEAE Barnhart, nom. cons. (= GRAMINEAE Juss., nom. cons.)

Cosmopolitan but especially tropical and North temperate, sub-arid regions, 715 genera  $c. 10550$  species; 263 genera 1291 species in India.

#### Key to genera

- |                                                                                                                                                                                              |                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 1a. Culms woody; lower culm sheaths broad with rudimentary blades                                                                                                                            | <b>6. Dendrocalamus</b> |
| 1b. Culms not woody, herbaceous; lower culm sheaths with normal blades                                                                                                                       | 2                       |
| 2a. Spikelets arranged in pairs (rarely triads) on fragile racemes; raceme rachis breaking up into segments bearing a sessile and pedicelled spikelets                                       | 3                       |
| 2b. Spikelets arranged singly in panicles or racemes (occasionally raceme fragile but spikelets single; or spikelets paired but raceme tough)                                                | 18                      |
| 3a. Spikelets disarticulating at maturity above glumes                                                                                                                                       | <b>15. Phragmites</b>   |
| 3b. Spikelets falling entire at maturity, either singly or with other spikelets and inflorescence parts attached                                                                             | 4                       |
| 4a. Spikelets single, or if paired both spikelets alike; glumes thinner than fertile floret, lower glume short or even suppressed; fertile floret papery to crustaceous or leathery, awnless | 5                       |
| 4b. Spikelets paired, often dissimilar; glumes as long as spikelet, tougher than and enclosing hyaline florets; fertile florets often with geniculate awn                                    | 12                      |
| 5a. Spikelets subtended by bristles or a spiny involucre; or raceme rachis prolonged into a bristle or short point beyond the uppermost spikelet                                             | 6                       |
| 5b. Spikelets not subtended by bristles; or raceme rachis terminating in a spikelet                                                                                                          | 7                       |
| 6a. Leaf blades linear to lanceolate, sometimes plicate or narrowed to a false petiole; bristles persisting on the axis after the spikelets have fallen                                      | <b>19. Setaria</b>      |
| 6b. Leaf blades flat, folded or convolute; ligule a ciliate membrane; bristles or spines falling as involucres around the spikelets                                                          | <b>3. Cenchrus</b>      |
| 7a. Inflorescence an open, contracted or spike-like panicles; pedicels usually all slender and distinct                                                                                      | 8                       |
| 7b. Inflorescence of unilateral racemes; pedicels often very short, at least for one spikelet of a pair                                                                                      | 9                       |

- 8a. Panicle effusely spreading **13. Panicum**
- 8b. Panicle narrow, spiciform, cylindrical to oblong **18. Sacciolepis**
- 9a. Apex of upper lemma awned **1. Alloteropsis**
- 9b. Apex of upper lemma not as above 10
- 10a. Leaf blades lanceolate to ovate; spikelets laterally compressed; lower glumes awned **12. Oplismenus**
- 10b. Leaf blade not as above; spikelets dorsally compressed; lower glumes awnless 11
- 11a. Upper lemma cartilaginous to papery, the margins broad, flat and hyaline, covering much of the palea **8. Digitaria**
- 11b. Upper lemma coriaceous to bony with inrolled or flat margins exposing much of the palea **23. Urochloa**
- 12a. Spikelets all unisexual, separated in different inflorescences or in different parts of the same inflorescence; male and female separated **24. Zea**
- 12b. Spikelets all bisexual, or at least the sessile spikelet of a pair, male and female not separated 13
- 13a. Rachis internodes and pedicels stout, angular, columnar or widening upward, internode and pedicel sometimes joined; upper lemma awnless **11. Hackelochloa**
- 13b. Rachis internodes and pedicels slender, filiform to linear, or if widened upward the upper lemma awned 14
- 14a. Spikelets of a pair similar in shape, usually both fertile 15
- 14b. Spikelets of a pair different in shape and sex (rarely pedicelled spikelet vestigial or reduced to pedicel) 16
- 15a. Inflorescence of solitary or sub-digitate or digitate racemes **16. Pseudopogonatherum**
- 15b. Inflorescence with elongate central axis, longer than lowest raceme **17. Saccharum**
- 16a. Racemes borne on an elongate central axis or its branches, axis longer than lowest raceme, not supported by spathes **4. Chrysopogon**
- 16b. Racemes solitary, paired or subdigitate, often supported by spathes 17
- 17a. Inflorescence a many-time compound panicle **5. Cymbopogon**
- 17b. Inflorescence digitate, of usually more than one, very shortly peduncled raceme **7. Dichanthium**
- 18a. Spikelets with strictly 2 florets and no rachilla extension; lower floret staminate or barren, sometimes reduced to an empty lemma, upper floret fertile **2. Arundinella**
- 18b. Spikelets with 1 to many florets (if 2 florets, then both fertile, or the lower fertile, or rachilla extension present 19
- 19a. Leaf blades with cross veins, broadly linear to ovate **21. Thysanolaena**
- 19b. Leaf blades without cross veins, usually narrow 20
- 20a. Inflorescence composed of one or more racemes, or racemes in a cylindrical spiciform structure 21
- 20b. Inflorescence an open, contracted or spike-like panicle 23
- 21a. Racemes not in a cylindrical spiciform structure, usually with 2 pairs of involucrel spikelets at base **20. Themeda**
- 21b. Racemes in a cylindrical spiciform structure, without involucrel spikelets at base 22
- 22a. Spikelets with long flexuous awns **14. Perotis**
- 22b. Spikelets awnless or mucronate **22. Tragus**
- 23a. Inflorescence a panicle **10. Eragrostis**
- 23b. Inflorescence of one or more racemes **9. Eragrostiella**

## 1. **ALLOTEROPSIS** C.B. Presl

Old World Tropical regions, 5 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Alloteropsis cimicina** (L.) Stapf, Fl. Trop. Afr. 9(3): 487. 1919; Haines, Bot. Bihar Orissa 1009. 1924; Mooney, Suppl. Bot. Bihar Orissa: 172. 1950; N.P. Singh & al., Fl. Bihar: 588. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1036. 2005. *Milium cimicinum* L., Mant. Pl. Altera: 184.1771; Ranjan, Fl. Parasnath Wildlife Sanct.:228. 2014. *Axonopus cimicinus* (L.) P. Beauv., Ess. Agrostogr. 12. 1812; Hook.f., Fl. Brit. India 7: 64. 1896. **Plate 14A**

Annual. Culms 20–60 cm high, ribbed, sparsely tuberculate hairy. Leaf sheath keeled towards apex, ribbed, sparsely tuberculate hairy; ligule *c.* 0.3 mm long, membranous, fimbriate at apex. Leaf blades ovate to lanceolate, 2–8 × 0.4–1.8 cm, rounded to semiamplexicaul at base, ciliate at margins, acute to acuminate at apex, scabrid, midrib hairy. Racemes 4–8, whorled or subdigitate, 6–20 cm long, villous white hairy on apical node; peduncle elongate, 9–30 cm long, ribbed. Spikelets solitary, ovate to elliptic, 3–3.5 × 1.5–2 mm, acuminate; rachis triquetrous, scabrid; pedicels 2–3 mm long. Glumes unequal, lower glume lanceolate, *c.* 3 × 1.5 mm, 3-veined; upper glume ovate-lanceolate, 3–3.5 × 1.5–2 mm, 5-veined, cartilaginous, ciliate. Florets 2; lower male, upper bisexual. Lemma similar, ovate or boat shaped, 2.4–3 × 0.7–1.5 mm, acute, awned, 5-veined, arista straight, *c.* 1 mm. Palea ovate-lanceolate, 1.2–2.5 × 0.5–1 mm, acute or acuminate, 2-veined, 2-keeled greenish. Lodicules 2, *c.* 0.2 mm long, membranous, hyaline. Stamens 3, exerted; anthers 0.6–0.8 mm long, brownish purple; filaments 0.2–0.4 mm long. Ovary dorsally compressed, ovate to elliptic, *c.* 0.4 × 0.2 mm, greenish; style 0.8–1 mm, hyaline; stigma plumose, *c.* 1 mm, purplish. Caryopsis dorsally compressed, oblong-elliptic to ovate, *c.* 1–1.5 × 0.8–1 mm, obtuse, brownish.

*Fl. & Fr.*: August – September.

*Habitat*: On the rocky hill, dry deciduous forests.

*Distribution*: Jharkhand, Koderma, Koderma Wildlife Sanctuary: Dengra Pahar, near RIT institute, Chattarbar; Near the Phulwarwaria jungle, Koderma NRF; occational. INDIA: Andaman, Andhra Pradesh, Bihar, Daman & Diu, Delhi, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal. INDIA: Old World Tropical.

*Specimen examined*: Dengra Pahar, near RIT institute, Chattarbar, 390 m, 24°27'58.8" N, 85°34'14.9" E, 13th August 2011, *Shyam Biswa* 49788; Near the Phulwarwaria jungle, Koderma NRF, 394m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49543.

## 2. **ARUNDINELLA** Raddi.

Subtropical regions *c.* 60 species, *c.* 20 in India; 4 in Jharkhand, 1 in KWLS.

**Arundinella nepalensis** Trin., Gram. Panic. 62. 1826 & Sp. Gram. t. 268. 1836; N.P. Singh & al., Fl. Bihar: 593. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1041. 2005.

Perennial. Culms 0.9– 1.5 m high, simple or branched. Leaf sheathd sparsely tuberculate hairy; ligule ovate to truncate, *c.* 1 mm, membranous. Leaf blades linear-lanceolate, 15–30 × 0.5–1 cm, rounded to shallowly cordate at base, obtuse to acuminate at apex, sparsely tuberculate hairy. Panicle lax, densely spiculate, 20–30 cm long. Spikelets with 2 florets elliptic-lanceolate, 3–5 mm



long; pedicels 3–5 mm. Glumes persistent, gaping. Lower glume ovate,  $3-3.5 \times c. 1$  mm, acute to acuminate at apex, 3-veined, 1-keeled. Upper glume ovate-lanceolate,  $3.5-5 \times c. 1$  mm, acuminate at apex, 5-veined, 1-keeled. Florets 2; lower male, upper bisexual; disarticulating below florets; callus bearded. Lower lemma oblong-lanceolate,  $c. 3.5$  mm, acute at apex, 3–5-veined. Lower palea oblong-elliptic,  $c. 2.5$  mm, hyaline, 2-veined, 2-keeled, keels ciliate. Upper lemma ovate to oblong,  $c. 2$  mm, bifid at apex, awned from sinus, granulose, 3-veined; awn geniculate,  $c. 3$  mm, column 1–2 mm long. Upper palea elliptic-oblong, 1–1.5 mm, granulate dorsally. Lodicules 2. Stamens 3; anthers 1.8–2 mm long. Ovary oblong,  $c. 0.5$  mm; style  $c. 1.5$  mm long, stigma  $c. 1.5$  mm long, plumose.

*Fl. & Fr.*: September–October.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; not common. WORLD: South East Asia, Bhutan, China, Japan, Pakistan, Nepal. INDIA: Andhra Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Uttar Pradesh.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 390 m,  $24^{\circ}29'06.6''$  N,  $85^{\circ}35'49.8''$  E, 4th September 2010, *Shyam Biswa* 49554.

### 3. CENCHRUS L.

Tropical to temperate regions,  $c. 108$  species, 22 in India, 10 in Jharkhand (2 cultivated) and 1 in KWLS.

**Cenchrus pedicellatus** (Trin.) Morrone, Ann. Bot. (Oxford) n.s., 106(1): 128. 2010. *Pennisetum pedicellatum* Trin., Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3(2): 184. 1834; Hook.f., Fl. Brit. India 7: 86. 1896; Haines, Bot. Bihar Orissa: 986. 1924; N.P. Singh & al., Fl. Bihar: 641. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 702. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1118. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 244. 2014.

**Plate 15B**

Annual or perennial. Culms 90–140 cm high, ribbed. Leaf sheaths 7–10 cm, keeled towards apex; ligule membranous,  $c. 1$  cm. Leaf simple, linear-lanceolate,  $11-20 \times 0.5-0.8$  cm, cordate or rounded at base, finely serrulate or spiny at margins, acuminate at apex, midrib prominent, sparsely tuberculate hairy on both surfaces, margin curled inward. Inflorescence a terminal raceme, hairy tail like, 6–14 cm long, pinkish or purplish yellow with green tinge. Spikelets in involucre, one sessile and one or two short and long pedicelled ones in an involucre, ovate-lanceolate, 1.5–1.7 cm long (with bristles); entire involucre disarticulating as a single unit with the upper floret easily deciduous; involucre bristles 0.5–2 cm long, woolly plumose and interlocked in lower 2/3 and barbellate above; pedicels 0.4–2 mm, long. Lower glume ovate-lanceolate,  $1.7-3 \times c. 0.5$  mm, acute to 2-lobed, membranous, faintly 1-veined, scabrid. Upper glume broadly ovate-lanceolate,  $2.5-4.5 \times c. 1.8$  mm, shortly 3-lobed, membranous, faintly 5-veined. Florets 2, dissimilar; lower male, upper bisexual. Lower lemma ovate-lanceolate,  $2.8-3.8 \times c. 1$  mm, 3-lobed, faintly 5-veined, ciliate at apex, margins incurved. Lower palea elliptic-lanceolate,  $2.3-3.2 \times c. 0.7$  mm, scabrellate at apex, faintly 2-veined, 2-keeled, keels scabrellate, long ciliate at apex. Upper lemma ovate-lanceolate,  $1.8-2.5 \times c. 0.8$  mm, scabrellate to ciliate at apex, faintly 3–5-veined, margins incurved. Upper palea narrowly ovate-lanceolate,  $1.7-2.5 \times c. 0.6$  mm, similar to upper lemma, faintly 2-veined. Lodicule absent. Stamens 3; filaments  $c. 0.5$

mm long, brownish; anthers 1.5–2 mm long. Ovary ovate-lanceolate, *c.* 0.5 × 0.3 mm; style 1–1.7 mm, brownish, straight; stigma plumose, 1–3 mm, brownish. Caryopsis oblong-elliptic to obovate, *c.* 1.5 × 1 mm, brownish green.

*Fl. & Fr.*: November – March.

*Habitat*: In the open grasslands.

*Distribution*: KWLS: Inside the enclosure, Koderma NRF; Near RFO office, Koderma NRF; common. WORLD: Tropical of Old World. INDIA: Andhra Pradesh, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

*Specimen examined*: Inside the enclosure, Koderma NRF, 395 m, 24°28'58.1" N, 85°36'03.0" E, 1st March 2012, *Shyam Biswa* 54025; Near RFO office, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 29th November 2012, *Shyam Biswa* 54111.

#### 4. **CHRYSOPOGON** Trin. nom. cons.

Subtropical regions especially Old World, 44 species, 14 in India, 8 in Jharkhand, 2 in KWLS.

##### Key to species

- |                                                                                                  |                                |
|--------------------------------------------------------------------------------------------------|--------------------------------|
| 1a. Culms decumbent to 30 cm high; callus of sessile spikelets as long as spikelets,<br>acicular | <b>1. <i>C. aciculatus</i></b> |
| 1b. Culms erect to 2 m high; callus not as long as spikelets                                     | <b>2. <i>C. hamiltonii</i></b> |

**1. *Chrysopogon aciculatus* (Retz.) Trin., Fund. Agrost. 188. 1820; Haines, Forest Fl. Chota Nagpur: 574. 1910 & Bot. Bihar Orissa: 1035. 1924; N.P. Singh & al., Fl. Bihar: 602. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 672. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1049. 2005. *Andropogon aciculatus* Retz., Observ. Bot. 5: 22. 1788; Hook.f., Fl. Brit. India 7: 188. 1896.**

**Plate 14B**

Vern. Name: *Chora kanta*

Perennial. Culms decumbent, with rhizomatous base, to 30 cm high, glabrous. Leaf sheath 1–1.5 cm long; ligule 0.2–0.4 mm long. Leaf blades lanceolate, 3–5 × 0.2–0.5 cm, truncate at base, sparsely hairy or infolded at margins, acute to acuminate at apex, aggregated near base. Panicle narrow, 5–11 × 0.8–2.6 cm; peduncle *c.* 16 cm long, smooth. Racemes 2–4 cm long; entire spikelet disarticulating; pedicels *c.* 2 mm long. Sessile spikelet lanceolate, 4–4.5 × 0.8–1 mm, acuminate, purplish, awned. Lower glume oblong-lanceolate, *c.* 4 × 0.6 mm, 2-lobed and aristate, 3-veined, 2-keeled, serrulate on keels. Upper glume boat shaped, 2.8–3.2 × *c.* 0.6 mm with 0.4–1 mm long awn, 3-veined, midrib keel serrulate, scabrid in upper half near keel. Florets 2; lower barren, epaleate, upper bisexual, paleate. Lower lemma ovate-lanceolate, 2.5–3.1 × *c.* 0.5 mm, veinless. Upper lemma ovate-lanceolate, 2–3 × *c.* 0.5 mm, awned, 1-veined; awn 2.2–5 mm, straight, barbellate. Upper palea oblong, 1.7–2 × *c.* 0.6 mm, veinless, flat. Lodicules 2, truncate, 0.2–0.5 mm. Stamens 3; filaments *c.* 0.6 mm long; anthers 0.5–0.8 mm, brownish yellow. Ovary oblong, *c.* 0.5 × 0.2 mm, acute; style *c.* 0.4 mm, divergent; stigma plumose, 0.5–1.2 mm, purplish. Caryopsis oblong, 1.5–2 × *c.* 0.5 mm. Pedicelled spikelet lanceolate, 4.4–5.3 × *c.* 0.5 mm, acuminate, unawned, purplish yellow. Lower glume oblong-lanceolate, 4–5 × *c.* 1 mm, acuminate, 5-veined, 1-keeled towards apex; arista barbellate. Upper glume oblong-lanceolate, *c.* 4 × 0.5–0.6 mm, 3-veined, 1-keeled, purplish green. Florets 2; lower barren, epaleate, upper male, paleate. Lower lemma oblong-lanceolate, 2.6–3.4 × *c.* 0.4 mm, hyaline, veinless. Upper lemma

2.7–3 × *c.* 0.4 mm, similar to lower lemma. Upper palea oblong, 1.8–2.2 × *c.* 0.3 mm, hyaline, veinless. Stamens 3; anthers *c.* 1.8–2 × *c.* 0.2 mm, yellow.

*Fl. & Fr.*: August – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Dengra Pahar, near RIT institute, Chattarbar; common. WORLD: Tropical Asia, Nepal, Sri Lanka, Indo-China, China, Malaysia, Polynesia, Australia. INDIA: Andaman, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh.

*Specimen examined*: Dengra Pahar, near RIT institute, Chattarbar, 421 m, 24°28'09.3" N, 85°34'14.9" E, 13th August 2011, *Shyam Biswa* 49792.

**2. *Chrysopogon hamiltonii* (Hook.f.) Haines, Haines, Bot. Bihar Orissa 1036. 1924; N.P. Singh & al., Fl. Bihar: 602. 2001; *Andropogon hamiltonii* Hook.f., Fl. Brit. India 7: 190. 1896.**

**Fig. 11; Plate 14C**

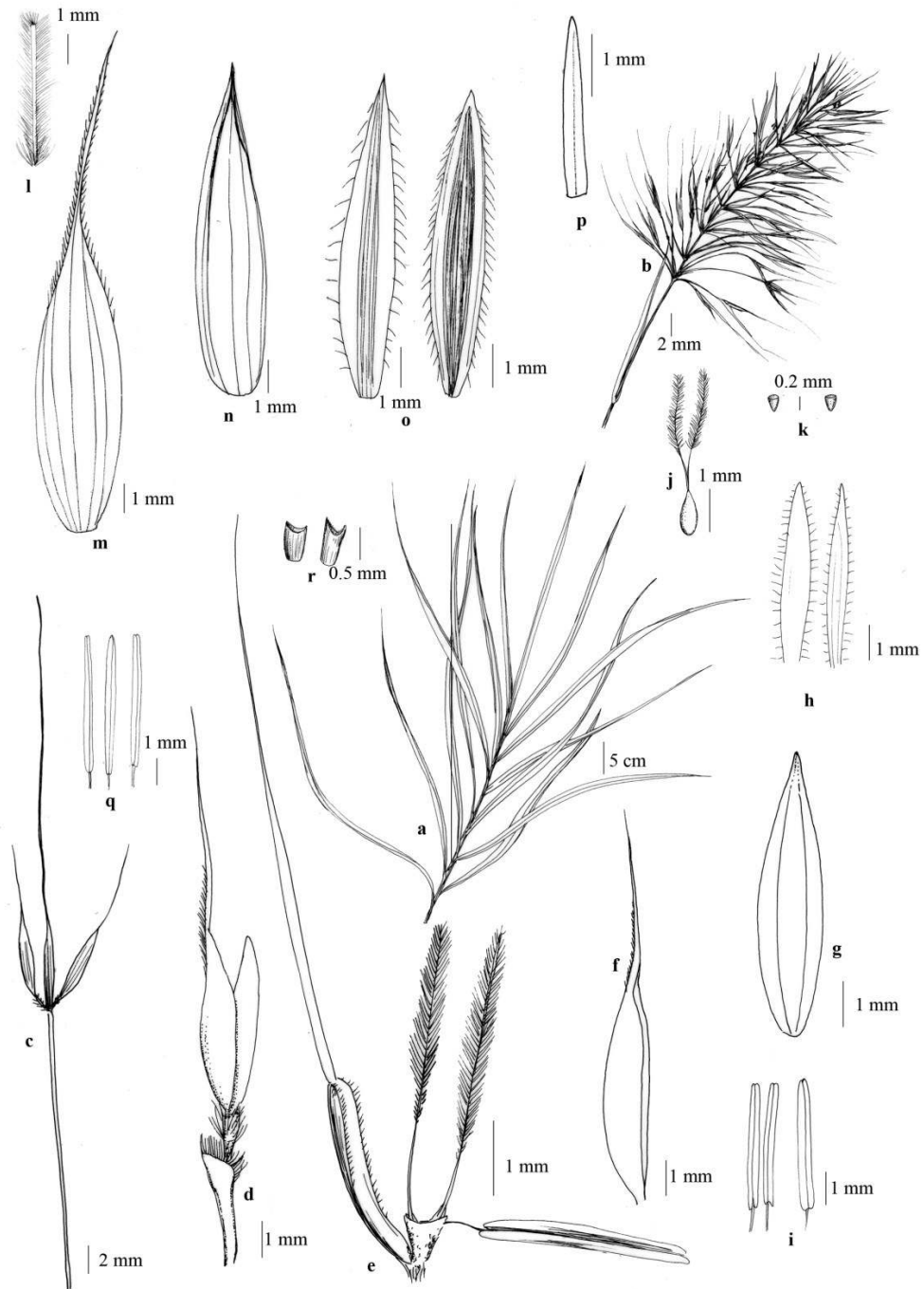
Perennial. Culms erect to 1.6 m high. Leaf sheaths terete, smooth, glabrous; ligule a ridge of minute hairs; Leaf blades mostly basal, compact; cauline leaves long, free, oblong to linear-lanceolate, 40–60 × 1–1.5 cm, contracted at base, sharp, scabrid at margins finely acuminate at apex, many veined, minutely scaberulous above. Panicle ovoid, 25–30 × 10–15 cm, peduncle of the spikelet 7–8 cm long, sessile peduncle bearing 2 lateral male floret and a bisexual central sessile floret. Spikelets 3 in a group, one sessile, 2 pedicelled; entire group disarticulating together; callus with long brown-villous hairs, 1–2 mm long. Sessile central spikelet oblong-lanceolate, 1.5–1.7 mm long including the awn (awn *c.* 10 mm long), awned, upper half with hirsute scabrid hairs. Lower glume oblong-lanceolate, 1.5–1.7 × 0.5–0.7 mm (awn 10 mm long), keeled towards margin, scabrid at the tips. Lower lemma lanceolate, 2 veined. Upper lemma hyaline base of awn, *c.* 3.5 × 0.3 mm, veinless, delicate; awn 4–5 cm, geniculate; column of 0.8–1 mm, long, white to yellowish brown hairy; bristle brownish, barbellate. Lower palea oblong-ob lanceolate, *c.* 6 × 0.5–1 mm, cilliate at margin, veinless. Upper palea oblong-ob lanceolate, 5–6 × 0.5–1 mm, cilliate at margin, veinless. Lodicules 2, obovate, *c.* 0.2 × 0.1 mm, truncate. Stamens 3; anthers *c.* 4 × 0.2–0.3 mm, yellowish brown; filaments *c.* 1.5 mm. Ovary oblong, 0.8–1 × 0.2–0.4 mm, acute, greenish; style 0.8–1 mm; stigma plumose, 2.5–3 mm. Caryopsis oblong to elliptic, *c.* 5 mm, brown, smooth. Pedicelled spikelet lanceolate, 9–10 × 1.5–1.8 mm (without awn), acute to acuminate, both glumes or only the lower awned; pedicel solid, 4–5 × *c.* 0.4 mm, hairy. Lower glume lanceolate, 9–10 × 1.5–1.8 mm, infolded, 5–7-veined; awn 8–12 mm, hairs of *c.* 0.6 mm long near base, barbellate towards apex. Upper glume oblong to oblanceolate, 3-veined, margins infolded. Florets epaleate; lower lemma narrowly oblong-lanceolate, 7–8 × *c.* 1 mm, margins infolded and ciliate. Upper lemma narrowly oblong, 6–7 × *c.* 1 mm, margins infolded, ciliate. Lodicules 2, 0.5–0.7 × 0.2–0.3 mm. Stamens 3; filaments 0.3–0.5 mm, anthers 4.5–5 × 0.2–0.3 mm, yellowish brown.

*Fl. & Fr.*: September – October

*Habitat*: On the hill slopes of dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; rare; INDIA: Andhra Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Odisha and Tamil Nadu. WORLD: Myanmar, Malaysia, Sri Lanka.





**Fig. 11. *Chrysopogon hamiltonii* (Hook.f.) Haines:** a. leafy twig; b. panicle; c. spikelets; d. lateral male spikelet; e. sessile central spikelet; f. glume; g. lemma; h. paleas; i. stamens; j. pistil; k. lodicules; l. callus; m. glume of lateral floret; n. lemma of lateral floret; o. paleas of lateral florets; q. stamens of lateral florets; r. lodicule of lateral florets.

*Specimen examined:* Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49588.

*Note:* ENDEMIC to Munger (N.P. Singh & al., 2001).

### 5. CYMBOPOGON Spreng.

Old World Tropical & subtropical regions *c.* 70 species, *c.* 20 in India, 7 (1 cultivated) in Jharkhand and 1 in KWLS.

**Cymbopogon martini** (Roxb.) Will. Watson, in Atkins., Gaz. N.-W. Prov. Ind. 10: 392. 1882; Haines, Forest Fl. Chota Nagpur: 580. 1910 & Bot. Bihar Orissa: 1046. 1924; N.P. Singh & al., Fl. Bihar: 606. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1055. 2005. *Andropogon martini* Roxb., Fl. Ind1: 280. 1820. *Andropogon schoenanthus* L. var. *martini* (Roxb.) Benth. Fl. Austral.7: 534 1878; Hook.f., Fl. Brit. India 7: 204. 1896.

#### Plate 14D

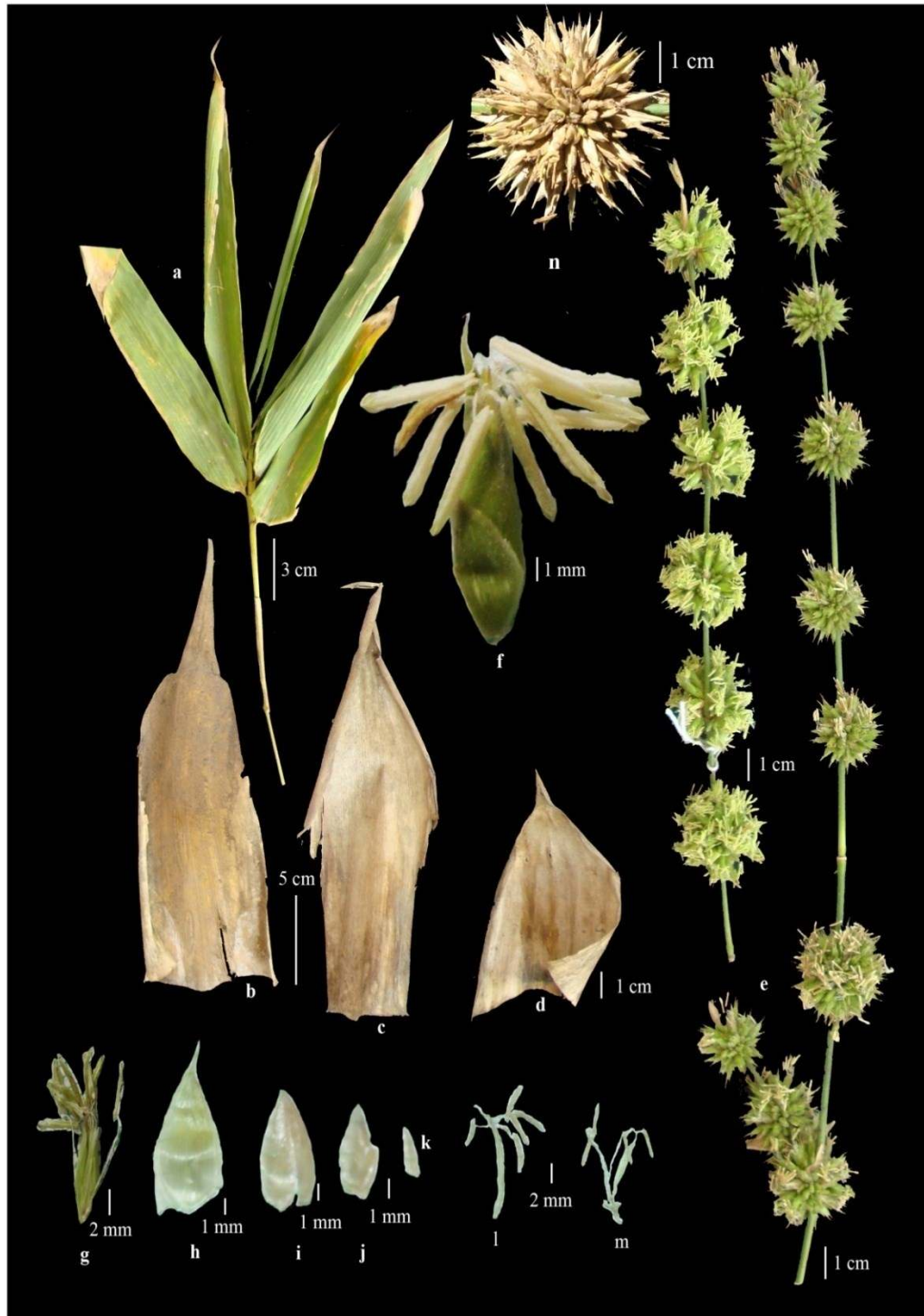
Perennial, rhizomatous. Culms erect, terete, ribbed to 90 cm high. Leaf sheath ribbed, 5–9 cm long, purplish margins; ligule 3–4 mm long. Leaf blades lanceolate to linear-lanceolate, 5–26 × 0.4–2 cm, subcordate to amplexicaul at base, entire and enrolled at maturity at margins, serrulate towards apex, acuminate at apex, midrib prominent. Panicle 14–35 × *c.* 4 cm; peduncle 0.6–1 cm, pubescent; spathe narrowly oblong-lanceolate, 2–3 cm, acuminate at apex; spatheole 2–2.3 cm, similar to spathe, ends with pair of racemes. Racemes sessile and subsessile, 1.5–1.7 cm; joints narrowly oblong to linear, 2–2.2 mm, dentate at apex, hairs up to 2 mm long; pedicels *c.* 2 mm, similar to joints, lowermost pedicel of sessile raceme swollen. Spikelets paired, dissimilar. Sessile spikelet oblong-lanceolate, *c.* 3.5 × 1 mm, acute to acuminate at apex. Lower glume oblong to elliptic-lanceolate, *c.* 3.5 × 1 mm, acuminate to retuse at apex, 2-veined, 2-keeled, keels winged, wing serrulate, margins incurved. Upper glume oblong-lanceolate, *c.* 3.1 × 0.7 mm, acuminate at apex, 3-veined, midrib keeled towards apex, keel winged, pubescent, margins incurved, ciliate. Florets 2, both epaleate; lower barren, upper bisexual. Lower lemma narrowly oblong-lanceolate, *c.* 3 × 0.5 mm, subacute at apex, veinless, margins infolded, ciliate. Upper lemma oblong, *c.* 1 × 0.5 mm, 2-lobed; awned from sinus; awn *c.* 1.5 cm long, column twisted, brownish, bristle barbellate. Lodicules 0.4–0.5 mm, dentate at apex. Stamens 3; anthers *c.* 1.5 mm long. Ovary narrowly oblong, *c.* 0.5 × 0.2 mm, brownish; style *c.* 1 mm long; stigma plumose, *c.* 1.5–2 mm long, purplish. Pedicelled spikelet oblong to elliptic-lanceolate, 3–3.5 × *c.* 1 mm, acuminate at apex. Lower glume oblong to elliptic-lanceolate, 3–3.5 × *c.* 1 mm, acuminate at apex, prominently 7–9-veined, 2-keeled, Upper glume ovate-lanceolate, *c.* 3 × 0.5 mm, acuminate at apex, 3-veined, margins incurved, ciliate. Lower lemma narrowly oblong, 2.2–3 × *c.* 0.5 mm, truncate to obtuse at apex, veinless, margins infolded, ciliate. Stamens 3; anthers *c.* 1.5 × 0.2 mm, brownish.

*Fl. & Fr.:* November – December.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Near Dhawjadhari temple Koderma NRF; Occasional. WORLD: Myanmar, Pakistan, cultivated in Tropical. INDIA: Andhra Pradesh, Assam, Bihar, Central India, Gujarat, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu.

*Specimen examined:* Near Dhawjadhari temple Koderma NRF, 438 m, 24°29'16.2" N, 85°35'45.0" E, 19th November 2012, *Shyam Biswa* 54058.



**Fig. 12. *Dendrocalamus strictus* (Roxb.) Nees:** a. leafy twig; b.,c.d. spathe; e. spike; f. floret; g. floret with bract removed; h. glume; i.,j. lemma; k. palea; l.,m. stamens; n. fruiting head.



## 6. **DENDROCALAMUS** Nees

India and Sri Lanka to China and Philippines *c.* 40 species, 8 in India, 2 (1 cultivated) in Jharkhand, 1 in KWLS.

**Dendrocalamus strictus** (Roxb.) Nees, Linnaea 9(4): 476. 1835; Gamble in Hook.f., Fl. Brit. India 7: 404. 1896; Haines, Forest Fl. Chota Nagpur: 585. 1910 & Bot. Bihar Orissa: 947. 1924; N.P. Singh & al., Fl. Bihar: 609. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 678. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1061. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:233. 2014. *Bambos stricta* Roxb., Pl. Coromandel 1(4): 58, t. 80. 1798.

### Fig. 12

Vern. Name: *Bas*.

Perennial. Culms woody, 3–6 m high; internodes 5–45 cm long, hollow, glaucous when young, green; nodes swollen. Culm sheaths 8–30 cm long, variable, broad with rudimentary blades, slightly auricled, ciliate on margins, rounded at apex, striate, covered on the back with brown hairs; ligules narrow. Leaf blades linear-lanceolate, 5–25 × 1–3.5 cm, rounded at base into a short petiole, scabrous at margins, acute to acuminate at apex. Inflorescences a large, branched panicle with dense, glabrous, spaced globose heads, heads to 4.4 cm across; rachis rounded, smooth. Spikelets 1.5–2 cm long, more than one floret, spinescent, hairy, fertile and sterile mixed. Empty glumes 2 or more, ovate, spinescent, many-veined. Lemma ovate, 7–8 × 2–3 mm, ending in a sharp spine, surrounded by ciliate tufts of hairs. Palea ovate or obovate, emarginate, 6–8-veined; keels ciliate. Anthers apiculate, 4–6 mm long, yellowish green. Ovary ovoid, shortly appendage at apex; style 6–10 mm long, undivided; stigma feathery, purple. Pericarp ovoid-subglobose, beaked with persistent style, 7–8 mm long, free, shining, brown.

*Fl. & Fr.*: February – March.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Inderwa Chittarpur near the road; Way to Muglamaram forest road, Taraghati forest DWLS: Kokara; common. INDIA: Throughout. WORLD: Himalaya to Vietnam.

*Specimen examined*: Inderwa Chittarpur near the road, 408 m, 24°28'23.1" N, 85°39'31.0" E, 5th March 2011, *Shyam Biswa* 49682, Way to Muglamaram forest road, Taraghati forest, 321m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49851.

## 7. **DICHANTHIUM** Willemet

Old World tropical regions, *c.* 20 species, 7 in India, 3 in Jharkhand, 1 in KWLS.

**Dichanthium annulatum** (Forssk.) Stapf in Oliver, Fl. Trop. Afr. 9: 178. 1917; Haines, Bot. Bihar Orissa: 1039. 1924; Mooney, Suppl. Bot. Bihar Orissa: 188. 1950; N.P. Singh & al., Fl. Bihar: 610. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 679. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1063. 2005. *Andropogon annulatus* Forssk., Fl. Aegypt.-Arab.: 173. 1775; Hook.f., Fl. Brit. India 7: 196. 1896.

Annual or perennial. Culms erect, 40–60 cm high. Leaf sheaths *c.* 4 cm long, keeled towards apex, mouth bearded; ligule 1–1.5 mm long, fimbriate hairy at apex. Leaf blade linear-lanceolate, 3–5 × 0.4–0.5 cm, rounded to truncate at base, entire and more or less cartilaginous at margins, tapering at apex, sparsely hairy when young becoming glabrous later. Inflorescence of 1–8 digitate or subdigitate racemes; peduncle 20–23 cm, long. Racemes 3.5–7 cm. Spikelets

compactly arranged, paired, one sessile, other pedicelled; callus bearded; pedicels 1.5–2 mm, hairy. Sessile spikelet oblong-lanceolate,  $2.8-4 \times c. 1.2$  mm, acute, hairy throughout, awned; brownish. Lower glume oblong-lanceolate,  $3-3.5 \times c. 1$  mm, obtuse, chartaceous, 7–11-veined, midrib prominent, keeled above middle, keel scabrid near apex, margins inrolled, sparsely hairy on keels and margins. Upper glume oblong-lanceolate,  $2.8-3.5 \times c. 1.2$  mm, acute to acuminate,

chartaceous, prominently 3-veined, midrib keeled and finely scabrellate on keel. Florets 2, both epaleate; lower barren, upper bisexual. Lower lemma oblong-lanceolate,  $2.3-2.5 \times c. 0.5$  mm, acuminate, membranous, hyaline, veinless, delicate, ciliate above on margins, otherwise glabrous. Upper lemma flat,  $1.8-2 \times c. 0.3$  mm, faintly 3-veined, reduced to hyaline base of awn; awn geniculate, 1.5–2 cm, column twisted, brownish, finely barbellate above. Lodicules 0.3–0.4 mm, truncate, 2-veined membranous, hyaline. Stamens 3; anthers  $c. 1.4$  mm, yellow; filaments  $c. 0.6$  mm long, hyaline. Ovary elliptic,  $c. 1 \times 0.4$  mm, acute, greenish; style  $c. 1$  mm, hyaline; stigma plumose, 1.8–2 mm, dark purplish to violet. Caryopsis oblanceolate to narrowly elliptic,  $1.3-2.2 \times 0.4-0.8$  mm, acute, greenish to brown. Or Pedicelled spikelets oblanceolate,  $3-3.5 \times c. 1$  mm, acute to obtuse, pubescent, greenish awnless, similar to sessile.

*Fl. & Fr.*: September – March.

*Habitat*: Dry deciduous forests or in open grassland.

*Distribution*: KWLS: Near Rest house Koderma NRF; very common. WORLD: Bhutan, Myanmar, Nepal, Sri Lanka, tropical and N. America. INDIA: Andhra Pradesh, Bihar, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Manipur, Nagarhaveli, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

*Specimen examined*: Near Rest house Koderma NRF 396 m,  $24^{\circ}29'04.4''$  N,  $85^{\circ}35'49.6''$  E, 3rd March 2012, *Shyam Biswa* 54046.

## 8. **DIGITARIA** Heist, ex Fabr.

Tropical & subtropical regions  $c. 250$  species, 20 in India, 10 in Jharkhand, 2 in KWLS.

### Key to species

- 1a. Spikelets heteromorphus, sessile spikelet glabrous to very few hairy, pedicelled  
one hairy with glassy bristles along with many ciliate **2. D. bicornis**
- 1b. Spikelets homomorphus, sessile and pedicelled spikelets hairy, hairs without  
glassy bristles **1. D. abludens**

**1. Digitaria abludens** (Roem. & Schult.) Veldkamp in Blumea 21(1): 53. 1973; N.P. Singh & al., Fl. Bihar: 611. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.:235. 2014. *Panicum abludens* Roem. & Schult., Syst. Veg. 2: 457. 1817. *Paspalum pedicellare* Trin. ex Hook.f., Fl. Brit. India 7: 19. 1896. *Digitaria pedicellaris* (Trin. ex Hook.f.) Prain, Bengal Pl. 1181. 1903. Mooney, Suppl. Bot. Bihar Orissa: 172. 1950; *Digitaria granularis* (Trin. ) Henrard Monogr. Digitaria 302. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1067. 2005.

Annual. Culms 30–50 cm high, smooth. Leaf sheaths basal keeled, cauline ones terete, more or less ribbed, hairy; ligule truncate,  $c. 1$  mm, membranous. Leaf blades linear-lanceolate,  $16-23 \times 0.2-0.4$  cm, truncate to rounded at base, cartilaginous at margins acuminate at apex, flat to infolded, tuberculate hairy. Inflorescence of 2–9 racemes, subdigitate or a short panicle. Racemes 5–9 cm long, spreading from central axis, at times 0.5–2.5 cm long secondary branches with 1 or 2 pairs of spikelets; rachis triquetrous to capillary, narrowly winged, scabrid. Spikelets 3–4 in a group, distantly arranged, elliptic to obovate,  $c. 1.5 \times 0.5-0.8$  mm, turgid, yellowish; pedicels 0.5–2.5 mm. Lower glume usually absent. Upper glume oblong to elliptic lanceolate,  $1.4-1.5 \times$

0.5–0.8 mm, chartaceous, 7-veined, margins and sides with clavate hairs. Florets 2; lower barren, epaleate; upper bisexual, paleate. Lower lemma elliptic or boat shaped, *c.* 1.4 × 0.8 mm, acute at apex, chartaceous, 7-veined. Upper floret elongated and extended beyond glumes and lower lemma. Upper lemma elliptic-lanceolate, *c.* 1.4 × 0.6–0.8 mm, cartilaginous, faintly 3-veined, margins almost enclosing palea, hyaline. Upper palea elliptic-lanceolate, 1.2–1.3 × *c.* 0.6 mm, cartilaginous, 2-veined, margins incurved more towards base, striate at maturity. Lodicules 2, *c.* 0.3 mm, truncate at apex, membranous. Stamens 3; anthers 0.4–0.5 mm, yellow to brownish. Ovary narrowly oblong, *c.* 0.3 mm, acute at apex, yellow to brownish; stigma plumose. Caryopsis oblong-elliptic, *c.* 0.8 × 0.5–0.7 mm, turgid, greenish yellow to brownish.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49537.

**2. *Digitaria bicornis* (Lam.) Roem. & Schult., Syst. Veg., ed. 15 bis 2: 470. 1817; N.P. Singh & al., Fl. Bihar: 611. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 680. 2002. *Paspalum bicornis* Lam., Tabl. Encycl. 1: 176. 1791.**

**Fig. 13**

Annual to perennial. Culms terete to angled, 30–40 cm high. Leaf sheath terete, keeled towards apex, 2–4.2 cm long; ligule 0.5–0.7 mm long. Leaf blades, linear-lanceolate 3–6.5 × 0.5–0.8 cm, rounded to narrowed at base, cartilaginous at margins acuminate at apex, glaucous, sparsely hairy, hairs falling later; Inflorescence of 1–9 digitate to subdigitate racemes; peduncle 7–30 cm. Racemes 5–7 cm long; rachis winged, straight to wavy, wing serrulate. Spikelets paired, sessile one nearly glabrous and pedicelled one hairy, but both hairy at maturity; pedicels *c.* 2 mm, scabrellate; entire spikelets disarticulating from pedicel apex and axis joints. Spikelets narrowly elliptic lanceolate, 3–3.5 × 1–2 mm, acuminate at apex, yellow to brownish, glabrous to finely ciliate hairy; pedicelled spikelet more or less similar, but pubescent, pectinate. Lower glume absent or scaly Upper glume lanceolate, 3–3.5 × *c.* 1 mm, acuminate at apex, chartaceous, prominently 3 or 5-veined, with few to many long hairs along margins. Florets 2; lower barren, epaleate; upper bisexual, paleate. Lower lemma ovate to oblong-lanceolate, *c.* 3 × 1 mm, acute to acuminate at apex, subcoriaceous, greenish yellow, 5–7-veined, margins incurved, ciliate; bristles up to 2–2.5 mm on sides along with other thinner hairs on margins. Upper lemma ovate lanceolate, boat shaped, 3 × 0.8–1 mm, acuminate to apiculate at apex, cartilaginous, yellowish, 3-veined, incurved laterally. Upper palea elliptic-lanceolate, *c.* 3 × 0.8 mm, acuminate at apex, cartilaginous, yellowish, 2-veined, margins more incurved beneath. Lodicules obovate, *c.* 0.2 mm, obtuse at apex. Stamens 3; anthers *c.* 0.5 mm, yellow. Ovary oblong to elliptic, 0.4–0.6 mm; stigma plumose, 0.8–1 mm, brownish. Caryopsis ovate to oblong, 1.5–1.7 × 0.6–0.7 mm, obtuse at apex, rounded at base, turgid, greenish.

*Fl. & Fr.*: September – October.

*Habitat*: Dry deciduous forests.

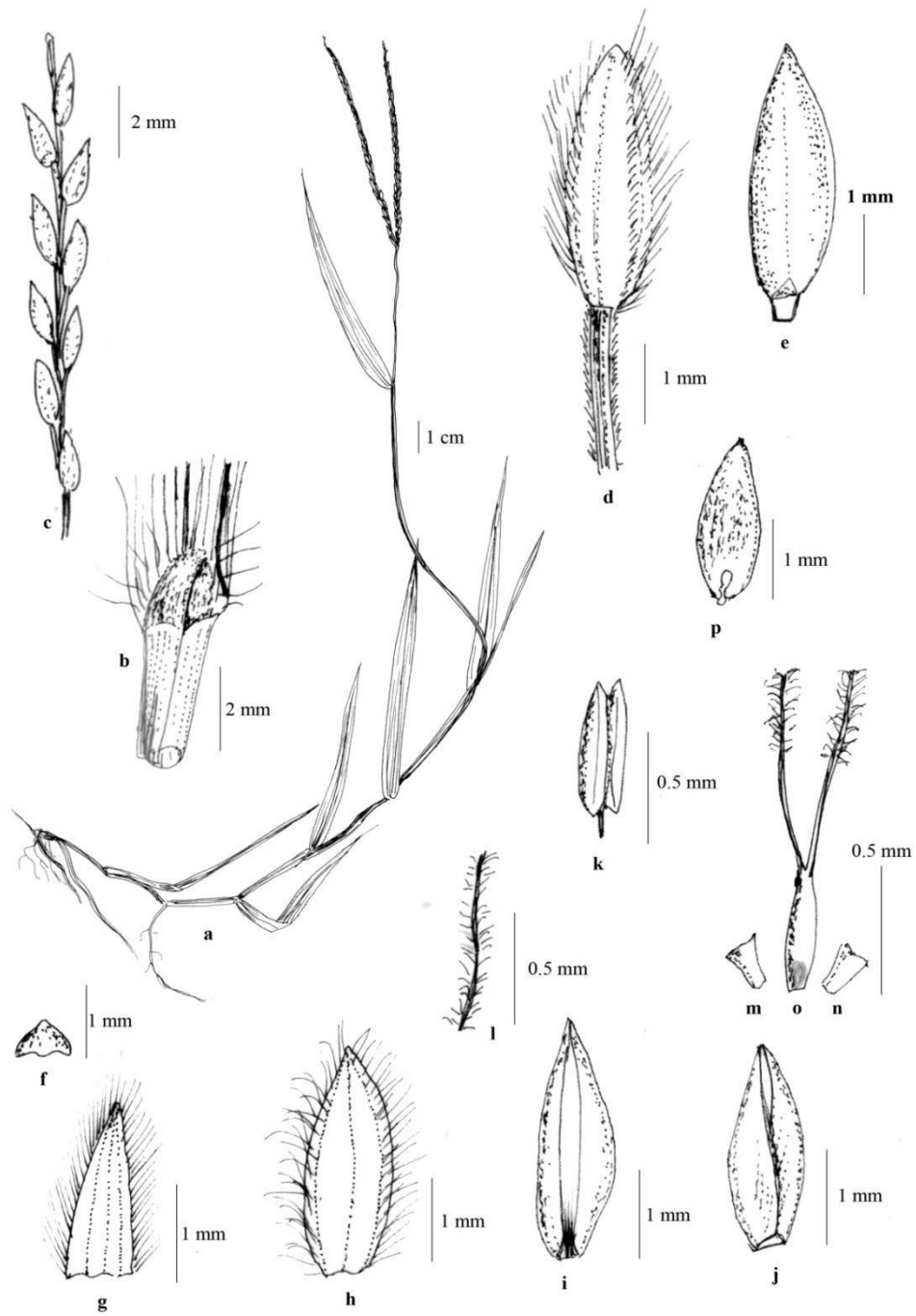
*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; occasional. INDIA: WORLD: Africa, Australia, introduced in America, China, Indonesia, Malaysia, Myanmar, New Guinea, Sri Lanka, Thailand.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 390m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49558.

## 9. *ERAGROSTIELLA* Bor

East Africa, Sri Lanka to North Australia 6 species, 5 in India, 3 in Jharkhand and 1 in KWLS.





**Fig. 13.** *Digitaria bicornis* (Lam.) Roem. & Schult. ex Loudon: a. habit; b. ligule; c. raceme; d. pedicel spikelet; e. sessile spikelet; f. lower glume; g. upper glume; h. lower lemma; i. upper lemma; j. upper palea; k. anther; l. filament; m, n. lodicules; o. pistil; p. caryopsis.

**Eragrostiella bifaria** (Vahl) Bor, Indian Forester 66: 270. 1940 & Grass. Burm. Ceyl. Ind. Pak. 494. 1960; Mooney, Suppl. Bot. Bihar Orissa: 161. 1950; N.P. Singh & al., Fl. Bihar: 616. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 685. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1080. 2005. *Poa bifaria* Vahl, Symb. Bot. 2: 19. 1791. *Eragrostis coromandeliana* (Koen. ex Rottl.) Trin. Mem. Acad. Sci. St. Petersburg ser. 6, Sci. Math. 1: 415. 1831; Stapf in Hook.f., Fl. Brit. India 7: 326. 1896; Haines, Bot. Bihar Orissa 961. 1924.

**Plate 14E**

Annual or perennial. Culms ribbed, 35–70 cm high. Leaf sheath 3–4.5 cm long, auricled at mouth; ligule oblong, *c.* 0.2 × 0.5 cm, fimbriate at apex. Leaf blade filiform, linear-lanceolate, 2–15 × 0.1–0.2 cm, rounded at base, inrolled or folded inward at margin, narrowed and serrulate at apex, glabrous, sparsely long ciliate along margins. Spikes terminal, erect, 9–22 cm long, with alternate sessile spikelets, usually compactly arranged. Spikelets oblong to ovate-lanceolate, 5–10 × 1.5–2 mm, straw-coloured or off white. Lower glume ovate-lanceolate, 2–2.5 × 0.5–2 mm, acute to acuminate, chartaceous, prominently 1-veined, keeled, serrulate on keel, yellowish. Upper glume ovate-lanceolate, 2–2.5 × 0.5–1 mm, acute, chartaceous, prominently 1-veined, greenish. Florets usually 7–14; palea persistent for sometime before falling finally. Lemma ovate-lanceolate, boat shaped, 2–2.5 × 1–1.5 mm, acute or retuse with emarginate apex, chartaceous, greenish, faintly 3-veined, 1-keeled. Palea ovate to elliptic, 1.8–2 × 0.5–1 mm, narrowly truncate at base, rounded at apex, chartaceous, hyaline, 2-keeled, keels broadly winged, wings 0.2–0.3 mm broad, ciliate on wings, margins infolded. Lodicules 2, obovate, *c.* 0.2 × 0.1 mm, truncate, more or less 2-ridged, membranous, hyaline. Stamens 3; anthers 0.7–0.8 mm, slightly divergent at apex, yellowish purple; filaments *c.* 0.3 mm, hyaline. Ovary ovate, *c.* 0.5 × 0.1 mm, stipitate, greenish; style 0.5 mm, hyaline; stigma plumose, 0.5–0.8 × 0.2 mm, greenish purple. Caryopsis sub-globose to globose, 0.5–0.6 × 0.2–0.4 mm, obtuse at apex.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; Koderma NRF; common. INDIA: Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu. WORLD: Eastern Africa, north eastern Australia, Myanmar and Sri Lanka; probably also in Thailand and Indonesia.

*Specimen examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49521; Koderma NRF, 392 m, 24°29'06.6" N, 85°36'49.8" E, 9th August 2011, *Shyam Biswa* 49767.

# 10. ERAGROSTIS Wolf

Temperate and tropical regions, *c.* 350 species, 32 in India, 20 in Jharkhand, 6 in KWLS.

## Key to species

- |                                                                           |                        |
|---------------------------------------------------------------------------|------------------------|
| 1a. Lemma ciliate along margins                                           | <b>2. E. coractata</b> |
| 1b. Lemma glabrous along margins                                          | 2                      |
| 2a. Keels of lemmas ciliate, hairs spreading beyond the margins of glumes | <b>5. E. tenella</b>   |
| 2b. Keels of lemmas glabrous or minutely ciliate                          | 3                      |
| 3a. Paleas persistent                                                     | <b>4. E. minor</b>     |
| 3b. Paleas deciduous with lemmas                                          | 4                      |

- |                                                                      |                                |
|----------------------------------------------------------------------|--------------------------------|
| 4a. Spikelets >2.5 mm wide; lemmas tinged with pink or purple apex   | <b>6. <i>E. unioides</i></b>   |
| 4b. Spikelets <2.5 mm wide; lemma hardly tinged                      | 5                              |
| 5a. Annual; Lemmas <1.3 mm long; spikelets < 2 mm wide; anthers 2    | <b>3. <i>E. gangetica</i></b>  |
| 5b. Perennial; Lemmas > 1.5 mm long; spikelets >2 mm wide; anthers 3 | <b>1. <i>E. atrovirens</i></b> |

**1. *Eragrostis atrovirens*** (Desf.) Trin. ex Steud., Nomencl. Bot. ed. 2. 1: 562. 1840; N.P. Singh & al., Fl. Bihar: 617. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1083. 2005. *Poa atrovirens* Desf., Fl. Atlant. 1: 73. t. 1. 1798.

Annual or perennial. Culms 20–60 cm high, ribbed. Leaf sheath 6–15 cm, mouth bearded; ligule 0.2–0.3 mm, membranous with fimbriate apex. Leaf blade linear-lanceolate, 8–33 × c. 0.3 cm, rounded or truncate at base, entire and curled at margins, attenuate at apex, scabrid above. Panicle 4–9 × 2–5 cm, effuse, branches alternate, naked in lower part; peduncle 18–34 cm long. Spikelets oblong, 5–7 × 1.7–2 mm, acute on ends; pedicels 1–4 mm, barbellate. Lower glume ovate-lanceolate, 1–1.3 × c. 0.4 mm, acute, chartaceous, greenish with purple dots, prominently 1-veined, keeled, scabrid towards apex. Upper glume 1.5–2 × 0.5–1 mm, as in lower glume. Florets similar, bisexual, closely imbricate; rachilla slightly zigzag, wavy, angled; disarticulating from below upwards; rachilla persistent. Lowermost lemma ovate-lanceolate, 1.8–2 × c. 0.6 mm, acute, chartaceous, greenish, prominently 3-veined, lateral veins straight, 1-keeled. Palea elliptic, 1.3–1.8 × c. 0.4 mm, acute, chartaceous, greenish to hyaline, 2-veined, 2-keeled, scabrellate, persistent for sometime or falling along with lemma. Lodicules 2, truncate, membranous, hyaline. Stamens 3; anthers 0.5–0.8 mm, yellow; filaments c. 0.7 mm, hyaline. Ovary narrowly elliptic to oblanceolate, c. 0.4 × 0.2 mm; style 0.3–0.4 mm, hyaline; stigma plumose, c. 0.8 mm, greenish to brown. Caryopsis oblong-elliptic, 0.6–0.8 × c. 0.4 mm, striate dorsally when mature. Size of other florets reduced gradually towards apex, otherwise similar.

*Fl. & Fr.*: February – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the river Dhanarjay nadi, Meghatari; Phutlaiya Nala; occasional. INDIA: Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu. WORLD: Africa, Taiwan, Japan, Marianas, Mascarenes, Sri Lanka, Malaya peninsula.

*Specimen examined*: Near the river Dhanarjay nadi, Meghatari, 182 m, 24°34'32.9" N, 85°34'48.4" E 7th March 2011, *Shyam Biswa* 49707, Phutlaiya Nala, 328m, 24°30'36.3" N, 85°39'30.1" E, 27th February 2012, *Shyam Biswa* 54011.

**2. *Eragrostis coarctata*** Stapf, Hook.f., Fl. Brit. India 7: 313. 1896; Haines, Bot. Bihar Orissa 956.1924; N.P. Singh & al., Fl. Bihar: 618. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1084. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 237. 2014. **Plate 14F**

Perennial. Culms 5–40 cm high, internodes hollow. Leaf sheath ribbed, 2.2–5 cm, glabrous, ciliate at margin on one side, mouth bearded; ligule whitish hairy, hair c. 0.4 mm long. Leaf blade oblong to linear-lanceolate, 4–20 × 0.5–0.6 cm, truncate to rounded at base, incurved at margins, acuminate at apex. Inflorescence a spiciform panicle, oblong to linear, 1–5 × 0.5–1 cm, compact with short racemes. Racemes 0.5–1 cm, many, compactly arranged with few to many subsessile to pedicelled spikelets. Spikelets lanceolate, 2–2.2 × 1–2 mm; pedicels 0.2–0.4 mm long. Lower glume lanceolate, 0.8–1.2 × c. 0.8 mm, acute at apex, chartaceous, greenish yellow, prominently



1-veined, 1-keeled, margins ciliate below middle. Upper glume  $1.2-1.6 \times c. 0.6$  mm, similar to lower glume. Florets 3–12, bisexual, closely imbricate; rachilla 0.3–0.4 mm, zigzag. Lemma oblong-lanceolate, boat shaped,  $1.3-1.5 \times c. 0.5$  mm, acute to acuminate with mucronulate apex, chartaceous, greenish yellow, prominently 3-veined, 1-keeled, keel scabrid towards apex, margins ciliate to hispid hairy. Palea oblong-elliptic,  $1.2-1.4 \times 0.2-0.3$  mm, acute at apex, chartaceous, 2-veined, 2-keeled, keels long ciliate hairy, margins infolded, ciliate. Lodicules 2, yellowish. Stamens 3; anthers 0.3–0.4 mm, brown to purple. Ovary narrowly elliptic,  $c. 0.4$  mm, acute at apex, brownish; stigma plumose,  $c. 0.8$  mm, yellowish brown. Caryopsis oblong-elliptic to ovoid,  $0.5-1 \times c. 0.5$  mm, brownish.

*Fl. & Fr.*: July – March.

*Habitat*: On the grasslands or near the lakes/ ponds.

*Distribution*: KWLS: Near Meghatari Rest House. WORLD: Myanmar, Bangladesh, Nepal; Very Common. INDIA: Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal. Tamil Nadu.

*Specimen examined*: Near Meghatari Rest House, 190m,  $24^{\circ}34'39.6''$  N,  $85^{\circ}34'37.6''$  E, 9th March 2011, *Shyam Biswa* 49729.

**3. *Eragrostis gangetica*** (Roxb.) Steud. Syn. Pl. Glumac. 1(3): 266. 1854; Haines, Bot. Bihar Orissa: 958. 1924 ; Mooney, Suppl. Bot. Bihar Orissa: 160. 1950; N.P. Singh & al., Fl. Bihar: 618. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 687. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1085. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:237. 2014. *Poa gangetica* Roxb., Fl. Ind. 1: 341. 1820. *Eragrostis stenophylla* Hochst. ex Miq., Anal. Bot. Ind. 2: 27. 1851 Stapf in Hook.f., Fl. Brit. India 7: 318. 1896, p.p. **Plate 14G**

Annuals or perennial. Culms, erect or ascending, 40–60 cm high, simple. Leaf-sheaths 2–10 cm long, glabrous; ligule a membranous ring. Leaf blades narrowly linear,  $7-10 \times 0.1-0.3$  cm, truncate at base infolded at margins very acute at apex, usually convolute, sometimes flat, glabrous, smooth. Panicles lax, effuse, 7.5–12 cm long, suberect or nodding; branches alternate, rather distant, spreading when ripe, much divided upwards; rachis smooth; pedicels of spikelets filiform. Spikelets with 10–30 florets, crowded on branches, linear-oblong,  $4-6 \times 1-1.2$  mm; rachilla flexuous. Lower glume oblong to ovate-lanceolate,  $0.7-0.8 \times c. 0.3$  mm long, yellowish. Upper glume ovate-lanceolate,  $0.8-1 \times c. 0.4$  mm long. Florets bisexual; rachilla persistent. Lemmas ovate-oblong,  $c. 1 \times 0.5-1$  mm, 3-veined, smooth-keeled. Paleas elliptic,  $0.5-0.8 \times 0.2-0.4$  mm, serrulate at margins emarginate at apex, with scabrid keels, caducous with glumes. Lodicules 2, 0.1–0.2 mm long. Stamens 2; filaments  $c. 0.3$  mm long, hyaline; anthers 0.1–0.2 mm long, purplish brown. Ovary oblong, acute at apex,  $c. 0.4 \times 0.2$  mm, greenish; style  $c. 0.5$  mm long; stigma plumose,  $c. 0.5 \times 0.2$  mm, purplish to greenish. Caryopsis subglobose to ellipsoid,  $0.5-0.7 \times 0.3-0.4$  mm, reddish brown.

*Fl. & Fr.*: February – March.

*Habitat*: Near the rivers.

*Distribution*: KWLS: Near the river Dhanarjay nadi, Meghatari; Phutlaiya Nala. very common. INDIA: Andhra Pradesh, Bihar, Daman and Diu, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Tropical Africa and Asia.

*Specimen examined:* Near the river Dhanarjay nadi, Meghatari, 183 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49689; Phutlaiya Nala, 328m, 24°30'36.3" N, 85°39'30.1" E, 27th February 2012, *Shyam Biswa* 54010.

**4. *Eragrostis minor*** Host, Icon. Descr. Gram. Austriac. 4: 15. 1809; Stapf in Hook.f., Fl. Brit. India 7: 321. 1896; Haines, Bot. Bihar Orissa 960. 1924; N.P. Singh & al., Fl. Bihar: 619. 2001.

**Fig. 14**

Annual. Culms 5–15 cm high. Leaf sheath 1–4 cm long, ribbed, at times gland pitted along midvein, margins hairy or glabrous; ligule a fringe of *c.* 0.5 mm long hairs; Leaf blade linear lanceolate, 1–4 × *c.* 0.1 cm, flat to infolded at margins, acuminate at apex, scattered pilose. Panicle open, dense or loose, 1.5–4 cm long; branches stiff, usually glandular or eglandular, axils pilose. Spikelets oblong, 3–12 × 2–4 mm, solitary, laterally compressed, greenish purple; pedicels 1–3 mm long, usually with raised ring like glands below spikelets or at times eglandular. Glumes subequal, deciduous, shorter than spikelet. Lower glume ovate, 1–1.3 mm long, acute at apex, prominently 1-veined, 1-keeled, keel at times glandular. Upper glume as long as lower glume or slightly longer, acute at apex, 1–3-veined, 1-keeled. Florets bisexual, loosely imbricate, breaking up at maturity from below upwards; rachilla persistent and retaining paleas. Lemma ovate, 1.5–2 mm long, obtuse at apex, chartaceous, greenish yellow, prominently 3-veined, 1-keeled, keel glandular. Palea *c.* 1.5–1.8 mm long, 2-veined, 2-keeled, keels scabrellate, margins infolded. Stamens 2 or 3; filament 0.2–0.4 mm long, anthers *c.* 0.3–0.5 mm long. Ovary oblong, *c.* 0.2 mm; style *c.* 0.5 mm long; stigma plumose, *c.* 0.2 mm, purplish to greenish. Caryopsis broadly oblong to elliptic globose, 0.6–0.8 mm long, obtuse to truncate at apex, brownish.

*Fl. & Fr.:* February – October.

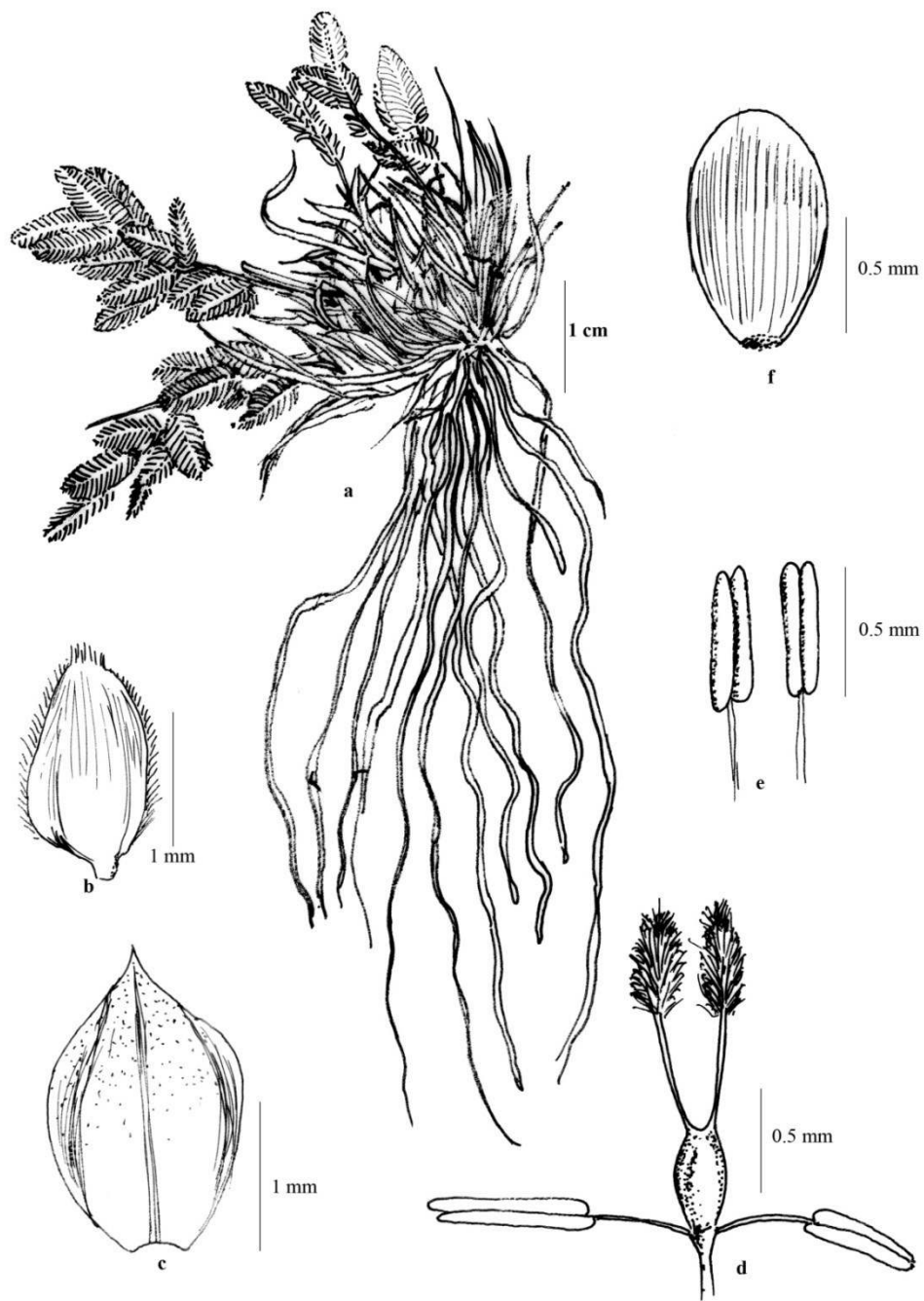
*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Near Rheio Ghoghar Dam, Chattarbar. Subtropical temperate and subtropical regions of Old World. INDIA: Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu. Tamil Nadu:

*Specimen examined:* Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49887.

**5. *Eragrostis tenella*** (L.) P. Beauv. ex Roem. & Schult., Syst. Veg. 2: 576. 1817; Stapf in Hook.f., Fl. Brit. India 7: 315. 1896; Haines, Bot. Bihar Orissa 956. 1924; N.P. Singh & al., Fl. Bihar: 620. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 690. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1088. 2005. *Poa tenella* L., Sp. Pl. 1: 69. 1753.

Annual. Culms 5–12 cm high, more or less ribbed. Leaf sheath 1.5–4 cm, margins sparsely ciliate, mouth bearded; ligule *c.* 0.4 mm, membranous with fimbriate apex. Leaf blade linear-lanceolate, 2–5 × *c.* 0.2 cm, rounded to truncate at base, inrolled at margins, serrulate towards apex narrowed at apex, midrib prominent, hairy at base. Panicle elliptic to pyramidal, 6–19 × 2–7 cm, effuse; peduncle 3–20 cm. Racemes subverticillate to alternate, 2.2–6 cm. Spikelets ovate to oblong-lanceolate, 2–3.4 × 0.8–1 mm, acute, greenish purple; pedicels 1.4–1.5 mm long. Lower glume oblong-lanceolate, 0.4–0.7 × *c.* 0.4 mm, acute, chartaceous, greenish to hyaline, prominently 1-veined, keeled with keel finely serrulate, persistent initially and later on falling. Upper glume lanceolate, 0.6–1 × *c.* 0.4 mm, acute to acuminate, chartaceous, greenish to hyaline,



**Fig. 14. *Eragrostis minor* Host:** a. habit; b. glume; c. lemma; d. pistil and stamen; e. stamen; f. caryopsis.



prominently 1-veined, keeled with keel serrulate towards apex, persistent for sometime and later falling. Florets 4–8, bisexual, palea persistent initially, but later on falling. Lemma ovate-lanceolate,  $1-1.2 \times 0.8-1$  mm, acute, obtuse to emarginate, membranous to chartaceous, hyaline, prominently 3-veined, 1-keeled with keel serrulate towards apex, smooth or scabrellate. Palea elliptic,  $c. 1 \times c. 0.2-0.4$  mm, acute at ends, membranous to chartaceous, greenish to hyaline, with  $c. 0.2-0.3$  mm long cilia on keels, straight initially and curved at maturity, margins infolded, hyaline. Stamens 3; anthers  $0.2-0.3$  mm, greenish yellow to purple; filaments  $0.4-0.5$  mm, hyaline. Ovary ovate to oblong,  $0.2-0.4 \times c. 0.1$  mm, acute, greenish brown; style  $c. 0.2$  mm; stigma plumose,  $c. 0.3-0.5$  mm, purplish to green. Caryopsis subglobose to obovate,  $c. 0.5 \times 0.2-0.3$  mm, brownish.

*Fl. & Fr.*: February – March.

*Habitat*: Near the rivers.

*Distribution*: KWLS: Near Dhanarjay nadi; common. INDIA: Andaman, Andhra Pradesh, Bihar, Daman & Diu, Gujarat, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal. WORLD: Old World Tropical

*Specimen examined*: Near Dhanarjay nadi, 189 m,  $24^{\circ}34'58.1''$  N,  $85^{\circ}35'21.4''$  E, 2nd March 2012, Shyam Biswa 54033.

**6. *Eragrostis unioides* (Retz.) Nees ex Steud., Syn. Pl. Glumac. 1(3): 264. N.P. Singh & al., Fl. Bihar: 621. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 689. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1091. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:238. 2014. *Poa unioides* Retz., Observ. Bot. 5. 19. 1789. *Eragrostis amabilis* Stapf in Hook.f., Fl. Brit. India 7: 317. 1896, *non* Wight & Amott ex Nees, 1838; Haines, Bot. Bihar Orissa 958. 1924.**

Annual. Culms 30–45 cm. Leaf sheath ribbed,  $c. 4$  cm, ciliate at mouth; ligule  $c. 0.2$  mm, membranous with fimbriate apex. Leaf linear-lanceolate,  $5-20 \times c. 0.4$  cm, subamplexicaul at base, infolded at margins acuminate at apex, scaberulous, midrib prominent. Panicle lax, 7–20 cm long, with alternate raceme branches. Racemes 1–8 cm with 10–15 pedicelled spikelets; rachis more or less furrowed. Spikelets ovate,  $2-8 \times 1-3$  mm, white or purplish green; pedicels 2–20 mm long. Lower glume ovate-lanceolate,  $1-2 \times 0.3-0.5$  mm, acute, chartaceous, purplish, prominently 1-veined, keeled, serrulate on keel. Upper glume  $1.5-2.3 \times c. 1$  mm, as in lower glume, mucronate at apex. Florets bisexual; disarticulating from below upwards, both lemma and palea deciduous. Lemma ovate-lanceolate, boat shaped,  $1.3-2 \times c. 1$  mm, acute at apex, chartaceous, prominently 3-veined, midrib keeled, keel serrulate, lateral veins clear near margins, white. Palea elliptic to lanceolate,  $1-1.5 \times 0.5-0.7$  mm, retuse or at apex, narrowly acute at base, membranous to chartaceous, hyaline, 2-veined, 2-keeled, keels serrulate to ciliate, narrowly winged, margins infolded. Lodicules 2, obovate,  $c. 0.2$  mm, truncate at apex, membranous, hyaline. Stamens 2; anthers roundish,  $c. 0.2$  mm; filaments  $c. 0.3$  mm long. Ovary oblong to elliptic,  $c. 0.4 \times 0.1$  mm, at times stipitate at base; style  $c. 0.2$  mm, hyaline; stigma plumose,  $0.2-0.3$  mm, purplish brown. Caryopsis narrowly elliptic to obovate,  $0.5-0.6 \times c. 0.2$  mm, stipitate. Florets vary slightly in size towards apex.

*Fl. & Fr.*: August – November.

*Habitat:* On the hill of Dry deciduous forests.

*Distribution:* KWLS: Near base of Dhawjadhari Pahar, Koderma NRF; occasional. INDIA: Andaman, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Nagravheli, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal. WORLD: Widespread in tropical Asia, Africa, Myanmar, Nepal, Sri Lanka.

*Specimen examined:* Near base of Dhawjadhari Pahar, Koderma NRF, 384 m, 24°29'16.2" N, 85°35'44.9" E, 19th November 2012, *Shyam Biswa* 54057.

## 11. **HACKELOCHLOA** Kuntze

Tropical regions, 1 species.

**Hackelochloa granularis** (L.) Kuntze, Revis. Gen. Pl. 2: 776. 1891; Mooney, Suppl. Bot. Bihar Orissa: 193. 1950; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 691. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1093. 2005. *Mnesithea granularis* (L.) de Koning & Sosef in Blumea 31(2): 295. 1986; N.P. Singh & al., Fl. Bihar: 633. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.:240. 2014. *Cenchrus granularis* L., Mant. Pl. Altera 575. 1771. *Manisuris granularis* (L.) L.f., Amoen. Acad., Schreb. ed. 10: 40 1790; Hook.f, Fl. Brit. India 7: 159. 1896; Haines, Bot. Bihar Orissa 1057. 1924.

Annual. Culms 10–40 cm high, ribbed, glabrous. Leaf sheaths 1– 2.5 cm long, keeled towards apex, hairy, margins winged, hyaline, ciliate towards apex; ligule ovate, *c.* 1.2 mm, membranous, fimbriate hairs at apex, hyaline. Leaf lanceolate, 2–8 × 0.2–0.8 cm, slightly cordate, truncate or semiamplexicaul at base, entire at margins, acute to acuminate at apex, sparsely tuberculate hairy, margins cartilaginous. Racemes terminal and axillary, spiciform, 8–10 mm long; pedicels fused with rachis and hollow, enclosing sessile spikelets. Spikelets paired, sessile spikelet bisexual, pedicelled one reduced. Sessile spikelet globose, 1–1.5 × *c.* 1 mm, obtuse at apex, green to yellowish. Lower glume broadly ovate to subglobose, 1.2–1.5 × 0.5–1 mm, crustaceous, wavy and pitted outside, with 3 or 4 transverse ridges in matured ones. Upper glume ovate to oblong, *c.* 1 × 0.8 mm, chartaceous to membranous, faintly 0–3-veined. Florets 2, lower sterile, upper bisexual. Lower lemma ovate, *c.* 1 × 0.8 mm, membranous, hyaline, veinless. Lower palea absent. Upper lemma ovate, *c.* 0.8 × 0.6 mm, membranous, hyaline, veinless, delicate, awnless. Upper palea ovate-lanceolate, *c.* 1 × 0.4–0.5 mm, similar to upper lemma. Lodicules 2, membranous, hyaline. Stamens 3; anthers *c.* 0.2 mm, yellow; filaments *c.* 0.5 mm long. Ovary oblong, *c.* 0.4 mm, greenish brown; style *c.* 0.3 mm; stigma plumose, *c.* 0.5 mm long, yellowish brown. Pedicelled spikelet ovoid, 1.2–1.3 × *c.* 0.8 mm, greenish, narrowly winged.

*Fl. & Fr.:* September – November.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Way to Basraon forest; not common. INDIA: Daman & Diu, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh. WORLD: Throughout the Tropical regions.

*Specimen examined:* Way to Basraon forest, 337 m, 24°34'33.6" N, 85°38'34.0" E, 6th September 2010, *Shyam Biswa* 49577.

## 12. **OPLISMENUS** Beauv.

Tropical & subtropical regions 5 species, 3 in India, 2 in Jharkhand and 1 in KWLS.

**Oplismenus burmanni** (Retz.) P. Beauv., Ess. Agrostogr. 54, 168. 1812; Hook.f., Fl. Brit. India 7: 68. 1896; Haines, Bot. Bihar Orissa 999.1924 ; N.P. Singh & al., Fl. Bihar: 634. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 696. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1105. 2005. *Panicum burmanni* Retz., Observ. Bot. 3: 10. 1783.

#### Plate 15A

Annual or perennial. Culms 6–25 cm high, prostrate, sparsely hairy; nodes lower ones rooting. Leaf sheaths keeled, 0.6–1.7 cm, ciliate at margins, veins prominent, mouth bearded; ligule truncate, *c.* 0.6 mm long. Leaf elliptic-lanceolate to linear-lanceolate, 1–4 × 0.4–1.1 cm, rounded to oblique at base, serrulate at margins, finely undulate on one side acuminate at apex, midrib prominent, sparsely tuberculate hairy. Panicle 3.4–4.5 cm long with alternate racemes; peduncle 3–8.5 cm long. Racemes 0.8–3 cm long. Spikelets pedicelled and sessile similar, ovate to oblong-lanceolate, 2.5–3 × *c.* 1 mm, truncate to rounded at base, acute at apex, greenish yellow, sparsely hispidulous hairy, falling; pedicels 1–1.5 mm, long hairy. Lower glume ovate-lanceolate, boat shaped, 1.5–2 × 0.5–1 mm, acute at apex, awned, chartaceous, greenish, 3–5-veined, midrib prominent, 1-keeled, margins ciliate; awn dorsal, 5–6 mm, straight to flexible, slender, minutely barbellate, pale yellowish. Upper glume with awn shorter, 2–4.5 mm long, otherwise similar to lower glume. Florets 2; lower barren, epaleate; upper bisexual, paleate; entire spikelet disarticulating from pedicel. Lower lemma elliptic-lanceolate, boat shaped, *c.* 1.5 × 1 mm, acute, chartaceous, greenish 7–9-veined, 1-keeled or not, sparsely ciliate dorsally and more so towards apex, margins ciliate; arista 0.8–1 mm, straight, barbellate. Upper lemma oblong to elliptic, 1.5–1.8 × 0.7–0.8 mm, acute to apiculate at apex, chartaceous to subcoriaceous, yellow to greenish, faintly 5-veined. Upper palea narrowly oblong to elliptic, *c.* 1.5 × *c.* 0.5 mm, acute to apiculate at apex, subcoriaceous, yellow to greenish, faintly 2-veined, margins incurved. Stamens 3; anthers *c.* 1 × 0.2–0.4 mm, yellow. Ovary oblong, 0.4–0.6 × *c.* 0.2 mm, acute, greenish; style 0.2–0.5 mm long. stigma *c.* 1 mm long, plumose, greenish. Caryopsis oblong, 0.8–1 × 0.2–0.3 mm, brownish.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; very common. WORLD: Widespread in tropical to subtropical regions of both hemispheres. INDIA: Almost throughout.

*Specimen examined*: Taraghati forest, 333 m, 24°32'02.2" N, 85°34'47.0" E, 21st November 2012, *Shyam Biswa* 53910.

### 13. PANICUM L.

Tropical to subtropical regions *c.* 300 species, 35 in India, 15 in Jharkhand, 1 in KWLS.

**Panicum notatum** Retz., Observ. Bot. 4: 18.1786; Fl. Ind. Enum. Monocot.: 241. 1989; N.P. Singh & al., Fl. Bihar: 637. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.:242. 2014. *Panicum montanum* Roxb., Hort. Bengal. 82. 1814; Fl. Ind. (Carey & Wallich ed.) 1: 315. 1820; Hook.f., Fl. Brit. India 7: 53. 1896; Haines, Forest Fl. Chota Nagpur: 562. 1910 & Bot. Bihar Orissa: 996. 1924.

Perennial. Culms to 1 m high, base woody, ribbed. Leaf sheaths 5–6 cm, ribbed, midrib prominent, hispid hairy dorsally, mouth bearded; ligule *c.* 0.4 mm long, membranous, long-pilose. Leaf lanceolate or ovate-lanceolate, 9–14 × 1.8–2.5 cm, semiamplexicaul at base, entire at



margins, acuminate at apex, sparsely hispid on both surfaces. Panicle effusely spreading, 10–25 cm long; peduncle 4–16 cm long; racemes 10–18 cm long. Spikelets ovate to ovoid-ellipsoid,  $2-2.5 \times 1-1.5$  mm, greenish brown; pedicels 3–15 mm long. Lower glume ovate-lanceolate,  $1.8-2.5 \times 0.8-1$  mm, chartaceous, greenish brown, prominently 3-veined with additional 2 faint veins or not, margins long ciliate towards apex, otherwise glabrous. Upper glume ovate to elliptic-lanceolate, boat shaped,  $2.2-2.5 \times 0.8-1$  mm, acute, chartaceous, green, prominently 5-veined. Florets 2; lower barren, epaleate, upper bisexual. Lower lemma more or less similar to upper glume but slightly shorter,  $c. 2 \times 0.8$  mm, obtuse to acute at apex. Upper lemma ovate to elliptic,  $1.8-2 \times 0.6-0.8$  mm, acute to apiculate and curved towards apex, subcoriaceous, smooth and shiny, faintly 3–5-veined, tightly enclosing palea. Upper palea ovate to elliptic-lanceolate,  $1.8-2 \times 0.6-1$  mm, subcoriaceous, faintly 2-veined, margins infolded. Lodicules 2, membranous, hyaline. Stamens 3; anthers 1–1.4 mm long, brownish; filaments  $c. 0.6$  mm. Ovary oblong or linear,  $c. 1$  mm long, acute, greenish; style  $c. 0.5$  mm long; stigma plumose  $c. 1$  mm, yellowish purple. Caryopsis obovate-lanceolate,  $c. 2 \times 1$  mm, yellowish.

*Fl. & Fr.*: August – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Almost throughout. WORLD: Tropical of Southeast Asia, China, Nepal and Sri Lanka.

*Specimen examined*: Muglamaram forest, 375 m,  $24^{\circ}30'50.5''$  N,  $85^{\circ}34'42.4''$  E, 24th November 2012, *Shyam Biswa* 53909.

#### 14. **PEROTIS** Ait.

Old World Tropical regions, 13 species, 2 in India, 1 in Jharkhand.

**Perotis indica** (L.) Kuntze, Rev. Gen. Pl. 2: 787. 1891; N.P. Singh & al., Fl. Bihar: 642. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 703. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1119. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:244. 2014. *Anthoxanthum indicum* L., Sp. Pl. 1: 28. 1753. *Perotis latifolia* Aiton, Hort. Kew. ed. 1: 85. 1789; Hook.f., Fl. Brit. India 7: 98. 1896; Haines, Bot. Bihar Orissa 978. 1924

Vern. Name: *Jaal Kete Ghas*.

Annual. Culms, 30–45 cm high, ribbed. Leaf sheaths 1.3–3 cm long, terminal one enclosing peduncle; ligules 0.2–0.5 mm long, membranous. Leaf blades, lanceolate,  $1.5-4.5 \times 0.4-0.8$  cm, rounded to semiamplexicaul at base, scabrid or long ciliate at margin sometimes cartilaginous, acute at apex, glabrous, veins riblike. Inflorescence a single spike like raceme, fox tail like,  $5-17.5 \times 1-1.5$  cm, central axis pubescent throughout on ribs. Spikelets many, compactly arranged, subsessile, oblong-lanceolate,  $1.4-2 \times 0.2-0.3$  mm, acute to emarginate, 2-awned, hispidulous to pubescent, yellowish white to purplish; pedicels 0.2–0.5 mm long. Lower glume linear-lanceolate,  $1.3-2.2 \times c. 0.4$  mm, awned, chartaceous, 1-veined, keeled, keel serrulate, scabrid; awn 5–6.5 mm, barbellate, whip like. Upper glume linear-lanceolate,  $1.5-2.2 \times c. 0.3$  mm, 1-veined, keeled or not, margins flat to inrolled, pubescent, awned; awn 3.5–4 mm. Floret one, bisexual. Lemma 0.8–1 mm, veins obscure. Palea similar to lemma. Lodicules 2,  $c. 0.2$  mm, obovate, truncate at apex. Stamens 3; filaments  $c. 0.2$  mm; anthers  $c. 0.4$  mm, yellow. Ovary  $c. 0.3 \times 0.2$  mm; style  $c. 0.2$  mm, hyaline; stigma plumose, 0.3–0.5 mm, purplish. Caryopsis linear, 1.3–1.5 mm long, terete, greenish to brownish.

*Fl. & Fr.*: September – December.

*Habitat*: Hilly tracks, Dry deciduous forests.

*Distribution*: KWLS: Way to Basraon forest; not common. WORLD: Nepal, Southeast Asia, Sri Lanka. INDIA: Andhra Pradesh, Assam, Bihar, Daman & Diu, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

*Specimen examined*: Way to Basraon forest, 337 m, 24°34'33.6" N, 85°38'34.0" E, 6th September 2010, *Shyam Biswa* 49576.

### 15. PHRAGMITES Adans.

Cosmopolitan 4 or 5 species, 2 in India, 1 in Jharkhand.

**Phragmites karka** (Retz.) Trin. ex Steud., *Nomencl. Bot.* ed. 2: 324. 1841; Hook.f., *Fl. Brit. India* 7: 304. 1896; Haines, *Forest Fl. Chota Nagpur*: 583. 1910 & *Bot. Bihar Orissa*: 952. 1924; Mooney, *Suppl. Bot. Bihar Orissa*: 159. 1950; N.P. Singh & al., *Fl. Bihar*: 643. 2001; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 1121. 2005. *Arundo karka* Retz., *Observ. Bot.* 4: 21. 1786.

Perennial. Culms to 2 m high smooth, ribbed, glabrous. Leaf sheaths 9–15 cm long, ribbed; ligule 0.4–0.6 mm long, fimbriate hairs at apex. Leaf simple, oblong to linear-lanceolate, 35–44 × 1–2 cm, rounded to truncate at base, thick and finely scabrid at margins; acuminate to attenuate at apex, midrib prominent, scabrellate on veins, glabrous, stripe like black glands evident between veins. Panicle to 55 × 15 cm, effuse when young and bushy when mature. Racemes much branched, 11–18 cm long, ending in long pedicelled spikelets, basal nodes long fimbriate hairy, base of lowest panicle branches slightly bearded; rachis scabrellate. Spikelets oblong when young, disarticulating at maturity above glumes, *c.* 1.2 × 0.8 mm, brownish; pedicels 4–11 mm long. Glumes unequal, persistent. Lower glume oblong to elliptic-lanceolate, 3–4 × 0.5–1 mm, narrowly truncate at base, 3-veined. Upper glume 4.3–6 × 0.8–1 mm, similar to lower glume. Florets 4–6, bisexual, similar, lowest floret male; rachilla 0.8–1.5 mm, long villous silky hairy. Lemma linear to oblong-lanceolate, 9–11 × *c.* 1 mm (excluding awn), awn at apex, 3-veined; awn 0.8–5 mm long. Palea oblong to elliptic, 3.2–4 × *c.* 0.5 mm, 2-veined, 2-keeled, keels finely serrulate, margins infolded. Lodicules 2, oblong to elliptic, at times rhomboid, 0.5–0.6 mm. Stamens 2 in lowest floret and 3 in upper bisexual florets; filaments *c.* 0.4 mm long; anthers 1.3–1.7 mm long, yellow to brown. Ovary linear or narrowly oblong, *c.* 0.4 × 0.2 mm, acute, brownish; style *c.* 0.3 mm; stigma plumose, 0.8–1 mm long, yellowish brown.

*Fl. & Fr.*: July – February.

*Habitat*: Near the rivers.

*Distribution*: KWLS: Phutlaiya Nala; common. INDIA: Almost throughout. WORLD: Tropical Africa, Polynesia, Sri Lanka to South east Asia and North Australia.

*Specimen examined*: Phutlaiya Nala, 328 m, 24°30'36.3" N, 85°39'30.1" E, 27th February 2012, *Shyam Biswa* 54008.

### 16. PSEUDOPOGONATHERUM A.Camus

Tropical & Subtropical Asia to N. Australia *c.* 6 species., 4 in India, 1 in Jharkhand.

**Pseudopogonatherum trispicatum** (Schantz) Ohwi, *Bull. Tokyo Sci. Mus.* 18: 3. 1947. *Andropogon trispicatus* Schult., *Syst. Veg.* 2, Mant. 452. 1824. *Pollinia argentea* (Brongn.) Trin., *Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat.* 4: 90 1836;

Hook.f., Fl. Brit. India 7: 111. 1896. *Eulalia argentea* Brongn. Voy. Monde, Phan. 92. 1831; Haines, Bot. Bihar Orissa 1018. 1924. *Eulalia tristachya* O. Kuntze, Rev. Gen. Pl. 2:775. 1891; Mooney, Suppl. Bot. Bihar Orissa: 185. 1950. *Eulalia trispicata* (Schult) Henrard, in Blumea 3:453. 1940; N.P. Singh & al., Fl. Bihar: 623. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.:239. 2014.

**Plate 14H**

Perennial. Culms 25–55 cm high. Leaf sheaths *c.* 7 cm long, ribbed; ligule membranous, *c.* 1 mm long, white fimbriate apex. Leaf blades linear, 5–20 × *c.* 0.5 cm, entire at margins, attenuate at apex, midrib prominent, brownish green, glabrous. Racemes 2–7 digitate or subdigitate, 3–8 cm long, densely silky; peduncles to 20 cm long; pedicels 1.5 mm with silky hairy. Spikelets elliptic to lanceolate, 3–8 × *c.* 0.8 mm; disarticulating from joints and pedicel apices; callus bearded with white hairs. Lower glume elliptic to oblong, boat shaped, *c.* 2 × 0.8 mm, retuse at apex, subcoriaceous, 2-veined, 2-keeled, keels scabrellate towards apex, hairs whitish, *c.* 2.5 mm long, margins incurved. Upper glume oblong-elliptic to lanceolate, boat shaped, *c.* 2 × 1 mm, subacute to acuminate at apex, subcoriaceous, 1–3-veined, 1-keeled, margins golden hairy above. Florets 2, both epaleate; lower barren, upper bisexual. Lower lemma narrowly oblong-lanceolate, 1.5–2 × *c.* 0.5 mm, subacute to acuminate at apex, subcoriaceous beneath and chartaceous above, hyaline, veinless, sparsely golden brown hairy along margins. Upper lemma oblong, 1.5–2 mm, hyaline, deeply 2-lobed above, lobes hyaline, 1-veined, awned from middle of lobes; awn 1.5–1.6 cm long, column twisted, *c.* 10 mm long, bristles barbellate. Lodicules *c.* 0.3 mm, truncate and 2-lobed at apex, membranous, hyaline. Stamens 3; anthers *c.* 1.5 mm; filaments *c.* 1 mm, hyaline. Ovary narrowly oblong, 0.5 mm, acute at apex, brownish; stigma plumose, *c.* 1 mm, brownish. Pedicelled spikelets similar to sessile one.

*Fl. & Fr.*: November – January.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near base of Dhawjadhari Pahar Koderma NRF; occasional. INDIA: Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Jammu-Kashmir, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Tamil Nadu. WORLD: Australia, Bhutan, China, Malaysia, Nepal and Sri Lanka.

*Specimen examined*: Near base of Dhawjadhari Pahar Koderma NRF, 384 m, 24°29'16.2" N, 85°35'44.9" E, 19th November 2012, *Shyam Biswa* 54056.

# 17. SACCHARUM L.

Tropical & subtropical regions 35–40 species (Incl. *Erianthus*) 15 in India, 7 in Jharkhand (2 cultivated) and 1 in KWLS.

**Saccharum spontaneum** L., Mant. Pl. Altera: 183. 1771; Hook.f., Fl. Brit. India 7: 118. 1896; Haines, Forest Fl. Chota Nagpur: 570. 1910 & Bot. Bihar Orissa: 1011. 1924; Mooney, Suppl. Bot. Bihar Orissa: 183. 1950; N.P. Singh & al., Fl. Bihar: 68. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 709. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1128. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:244. 2014.

**Plate 15C**

Vern. Name: *Ghas* (Hindi).

Perennial, rhizomatous. Culms to 1.5 m high. Leaf sheaths 10–20 cm long, ribbed, bearded hairy at mouth; ligule ovate, 2–3 mm, membranous. Leaf blades linear-lanceolate to narrowly elliptic-lanceolate, 30–55 × *c.* 0.5 cm, narrowly truncate at base, thick, finely serrulate at margins,



attenuate at apex, scabrid, midrib prominent. Panicle 20–45 cm long, basal racemes whorled, silver colored. Racemes 6–9 cm. Spikelets paired, one sessile and other pedicelled, both more or less similar; joints 3–5.5 mm, thickened towards apex, woolly; pedicels 2–2.5 mm, hairy. Sessile spikelet ovate-lanceolate,  $3.2\text{--}3.5 \times c. 1$  mm, truncate at base; entire spikelets disarticulating along with fragile joints and pedicels; callus bearded. Lower glume ovate to linear-lanceolate,  $3\text{--}4.2 \times c. 1.2$  mm, acuminate, 2-veined, 2-keeled, slightly margins ciliate towards apex. Upper glume ovate-lanceolate,  $3.1\text{--}4.1 \times c. 1.2$  mm, acuminate, 1-veined, keeled, keel finely ciliate beneath, margins ciliate towards apex. Florets 2, both epaleate; lower barren, upper bisexual. Lower lemma ovate to oblong-lanceolate,  $2.8\text{--}3.1 \times c. 0.6$  mm, acute, hyaline, veinless, margins ciliate. Upper lemma narrowly lanceolate,  $1.5\text{--}2.7 \times 0.1\text{--}0.3$  mm, hyaline, veinless, sparsely ciliate on margins. Lodicules 2, obovate,  $c. 0.3 \times 0.2$  mm, truncate, 2-horned like, faintly 3–4-veined, hyaline. Stamens 3; anthers 1.5–2 mm, yellowish; filaments  $c. 0.5$  mm. Ovary oblong,  $0.3\text{--}0.6 \times c. 0.2$  mm; style 0.5–1.2 mm; stigma plumose, 1.2–1.5 mm, purplish to brownish. Pedicelled spikelet  $3\text{--}4.1 \times c. 1$  mm, similar to sessile spikelet.

*Fl. & Fr.*: September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: Almost throughout. WORLD: Old World Tropical regions.

*Specimen examined*: Chattarbar forest, 379 m,  $24^{\circ}28'01.9''$  N,  $85^{\circ}32'13.1''$  E, 3rd September 2010, *Shyam Biswa* 49528.

#### 18. **SACCIOLEPIS** Nash

Tropical and subtropical regions, especially Africa *c.* 30 species, 4 in India, 3 in Jharkhand and 1 in KWLS.

**Sacciolepis myosuroides** (R.Br.) Chase ex. E.G. Camus & A. Camus in P.H. Lecomte & al., *Fl. Indo-Chine* 7: 460. 1922; Haines, *Bot. Bihar Orissa* 990. 1924; Mooney, *Suppl. Bot. Bihar Orissa*: 172. 1950; N.P. Singh & al., *Fl. Bihar*: 648. 2001. *Panicum myosuroides* R. Br., *Prodr. Fl. Nov. Holland*. 189. 1810.

Annual. Culms decumbent, 6–15 cm high. Leaf sheaths *c.* 2 cm long, glabrous; ligule obsolete, thin. Leaf blades oblong-lanceolate to linear-lanceolate,  $5\text{--}6 \times 0.1\text{--}0.5$  cm, rounded or narrowed near base, entire at margins, acuminate at apex, scabrid or glabrous. Panicle narrow, spiciform, cylindrical to oblong, 1–2.5 cm long, condensed to interrupted. Spikelets 2–5 in a cluster, ovate-oblong or subglobose, 1.5–2 mm, obtuse at apex, greenish purple; pedicels *c.* 1 mm long. Lower glume broadly ovate,  $c. 1 \times 1$  mm, acute at apex, 3-veined. Upper glume ovate or oblong,  $c. 1.5 \times 1$  mm, 5–7-veined, purplish. Florets 2; lower barren, upper bisexual. Lower lemma ovate to elliptic,  $c. 1.5 \times 1$  mm, 5–7-veined. Upper lemma ovate to elliptic,  $c. 1 \times 0.5$  mm, glossy, faintly 5–7-veined. Palea similar ovate to elliptic,  $0.8\text{--}1 \times 0.5$  mm, margins inflexed. Lodicules 2, *c.* 0.5 mm, dentate at apex. Stamens 3; anthers 0.3–0.4 mm, purplish. Ovary ovate, 0.5–1 mm; style *c.* 0.5 mm long; stigma plumose, *c.* 0.5 mm long. Caryopsis ellipsoid, *c.* 1 mm, turgid.

*Fl. & Fr.*: September – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure Koderma NRF; common. INDIA: Andaman, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra,

Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal. WORLD: Tropical of Asia and Australia.

*Specimen examined:* Inside the enclosure Koderma NRF, 395m, 24°28'58.1" N, 85°36'03.0" E, 1st March 2012, *Shyam Biswa* 53908.

## 21. **SETARIA** Beauv.

Tropical & Subtropical regions *c.* 140 species (Excl. *Paspalidium*), 15 in India, 8 in Jharkhand and 2 in KWLS.

### Key to species

- 1a. Inflorescence of racemes, only the uppermost spikelet of each raceme subtended by a bristle or short (often inconspicuous) point **1. *S. flavid***
- 1b. Inflorescence paniculate, often spike-like, all or many of the spikelets subtended by bristles or a spiny involucre **2**
- 2a. Involucral bristles retrorsely barbed **3. *S. verticillata***
- 2b. Involucral bristles antorsely barbed **2. *S. pumila***

**1. *Setaria flavid*** (Retz.) Veldkamp, Blumea 39(1–2): 376 (1994): 1994. *Panicum flavidum* Retz., Observ. Bot. 4: 15. 1786; Hook.f., Fl. Brit. India 7: 28. 1896. *Paspalidium flavidum* (Retz.) A. Camus in P.H. Lecomte & al., Fl. Indo-Chine 7: 419. 1922; Haines, Bot. Bihar Orissa: 1001. 1924; N.P. Singh & al., Fl. Bihar: 639. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1115. 2005.

Vern. Name: *Shyama Ghas*.

Annual or perennial. Culms 25–30 cm high, ribbed. Leaf sheaths keeled, 2–5 cm long, ribbed; ligule *c.* 0.2 mm, membranous with fimbriate apex, hyaline. Leaf blades linear to oblong-lanceolate, 3.5–13 × 0.1–0.7 cm, cordate to rounded at base, inrolled to flat at margins, ciliate towards apex margins, acuminate at apex, serrulate, hairy at base. Racemes 4–7, lanceolate, 0.5–1.5 × *c.* 0.5 cm, alternate on central axis; rachis triquetrous, Spikelets alternate, 2 rowed, ovate to elliptic, 1.5–2.5 × 1–1.5 mm, greenish with purple patches; entire spikelet disarticulating as single unit. Lower glume ovate, 1–1.2 × *c.* 1 mm, truncate at base, 3–5-veined. Upper glume ovate or boat shaped, 1.7–2 × 1–1.2 mm, 5–11-veined. Florets 2; lower male or barren, upper bisexual. Lower lemma ovate, 2.2–2.6 × 0.8–1.8 mm, acute, beaked, 5-veined. Lower palea elliptic, 1.8–2.2 × 1–1.5 mm, acute to retuse, 2-veined, 2-keeled, slightly winged on keel, margins infolded. Upper lemma ovate to globose, 2–2.5 × 1–1.2 mm, acute, beaked, 3-veined, granulate dorsally, exposes much of palea. Upper palea ovate-elliptic, 1.8–2.1 × *c.* 0.8 mm, acute, faintly 2-veined, 2-keeled or not, margins infolded. Lodicules 2, delicate, *c.* 0.5 × 0.2 mm, ciliate or fimbriate at apex. Stamens 3; filaments *c.* 0.4 mm; anthers 1–1.2 mm, brownish. Ovary oblong, 0.3–0.5 mm; style *c.* 1 mm long; stigma plumose, *c.* 1 mm long, brownish. Caryopsis elliptic or oval, 1.5–1.8 × 0.8–1 mm, greenish to whitish.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; common. INDIA: Andaman, Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Jammu-Kashmir, Karnataka, Kerala,

Madhya Pradesh, Maharashtra, Nagarhaveli, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. WORLD: Tropical Asia.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 390 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49544.

**2. *Setaria pumila* (Poir.) Roem. & Schult., Syst. Veg. 2: 891. 1817. N.P. Singh & al., Fl. Bihar: 652. 2001. *Panicum pumilum* Poir. in J. Lamarck & al., Encyc. Suppl. 4: 273. 1816. Plate 15D**

Annual. Culms 20–30 cm high, erect. Leaf sheaths 1.5–2 cm, ribbed, hairy along margins, glabrous; ligule 1.5 mm, fimbriate hairs at apex. Leaf blades linear to elliptic-lanceolate, 6–10 × 0.3–0.4 cm, narrowly rounded at base, entire at margins, acuminate at apex, midrib prominent. Inflorescence of spikes or spiciform panicles, compact, 0.5–1.5 × 0.5–0.8 cm, cylindrical; rachis pilose hairy; involucre bristles 4–10 per whorl, antrorsely barbed, persistent, 2–3 mm, barbellate. Spikelets in a cluster or solitary, ovoid to subglobose, 1.2–c. 2.2 × 2 mm, acute at apex, deciduous; pedicel minute, pilose hairy. Lower glume ovate, boat shaped, c. 1 × 0.5 mm, 3-veined. Upper glume ovate, boat shaped, c. 1.8 × 0.8 mm, 5–7-veined. Florets 2; lower male, upper bisexual. Lower lemma broadly elliptic to ovate, c. 2 × c. 1 mm, acute, 5–7-veined. Lower palea ovate to elliptic, c. 2 × 0.8 mm, 2-veined, 2-keeled, keels winged, margins infolded. Upper lemma ovate or boat shaped, c. 2 × 1 mm, acute and beak like at apex, rugose, 3–5-veined within, margins inrolled, thick. Upper palea ovate to elliptic, c. 1.5 × c. 0.8 mm, rugose dorsally, 2-veined, 2-keeled, margins infolded and winged along margins. Lodicules 2, obovate, c. 0.3 mm, truncate. Stamens 3; anthers c. 0.5 mm long; filaments c. 0.3 mm long. Ovary ovate to oblong c. 0.5 × 0.1 mm; style 2, c. 0.5 mm long; stigma c. 0.5 mm, plumose, violet to purplish. Caryopsis ovate-elliptic or rarely oblanceolate, c. 0.6 × 0.4 mm, acute or obtuse.

*Fl. & Fr.*: September – November .

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: Almost throughout. WORLD: Old World tropical regions.

*Specimen examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010 *Shyam Biswa* 49523.

**3. *Setaria verticillata* (L.) P.Beauv., Ess. Agrostogr. 51. 1812; Hook. f. Fl. Brit. India 7: 80. 1896; Haines, Bot. Bihar Orissa 989. 1924; Mooney, Suppl. Bot. Bihar Orissa: 177. 1950; N.P. Singh & al., Fl. Bihar: 652. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 712. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1131. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:247. 2014. *Panicum verticillatum* L., Sp. Pl. ed. 2. 1: 82. 1762. Plate 15E**

Vern. Name: *Ghas*

Annual or perennial. Culms tufted, 5–10 cm high, erect or decumbent. Leaf sheaths keeled, basal, ciliate on both margins; ligule c. 0.6 mm long. Leaf blade linear-lanceolate, 1.5–8 × 0.2–0.5 cm, entire or serrulate at margins, acuminate to attenuate at apex, pseudopetiolate when young, scabrid to sparsely tuberculate hairy. Raceme cylindrical, solitary and terminal, 1.5–3 × 1–2 cm, rachis hispidulous, hairy. Spikelets pedicellate, ovate to elliptic, 1.5–2.2 × 0.6–1.2 mm; bristle persistent, single per spikelet, 3.8–7.2 mm, retrorsely barbellate; pedicels retrorsely



scaberulous; entire spikelet disarticulating from pedicel tip. Lower glume ovate,  $0.5-1 \times c. 0.7$  mm, 1-3-veined. Upper glume boat shaped,  $1.3-1.7 \times c. 1$  mm, 5-7-veined, margins infolded. Florets 2; lower barren, upper bisexual, greenish yellow. Lower lemma elliptic-lanceolate,  $1.3-1.9 \times c. 0.8$  mm, 5-veined, margins flat to infolded. Lower palea oblong,  $0.6-0.8 \times c. 0.4$  mm, veinless. Upper lemma boat shaped,  $1.2-2 \times c. 0.8$  mm, rugulose 3-5-veined, margins enclose palea. Upper palea elliptic,  $1-1.8 \times c. 0.8$  mm, rugulose, 2-veined, margins infolded. Lodicules 2,  $c. 0.4 \times 0.2$  mm, truncate. Stamens 3; anthers  $c. 1$  mm long; filaments  $c. 0.4$  mm. Ovary oblong,  $0.3-0.6 \times c. 0.2$  mm; style  $c. 0.7$  mm, hyaline; stigma plumose,  $c. 0.4$  mm. Caryopsis ovate to elliptic,  $c. 1 \times 0.5$  mm, stipitate, greenish.

*Fl. & Fr.*: March – April.

*Habitat*: Near the rivers.

*Distribution*: KWLS: Near the river Dhanarjay nadi, Meghatari. Tropical and temperate regions of the Old World. INDIA: Found in almost every part of India.

Tamil Nadu

*Specimen examined*: Near the river Dhanarjay nadi, Meghatari, 182 m,  $24^{\circ}34'32.9''$  N,  $85^{\circ}34'41.6''$  E, 7th March 2011, *Shyam Biswa* 49704.

*Note*: The herbarium specimens studies at CAL does not matches completely with the specimens with *S. verticillata*.

## 20. **THEMEDA** Forssk.

Old World Tropical regions, 27 species, 18 in India, 8 in Jharkhand and 1 in KWLS.

**Themeda triandra** Forssk., Fl. Aegypt.-Arab. 178. 1775; N.P. Singh & al., Fl. Bihar: 658. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 717. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.:248. 2014. *Anthistiria imberbis* Retz., Observ. Bot. 3: 11. 1783; Hook.f., Fl. Brit. India 7: 211. 1896. *Themeda imberbis* (Retz.) T. Cooke, Fl. Bombay 2: 993. 1908; Haines, Bot. Bihar Orissa: 1049. 1924.

### **Plate 15F**

Perennial. Culms 2 m high, erect. Leaf sheaths 4–9 cm long, keeled mouth bearded; ligule ovate, 1–3.5 mm long. Leaf blades, oblong to linear-lanceolate,  $18-26 \times 0.3-0.6$  cm, truncate at base, entire at margins, acuminate to attenuate at apex, midrib prominent, serrulate towards apex, glabrous to sparsely pubescent dorsally. Panicles dense elongate, >50 cm long; raceme  $c. 6$  cm (including awns), consists of 4 sessile homogamous involucre male spikelets, 1 sessile awned bisexual spikelet and 2 pedicelled male spikelets. Involucral spikelets narrowly elliptic-lanceolate,  $6.5-11 \times 1-2.5$  mm, acute at apex, 1-flowered, male, epaleate, more or less at same level, unawned, persistent. Sessile spikelet oblong,  $4-7 \times 1-1.5$  mm, awned; callus 1.5–4 mm, bearded. Lower glume oblong,  $4.6-7 \times c. 1.2$  mm, 9-veined, hairy, margin inrolled. Upper glume oblong-lanceolate,  $4.8-6.5 \times c. 0.8$  mm, 3-veined, scabrid dorsally above middle. Florets 2; lower barren, epaleate; upper perfect and turns brownish when mature. Lower lemma ovate to broadly oblong,  $4.3-6 \times 1-1.2$  mm, 0-3-veined. Upper lemma reduced to stipitate, 0.8–1.7 mm; awn 3–4 cm long, stiff, geniculate, column twisted towards apex, hairy. Upper palea elliptic to oblong lanceolate,  $c. 2.5 \times 0.6$  mm, veinless. Lodicules 2,  $c. 1$  mm long, obovate to truncate. Stamens 3; anthers  $c. 1$  mm; filaments 0.1–1.5 mm long. Ovary oblong,  $c. 0.5$  mm; style 1–2 mm long, hyaline; stigma plumose, 1–1.5 mm long. Caryopsis oblong,  $2-3 \times c. 0.5$  mm, brownish. Pedicelled spikelets similar, oblong-lanceolate,  $7-10 \times c. 1$  mm, acute or acuminate at apex, brownish, unawned; pedicels 1.5–3 mm, seldom thickened at apex, glabrous or hairy.

*Fl. & Fr.*: February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Way to Muglamaram forest road, Taraghati forest; not common. INDIA: Almost throughout. WORLD: Subtropical and tropical regions of Old World.

*Specimen examined*: Way to Muglamaram forest road, Taraghati forest, 321m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49860.

## 21. **THYSANOLAENA** Nees

South East Asia 1 species.

**Thysanolaena latifolia** (Roxb. ex Hornem.) Honda, J. Fac. Sci. Tokyo, Sect. 3, Bot. 3: 312. 1930. *Melica latifolia* Roxb. ex Hornem., Suppl. Hort. Bot. Hafn.: 117. 1819. *Agrostis maxima* Roxb., Fl. Ind. 1: 319. 1820. *Thysanolaena agrostis* Nees, Edinburgh New Philos. J. 18: 180. 1835; Hook.f., Fl. Brit. India 7: 61. 1896; Haines, Forest. Fl. Chota Nagpur: 562. 1910 & Bot. Bihar Orissa: 982. 1924. *Thysanolaena maxima* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 794. 1891; N.P. Singh & al., Fl. Bihar: 659. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 718. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1135. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 249. 2014.

### Plate 15G

Perennial, rhizomatous. Culms erect, 1–2 m high. Leaf sheaths when young with dense yellowish pubescent, margins at times ciliate, collar ciliate; hairs 0.5–1.5 mm long, falling when mature; ligule *c.* 1.5 mm, truncate, membranous with hairs behind. Leaf blades lanceolate, 24–35 × 1–2 cm, subcordate to semiamplexicaul at base, entire at margins, acuminate at apex, tessellate veined, glabrous; Panicle effuse, 25–33 × *c.* 10 cm, drooping; branches capillary, opposite, nodes pubescent; rachis flexuous. Spikelets paired or not, ovate-lanceolate or lanceolate, *c.* 1 mm long; disarticulating along with upper portion of pedicel; pedicels 0.5–2 mm long. Glumes subequal, shorter than florets. Lower glume ovate, 0.5 mm long, acute, 1-veined. Upper glume *c.* 1 mm long, acute. Florets usually 2 or 3; lower sterile, median one bisexual, upper male or sterile; rachilla prolonged beyond the base of second floret and often bearing rudimentary florets. Sterile lemma lanceolate, *c.* 1 mm long, membranous to chartaceous, glabrous. Lower palea absent. Fertile lemma lanceolate, *c.* 1.5 mm, 3-veined, long ciliate on margins. Palea oblong-lanceolate, 0.5–1 mm, membranous, hyaline, 2-veined. Lodicules 2, truncate at apex. Stamens 2 or 3; anthers *c.* 0.5 mm long. Stigma plumose, purplish. Caryopsis ellipsoid, *c.* 0.5 mm.

*Fl. & Fr.*: March – June.

*Habitat*: On the rocky hill near the river.

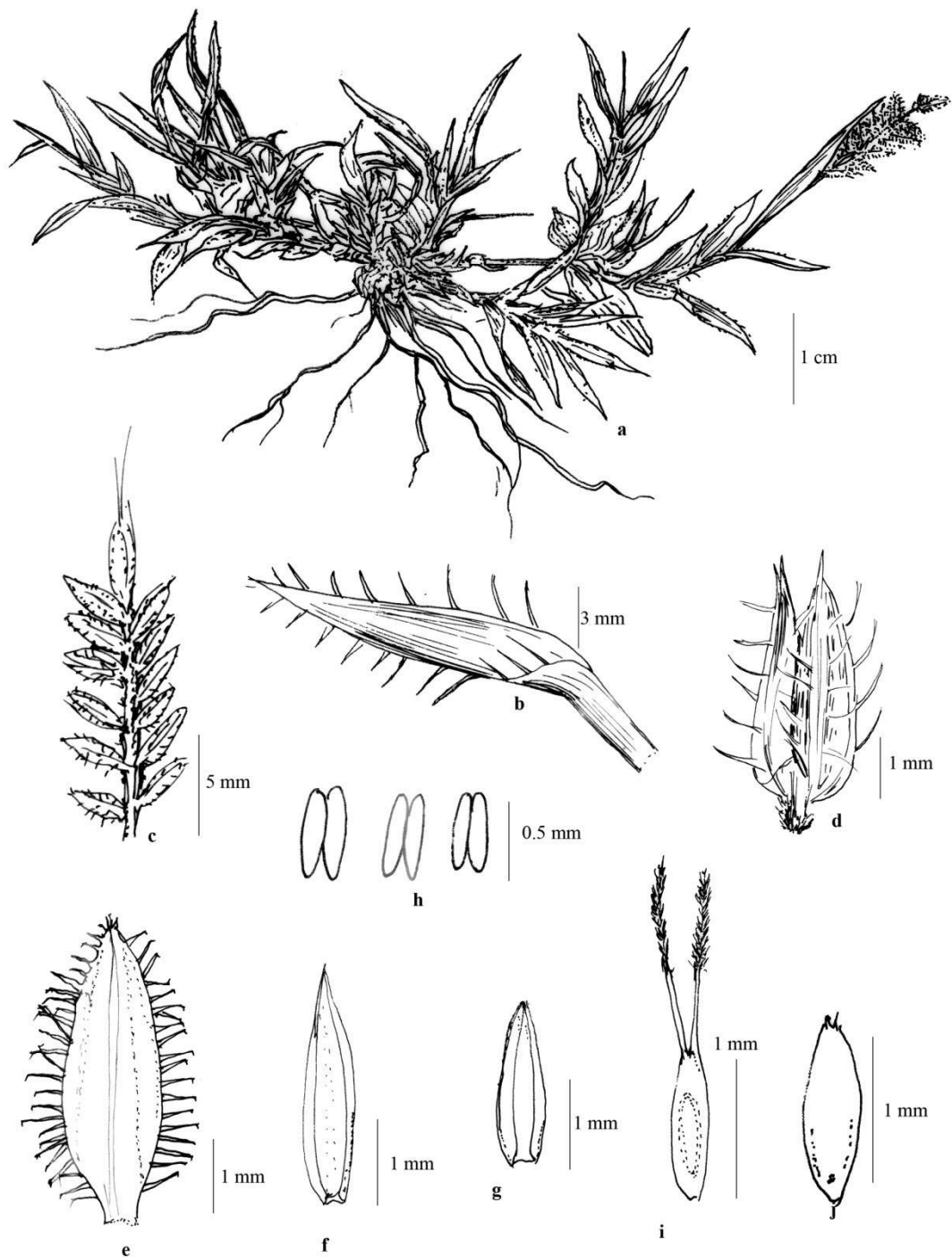
*Distribution*: KWLS: Rajdah, Meghatari. INDIA: Almost throughout. WORLD: Widespread in tropical Asia from India and Sri Lanka, occasionally introduced into other parts of world. INDIA: Throughout India.

*Specimen examined*: Rajdah, Meghatari, 188 m, 24°34'47.8"N, 85°35'56.0"E, 8th March 2011, *Shyam Biswa* 49726.

## 22. **TRAGUS** Hall.

Old World Tropical especially Africa, 7 species, 1 in India.

**Tragus racemosus** (L.) All., Fl. Pedem. 2: 241. 1785, *non* Scop., 1777; Hook.f., Fl. Brit. India 7: 97. 1896; Haines, Bot. Bihar Orissa 979. 1924. *Tragus roxburghii* Panigrahi. Kew Bull. 29 (3):



**Fig. 15. *Tragus roxburghii* Panigrahi:** a. habit; b. leaf; c. raceme; d. spikelet; e. glume; f. lemma; g. palea; h. anther; i. pistil; j. caryopsis.

496. 1974. N.P. Singh & al., Fl. Bihar: 659. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1136. 2005.

**Fig. 15; Plate 15H**

Annual stoloniferous. Culms 3–8 cm high, decumbent. Leaf sheaths 1.3–3 cm long, terete to keeled, ribbed; ligule 0.6–0.8 mm, a rim of whitish hairs. Leaf blades ovate-lanceolate,  $0.5-2 \times 0.1-0.3$  cm, amplexicaul to rounded at base, long ciliate at margins, acute to acuminate at apex, flat to wavy, glabrous or long ciliate-hispid hairy. Raceme terminal, narrowed,  $1-2 \times c. 0.7$  cm; peduncle whitish hispidulous hairy throughout or up to half; rachis terete to wavy, hispid hairy on nodes. Spikelets paired, arising at same level, subopposite, equal, ovate-lanceolate,  $3-4 \times c. 3.5$  mm, acute to acuminate at apex, subcoriaceous, covered with hooked hairs; pedicels  $c. 0.8 \times 0.2$  mm, stout, hairy. Lower glume 0.3–0.5 mm, reduced to a scale, membranous, hyaline, sometimes absent. Upper glume ovate-lanceolate,  $3-4 \times 1-1.5$  mm, acuminate at apex, narrowly truncate at base, 5-veined, thick ridged like with hooked hispid hairs dorsally, margins thick and encloses other parts tightly. Lemma ovate-lanceolate,  $c. 2 \times 0.6$  mm, acuminate at apex, chartaceous, 3-veined, sparsely hispid hairy dorsally. Palea ovate-lanceolate,  $c. 2 \times 0.5$  mm, membranous to chartaceous, whitish, 2-veined, margin flat to infolded. Lodicules 2, obtuse to at times 2-lobed,  $c. 0.4 \times 0.3$  mm, membranous. Stamens 3; filaments  $c. 1$  mm, hyaline; anthers  $c. 0.5$  mm long, yellow to purple. Ovary  $0.3-0.4 \times c. 0.3$  mm, acute to acuminate at apex; style 0.6–1 mm, hyaline; stigma, 0.7–1.2 mm, plumose whitish. Caryopsis narrowly ovate-lanceolate to oblong,  $1.3-1.8 \times c. 0.5$  mm, acute at base, acuminate at apex, brownish.

*Fl. & Fr.*: August – September.

*Habitat*: On the open grasslands.

*Distribution*: KWLS: Dengra Pahar, near RIT institute, Chattarbar; rare. INDIA: Andhra Pradesh, Assam, Bihar, Gujarat, Jammu-Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. WORLD: East Africa, Sri Lanka, Southeast Asia.

*Specimen examined*: Dengra Pahar, near RIT institute, Chattarbar 390 m,  $24^{\circ}28'09.3''$  N,  $85^{\circ}34'14.9''$  E, 13th August 2011, *Shyam Biswa* 49796.

### 23. **UROCHLOA** P.Beauv.

Tropical and subtropical regions 102 species; in India, 6 in Jharkhand and 1 in KWLS.

***Urochloa reptans*** (L.) Stapf in Prain, Fl. Trop. Afr. 9(4): 601. 1920; Haines, Bot. Bihar Orissa 1003. 1924. *Brachiaria reptans* (L.) C.A.Gardner & C.E.Hubb. in Hooker's Icon. Pl. 34: sub t. 3363. p 3. 1938. *Panicum reptans* L., Syst. Nat. ed.10. 2: 870. 1759. *Panicum prostratum* Lam., Tabl. Encycl. 1: 171. 1791; Hook.f., Fl. Brit. India 7: 33. 1896;

Annual. Culms decumbent, to 10 cm high. Leaf sheaths 0.5–1.5 cm long, pubescent to glabrous; ligules ovate,  $c. 0.2$  mm long, ciliate hairs at apex. Leaf blades ovate-lanceolate,  $1-1.5 \times 0.2-0.3$  cm, rounded to semiamplexicaul at base, entire and slightly wavy at margins, acute to acuminate at apex, pubescent. Panicle of 3–6 racemes, alternate,  $c. 2$  cm long; rachis triquetrous, shortly winged. Spikelets compactly arranged, paired, similar, short and long pedicelled, ovate to elliptic,  $1-1.8 \times 0.5-1$  mm, greenish; pedicels  $c. 0.5$  mm. Lower glume ovate,  $0.4-0.8 \times c. 1$  mm, faintly 3-veined. Upper glume ovate-lanceolate,  $1-1.5 \times c. 0.5$  mm, 5–7-veined. Florets 2, lower barren, upper bisexual. Lower lemma ovate to oblong-lanceolate,  $1.2-1.8 \times c. 0.5$  mm, 5-veined, similar



to upper glume. Lower palea oblong,  $1-1.5 \times c. 0.5$  mm, 2-veined, 2-keeled, keels hyaline to greenish. Upper lemma ovate to  $1.2-1.5 \times c. 0.5$  mm, with a mucro at apex, 3-5-veined, margins inrolled, exposing much of palea. Upper palea broadly elliptic,  $1-1.5 \times c. 0.5$  mm, rugulose or not, 2-veined. Lodicules 2,  $c. 0.2$  mm, membranous, hyaline. Stamens 3; anthers  $0.5-0.8$  mm, yellow to brown; filaments hyaline. Ovary oblong  $c. 0.5$  mm long; styles  $c. 0.5$  mm long; stigma plumose,  $c. 1$  mm long, purplish to greenish. Caryopsis ellipsoid,  $0.5-0.8 \times c. 0.4$  mm, yellowish green.

*Fl. & Fr.*: September–April.

*Habitat*: Near the rivers.

*Distribution*: KWLS: Near the river Dhanarjay nadi, Meghatari.

*Specimen examined*: Near the river Dhanarjay nadi, Meghatari, 182 m,  $24^{\circ}34'32.9''$  N,  $85^{\circ}34'41.6''$  E, 7th March 2011, *Shyam Biswa* 49705.

## 24. ZEA L.

Mexico, Central America and Nicaragua, 5 species and 1 in India.

**Zea mays** L., Sp. Pl. 2: 971. 1753; Hook.f., Fl. Brit. India 7: 102. 1896; Haines, Forest. Fl. Chota Nagpur: 564. 1910 & Bot. Bihar Orissa 1065. 1924; N.P. Singh & al., Fl. Bihar: 661. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 720. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 1139. 2005.

Vern. Name: *Makai*.

Annual. Culms to 2 m high, terete. Leaf blades, linear-lanceolate,  $30-70 \times 3-7$  cm, rounded at base entire, ciliate at margins acute at apex, glabrous or hairy. Male and female spikelets in separate inflorescence. Male terminal 10 to 20 cm long, female axillary. Male spikelets paired, one sessile, other pedicelled, ovate-oblong,  $c. 9$  mm long. Lower glume ovate-lanceolate,  $7-8 \times 2-3$  mm, membranous, 9-11-veined, keeled. Upper glume oblong-lanceolate,  $c. 8$  mm long, 7-veined. Florets 2. Lower lemma  $c. 7 \times 3$  mm, pubescent, 3-veined. Lower palea  $c. 5$  mm long. Upper lemma pubescent, to 5 mm long, hyaline, 2-veined, paleate. Stamens 3, anthers  $c. 2 \times 0.5$  mm. Female inflorescence enclosed by leaf sheath and numerous bracts; rachis woody. Female spikelets in many rows. Ovary ellipsoid,  $c. 2$  mm long, ciliate at base; styles  $2.5-3$  cm long; stigmas  $c. 2$  mm long, plumose. Caryopsis obovate, subglobose,  $c. 1.2$  cm, yellowish brown.

*Fl. & Fr.*: March – October.

*Habitat*: Cultivated or escaped.

*Distribution*: KWLS: Inside the enclosure Koderma NRF; common. INDIA: Throughout. WORLD: Native in America; widely cultivated in subtropical countries.

*Specimen examined*: Inside the enclosure, Koderma NRF, 395m,  $24^{\circ}28'58.1''$  N,  $85^{\circ}36'03.0''$  E, 1st March 2012, *Shyam Biswa* 54026.

## 24. PAPAVERACEAE Juss., nom. cons.

North temperate regions also Australia, tropical Africa and South America, 43 genera and  $c. 820$  species; 5 genera and 27 species in India

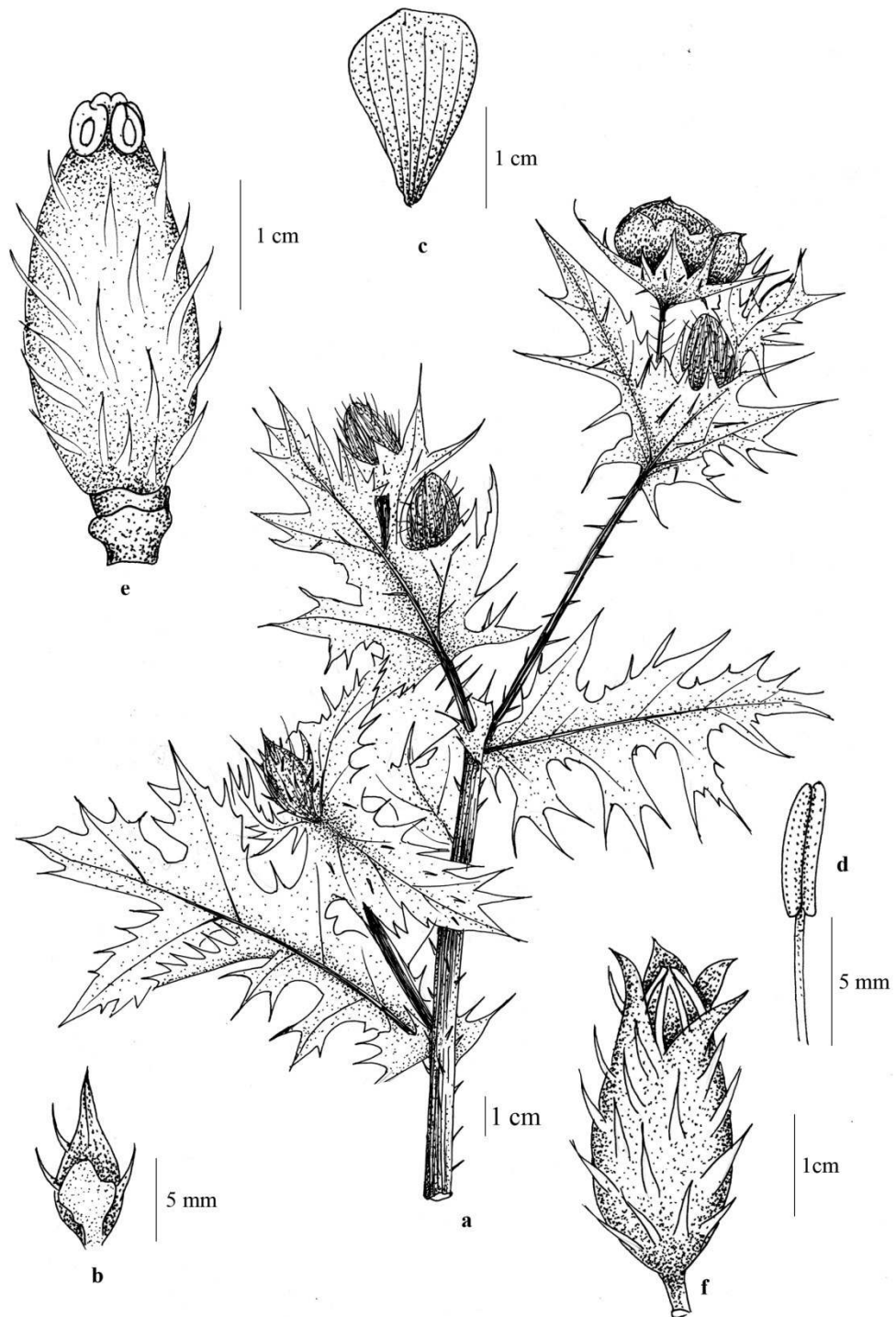


Fig. 16. *Argemone mexicana* L.: a. fruiting twig; b. sepal; c. petal; d. stamen; e. carpel; f. capsule.

# ARGEMONE L.

North and South Americas, West Indies, Hawaii, 23 species, 3 in India, 2 in Jharkhand and KWLS.

## Key to species

- 1a. Petals bright yellow; stigmatic lobes closely crowded together and appressed to styles at anthesis **1. A. mexicana**
- 1b. Petals white; stigmatic lobes divergent and not appressed **2. A. ochroleuca**

**1. Argemone mexicana** L., Sp. Pl. 1: 508. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 117. 1872; Haines, Forest Fl. Chota Nagpur: 155. 1910 & Bot. Bihar Orissa: 23. 1921; Debnath & M.P. Nayar in B.D. Sharma & N.P. Balakr., Fl. India 2: 2, fig. 1. 1993 (as var. mexicana); Paria & Chattopadhyay, Fl. Hazaribagh 1: 74. 2000; N.P. Singh & al., Fl. Bihar: 34. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 68. 20. **Fig. 16; Plate 16A**

Herb, 30–90 cm high, prickly. Stems terete, prickly; prickles straight, with yellow milky juice. Lower leaves with distinct petioles, crowded in a rosette; upper ones simple, alternate, sessile, sinuate-pinnatifid with 3–6 pairs of pinnatifid lobes, 4.5–13.5 × 2.5–8 cm, semi-amplexicaul at base, dentate at margins, each tooth terminated by prickle, acute to acuminate at apex terminating with a sharp prickle, variegated green and white; midrib and veins prickly. Inflorescence axillary or terminal. Flower solitary, 4–5 cm across; pedicel 1–2 cm long. Sepals oblong, c. 10 × 7 mm, prickly outside. Petals obovate, 2–2.5 × 1–1.5 cm, bright yellow. Stamens 7–12 mm long. Ovary 8–10 mm long, soft-prickly; stigma 3–6-lobed, dark pinkish. Capsules 5-grooved, ellipsoid to oblong, 3–3.5 × 1.5–2 cm, prickly, glaucous or green, open by 3–6 valves from top. Seeds numerous, globose, 1.5–1.8 mm across, brownish black.

*Fl. & Fr.*: February–December.

*Habitat*: Scrub forests and on open places and waste lands.

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout. WORLD: Native to Tropical America, now Pantropical.

*Specimen examined*: Lokai forest, 385 m, 24°29'02.9" N, 85°37'04.4" E, 28th February 2011, Shyam Biswa 49644.

**2. Argemone ochroleuca** Sweet, Brit. Fl. Gard. 3: t. 242. 1828; Debnath & M.P. Nayar in B.D. Sharma & N.P. Balakr., Fl. India 2: 5, fig. 2. 1993; N.P. Singh & al., Fl. Bihar: 34. 2001.

## Plate 16B

Herb, 5–50 cm high, prickly. Stems terete, prickly; prickles straight, pinkish-green with yellow milky juice. Lower leaves with distinct petioles, crowded in a rosette; upper ones simple, alternate, sessile, sinuate-pinnatifid with 3–6 pairs of pinnatifid-lobes, 12–20 × 6.5–9.5 cm (with prickles), semi-amplexicaul at base, dentate at margins, acute to acuminate at apex terminating with a prickle, variegated with glaucous bands, whitish green or light green; veins prickly. Inflorescence axillary or terminal. Flowers solitary or in pairs, sessile, 4–5 cm across; pedicels 0.5–2.5 cm long. Sepals oblong, c. 10 × 7 mm, prickly outside. Petals obovate, 2–2.5 × 1–1.5 cm, bright yellow. Stamens 7–12 mm long. Ovary 8–10 mm long, soft prickly; stigma 5 or 6-lobed, dark reddish. Capsules 5-grooved, ovoid or lanceolate-ovoid 3–3.5 × 1.5–2 cm, prickly, glaucous or green, open by 5 or 6 valves from top, T-shaped. Seeds numerous, globose, 1.5–1.8 mm, brownish black.

*Fl. & Fr.*: March–June.

*Habitat*: On wasteland or on dried up river beds.

*Distribution*: KWLS: Khararia jungle, near the Dhanarjay Nadi, Meghatari; not common. INDIA: Delhi, Punjab and Uttar Pradesh. WORLD: Native of Mexico.

*Specimen examined*: Khararia jungle, near the Dhanarjay nadi, Meghatari, 180 m, 24°34'53.4" N, 85°35'16.5" E, 9th March 2011, *Shyam Biswa* 49736.

*Note*: Observed only in the fallow fields, on the dried up river beds and river banks on sandy soil in the Meghatari Reserve Forest areas.

## 25. MENISPERMACEAE Juss., nom cons.

Tropical and subtropical regions, few temperate regions, 71 genera *c.*450 species; 22 genera 43 species in India.

### Key to genera

- 1a. Male sepals; petals 4; stamens connate into a column; anthers borne on margin of peltate disk; carpel solitary **1. Cissampelos**
- 1b. Male sepals 6; petals 3–6; stamens with filaments free or connate but anthers free; carpels-3 **2. Tinospora**

### 1. CISSAMPELOS L.

Tropical regions, *c.*20 species and 1 in India.

**Cissampelos pareira** L., Sp. Pl. 2: 1031. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 103. 1872; Haines, Forest Fl. Chota Nagpur: 147. 1910 & Bot. Bihar Orissa: 16. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 69. 2000; N.P. Singh & al., Fl. Bihar: 30. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 62. 2002. *Cissampelos hirsuta* Buch.-Ham. ex DC., Syst. Nat. 1: 535. 1818 (1817). *Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman, Kew Bull. 22: 356. 1968; M. Gangop. in B.D. Sharma & al., Fl. India 1: 317. 1993; Ranjan, Fl. Parasnath Wildlife Sanct.:31.2014. **Plate**

### 16C

Climber or twiner. Stems ribbed, pubescent, old stem woody. Leaves simple, alternate, peltate, broadly ovate to orbicular, 3–7.7 × 3.5–9 cm, slightly cordate, truncate to rounded at base, entire at margins, obtuse or retuse, mucronate at apex, sparsely puberulous above puberulous on lower surface, palmately 5–7-veined, raised beneath; petioles 3–8.5 cm long, inserted at the base of lamina or upto 10 mm from margin, densely to sparsely pubescent. Male inflorescences: subcorymbose, peduncled, cymes of 2–4 cm long, solitary or a few in fascicles, axillary. Male flowers: green to yellowish on *c.* 1.2 mm long pedicels; sepals 4, obovate, 1.2–1.5 mm long, pilose outside; petals 4, connate into a cupuliform corolla, *c.* 0.5 mm long, puberulous outside; stamens 4, connate in a peltate synandrium of 0.7–0.8 mm long. Female inflorescences: thyrsoid, to *c.* 16 cm long, composed of a pseudo-raceme of fascicles; bracts suborbicular, to 1.8 mm long, puberulous, accrescent; pedicels 1–1.5 mm long; sepal 1, broadly obovate, 1.2–1.5 mm long; petal 1, broadly cuneate-obovate, 0.7–0.75 mm long; staminode absent; ovary *c.* 0.5 mm long, pilose; style glabrous; stigma divaricately 3-lobed. Drupes obovoid with a basal stylar scar, *c.* 5 mm long, red. Seeds horseshoe-shaped.

*Fl. & Fr.*: August–January.

*Habitat*: Dry deciduous forests.



*Distribution:* KWLS: Inside the enclosure Koderma NRF; not too common. INDIA: Throughout. WORLD: Bangladesh to Malesia, Bhutan, Nepal and Pakistan.

*Specimen examined:* Inside the enclosure Koderma NRF, 397 m, 24°29'02.0" N, 85°35'59.6" E, 11th August 2011, *Shyam Biswa* 49778.

## 2. TINOSPORA Miers

Tropical regions Old World, 32 species, 4 in India, 2 in Jharkhand and 1 in KWLS.

***Tinospora cordifolia*** (Willd.) Miers ex Hook.f. & Thomson, Fl. Ind. 1: 184. 1855 & in Hook.f., Fl. Brit. India 1: 97. 1872; Haines, Forest Fl. Chota Nagpur: 149. 1910 & Bot. Bihar Orissa 18.1921; A. Pramanik in B.D. Sharma & al., Fl. India 1: 347. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 73. 2000; N.P. Singh & al., Fl. Bihar: 32. 2001. *Menispermum cordifolium* Willd., Sp. Pl. 4(2): 826. 1806.

**Plate 16D**

Vern. Name: *Satavar* (Birhore).

Woody climber. Stem terete, corky, glabrous with prominent circular spots/lenticels, young stem ribbed. Leaves simple, alternate, broadly ovate or orbicular, 4.5–12.2 × 4.5–12.1 cm, deeply cordate at base, entire at margin, acuminate at apex, palmately 3–7-veined, raised on lower surface, glandular domatia in vein axils on lower surface, sparsely puberulous on upper surface or glabrous and puberulous beneath; petioles 2–8 cm long, ribbed, glabrous. Inflorescence 1.5–12 cm, male in few flowered cluster, female usually borne singly along axis. Male flowers: axillary, pedicels 3–4 mm long, sepals 6, free, 2-seriate; free, outer 3-ovate, 1–1.5 mm long; inner 3 elliptic, concave 3–4 × 1.5–2 mm; petals 6, green, free, papillose on lower part, obovate, 2–2.5 × 1 mm. Stamens 6, free, club-shaped 2.5–3 mm long. Female flowers: pedicels 4–5 mm long; sepals similar to male, petals 6, broadly spatulate, papillose on lower part, 2.2–2.5 mm long; staminodes 6, linear to subulate, 1.2–1.5 mm long; carpels 3, ellipsoid, 1.5–1.7 mm long; stigma capitate. Drupes, size of a pea, reddish. Stone broadly ellipsoid 6–7 mm, rounded at both ends papillose.

*Fl. & Fr.:* August – February.

*Habitat:* Dry deciduous forest.

*Distribution:* KWLS: Lokai near Birhore Tola; common. INDIA: Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Myanmar and Sri Lanka.

*Specimens examined:* Lokai near Birhore Tola, 382 m, 24°28'57.6" N, 85°37'20.5" E, 24<sup>th</sup> February 2012, *Shyam Biswa* 54175; Lokai forest, near Birhore Tola, 398 m, 24°29'.158" N, 85°37'.038" E, 29th September 2013, *Shyam Biswa* 54194.

## 26. RANUNCULACEAE Juss., nom. cons.

Temperate (especially Northern) and Boreal regions, 56 genera & c. 2100 species; 38 genera 545 species in India.

### RANUNCULUS L.

Cosmopolitan, mostly in temperate regions and tropical mountains, c.600 species, 33 in India, 3 in Jharkhand and 1 in KWLS.

**Ranunculus sceleratus** L., Sp. Pl. 1: 551. 1753; Hook.f., & Thomson in Hook.f., Fl. Brit. India 1: 19. 1872; Haines, Bot. Bihar Orissa 6. 1921; M.A. Rau in B.D. Sharma & al., Fl. India 1: 128. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 67. 2000; N.P. Singh & al., Fl. Bihar: 25. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 55. 2002. **Plate 16E**

Vern. Name: *Jaldhania* (Hindi).

Annuals, erect, 10–50 cm high. Stems branched, ribbed, fistular, glabrous. Leaves simple, basal, alternate, glabrous; basal and lower ones petioled, rounded at base, 0.6–4 × 1–4 cm, 3-partite; segments cuneate and again lobed; uppermost leaves sessile, lanceolate or linear-lanceolate, c. 1.5 × 3 mm, tapering at base, slightly serrate at margins, acute at apex; petioles sheathing, 1.5–8.5 cm long, glabrous. Inflorescence a panicle, terminal. Flowers small to large. Sepals 5, lanceolate, 3–4 × 1.5–2 mm, reflexed, spreading, green outside. Petals 5, oblong/oblanceolate, 4–5 × 1.5–2 mm, glabrous, yellow. Stamens many, 2–3 mm long, free, attached to torus base; anthers 0.6–1 mm long, basifixed, yellow, laterally dehiscent. Carpels many, arranged on an elongated/cylindrical torus, 1-loculed, 1-ovuled; style very short; torus 4–10 mm long. Fruit an achene. Achenes obovoid, c. 0.8 mm long, compressed, numerous in a cylindrical or oblong, 7–8 mm long head; beak minute.

*Fl. & Fr.*: December – February.

*Habitat*: Water-logged or damp localities.

*Distribution*: KWLS: Bon Kali, Pipra Tan; common. INDIA: Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Manipur, Punjab, Uttar Pradesh and West Bengal. WORLD: Afghanistan, Bhutan, China, Europe, Japan, Kazakhstan, Korea, Nepal, North America, North Pakistan, Russia (Siberia), South West Asia and Thailand.

*Specimen examined*: Bon Kali, Pipra Tan, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 49873.

## 27. VITACEAE Juss., nom. cons.

Tropical and subtropical regions, 13 genera and 725 species; 11 genera and 109 species in India

### Key to genera

- 1a. Plants woody; leaves simple; flowers 5-merous; seeds elliptic-oblongoid **1. Ampelocissus**
- 1b. Plants not woody; leaves compound; flowers 4-merous, Seeds oblong-obovoid to subglobose **2. Cyphostemma**

### 1. AMPELOCISSUS Planch., nom. cons.

Tropical regions, c.100 species, 10 in India, 4 in Jharkhand and 2 in KWLS.

### Key to species

- 1a. Leaflets shallowly lobed, serrate at margins, glabrous on both surfaces **1. A. latifolia**
- 1b. Leaflets deeply lobed, double serrate at margins, coarse above, tomentose beneath **2. A. tomentosa**

**1. Ampelocissus latifolia** (Roxb.) Planch., Vigne Amér. Vitic. Eur. 8(12): 374. 1884; Paria & Chattopadhyay, Fl. Hazaribagh 1: 494. 2000; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 256, f. 58. 2000; N.P. Singh & al., Fl. Bihar: 110. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 152. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 63.

2014. *Vitis latifolia* Roxb., Hort. Bengal.: 18. 1814; M.A. Lawson in Hook.f., Fl. Brit. India 1: 652. 1875; Haines, Forest Fl. Chota Nagpur: 276. 1910 & Bot. Bihar Orissa: 203. 1921.

**Plate 16F**

Vern. Name: *Ghoralidi* (Hindi).

Climber; roots tuberous; branches terete, striate, hollow, glabrous. Leaves simple, broadly cordate-ovate, 2–11.5 × 3–15 cm, shallowly 3–5-lobed, deeply cordate at base, serrate at margins, acute to acuminate at apex, glabrous, 5(–7)-veined at base; petioles 1–7.5 cm long, upper half deeply grooved. Inflorescence thyrsoid cymose panicles; peduncles 5–10 cm long, glabrous, bearing tendrils; tendrils branched, 10–15 cm long, puberulous. Flowers *c.* 2 mm long, 5-merous, reddish brown; pedicels 1–10 mm long; primary branch of inflorescence 1.5–5 cm long; thyrses 3–7 cm long, puberulous. Calyx saucer-shaped, entire, glabrous. Petals oblong, slightly incurved at apex, *c.* 1.5 × 0.8 mm, glabrous. Stamens 4 or 5, *c.* 1.2 mm long; anthers globose. Disk enclosing about half of ovary, 5-grooved. Ovary *c.* 1 mm across, glabrous; stigma subsessile. Berries globose, 5–10 mm, glossy, green, black when ripe, 2–4-seeded. Seeds elliptic-oblongoid, 6–7 × 4–5 mm, adaxial surface with a broad longitudinal ridge and a groove on either side.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Phulwarwaria jungle, Koderma NRF; common. INDIA: Throughout. WORLD: Bangladesh, Nepal and Pakistan.

*Specimens examined*: Phulwarwaria Jungle, Koderma NRF, 393 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49542; Phutlaiya Nala, 328 m, 24°30'36.3" N, 85°39'30.1" E, 17th August 2011, *Shyam Biswa* 49821.

**2. *Ampelocissus tomentosa* (Roth) Planch., Vigne Amér. Vitic. Eur. 8: 375. 1884; Mooney, Suppl. Bot. Bihar Orissa: 43. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 495. 2000; B.V. Shetty & P. Singh in N.P. Singh & al., Fl. India 5: 261. 2000; N.P. Singh & al., Fl. Bihar: 110. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 153. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 63. 2014. *Vitis tomentosa* Roth in Roem. & Schult., Syst. Veg., 5: 318. 1819; M.A. Lawson in Hook.f., Fl. Brit. India 1: 650. 1875; Haines, Forest Fl. Chota Nagpur: 276. 1910 & Bot. Bihar Orissa: 203. 1921.**

**Plate 16G**

Vern. Name: *Shewat*.

Climber. Stems and branches terete, ribbed, glabrous. Leaves simple, alternate, broadly cordate-ovate, 5.7–20 × 7.3–26 cm, deeply 3 or 5-lobed, cordate at base, double serrate at margins, acute to acuminate at apex, coarse above, tomentose beneath, 5(–7)-veined at base; petioles 3–15.5 cm long, hairy. Inflorescence thyrsoid cymose panicles; peduncles 5–10 cm long, glabrous, bearing tendrils; tendrils branched, 10–15 cm long, puberulous. Flowers 3–4 mm across; pedicels *c.* 0.5 mm long. Calyx cupular, 4 or 5-lobed, woolly. Petals 5, oblong or ovate, 1.5–2 × *c.* 1 mm, glabrous, reddish. Stamens 5, 0.5–1 mm long; anthers globose, bright yellow. Disk enclosing about half of ovary, 5-grooved. Ovary *c.* 1 mm across, glabrous; stigma subsessile. Berries globular, 1–1.5 cm, glossy, green, turning reddish first and finally blackish when fully ripe. Seeds elliptic-oblong, 6–7 × 4–5 mm, adaxial surface with a broad longitudinal ridge and a groove on either side.

*Fl. & Fr.*: September – December.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF, near the Phulwarwaria jungle; not common. INDIA: Dry deciduous forests of central and eastern India and hill forests of peninsular India, to 1500 m. Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Bangladesh and Myanmar.

*Specimen examined*: Koderma NRF, near the Phulwarwaria jungle, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49547.

## 2. **CYPHOSTEMMA** (Planch.) Alston

Subtropical regions, *c.* 150 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Cyphostemma auriculatum** (Roxb.) P. Singh & B.V. Shetty, *Taxon* 35(3): 596. 1986; B.V. Shetty & P. Singh in N.P. Singh & al., *Fl. India* 5: 298, f. 65. 2000. *Cissus auriculata* Roxb., *Fl. Ind.* 1: 430. 1820. *Vitis auriculata* Wight & Arn., *Prodr. Fl. Ind. Orient.*: 129. 1834, p.p.; M.A. Lawson in Hook.f., *Fl. Brit. India* 1: 658. 1875; Haines, *Forest Fl. Chota Nagpur*: 277. 1910 & *Bot. Bihar Orissa*: 206. 1921. *Cayratia auriculata* (Roxb.) Gamble, *Fl. Madras*: 237. 1918; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 496. 2000; N.P. Singh & al., *Fl. Bihar*: 110. 2001.

### Plate 16H

Vern. Name: *Lauwat*.

Climber. Stems and branches terete, subsucculent, pubescent when young; tendrils leaf-opposed, 2 or 3-fid. Leaves compound, alternate, palmately 5-foliolate; petioles 3.5–15.5 cm long; stipules falcate, *c.* 1 × 0.5 cm; leaflets obovate to rhomboidal or elliptic, 3.5–10.5 × 1.8–7.5 cm, cuneate at base, serrate at margins, acute or shortly acuminate at apex; petiolules 0.3–1 cm long. Inflorescence divaricate cyme, axillary or pseudo-terminal, 11–26 cm long, much-branched; peduncles 8–20 cm long, pubescent. Flowers 4-merous, *c.* 3 mm long, contracted in middle; pedicels 2–3 mm long, pubescent. Calyx cupular, truncate, pubescent. Petals oblong, *c.* 2.5 × 1.5 mm, hooded. Stamens *c.* 2 mm long; anthers globose. Disk of 4 glands, almost covering ovary. Ovary pyramidal, *c.* 1.5 mm across, hairy; style *c.* 1 mm long. Berries subglobose, 1.5–2 × 1–1.5 cm, glabrous, glossy, green turning reddish when ripe, 1-seeded. Seeds oblong-obovoid to subglobose, *c.* 8 × 6 mm, with a crest on dorsal side.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Near the base of the Rishi Dhurwasa Pahar; occasional. INDIA: Andhra Pradesh, Bihar, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and West Bengal. WORLD: Bangladesh and Myanmar.

*Specimen examined*: Near the base of the Rishi Dhurwasa Pahar, 212 m, 24°35'23.8" N, 85°34'55.8" E, 11th September 2010, *Shyam Biswa* 49607.

*Note*: The ripened fruits are used for preparing chutneys. The unripe green fruits when eaten congest the throat and give uneasiness.

## 28. **ZYGOPHYLLACEAE** R. Br., nom. cons.

Tropical and subtropical regions, 26 genera and *c.* 280 species; 8 genera and *c.* 18 species in India.



**BALANITES** Delile, nom. cons.

Tropical Africa, India and Burma, 9 species, 1 in India.

**Balanites roxburghii** Planch., Ann. Sci. Nat., Bot. Ser. 4, 2: 258, t. 2. 1854; A.W. Benn. in Hook.f., Fl. Brit. India 1: 522. 1875; Haines, Forest Fl. Chota Nagpur: 239. 1910 & Bot. Bihar Orissa: 154. 1921. *Balanites aegyptiaca* auct. non (L.) Delile 1813: Basak in Fasc. Fl. India 4: 20. 1980.

Vern. Name: *Hegni or Ingun* (Birhore).

Shrub or tree, to 4 m high, deciduous, armed; thorns to 5 cm long. Leaves compound; leaflets 2, elliptic-oblong or oblanceolate, 1.5–4.5 × 0.5–2.5 cm, acute or cuneate at base, entire at margins, obtuse or acute at apex; petioles 1–5 mm long; petiolules 3–5 mm long. Flowers 4–12 in axillary fascicled cymes, fragrant; pedicels 5–8 mm long. Sepals 5, oblong or elliptic-ovate, c. 3 × 1.5 mm, pubescent outside, woolly inside. Petals 5, elliptic-oblong, c. 4 × 1.5 mm, glabrous outside, hairy inside. Stamens 10, c. 3 mm long. Ovary globose, c. 2 mm; styles c. 1 mm long. Drupes ovoid or oblongoid, 4.5–5 × 3.5–4 cm, puberulous, green, yellow when ripe. Seed solitary, stony.

*Fl. & Fr.*: March – November.

*Habitat*: Dry deciduous forest.

*Distribution*: KWLS: Dhodhakola, near Birhore Tola, Safi nalwa; not common. INDIA: Andhra Pradesh, Bihar, Delhi, Gujarat, Jammu and Kashmir, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Myanmar and Pakistan.

*Specimen examined*: Dhodhakola, near Birhore Tola, Safi nalwa, 380 m, 24°33'15.1" N, 85°39'37.9" E, 27th February 2012, *Shyam Biswa* 53928.

**29. LEGUMINOSAE** Juss., nom. cons. (= **FABACEAE** Lindl. nom. cons.)

Leguminosae: Papilionoideae, Caesalpinoideae and Mimosoideae

Cosmopolitan, c. 720 genera and c. 19500 species; 133 genera and 973 species in India.

**Key to subfamily**

1a. Flowers mostly papilionate and bilaterally symmetrical, less commonly radially symmetrical; median (standard) petal outermost, enclosing the wing and keel petals (especially in bud) or the wing and keel petals lacking; sepals united, at least at the base, into a calyx tube or completely enclosing the floral bud; seeds with a complex hilar valve, pleurogram absent; embryo radicle usually curved

**I. Papilionoideae**

1b. Flowers not papilionate (if rarely appearing papilionate then the median petal innermost), either bilaterally or radially symmetrical, median (standard) petal innermost, or petals valvate (in the mimosoid clade of the Caesalpinoideae); sepals free or fused; seeds lacking complex hilar valve, with or without a pleurogram; embryo radicle usually straight 2

2a. Leaves bipinnate; seeds commonly with an open or closed pleurogram on each side

**IV. Caesalpinoideae**

2b. Leaves never bipinnate; seeds without an open or closed pleurogram on either side 4

3a. Leaves unifoliolate, bilobed or entire, or compound and bifoliolate; seed hilum circular or crescent-shaped

**II. Cercidoideae**

3b. Leaves various; if simple or bifoliolate, then the seed hilum not crescent-shaped, and rarely circular

**III. Detarioideae**

**I. LEGUMINOSAE: PAPILIONOIDEAE (503 genera, c. 14,000 species)**

**Key to genera**

|                                                      |                                          |
|------------------------------------------------------|------------------------------------------|
| 1a. Trees                                            | 2                                        |
| 1b. Herbs or shrubs or climbers                      | 7                                        |
| 2a. Resin red; pods orbicular, winged                | <b>20. Pterocapus</b>                    |
| 2b. Resin not red; pods neither orbicular nor winged | 3                                        |
| 3a. Leaflets 3                                       | 4                                        |
| 3b. Leaflets 5 or more                               | 5                                        |
| 4a. Flowers reddish; pods 1-seeded                   | <b>4. Butea</b> ( <i>B. monosperma</i> ) |
| 4b. Flowers white or pinkish; pods 2–5-seeded        | <b>12. Ougeinia</b>                      |
| 5a. Leaflets opposite; pods woody                    | <b>19. Pongamia</b>                      |
| 5b. Leaflets alternate; pods coriaceous              | 6                                        |
| 6a. Leaflets 5, alternate                            | <b>8. Dalbergia</b> ( <i>D. sissoo</i> ) |
| 6b. Leaflets 5–7, opposite                           | <b>10. Gliricidia</b>                    |
| 7a. Leaflets even-pinnate                            | 8                                        |
| 7b. Leaflets simple or odd-pinnate                   | 9                                        |
| 8a. Plants herb, erect or prostrate                  | <b>26. Zornia</b>                        |
| 8b. Plants twining shrub                             | <b>1. Abrus</b>                          |
| 9a. Leaves simple                                    | 10                                       |
| 9b. Leaves odd-pinnate                               | 12                                       |
| 10a. Stamens monadelphous                            | <b>7. Crotalaria</b>                     |
| 10b. Stamens diadelphous                             | 11                                       |
| 11a. Corolla exceeding calyx                         | <b>18. Polhillides</b>                   |
| 11b. Corolla not exceeding calyx                     | <b>3. Alysicarpus</b>                    |
| 12a. Leaflets always 3                               | 13                                       |
| 12b. Leaflets 5 or more                              | 22                                       |
| 13a. Herbs or undershrubs or shrubs                  | 14                                       |
| 13b. Climbers or twiners                             | 15                                       |
| 14a. Umbels not enclosed in 2 opposite leafy bracts  | <b>11. Grona</b>                         |
| 14b. Umbels enclosed in 2 opposite leafy bracts      | <b>17. Phyllodium</b>                    |
| 15a. Pods with bristly stinging hairs                | 16                                       |
| 15b. Plants without bristly stinging hairs           | 17                                       |
| 16a. Lianas; roots tuberous; seeds <5 mm long        | <b>21. Pureria</b>                       |
| 16b. Twining shrubs; roots not tuberous; seeds >8 mm | <b>16. Mucuna</b>                        |
| 17a. Leaves gland-dotted beneath                     | 21                                       |
| 17b. Leaves not gland-dotted beneath                 | 18                                       |
| 18a. Woody climbers                                  | 19                                       |
| 18b. Herbs or climbers, but not woody                | 20                                       |
| 19a. Flowers 1.5–8 cm long, yellow to scarlet        | <b>4. Butea</b> ( <i>B. suberba</i> )    |
| 19b. Flowers 0.5–1 cm long, purple or white          | <b>23. Spatholobus</b>                   |

- |                                                                                                                                           |                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| 20a. Stipules lanceolate, glabrous; leaflets toothed; pods glabrous                                                                       | <b>14. Melilotus</b>                      |
| 20b. Stipules foliaceous obovate or obovate-oblong cillitate; pods with bristles                                                          | <b>25. Vigna</b>                          |
| 21a. Flowers solitary or in pairs; pods compressed                                                                                        | <b>5. Cajanus</b>                         |
| 21b. Flowers in simple or branched racemes panicles; pods turgid                                                                          | <b>9. Flemingia</b>                       |
| 22a. Stamens monadelphous                                                                                                                 | 23                                        |
| 22b. Stamens diadelphous                                                                                                                  | 24                                        |
| 23a. Trees; petals yellowish white                                                                                                        | <b>8. Dalbergia (<i>D. sissoo</i>)</b>    |
| 23b. Herbs; petals purple                                                                                                                 | <b>24. Tephrosia</b>                      |
| 24a. Climbers                                                                                                                             | 25                                        |
| 24b. Herbs                                                                                                                                | 27                                        |
| 25a. Inflorescence a dense panicle; stamens in 5 + 5 condition                                                                            | <b>8. Dalbergia (<i>D. volubilis</i>)</b> |
| 25b. Inflorescence a raceme or flower solitary; stamens in 9 + 1 condition                                                                | 26                                        |
| 26a. Herbaceous climber; petals white; pods 10-seeded                                                                                     | <b>6. Clitoria</b>                        |
| 26b. Woody climber; petals purplish; pods 4-seeded                                                                                        | <b>15. Millettia</b>                      |
| 27a. Petals yellow; stamens in 5 + 5 condition                                                                                            | 28                                        |
| 27b. Petals pinkish purple or red; stamens in 9 + 1 condition                                                                             | <b>13. Indigofera</b>                     |
| 28a. Stipules spurred below point of insertion, appendaged or auricled at base; leaves even-pinnate; pods twisted, concealed in the calyx | <b>22. Smithia</b>                        |
| 28b. Stipules not as above; leaves odd-pinnate; pods not as above                                                                         | <b>2. Aeschynomene</b>                    |

#### 1. **ABRUS** Adans.

Pantropical, 17 species, 3 in India, 1 in Jharkhand.

**Abrus precatorius** L., Syst. Nat. ed. 12, 2: 472. 1767; Baker in Hook.f., Fl. Brit. India 2: 175. 1876; Haines, Forest Fl. Chota Nagpur: 333. 1910 & Bot. Bihar Orissa: 247. 1922; Sanjappa, Leg. India: 74. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 320. 2000; N.P. Singh & al., Fl. Bihar: 119. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 175. 2002.

#### **Plate 17A & B**

Vern. Names: *Karjan*; *Rakit*, *Rati* (Hindi).

Climbing or twining slender shrub; root woody. Stems terete, much-branched, branches slender, glabrous or appressed-hairy. Leaves compound, 3–7 cm long, leaf-rachis hairy, pari-pinnate; petioles 6–12 mm long, thickened and hairy at base; stipules linear-subulate, 2.5–3.5 mm long, pubescent, deciduous; leaflets 10–16 pairs, oblong, linear-oblong or obovate (terminal leaflets), 3–11 × 2–5 mm, rounded at base, entire at margins, truncate or rounded-truncate and mucronate at apex, puberulous at both surfaces; petiolules *c.* 0.5 mm long. Racemes axillary or terminal, 2.5–15 cm long; peduncles 5–15 cm long; pedicels 1–2 mm long. Bracteoles *c.* 0.5 mm long, hairy. Calyx cup-shaped, 2–3 mm long, obscurely toothed, appressed-hairy outside. Corolla exserted; standard broadly obovate, *c.* 1 × 0.4–0.5 cm; clawed, pale purplish-white; wings narrowly oblong-falcate, *c.* 8 × 3 mm, clawed, purplish-white; keels curved, *c.* 8 × 2 mm, clawed, whitish. Stamens 9; staminal sheaths *c.* 8 mm long. Ovary subsessile, pubescent; ovules numerous; style short, incurved; stigma capitate. Pods oblong, truncate at base, with a sharp deflexed beak, 2–4 × 1–1.4 cm, silky pubescent. Seeds 3–5, ovoid, 5–6.5 × 4–5 mm, bicoloured, scarlet with a black, lateral blotch around the hilum.

*Fl. & Fr.*: September – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: Throughout, to 1200 m. WORLD: Pantropical.

*Specimen examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49529.

*Note*: Haines had observed leaflets glabrous or silky beneath, but the collection from KWLS the leaflets are puberulous on both surfaces.

## 2. AESCHYNOMENE L.

Tropical and subtropical regions, *c.* 175 species, 3 in India, 2 in Jharkhand and 1 in KWLS.

**Aeschynomene indica** L., Sp. Pl. 2: 713. 1753; Baker in Hook.f., Fl. Brit. India 2: 151. 1876; Haines, Forest Fl. Chota Nagpur: 343. 1910 & Bot. Bihar Orissa: 254. 1922; Mooney, Suppl. Bot. Bihar Orissa: 50. 1950; Sanjappa, Leg. India: 75. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 322. 2000; N.P. Singh & al., Fl. Bihar: 120. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 176. 2002.

Vern. Name: *Laugauni* (Hindi).

Herb, 20–40 cm high, slender. Stems terete, green, hairy on younger parts. Leaves, compound, alternate, 2–9 cm long; stipules lanceolate, *c.* 5mm long, acuminate at apex, prolonged beneath their insertion into acute auricles, deciduous; leaflets 20–60, alternate, subsessile, lanceolate-oblong to elliptic, 3–3.5 × 1–1.5 mm, obliquely rounded-subcordate at base, entire at margins, obtuse and apiculate at apex, somewhat glaucous beneath. Racemes 1–4-flowered, 2–3 cm long; bracts foliaceous, 1–2 mm long, stipule-like; bracteoles linear-oblong, acute at apex, 3–4 mm long. Flowers 5–6 × 8–10 mm. Peduncles 0.5–1.5 cm long, glabrous; pedicels 0.5–1.2 cm long, *c.* 1.5 cm long (in fruit), pubescent. Calyx 4–6 mm long, light pinkish, glabrous; upper lip retuse or bifid; lower lip deeply 3-lobed. Standard broadly ovate 5.5– 6 × 7 mm, bright yellow; wings elliptic 5–6 × 4–4.5 mm, yellow; keels upcurved *c.* 5 × 4–5 mm bright yellow; staminal sheaths 3.5–4 mm long. Stamens 10 in 2 bundles of 5 each, alternately long and short. Ovary stipitate, 2 or more-ovuled; style incurved, not bearded; stigma terminal. Pods linear, not twisted, 13–14 × 3–5 cm, margins thick, muricated, pinkish-green, pubescent; transversely divided into 1-seeded segments, 7–15 seeded. Seeds 1.5–2 × 1.5–1.8 mm.

*Fl. & Fr.*: September – November.

*Habitat*: On the hills slopes.

*Distribution*: KWLS: Dhawjadhari Pahar; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49594.

## 3. ALYSICARPUS Necker ex Desv. nom. cons.

Old World tropical regions, *c.* 25–30 species, 15 in India, 9 in Jharkhand and 2 in KWLS.

### Key to species

1a. Stems densely hairy, deep pinkish; pods moniliform

1. **A. monilifer**

1b. Stems sparsely hairy, whitish-orange; pods terete

2. **A. vaginalis**



**1. *Alysicarpus monilifer* (L.) DC.**, Prodr. 2: 353. 1825; Baker in Hook.f., Fl. Brit. India 2: 157. 1876; Haines, Bot. Bihar Orissa 259.1922; Sanjappa, Leg. India: 79. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 324. 2000; N.P. Singh & al., Fl. Bihar: 122. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 177. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 69. 2014. *Hedysarum moniliferum* L., Mant. Pl.: 102. 1767. **Plate 17C**

Herb, runner. Stems angular, ribbed, pinkish, hairy; hair 1–1.5 mm long. Leaves simple alternate, orbicular or ovate, 0.5–2 × 0.5–1.5 cm, cordate at base, entire at margins, emarginate or rounded at apex, glabrous above, pubescent beneath, long hairy on veins, light green in the middle of lamina; petioles 3–10 mm long with long hair. Racemes lax, slender. Flowers c. 1.5 cm long; pedicels 2–3 mm long. Calyx 3–4 mm long. Standard obovate, 3.5–4 mm long, emarginate at apex, pinkish; wings oblong, 3.5–4 mm long, dark pinkish; keels curved, 2.5–3 mm long, light pinkish. Pods distinctly moniliform, 1–2.5 × 0.2–0.3 cm, beaked, turgid, pubescent, dehiscent, 3–8-seeded. Seeds roundish, 2–2.5 mm, smooth, maroon.

*Fl. & Fr.*: August – December.

*Habitat*: On the rocky hills.

*Distribution*: KWLS: Near Rishi Dhurwasha Pahar, Meghatari; occasional. INDIA: Throughout plains. WORLD: Pakistan, Burma, Ethiopia.

*Specimens examined*: Near Rishi Dhurwasha Pahar, Meghatari, 226 m, 24°35'24.54" N, 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 49817.

**2. *Alysicarpus vaginalis* (L.) DC.**, Prodr. 2: 353. 1825; Baker in Hook.f., Fl. Brit. India 2: 158. 1876; Haines, Bot. Bihar Orissa 259. 1922; Sanjappa, Leg. India: 81. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 326. 2000; N.P. Singh & al., Fl. Bihar: 123. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 179. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 70. 2014. *Hedysarum vaginale* L., Sp. Pl. 2: 746. 1753. **Plate 17D**

Herb prostrate. Stems terete, sparsely hairy as compared to *A. monilifer*. Stipules c. 5 mm long. Leaves simple, alternate, lower leaves orbicular or oval 0.6–3.2 × 0.6–2.2 cm, cordate at base entire at margins emarginate or rounded and mucronate at apex, white in the middle of lamina and margins; upper leaves linear-lanceolate or ovate-lanceolate, 3–6 × 0.6–1.6 cm cordate at base entire and hairy at margins, acute to acuminate at apex, white in the middle of lamina and margins; sparsely hairy; petioles 3–6 mm. Racemes lax, slender. Flowers c. 6 mm long. Calyx 5–6 mm long. Standard obovate, 4–5 mm long, emarginate at apex, orange; wings oblong 3.5–4.5 mm long, purplish-orange; keels curved 3–3.5 mm, light orange. Pods terete, 1–2.5 × 0.3 cm, faintly reticulate, rugose, distinctly jointed, dehiscent, 3–7-seeded.

*Fl. & Fr.*: September – October.

*Habitat*: On the shades of Dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure forest Koderma NRF; occasional. INDIA: Throughout. WORLD: Tropical regions of the Old world, introduced in America.

*Specimen examined*: Inside the enclosure forest, Koderma NRF, 388 m, 24°29'18.7" N, 85°35'50.1" E, 8th September 2010, *Shyam Biswa* 49602.



**Fig. 17. *Butea monosperma* (Lam.) Taub.:** a. flowering twig; b. flower front view; c. flower back view; d. calyx and pedicel; e. standard petal; f.,g. wing petals; h. keel petal; i. staminal column; j. carpel; k. fruit.

4. **BUTEA** König ex Willd., nom. cons.

Indomalesia, 2 species, 2 in India, Jharkhand and KWLS.

**Key to species**

- 1a. Tree; pedicels 2 cm long (in flowers); flowers smaller as compared to latter;  
carpel 5.5–6 cm long, curved **1. B. monosperma**
- 1b. Scandent shrub; pedicel more than 2 cm long (in flowers); flower larger than  
the former; carpel c. 8 cm long, slightly curved **2. B. superba**

**1. Butea monosperma** Kuntze, Revis. Gen. Pl. 1: 202 1891; Sanjappa, Leg. India: 99. 1992; Paria & Chattopodhyaya, Fl. Hazaribagh 1: 329. 2000; N.P. Singh & al., Fl. Bihar: 124. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 180. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 70. 2014. *Erythrina monosperma* Lam., Encycl. 2: 391. 1786. *Butea frondosa* Roxb. ex Willd., Sp. Pl. 3(2): 917. 1802, nom. superfl.; Baker in Hook.f., Fl. Brit. India 2: 194. 1876; Haines, Forest Fl. Chota Nagpur: 330. 1910 & Bot. Bihar Orissa: 279. 1922; Mooney, Suppl. Bot. Bihar Orissa: 54. 1950. **Fig. 17**

Vern. Name: *Palash*.

Tree, to 15 m high, deciduous. Branchlets densely tomentose. Leaves compound, pinnately 3-foliolate; petioles 10–15 cm long; stipules linear-lanceolate; leaflets: terminal leaflet rhomboid or broadly obovate, 10–20 × 8–18 cm, cuneate at base, entire at margins, rounded and retuse at apex, coriaceous, glabrous above, finely silky pubescent beneath; lateral leaflets obliquely ovate, 7–16 × 6–15 cm, rounded at base, entire at margins, obtuse or emarginated at apex; petiolules stout, 4–5 mm long; stipels subulate. Racemes 8–15 cm long. Flowers together on nodes of olive-green rachis 5–6 cm long; pedicels 1–2 cm long, densely pubescent. Bracts and bracteoles small, velvety. Calyx 1.5–1.8 cm long, densely velvety outside, silky hairy inside, dark olive-green. Standard ovate to lanceolate, 4–4.5 × 2.5–3 cm, bright reddish, silky-pubescent; wing lanceolate, 4–4.5 × 1.3–1.7 cm orange-reddish, silky-pubescent; keel oblanceolate 4.5–5 × 1.5–2 cm, orange-reddish, silky pubescent. Staminal sheath curved, 5–5.8 cm long. Stamens diadelphous, anther acropetally arranged. Carpel 5.5–6 cm long, curved, ovary sessile or shortly stalked; ovules 2; style elongated, silky pubescent; stigma terminal, very small. Pods 8.5–16 × 2–4.5 cm, rounded at base, thickened at sutures, narrowed suddenly into a stalk 2–2.5 cm, velvety-brownish pubescent; seeds ovoid, 2–3.5 cm long, compressed, brown.

*Fl. & Fr.*: March – May.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Lokai forest; very common. INDIA: Throughout except Jammu and Kashmir and Arunachal Pradesh. WORLD: Indonesia, Myanmar, Nepal, New Guinea (introduced) Pakistan, Sri Lanka and Thailand.

*Specimen examined*: Lokai forest, 397 m, 24°29'02.9" N, 85°37'04.4" E, 29th March 2013, *Shyam Biswa* 54120.

**2. Butea superba** Roxb. ex Willd., Sp. Pl. 3(2): 917. 1802; Baker in Hook.f., Fl. Brit. India 2: 195. 1876; Haines, Forest Fl. Chota Nagpur: 330. 1910 & Bot. Bihar Orissa 280. 1922. Sanjappa, Leg. India: 99. 1992; Paria & Chattopodhyaya, Fl. Hazaribagh 1: 330. 2000; N.P. Singh & al., Fl. Bihar: 124. 2001. **Plate 17E**

Vern. Names: *Dorang* (Kharwari); *Lat Palash*.

Scandent, deciduous. Branchlets brownish tomentose. Leaves compound, pinnately 3-foliolate; petioles 8–14 cm long; stipules linear-lanceolate; leaflets: terminal leaflet rhomboid or broadly obovate, 12–25 × 11–20 cm, cuneate at base, entire at margins, rounded and retuse at apex, coriaceous, glabrous above, finely silky pubescent beneath; lateral leaflets obliquely ovate, 7–15 × 6–16 cm, rounded at base, entire at margins, obtuse or emarginated or acute at apex; petiolules stout, 3–5 mm long; stipels subulate. Racemes 8–15 cm long. Flowers together on nodes of olive-green rachis, 6–8 cm long; pedicels 2–3.5 cm long densely pubescent; bracts and bracteoles small, velvety. Calyx 1.5–2 cm long, densely velvety outside, silky hairy inside, dark olive-green. Standard ovate, 4.6–5 × 3.6–3.7 cm, bright reddish, silky-pubescent, more dense outside; wing lanceolate, 6–6.2 × 2.5–2.7 cm orange-reddish, silky-pubescent more dense outside; keel oblanceolate 5.5–5.7 × 1.8–2 cm, orange-reddish, silky pubescent, more dense outside. Staminal sheath curved, c. 6.5 cm long, pubescent more on basal portion; stamens diadelphous, anther acropetally arranged, 5–7 mm long. Carpel c. 8 cm long, slightly curved, basal portion silky pubescent; ovary 2–3 mm in diameter; ovules 2; style elongated, silky pubescent; stigma terminal, very small. Pods 10–15 × 2.5–5 cm, rounded at base, thickened at sutures, narrowed suddenly into a stalk 8–20 mm, apex rounded, velvety-brownish pubescent; seeds ovoid, 2–3.5 cm long, compressed, brown.

*Fl. & Fr.*: March – May.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Bholaghat jungle; not common. INDIA: Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh, W Bengal. WORLD: Burma, Thailand, Indo-China.

*Specimen examined*: Bholaghat jungle, 412 m, 24°30'14.1" N, 85°37'19.8" E, 30th March 2013, *Shyam Biswa* 54125.

#### 5. **CAJANUS** Adans., nom. & orth. cons.

Old World tropical regions, 34 species, 16 in India, 4 in Jharkhand (1 cultivated) and 1 in KWLS.

**Cajanus scarabaeoides** (L.) Thouars, Dict. Sci. Nat. 6: 167. 1817; Sanjappa, Leg. India: 103. 1992; N.P. Singh & al., Fl. Bihar: 125. 2001. *Dolichos scarabaeoides* L., Sp. Pl. 2: 726. 1753; Ranjan, Fl. Parasnath Wildlife Sanct.: 71. 2014. *Atylosia scarabaeoides* (L.) Benth. in Miq., Pl. Jungh. 2: 242. 1852; Baker in Hook.f., Fl. Brit. India 2: 215. 1876; Haines, Forest Fl. Chota Nagpur: 320. 1910 & Bot. Bihar Orissa: 274. 1922. *Cantharospermum scarabaeoides* (L.) Baill., Bull. So Linn. Paris 1: 384. 1883; Mooney, Suppl. Bot. Bihar Orissa: 52. 1950. **Plate 17F & G**

Vern. Name: *Ban Kurthi*.

Climber, twining; roots woody. Stem and branchlets densely pubescent. Leaves compound, pinnately 3-foliolate, c. 2.5 cm long, gland-dotted beneath; leaflets ovate-elliptic or oblong-obovate, 1.5–3.6 × 0.5–1.6 cm, cuneate at base, entire at margins, acute to obtuse at apex, velvety-pubescent; petioles 0.7–2.4 cm long; petiolules of central leaflet 3–6 mm long, lateral leaflet sessile; stipules c. 1 mm long. Raceme axillary, usually less than 2 cm long, 2–6-flowered; Flowers c. 1 cm long; peduncles c. 5 mm densely brown-villous; pedicels to 4 mm long. Calyx-tube to 4 mm long, pubescent; lobes lanceolate; upper ones c. 2.5 mm long; lower ones c. 3.5 mm long. Standard obovate c. 8 × 6 mm; wings oblong c. 7 × 2 mm; keels lunate c. 7 × 2 mm. Staminal sheath c. 7 mm long; filaments c. 1.5 mm long. Ovary sessile c. 5 mm long, densely



woolly; ovules 3; style filiform, incurved, *c.* 6 mm long glabrous; stigma capitate. Pods *c.* 2 × 0.7 cm, densely pubescent with transverse depression; seeds 3–5, oblong, *c.* 3.5 × 2.5 mm, brownish.

*Fl. & Fr.*: September – March.

*Habitat*: Scrub and dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; Near base of Dhawjadhari Pahar Koderma NRF; On the dried river bed Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: South and Southeast Asia, Australia, Pacific Islands, Mauritius, Madagascar, Zanzibar, Coastal W. Africa, Jamaica.

*Specimens examined*: Chattarbar forest 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49525; Near base of Dhawjadhari Pahar Koderma NRF, 435 m, 24°28'58.3" N, 85°35'48.5" E, 5th September 2010, *Shyam Biswa* 49572; 54135, 31st March 2012; On the dried river bed Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E.

## 6. CLITORIA L.

Tropical regions, especially America, 62 species, 3 species in India, 1 species in Jharkhand and KWLS.

**Clitoria ternatea** L., Sp. Pl. 2: 753. 1753; Baker in Hook.f, Fl. Brit. India 2: 208. 1876; Haines, Forest Fl. Chota Nagpur: 332. 1910 & Bot. Bihar Orissa 293. 1922. Sanjappa, Leg. India: 114. 1992; Paria & Chattopodhyaya, Fl. Hazaribagh 1: 333. 2000; N.P. Singh & al., Fl. Bihar: 127. 2001.

### Plate 17H

Climber. Stems terete, twining. Leaves compound, alternate, impari-pinnate, rachis 6.5–12.5 cm long; leaflets 5–7, ovate 1.5–5.5 × 1.2–3.5 cm, rounded at base, entire at margins, obtuse or emarginated at apex, minutely pubescent; stipels subulate *c.* 2 mm; stipules narrowly lanceolate *c.* 4 mm. Flowers solitary, axillary; bracts linear or linear-lanceolate 1–2 mm long; bracteoles ovate or orbicular *c.* 6 × 4 mm in flower, *c.* 10 × 9 mm in fruit. Calyx tube 5–8 mm, teeth ovate 7–8 mm. Standard broadly ovate, *c.* 3 × 2 cm, veins prominent white fading to yellow at mid-base, wing *c.* 10 × 6 mm, white; keel *c.* 8 × 4 mm, white. Pods coriaceous, 5–10 × 0.8–1 cm, acute at both ends beak at apex, hairy. Seeds upto 10, black.

*Fl. & Fr.*: August – November.

*Habitat*: Near the villages or near the roadside.

*Distribution*: KWLS: Chattarbar forest; Near RFO office, Koderma NRF; common. INDIA: Throughout - also cultivated. WORLD: Tropical America, Australia, Bhutan, British Honduras, Burma, China, Indonesia, Mexico, South-East USA, Thailand, West Africa, West Indies and Zambia.

*Specimens examined*: Chattarbar forest, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49839, Near RFO office, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 29th November 2012, *Shyam Biswa* 54103.

## 7. CROTALARIA L., nom. cons.

Tropical and subtropical *c.* 700 species, 86 in India, *c.* 20 in Jharkhand and 3 species and 1 variety in KWLS.

### Key to species

1a. Herb or undershrub, upto 2.5 m high, flowers 2–2.5 cm long

**3. *C. spectabilis***

- 1b. Herbs less than 50 cm high, flowers less than 1 cm long 2  
 2a. Racemes 5–20-flowered, pods oblong-cylindric,  $8-10 \times c. 5$  mm,  
 prominently veined **1. C. albida**  
 2b. Racemes 2–4 flowered, pods obovate-oblong  $10-18 \times 5-6$  mm,  
 vein not prominent **2. C. prostrata**

**1. Crotalaria albida** B. Heyne ex Roth, Nov. Pl. Sp.: 333. 1821; Baker in Hook.f., Fl. Brit. India 2: 71. 1876; Haines, Forest Fl. Chota Nagpur: 313. 1910 & Bot. Bihar Orissa: 231. 1922; Sanjappa, Leg. India: 116. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 334. 2000; N.P. Singh & al., Fl. Bihar: 127. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 183. 2002; A.A. Ansari, Crotalaria India: 154. f. 32. 2008; Ranjan, Fl. Parasnath Wildlife Sanct.: 71. 2014.

**Plate 18A**

Vern. Name: *Ban-methi* (Hindi).

Herb or undershrub, 20–50 cm high; rootstocks woody. Stems terete, branched at base silky whitish-pubescent; branches slender, terete. Leaves simple, alternate oblong or oblanceolate or oblong-elliptic,  $1.5-3.8 \times 0.5-1$  cm, cuneate or attenuate at base, entire at margins, obtuse or rounded and mucronate at apex, chartaceous, pubescent above, appressed glaucous and silky beneath; petioles 2–3 mm long; stipule 0 or minute subulate. Racemes 5–12.5 cm long, 5–20-flowered. Flowers 8–10 mm long; pedicels 3–5 mm long, pinkish; bracts linear,  $c. 1-1.5$  mm long; bracteoles linear, 2–2.5 mm long, appressed to calyx. Calyx 7–8 mm long; 3 lower teeth linear, acuminate; 2 upper teeth oblong, obuse, very silky. Corolla shortly exserted. Standard ovate-oblong or suborbicular,  $8-15 \times 6-7$  mm, shortly clawed, sparsely pubescent beneath; wings oblong,  $c. 15 \times 4$  mm obtuse; keels ovate or oblong, with twisted beak,  $c. 8 \times 4.5$  mm. Staminal sheath  $c. 5$  mm long. Carpel 5–6 mm, ovary oblong,  $c. 4$  mm long, glabrous; style geniculate, 6–6.5 mm long, pubescent, stigma minute oblique. Pods oblong-cylindric,  $8-10 \times c. 5$  mm apiculate at apex, glabrous, prominently veined, 6–8-seeded; seeds  $c. 1$  mm, brown.

*Fl. & Fr.*: November–March

*Habitat*: On the shades of Dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure forest, Koderma NRF; Phoolwarya forest road; common. INDIA: Almost throughout. WORLD: Bhutan, China, Malesia, Myanmar, Pakistan and Taiwan.

*Specimens examined*: Inside the enclosure forest, Koderma NRF, 16th September 2010, 390 m,  $24^{\circ}29'18.7''$  N,  $85^{\circ}35'50.1''$  E, *Shyam Biswa* 49628; Phoolwarya forest road, 403 m,  $24^{\circ}29'12.2''$  N,  $85^{\circ}35'48.5''$  E, 20th November 2012, *Shyam Biswa* 53906.

**2. Crotalaria prostrata** Rottler ex. Willd., Enum. Pl. 2. 747. 1809; Baker in Hook.f. Fl. Brit. India 2: 67. 1876; Haines, Forest Fl. Chota Nagpur: 314. 1910 & Bot. Bihar Orissa: 229. 1922; Mooney, Suppl. Bot. Bihar Orissa: 45. 1950; Sanjappa, Leg. India: 127. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 339. 2000; N.P. Singh & al., Fl. Bihar: 130. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 186. 2002; A.A. Ansari, Crotalaria India: 195. f. 46. 2008; Ranjan, Fl. Parasnath Wildlife Sanct.: 72. 2014.

Herb, 15–40 cm high. Stems terete, pubescent; branches slender, pubescent, silky. Leaves simple, alternate, oblong or oblong-obovate,  $1.5-3.5 \times 1-1.5$  cm, oblique or subcordate or obtuse at base, entire at margins, obtuse or rounded at apex, pubescent on both surfaces; petioles  $c. 2$  mm long.

Racemes 2–4 flowered; pedicels short. Calyx (3+2), 3–4 mm long, teeth linear, densely pubescent. Corolla yellow; standard suborbicular to elliptic, 4–5 mm, obtuse to retuse at apex; wings oblong, as long as standard; keel narrowed apically from middle and extended into a long beak included in calyx. Staminal sheath 4–5 mm long. Ovary subsessile; style *c.* 3 mm long, pubescent, stigma capitate. Pods inflated, 1–1.6 cm long, glabrous.

#### Key to variety

- 1a. Plant *c.* 40 cm high, leaves oblong-obovate pubescent; calyx pubescent;  
pod glabrous **2.1. *C. prostrata* var. *prostrata***
- 1b. Plant *c.* 15 cm high; leaves oblong or oblong-elliptic, strigose hairy white;  
calyx strigose hairy; pod strigose **2.2. *C. prostrata* var. *levis***

#### **2.1. *Crotalaria prostrata* Rottler ex. Willd. var. *prostrata***

*Fl. & Fr.*: February–March

*Habitat*: On open grassland

*Distribution*: KWLS: Muglamaram forest road; common. INDIA: Throughout ascending upto 2000 m in Himalayas. WORLD: Myanmar, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Muglamaram forest road, 321m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49857.

**2.2. *Crotalaria prostrata* var. *levis* Haines, Haines, Bot. Bihar Orissa 2: 230. 1922; Mooney, Suppl. Bot. Bih. Or. 45. 1950; Sanjappa, Leg. India: 127. 1992; N.P. Singh & al., Fl. Bihar: 131. 2001; A.A. Ansari, *Crotalaria* India: 202. 2008.**

**Fig. 18; Plate 18B**

Herb, 5–15 cm high. Stems terete, branched at base; branches slender, terete, silky whitish-pubescent. Leaves simple, alternate, oblong or oblong-elliptic, 2–1.8 × 1–1.2 cm, rounded at base, entire at margins, obtuse or rounded at apex, strigose hairy white on both surfaces; petioles 1–2 mm long. Racemes solitary and axillary. Flowers 6–7 mm long; pedicels 2–3 mm long. Calyx (3+2), lower 3-lobed 4–5 mm long, acute at apex, greenish, upper 2-lobed *c.* 4 mm long, pinkish, strigose hairy. Standard suborbicular, 5–5.2 × 3.5–4 mm, bright yellow with pink veins; wings oblong, 4–4.5 × 1.5–2 mm, yellow curved clawed; keels ovate, 3–4 × *c.* 1.5 mm, white. Staminal sheath 4–5 mm long. Ovary semi-circular, 2.5–3 mm long, glabrous; style *c.* 3 mm long, persistent, pubescent, stigma capitate. Pods obovate-oblong 10–18 × 5–6 mm, strigose.

*Fl. & Fr.*: February–March

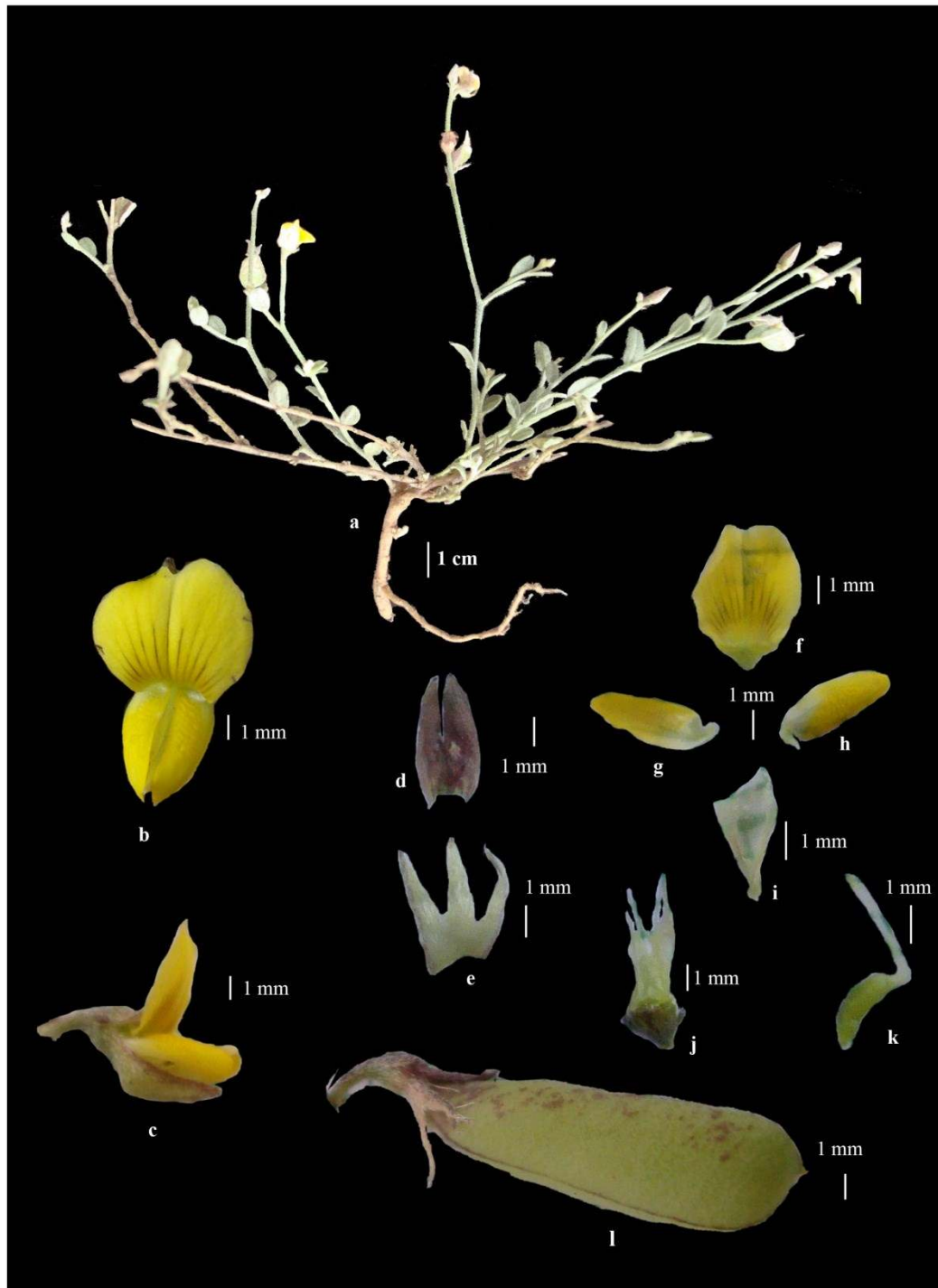
*Habitat*: On open grassland

*Distribution*: KWLS: Near Koderma RH, Koderma NRF; rare. INDIA: Bihar and Uttar Pradesh. WORLD: Burma.

*Specimen examined*: Near Koderma RH, Koderma NRF, 410 m, 24°28'49.7" N, 85°36'00.5" E, 5th March 2011, *Shyam Biswa* 49668.

**3. *Crotalaria spectabilis* Roth, Nov. Pl. Sp.: 341. 1821; Sanjappa, Leg. India: 130. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 341. 2000; N.P. Singh & al., Fl. Bihar: 132. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 187. 2002; A.A. Ansari, *Crotalaria* India: 284. f. 79. 2008. *Crotalaria sericea* Retz., Observ. Bot. 5: 26. 1788, non Burm.f., 1768; Baker in Hook.f., Fl. Brit. India 2: 75. 1876; Haines, Forest Fl. Chota Nagpur: 312. 1910 & Bot. Bihar Orissa: 232. 1922.**

**Plate 18C**



**Fig. 18.** *Crotalaria prostrata* var *levis* Haines: a. habit; b.,c. flower (upper & lateral views); d.,e. sepals; f. standard petal; g.,h. wing petals; i. keel petal; j. staminal column; k. carpel; l. pod.



Vern. Names: *Jhumjhumo*, *Jhunjhuria* (Hindi).

Herb or undershrub, annual or biennial, to 2.5 m high. Branches stout, striate, sub-glabrous. Leaves simple, upper leaves smaller and linear or linear-lanceolate, lower leaves larger, obovate or oblanceolate-oblong, 4–14 × 1.5–7 cm cuneate or attenuate at base, entire at margins, obtuse or rounded and mucronate at apex, chartaceous, glabrous above, silky hairy beneath; petiole 4–6 mm long; stipules ovate, cordate at base, acuminate at apex, 5–10 × 5–7 mm, leafy, persistent. Racemes terminal, 15–60 cm long; bracteoles subulate, 2–3 × c. 2 mm, inserted subapically on pedicel. Flowers 2.2–2.5 × c. 1.5 cm. Calyx 1–1.5 cm long, almost glabrous outside; upper 2 lobes large, triangular, acute at apex, 5–6 mm long; lower 3-lobes smaller, linear-lanceolate, acute at apex. Standard broadly ovate, 2–2.5 × 1–1.5 cm, retuse at apex strongly mid-ribbed on back, yellow with a purple tinge; wings obovate, 1.8–2 × 0.7–0.8 cm, yellow; keels falcate, c. 1.6 × 0.6 cm, spirally beaked. Staminal sheath 12–15 mm long. Ovary 6–8 × c. 2 mm, glabrous; style geniculate, 7–8 mm long, stigma minute, pubescent. Pods linear-oblong, 5–6 cm, long short-salked, glabrous, 20–30-seeded. Seeds c. 5 × 4 mm.

*Fl. & Fr.*: November–December

*Habitat*: Near the hedges or on open waste land

*Distribution*: KWLS: Near NH -31, Chattarbar; common. INDIA: Almost throughout. WORLD: Pantropical.

*Specimen examined*: Near NH-31, Chattarbar, 375 m, 24°28'36.5" N, 85°32'20.5" E, 29th November 2012, *Shyam Biswa* 54109.

*Note*: Stems, bracts, calyx having lenticels.

#### 8. **DALBERGIA** L.f., nom. cons.

Tropical c. 250 species, 33 in India, 5 in Jharkhand and 2 in KWLS.

##### Key to species

- 1a. Tree, leaflets 3–5, stamens 9, monadelphous; pods strap-shaped  
or linear-oblong **1. *D. sissoo***
- 1b. Woody climber, leaflets 11–13-foliolate; stamens (5 + 5), diadelphous;  
pods oblong-elliptic **2. *D. volubilis***

**1. *Dalbergia sissoo*** Roxb. ex DC., Fl. Ind. 3: 223. 1832; Baker in Hook.f., Fl. Brit. India 2: 231. 1876; Haines, Forest Fl. Chota Nagpur: 335. 1910 & Bot. Bihar Orissa: 293. 1922; Sanjappa, Leg. India: 140. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 343. 2000; N.P. Singh & al., Fl. Bihar: 133. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 183. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 73. 2014. **Plate 18D**

Vern. Names: *Seesam*, *Shisham* (Hindi).

Tree, 12–24 m high, semi-deciduous. Branchlets pubescent. Leaves imparipinnate; rachis 4–7.5 cm long, zig-zag; leaflets, alternate 3–5, broadly elliptic, obovate to orbicular, 2–6 × 2–5.3 cm, cuneate to rounded at base, entire at margin, abruptly acuminate at apex, puberulous when young, soon glabrescent, shiny above; petiolules 5–8 mm long; stipules 5–6 mm long. Inflorescences panicles, axillary, hairy; branches erecto-patent, densely pubescent; bracts small, pubescent, caducous. Flowers 5–7 mm long. Calyx 2–4 mm long, hairy; teeth very short; the lowest longest,

lanceolate. Standardobovate, *c.* 5 × 2–3, long-clawed, yellowish white; wings and keel oblong *c.* 4 × 1 mm. Stamens 9, monadelphous; anthers uniform. Ovary pubescent; ovules, marginal. Pods strap-shaped or linear-oblong, narrowed at base into a stalk, 4–8 × 0.6–1.2 cm, glabrous, pale brown, 1–3-seeded.

*Fl. & Fr.*: February–September

*Habitat*: Planted along the roads and also naturalised

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout. WORLD: Afghanistan, Bangladesh, Bhutan, Iran, Iraq, Myanmar and Pakistan. Cultivated elsewhere.

*Specimen examined*: Lokai forest, 400 m, 24°29'17.5" N, 85°36'37.4" E, 15th September 2010, Shyam Biswa 49625.

**2. *Dalbergia volubilis* Roxb.**, Pl. Coromandel 2: 48, t. 191. 1805 & Fl. Ind. 3: 231. 1832; Baker in Hook.f., Fl. Brit. India 2: 235. 1876; Haines, Forest Fl. Chota Nagpur: 337. 1910 & Bot. Bihar Orissa: 295. 1922; Sanjappa, Leg. India: 142. 1992; N.P. Singh & al., Fl. Bihar: 134. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 73. 2014. **Plate 18E**

Climber, large; roots woody. Bark dark brown. Stems deeply fluted, woody, ash-coloured; branchlets often terminating into a tendril. Leaves compound, alternate, 11–13-foliate, 10–15 cm long; leaflets elliptic-oblong or obovate, 1–4 × 0.6–2.5 cm, cuneate at base, entire at margins, obtuse or emarginate and mucronate at apex, glabrous above, appressed-hairy beneath. Inflorescences a dense panicle, terminal and axillary, 20–30 cm long, dense; branches of panicles rusty-pubescent. Calyx *c.* 3 mm long, velvety outside; upper two lobes obtuse; lower ones acute. Standard suborbicular, *c.* 4 × 6 mm, claws *c.* 2 mm long, purplish; wings and keels elliptic, *c.* 4.5 × 3 mm, purple. Stamens diadelphous (5 + 5); staminal-tube *c.* 0.3 cm long; anthers uniform, small. Ovary *c.* 0.5 cm long, hairy at base and on the margins; styles *c.* 0.2 cm long. Pods oblong-elliptic, 5–8 × 1.5–2 cm, flat, glabrous, 1 or 2-seeded.

*Fl. & Fr.*: March–May.

*Habitat*: On river bank of Dry deciduous forests.

*Distribution*: KWLS: Near the river Dhanarjay Nadi, Meghatari; common. INDIA: Andaman Islands, Assam, Bihar, Gujarat, Meghalaya, Mizoram, Peninsular India, Rajasthan, Sikkim, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Myanmar and Sri Lanka.

*Specimen examined*: Near the river Dhanarjay Nadi, Meghatari, 184 m, 24°34'39.3" N, 85°34'48.4" E, 7th March 2011, Shyam Biswa 49710.

#### 9. **FLEMINGIA** Roxb. ex W.T. Aiton, nom. cons.

Old World tropical regions, 30 species, 17 in India, 7 in Jharkhand and 1 in KWLS.

**Flemingia chappar** Buch.-Ham. ex Benth. in Miq., Pl. Jungh. 244. 1852; Baker in Hook.f., Fl. Brit. India 2: 227. 1876; Haines, Forest Fl. Chota Nagpur: 317. 1910 & Bot. Bihar Orissa: 267. 1922; Sanjappa, Leg. India: 175. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 354. 2000; N.P. Singh & al., Fl. Bihar: 139. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 198. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 78. 2014. **Plate 19C**

Vern. Names: *Salpan* (Hindi); *Galphuli* (Kharwari); *Chulbuli*.

Shrub or undershrub, 1–2 m high, much-branched. Stems terete, appressed-hairy. Leaves simple alternate, unifoliate, orbicular-cordate,  $5-10 \times 4.5-9$  cm, cordate to sub-cordate at base, entire at margin, blunt-acute to acuminate at apex, subcoriaceous, glabrous above sparsely hairy beneath more on veins, gland-dotted beneath; petioles 1–2.5 cm long, thickened at ends, hairy. Racemes often combined into panicles, axillary; bracts butterfly wings like folded enclosing a flower, cordate,  $2-2.5 \times 4-4.5$  cm, deeply emarginated, short-stalked, foliaceous, membranous, glabrescent, persistent, conspicuously reticulate-veined. Flowers *c.* 1 cm long. Calyx lobes lanceolate, 4–5 mm long hairy outside. Standard cuneiform or obovate,  $1-1.2 \times 0.8-1$  cm, with 2 basal inflexed auricles; wings oblong 9–10 mm, claw *c.* 3–4 mm, spur *c.* 1 mm long; keels slightly curved 9–10 mm, claw *c.* 3–4 mm. Stamens diadelphous; anthers uniform *c.* 7–8 mm. Ovary subsessile short *c.* 2 mm long; ovules 2; style filiform 7–8.5 mm, boomerang shaped; stigma small, capitate. Pods oblong,  $6-10 \times 3.5-6$  mm, densely hairy, completely concealed by bracts. Seeds 2, orbicular-oblong, black.

*Fl. & Fr.*: February–April.

*Habitat*: Under canopy of Hilly slopes of Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest, way to Muglamaram forest road; common. INDIA: Bihar, East Himalaya, Peninsular India, Uttar Pradesh and West Bengal. WORLD: Myanmar and Nepal.

*Specimen examined*: Taraghati forest, way to Muglamaram forest road, 321m,  $24^{\circ}32'13.5''$  N,  $85^{\circ}35'12.3''$  E, 23rd February 2012, *Shyam Biswa* 49854.

*Note*: Observed in the wing petal spur *c.* 1 mm long and a long claw.

#### 10. GLIRICIDIA Kunth.

Tropical regions, 5 species, 1 in India.

**Gliricidia sepium** (Jacq.) Kunth ex Walp., Repert. Bot. Syst. 1(4): 679. 1842; Sanjappa, Leg. India: 181. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 356. 2000; N.P. Singh & al., Fl. Bihar: 142. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 200. 2002. *Robinia sepium* Jacq., Enum. Syst. Pl. 28. 1760. *Gliricidia maculata* Kunth in H.B.K., Nov. Gen. Sp. 6: 393. 1824 *in nota*, Benth., Trees Calc. 146. 1900. **Plate 19D**

Tree 10–24 m high. Leaves compound, 15–25 cm, leaflets oblong-ovate,  $4.5-7 \times 2-3$  cm, rounded at base, entire at margins, bluntly acute at apex, often oblique, pubescent on veins beneath, otherwise glabrous, deciduous; petiolules 3–5 mm. Racemes 7–15 cm. Flowers 2–3 cm long. Calyx cupuliform 5–6 mm, glabrous, greenish-pink. Standard orbicular  $2-2.5 \times 2-2.2$  cm, short claw, bilobed at apex, light pinkish with central portion whitish-yellow; wings oblong  $1.8-2 \times 0.4-0.6$  cm, claw *c.* 3 mm long, deeper pink; keel oblanceolate,  $1.6-1.8 \times 0.4-0.5$  mm, claw *c.* 5 mm long, white. Stamens diadelphous, staminal sheath 2–2.2 cm long, white, anthers yellow. Ovary elongated 1–1.5 cm long, purplish, style *c.* 5 mm white, stigma capitate. Pods 10–14  $\times$  1.5 cm, on basal stalks *c.* 7.5 mm.

*Fl. & Fr.*: February–March.

*Habitat*: Dry deciduous forests, near the village.

*Distribution*: KWLS: Near the RfO office Koderma NRF; common INDIA: cultivated in gardens and as green manure plant. WORLD: A native of South America.

*Specimen examined*: Near the RFO office, Koderma NRF, 401 m,  $24^{\circ}28'49.6''$  N,  $85^{\circ}35'49.6''$  E, 10th March 2011, *Shyam Biswa*, 49747.

# 11. GRONA Lour.

Tropical and sub-tropical regions c.50 species, 3 species in India and 2 in Jharkhand & KWLS.

## Key to species

1a. Erect herb leaflets obovate-elliptic or elliptic-oblong

**1. G. heterocarpos**

1b. Prostrate herb, leaflets obcordate

**2. G. trifolium**

**1. Grona heterocarpos** (L.) H. Ohashi & K. Ohashi, J. Jap. Bot. 93(2): 112. 2018. *Hedysarum heterocarpon* L., Sp. Pl. 2: 747. 1753. *Desmodium polycarpon* (Poir.) DC, Prodr. 2: 334. 1825, p.p.; Haines, Bot. Bihar Orissa: 264. 1922. *Desmodium polycarpon* (Poir.) D var. *trichocaulon* (D) Baker in Hook.f., Fl. Brit. India 2: 172. 1876; Haines, Forest Fl. Chota Nagpur: 347. 1910 & Bot. Bihar Orissa: 264. 1922. *Desmodium heterocarpon* (L.) DC., Prodr. 2: 337. 1825; Sanjappa, Leg. India: 154. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 346. 2000; N.P. Singh & al., Fl. Bihar: 135. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 190. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 75. 2014.

## Plate 18F

Undershrub scandent, to 50 cm high. Stems hairy; branches slender, slightly angular, glabrous downwards, densely patent-hairy towards apex. Leaves 3-foliolate; petioles 0.7–3.5 cm long, angular, appressed hairy; stipules lanceolate-subulate, 1.5–2 cm long, reddish; leaflets obovate-elliptic or elliptic-oblong, lateral leaflets 0.9–5 × 1.7–2.2 cm, central leaflets 3–7.5 × 1.6–3.5 cm, rounded at base, entire at margins, obtuse or retuse at apex, subcoriaceous, glabrate or thin-hairy above, appressed pubescent beneath; petiolules 1.5–2 mm long; stipels filiform, 1–2 mm long. Racemes, lax, 5–15 cm long. Flowers 4–5 mm long; pedicels filiform, 3–5 mm long, ascending; bracts ovate-cuspidate, 3–4 mm long, reddish, ciliate. Calyx 2.2–2.5 mm long, glabrescent; lobetriangular, acute at apex. Standard obovate-orbicular, c. 1 × 0.8 cm, violet-bluish; wings oblong or obovate, c. 6 × 4 mm, dark violet or bluish; keels oblong or obovate, c. 1 × 4 mm, light bluish or violet. Staminal sheath 7–8 mm long, light violet. Ovary 7–8 mm long, style persistent. Pods linear, 1.5–3 cm long, undulating along margin, 2 to 7 segments, constricted between seeds, hairy; 2.5–3 × 2.5–3 mm, 2–7 seeded.

*Fl. & Fr.*: September–October.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; common. INDIA: Peninsula, E. India and Andaman & Nicobar Islands. WORLD: Australia, East, South and South-East Asia.

*Specimens examined*: Near the base of Dhawjadhari Pahar 424 m, 24°28'59.3" N, 85°35'42.4" E, 5th September 2010, *Shyam Biswa* 49573; Phutlaiya Nala, 328 m, 24°30'36.3" N, 85°39'30.1" E, 28th September 2013, *Shyam Biswa* 54185.

**2. Grona triflora** (L.) H. Ohashi & K. Ohashi J. Jap. Bot. 93: 117. 2018. *Hedysarum triflorum* L., Sp. Pl. 2: 749. 1753, excl. vars. *Desmodium triflorum* (L.) DC., Prodr. 2: 334. 1825; Baker in Hook.f., Fl. Brit. India 2: 173. 1876; Haines, Forest Fl. Chota Nagpur: 345. 1910 & Bot. Bihar Orissa: 266. 1922; Sanjappa, Leg. India: 163. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 350. 2000; N.P. Singh & al., Fl. Bihar: 137. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 195. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 77. 2014. **Plate 19A**

Vern. Name: *Kudaliya* (Hindi).



Herb, prostrate, much-branched from rootstock. Stems terete, c. 30 cm long, rooting from nodes, appressed-hairy with white spreading hairs. Leaves, compound, 3-foliolate; petioles 3–10 mm long; stipules obliquely ovate, 2–3 × 1 mm long, acuminate at apex, persistent; leaflets obcordate-obovate, 3–10 × 2–8 mm, cuneate at base, entire at margins, retuse and mucronate at apex, membranous, glabrous above, hairy beneath; petiolules c. 2 mm long of central leaflet and c. 1 mm of lateral leaflet, hairy; stipels subulate, 2–2.5 mm long. Flowers solitary or 2–5 in clusters, axillary, c. 4–5 mm long; bracts ovate-lanceolate, ciliate, persistent; bracteoles minute; pedicels 3–10 mm long. Calyx 4.5–5 mm long, appressed-hairy; teeth lanceolate, ciliate. Standard broadly obovate, 4 × 2–3 mm long, cuneate at base, white with violet ting; wings 3–4 × 1 mm long, whitish-violet; keels 2.5–3 × 1 mm long, whitish-violet. Staminal sheath c. 3 mm long. Ovary c. 3 mm long; style c. 2 mm long, incurved. Pods, oblong or linear-oblong, 4–12 × 2–3 mm, 2–4 segments, undulating along margin, constricted between seeds; pubescent, indehiscent, 1–4 seeded.

*Fl. & Fr.*: September–March or Throughout the year.

*Habitat*: Ground vegetation on the shades of Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; Lokai forest; Koderma NRF; very common. INDIA: Throughout plains. WORLD: Tropical Asia, Africa and America.

*Specimens examined*: Muglamaram forest, 375 m, 24°30'50.5" N, 85°34'42.4" E, 24th November 2012, *Shyam Biswa* 54084; Lokai forest, 400 m, 24°29'17.5" N, 85°36'37.4" E, 29th March 2013, *Shyam* 54123; Koderma NRF, 390 m, 24°29'18.7" N, 24° 29'18.7" E, 28th September 2013, *Shyam Biswa* 54187.

## 12. INDIGOFERA L.

Tropical and subtropical regions, c. 730 species, 59 in India, 15 in Jharkhand and 3 in KWLS.

### Key to species

- 1a. Prostrate herb, leaves simple; pods ovoid-globose, 2–3 mm, hairy, 1-seeded ... **3. I. linifolia**
- 1b. Erect herb or shrub, leaves compound, pod linear, 2.5–4.5 cm long, glabrous; each valve curling spirally after dehiscence; seeds 8–12 2
- 2a. Leaflets 5–11; raceme, axillary, to 2.5 cm long **1. I. astragalina**
- 2b. Leaflets 11–21; raceme, 5–15 cm long **2. I. cassioides**

**1. Indigofera astragalina** DC., Prodr. 2: 228. 1825; Sanjappa, Leg. India: 185. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 359. 2000; N.P. Singh & al., Fl. Bihar: 143. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 202. 2002. *Indigofera hirsuta* auct. non L., 1753: Baker in Hook.f., Fl. Brit. India 2: 98. 1876, p.p.; Haines, Forest Fl. Chota Nagpur: 342. 1910 & Bot. Bihar Orissa: 239. 1922.

**Plate 19E**

Herb or shrub, 20–80 cm high, erect, annual. Stems and branches terete, pinkish, hirsute, sticky. Leaves compound, alternate, ovate, to c. 14.5 cm long, imparipinnate, stipules linear 0.8–1.5 cm long, pubescent; leaflets 5–11, oblong or elliptic-obovate, 1–4 × 0.8–1.6 cm, rounded at base entire at margins, acute and apiculate at apex, appressed-hairy; petiolules 1–3 mm long, light pinkish, hairy. Inflorescences a raceme, axillary, to 2.5 cm long; bracts ovate-lanceolate, 1.3–1.5 mm long; pedicels 0.5–1 mm long. Flowers 3–4 mm long. Calyx / bracteoles linear-lanceolate, 3–4 mm long, margin ciliate, hairy. Standard obovate, c. 4 × 3–4 mm, truncate at apex, pink or pale light red; wings obovate, 4–5 mm long, glabrous pink or pale light red, base dark; keels c. 3 mm long, pale light red. Stamens diadelphous; staminal sheath 3–4 mm long; anthers oblong c. 0.5 mm long and apiculate. Ovary sessile, c. 2 mm long, hirsute / bushy hairy; style glabrous, c. 1

mm long; stigma capitate. Pods linear, deflexed,  $10-20 \times c. 4$  mm, densely whitish hirsute, 5–7-seeded.

*Fl. & Fr.*: August–September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure forest Koderma NRF; common. INDIA: Throughout. WORLD: Afghanistan, Australia, China, Eritrea, Ethiopia, Malesia, Nepal, New Guinea, Philippines, Sudan, Taiwan and Vietnam.

*Specimens examined*: Inside the enclosure forest Koderma NRF, 390 m,  $24^{\circ}29'18.7''$  N,  $85^{\circ}35'15.1''$  E, 8th September 2010, *Shyam Biswa* 49597; Baghi tan road, Koderma NRF, 390 m,  $24^{\circ}29'06.6''$  N,  $85^{\circ}36'49.8''$  E, 9th August 2011, *Shyam Biswa* 49760.

**2. *Indigofera cassioides*** Rottler ex DC., Prodr. 2: 225. 1825; Sanjappa, Leg. India: 186. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 359. 2000; N.P. Singh & al., Fl. Bihar: 143. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 203. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 79. 2014. *Indigofera pulchella* Roxb., Fl. Ind. 3: 382. 1832; Baker in Hook.f., Fl. Brit. India 2: 101. 1876. *Indigofera pulchella* var. *purpurascens* (Roxb.) Haines, Bot. Bihar Orissa: 240. 1922.

**Plate 19F**

Shrub, 1–2 m high. Branches alternate, striate, hairy when young. Leaves compound, alternate, imparipinnate; rachis 7–15 cm long, hairy; petioles 1–2 cm long, stipules linear, 2–4 mm long, deciduous; leaflets 11–21, opposite or rarely a few alternate, oblong to elliptic,  $1-3.5 \times 0.8-2.5$  cm, subcuneate or rounded at base, entire at margin, obtuse, truncate to slightly emarginate and mucronate at apex, hairy on both surface; petiolules 1–2 mm long; stipels c 1 mm long. Raceme, 5–15 cm long, dense; axis covered with sterile scales at base; Flowers c. 2 cm long; bracts ovate, 3–6 mm long, appressed-hairy, caducous; pedicels 1–2 mm long. Calyx 2.5–4 mm long, pilose; lobes or teeth subequal, deltoid, 0.8–1.2 mm long. Standard elliptic  $12-15 \times 6-8$  mm, hairy at margins, pinkish-purple; wings oblong,  $12-13 \times 3-4$  mm; keels oblong,  $13-14 \times 2-3$  mm, light pinkish. Stamens diadelphous; staminal tube 8–10 mm long; anthers roundish, c. 1 mm, apiculate or gland-tipped. Ovary 6–8 mm long; style curved c. 3 mm long; stigma capitate. Pods straight, 2.5–4.5 cm long, glabrous; each valve curling spirally after dehiscence. Seeds 8–12, angular, as long as broad, c. 2 mm, dark brown-blackish.

*Fl. & Fr.*: February–April.

*Habitat*: Scrub and dry deciduous forests.

*Distribution*: KWLS: Taraghati forest, way to Muglamaram forest road; common. INDIA: Throughout. WORLD: China, South and South-East Asia.

*Specimen examined*: Taraghati forest, way to Muglamaram forest road, 321 m,  $24^{\circ}32'13.5''$  N,  $85^{\circ}35'12.3''$  E, 23rd February 2012, *Shyam Biswa* 49853.

**3. *Indigofera linifolia*** (L.f.) Retz., Observ. Bot. 4: 29. 1786 & 6: 33, t. 2. 1791; Baker in Hook.f., Fl. Brit. India 2: 92. 1876; Haines, Bot. Bihar Orissa: 237. 1922; Sanjappa, Leg. India: 192. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 363. 2000; N.P. Singh & al., Fl. Bihar: 144. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 204. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 80. 2014. *Hedysarum linifolium* L.f., Suppl. Pl.: 331. 1782. **Plate 19G**

Vern. Name: *Torki* (Hindi).

Herb, decumbent or prostrate; rootstocks woody, long tap root. Stems 15–45 cm long, strigose. Leaves simple, alternate, elliptic, ovate to oblong or linear,  $2-20 \times 1-4$  mm, rounded or acute to

obtuse at base, entire at margins, acute and mucronate at apex, appressed silvery hairy; petiole 1–3 mm long, strigose; stipules 2, lanceolate or subulate, 1–2 mm long. Raceme, axillary, to 2.5 cm long. Flowers *c.* 5 mm long; bracts ovate-lanceolate, 1.3–1.5 mm long; pedicels 0.5–1 mm long. Calyx 5-lobed, more than half lobed, sepals ovate-lanceolate, 2–3 mm long, margin ciliate, hairy. Standard obovate, 3–4 × 2 × 3 mm, mucronate at apex, appressed-hairy beneath, bright red, dark red at base; wings oblong, 4 mm long, glabrous bright red, retuse or wavy at apex; keels obovate *c.* 3 mm long, dark red. Stamens diadelphous; staminal sheath 3–4 mm long; anthers apiculate. Ovary sessile, *c.* 1 mm long; style glabrous, 2–4 mm long; stigma capitate. Pods ovoid-globose, 2–3 × *c.* 2 mm, appressed silvery-pubescent, with a tip, 1-seeded. Seeds globose, 1–1.5 mm, punctuate, brownish.

*Fl. & Fr.*: August–March.

*Habitat*: On grassland in open places or near the banks.

*Distribution*: KWLS: Near the Dumaria village, Koderma NRF; Bishnutikar Jungle, Meghatari; Near enclosure Phoolwaria road; Phutlaiya Nala; common. INDIA: Throughout. WORLD: Afghanistan, Australia, China, Eritrea, Ethiopia, Malesia, Nepal, New Guinea, Philippines, Sudan, Taiwan and Vietnam.

*Specimens examined*: Near the Dumaria village, Koderma NRF, 394 m, 24°29'36.6" N, 85°35'49.8" E, 9th August 2011, *Shyam Biswa* 49768; Bishnutikar Jungle, Meghatari, 189 m, 24°34'58.1" N, 85°35'05.8" E, 2nd March 2012, *Shyam Biswa* 54035; Near enclosure Phoolwaria road, 400 m, 24°29'20.4" N, 85°38'46.9" E, 20th November 2012, *Shyam Biswa* 54064; Phutlaiya Nala, 328 m, 24°30'36.3" N, 85°39'30.1" E, 28th September 2013, *Shyam Biswa* 54186.

### 13. MELILOTUS Mill.

Temperate and subtropical regions, *c.* 20 species, 4 in India, 2 in Jharkhand and 1 in KWLS.

**Melilotus albus** Medik. in Vorles. Churpfälz. Phys.-Ökon. Ges. 2: 382. 1787. *Melilotus officinalis* (L.) Lam. subsp. *albus* (Medik.) H. Ohashi & Tateishi, Sci. Rep. Tohoku Univ., Ser. 4, Biol. 38(4): 319. 1984. *Melilotus alba* Medik. ex Desr. in Lam., Encycl. 4: 63. 1797; Baker in Hook.f., Fl. Brit. India 2: 89. 1876; Haines, Bot. Bihar Orissa: 235. 1922; Sanjappa, Leg. India: 211. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 370. 2000; N.P. Singh & al., Fl. Bihar: 149. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 209. 2002.

Vern. Name: *Safed Senji* (Hindi).

Herb, 25–45 cm high. Stems terete, much-branched, glabrous. Leaves 3-foliolate; petioles 1.5–2 cm long, slender; stipules adnate to petiole in their lower halves, lanceolate to linear, 4–5 mm long; Leaves compound, alternate, leaflets oblanceolate or elliptic oblong, 5–20 × 2–6 mm rounded or cuneate at base, dentate at margins, truncate or rounded at apex, veins of leaflets usually excurrent with teeth; petiolules 1–6 mm long. Raceme, 4–6.5 cm long. Flowers 4.5–6 mm long; bracts subulate, 1.2–2 mm long; pedicels 0.5–1.5 mm long. Calyx 1–1.5 mm long, lobes triangular. Standard obovate 3–5 mm long, retuse at apex, white; wings oblong, *c.* 3 mm long, auricled at base, white; standard and wings adherent to obtuse keel, keel white. Stamens diadelphous; filaments not dilated; anthers uniform. Ovary narrowly ovate; ovules 2–4; style filiform, incurved; stigma terminal. Pods ellipsoid, 2.5–3.5 × 1.5–2 mm long, glabrous, reticulate-veined, persistent style, 1-seeded. Seeds blackish.

*Fl. & Fr.*: March–April.

*Habitat*: Damp and moist area near the village.

*Distribution:* KWLS: Khararia jungle, Meghatari, near Chirkundi Village; common. INDIA: Throughout. WORLD: Afghanistan, Arabia, Bhutan, Central Asia, Europe, Myanmar, Pakistan, Turkey, USSR; introduced into America, Malaysia, East Asia and Australia.

*Specimen examined:* Khararia jungle, Meghatari, near Chirkundi Village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49721.

#### 14. **MILLETTIA** Wight & Arn., nom. cons.

Old World tropical regions, c.150 species (incl. Pongamia), 13 in India, 3 in Jharkhand and 1 in KWLS.

**Millettia extensa** (Benth.) Benth. ex Baker in Hook.f., Fl. Brit. India 2: 109. 1876; Sanjappa, Leg. India: 213. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 372. 2000; N.P. Singh & al., Fl. Bihar: 149. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 210. 2002. *Otosema extensa* Benth. in Miq., Pl. Jungh. 2: 249. 1852; Ranjan, Fl. Parasnath Wildlife Sanct.: 80, f. 10. 2014. *Millettia auriculata* Baker ex Brandis, Fore. Fl. Ind.: 138. 1874; Baker in Hook.f., Fl. Brit. India 2: 108. 1876; Haines, Forest Fl. Chota Nagpur: 339. 1910 & Bot. Bihar Orissa: 246. 1922.

**Plate 20A**

Vern. Names: *Gaj* (Hindi); *Bandar lat*.

Climber, large, robust. Stem and branches terete, woody. Leaves 9–28 cm long; petioles 10–15 cm long; stipules 6–7 mm long, persistent; leaflets imparipinnate, 5–9, terminal leaflet obovate, lateral leaflet oblong-elliptic or lanceolate-oblong, 5.5–12 × 3–9 cm, obtuse to rounded at base entire at margins, acuminate at apex, glabrescent above, hairy beneath; lateral veins 8–12, strong; petiolules 5–7 mm long; stipels linear 3–4 mm long, deciduous. Raceme, 10–25 cm long, usually many, clustered on a stout axillary peduncles, densely silky. Flowers 1–1.2 cm long, fascicled on rachis; pedicels 3–8 mm long; bracts linear, minute. Calyx 2.5–3 mm long, densely silky, teeth very short. Standard suborbicular, 10–12 mm long, auriculate at base, emarginated at apex, cream-coloured; wing linear-oblong, c. 8 × 3 mm, clawed, cream-coloured; keel obovate c. 8 × 3 mm, clawed, cream coloured. Stamenes monadelphous; filaments filiform, unequal in length, c. 1.5 mm long; anthers c. 0.8 mm long, uniform, bearded at base. Ovary appressed-silky c. 6 mm long; style c. 2 mm long. Pods linear-oblong, 10–16.5 × 2–2.5 cm, straight, not septate, hard and woody, golden-brown tomentose, tardily dehiscent, brownish, margins thicken. Seeds 4, each c. 1.5 cm across, orbicular, flattend.

*Fl. & Fr.:* March–August.

*Habitat:* Dry deciduous and mixed deciduous forests.

*Distribution:* KWLS: Taraghati forest; common. INDIA: Himalayas from Kashmir to Sikkim, Assam, Bihar, Madhya Pradesh and Odisha. WORLD: Bhutan, Indochina and Nepal.

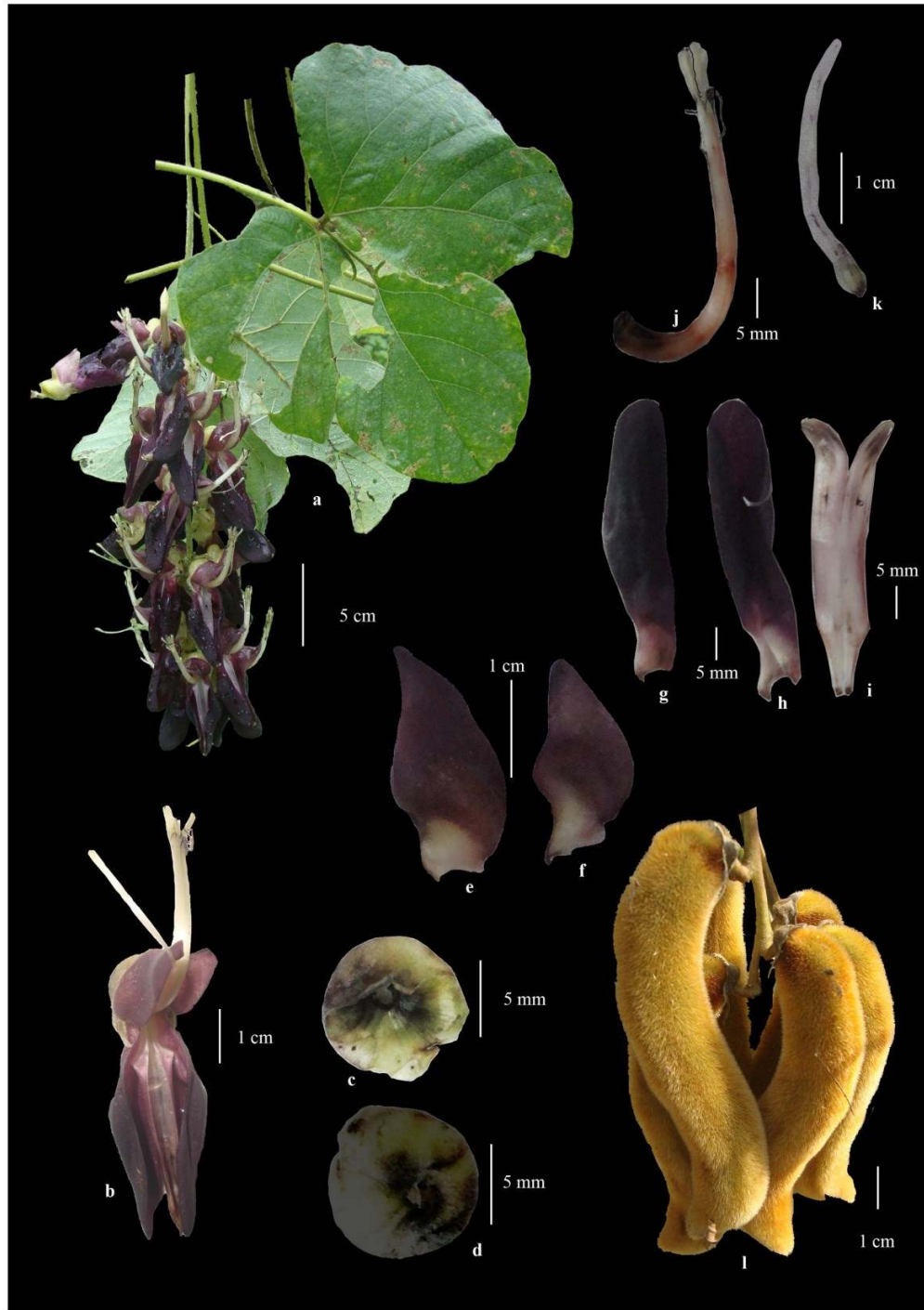
*Specimen examined:* Taraghati forest, 321 m, 24°32'13.5" N, 85°35'12.3" E, 18th August 2011, *Shyam Biswa* 49830.

#### 15. **MUCUNA** Adans., nom. cons.

Tropical regions, 105 species, 9 in India, 2 in Jharkhand and 1 in KWLS.

**Mucuna pruriens** (L.) DC., Prodr. 2: 405. 1825; Baker in Hook.f., Fl. Brit. India 2: 187. 1876; Haines, Forest Fl. Chota Nagpur: 324. 1910; Sanjappa, Leg. India: 217. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 373. 2000; N.P. Singh & al., Fl. Bihar: 150. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 211. 2002. *Dolichos pruriens* L., Herb.





**Fig. 19. *Mucuna pruriens* (L.) DC.:** a. flowering twig; b. flower; c.,d. calyx (upper & lower views); e.,f. standard petal; g.,h. wing petals; i. keel petal; j. staminal column; k. carpel; l. pods.

Amboin.: 23. 1754. *Mucuna prurita* Wight., Bot. Misc. 2: 348. 1831; Haines, Bot. Bihar Orissa: 283. 1922. *Mucuna minima* Haines, J. Proc. Asiat. Soc. Bengal 15: 313. 1920 & Bot. Bihar Orissa: 284. 1922.

**Fig. 19**

Vern. Names: *Alkusi*; *Kivach* (Hindi).

Climbing shrub. Stem and branches ribbed, densely pubescent when young. Leaves compound, pinnately 3-foliolate; petioles 7–15 cm long; leaflets ovate-elliptic or ovate-rhomboid, 7–11 × 7–10 cm, truncate or rounded at base, entire at margins, obtuse or retuse and mucronate at apex, finely pubescent more beneath, lateral veins 6 or 7, strong; petiolules 5–10 mm long; stipels subulate, 2–5 mm long. Raceme, axillary, 25–35 cm long. Flowers 8–9 cm long, solitary or 2 or 3 together; bracts lanceolate, 1–1.2 cm long; pedicels 4–6 mm long. Calyx 1.2–1.3 cm long, clothed with few irritating bristles; lobes unequal, rounded at base, deltoid at apex, acute, upper 2-lobes connate, lowest lobe larger. Standard ovate, 2.1–2.5 × 1–1.5 cm, dark purplish, lower basal portion light purplish-white; wings linear-oblong 4–4.5 × 1.2–1.5 cm long, dark purplish, rounded at apex; keels linear 4–4.5 × c. 0.5 cm, incurved at apex, light purplish-white. Stamens diadelphous (9+1); staminal sheath 4–4.5 cm long curved, whitish; anthers dimorphous, alternate long and short, dorsifixed, dark purplish. Ovary 0.8–1 cm long hairy, greenish-white; style filiform c. 3 cm long, white, stigma capitate, white. Pods J- or S-shaped, 5–10 × 1.2–1.5 cm, turgid, densely covered with ferruginous irritating bristles, brownish, 3–10-seeded. Seeds transversely oblong.

*Fl. & Fr.*: September –February.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Lokai forest near Birhore Tola; very common. INDIA: Throughout plains and Terai Himalayas, Assam and Meghalaya. WORLD: Pantropical.

*Specimen examined*: Lokai forest near Birhore Tola, 398 m, 24°29'.158" N, 85°37'.038" E, 29th September 2013, *Shyam Biswa* 54179.

## 16. *OUGEINIA* Benth.

India and Nepal, Monotypic

***Ougeinia oojeinensis*** (Roxb.) Hochr., Bull. Soc. Bot. Genève 13 & 14: 51. 1909; Sanjappa, Leg. India: 224. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 374. 2000; N.P. Singh & al., Fl. Bihar: 151. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 81. 2014. *Dalbergia oojeinensis* Roxb., Fl. Ind. 3: 220. 1832. *Ougeinia dalbergioides* Benth. in Miq., Pl. Jungh. 2: 216. 1852; Haines, Forest Fl. Chota Nagpur: 349. 1910 & Bot. Bihar Orissa: 259. 1922. *Desmodium oojeinense* (Roxb.) H. Ohashi, Ginkgoana 1: 117. 1973. **Plate 18G & H**

Hindi: *Panan*; Kharwari: *Pandan*.

Tree, to 18 m high; trunk whitish-brown; branches slender, terete, grey. Leaves pinnately 3-foliolate, 13–19 cm long; petioles 3–5 cm long; stipules lanceolate, acute at apex, leaflets: terminal one larger than lateral, ovate, orbicular or obovate, 8.5–14 × 7.5–12.5 cm, cuneate at base, entire at margins, acute or acuminate at apex; petiolules c. 4.5 cm long, swollen at apex; lateral ones opposite, obliquely ovate, 4.8–11.5 × 3–8 cm, rounded or inequilateral at base, entire at margins, acute to subacute at apex, glabrous above, sub-tomentose beneath; petiolules c. 3–5 mm, swollen; stipels linear, 3–5 mm long. Racemes short, arising from nodes of old branches. Flowers 10–12 mm long, fragrant; pedicels filiform, 5–15 mm long, dark pinkish, villous; bracts ovate, acuminate at apex, 1.2–1.5 mm long, villous outside; bracteoles minute, villous. Calyx

campanulate, 5-lobed, 4–6 mm long, dark pinkish, villous. Standard broadly ovate,  $8-10 \times 7-9$  mm, white with light pinkish veins, yellowish-green at central-base, margins incurved; wings  $7-9 \times 3-4$  mm, clawed, white; keels  $7-9 \times 2.5-3$  mm, clawed white. Stamens diadelphous (9+1), 8–10 mm long; anthers uniform. Ovary sessile *c.* 5–6 mm long, pinkish; ovules many; style incurved, 2–3 mm, long, subulate; stigma capitate. Pods linear-oblong,  $5-6.5 \times 0.7-1.2$  cm, long, undulate along both sutures and dividing into 2–4 rounded segments constricted between seeds, reticulately veined, glabrous.

*Fl. & Fr.*: March–April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Baghitan forest; common. INDIA: Throughout in deciduous forests. WORLD: Nepal.

*Specimen examined*: Baghitan forest, 402 m,  $24^{\circ}29'06.6''$  N,  $85^{\circ}36'08.7''$  E, 3rd March 2011, Shyam Biswa 49660.

### 17. **PHYLLODIUM** Desv., nom. cons.

South Asia, North Australia, 8 species, one in India.

**Phyllodium pulchellum** (L.) Desv., J. Bot. Agric. 1: 124, t. 5, f. 24. 1813. *Hedysarum pulchellum* L., Sp. Pl. 2: 747. 1753. *Desmodium pulchellum* (L.) Benth., Pl. Jungh. 2: 217. 1852; Baker in Hook.f., Fl. Brit. India 2: 162. 1876; Haines, Forest Fl. Chota Nagpur: 346. 1910 & Bot. Bihar Orissa: 261. 1922; Sanjappa, Leg. India: 160. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 348. 2000; N.P. Singh & al., Fl. Bihar: 137. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 192. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 76. 2014.

#### Plate 20B

Shrub 0.8–1.5 m high, much-branched. Branches trigonous, slender, pubescent. Leaves compound, alternate, 3-foliolate; petioles 0.3–1 cm long; stipules lanceolate or ovate, 3–5 mm long, acuminate at apex; leaflets elliptic or ovate  $4.5-10.2 \times 2-4.5$  cm, terminal leaflet at least twice as large as lateral ones, rounded at base, entire and somewhat undulate at margins acute or obtuse at apex, pubescent especially beneath; stipels subulate *c.* 3 mm. Inflorescence racemiform, axillary or terminal, consisting of an elongate series of 2 opposite leafy persistent bracts, bracts elliptic or suborbicular  $0.8-1.5 \times 0.5-1.2$  cm, hairy on veins, each concealing 3–6 flowers in fascicles. Flowers 6–7 mm long. Bracteoles linear-lanceolate 3–5 mm long. Calyx 2–3 mm long. Standard elliptic *c.*  $6.5 \times 4$  mm, white or pale yellow, wings oblong *c.*  $3.5 \times 1$  mm, shortly auriculate at base, keel spathulate *c.*  $6 \times 2$  mm, white or pale yellow. Stamens monadelphous; staminal tube *c.* 3 mm long; anther *c.* 0.4 mm long. Ovary *c.* 1.5 mm long, pubescent; style *c.* 2.5 cm long, incurved; stigma terminal, minute, capitate. Pod suborbicular or oblong  $5-10 \times 2-4$  mm, indented along both sutures into suborbicular segments, pubescent along sutures, otherwise glabrous, reticulate veins prominent, with a persistent style, 1–3-seeded.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near base of Dhawjadhari Pahar; common INDIA: Throughout hills, and in Eastern Himalayas, Meghalaya. WORLD: Burma, China, Nepal, Malesia, Ryukyu, Sri Lanka, Taiwan, Thailand, Vietnam.

*Specimens examined:* Near base of Dhawjadhari Pahar, 424 m, 24°28'59.3" N, 85°35'42.4" E, 19th November 2012 *Shyam Biswa* 49513; Near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 2nd March 2012, *Shyam Biswa* 54055.

18. **POLHILLIDES** H.Ohashi & K.Ohashi

Tropical & Subtropical regions Old World, Monotypic.

**Polhillides velutina** (Willd.) H.Ohashi & K.Ohashi, J. Jap. Bot. 94: 72. 2019. *Hedysarum velutinum* Willd., Sp. Pl. 3: 117. 1803. *Hedysarum latifolium* Roxb., Fl. Ind. 3: 350. 1832. *Desmodium latifolium* (Roxb.) DC., Prod. 2: 328. 1825; Wight & Am, Prod. 225. 1834 *incl. vars.*; Baker in Hook.f., Fl. Brit India 2: 168. 1876. Haines, Forest Fl. Chota Nagpur: 348. 1910 & Bot. Bihar Orissa: 265. 1922; Sanjappa, Leg. India: 165. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 351. 2000; N.P. Singh & al., Fl. Bihar: 138. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 196. 2002. *Desmodium velutinum* (Willd.) DC., Prod. 2: 328. 1825; Schubert, J. Arn. Arb. 44: 292. 1963; Ranjan, Fl. Parasnath Wildlife Sanct.: 77. 2014.

**Plate 19B**

Shrub or undershrub, 1 m high, erect or scandent. Branches terete, much-branched, densely patently brown-hairy. Leaves simple, broadly ovate-rounded, 3–13.3 × 2–11.6 cm inequilateral, subcordate or rounded or truncate at base, sinuate-repand at margins, obtuse or sometimes retuse and mucronate at apex, fulvous-tomentose beneath, hairy above; young leaves densely tomentose, petioles 0.5–2.2 cm long, densely fulvous-hairy; stipules linear-lanceolate or cordate-ovate, ciliate at margins, long-acuminate at apex, 5–6 mm long, hairy, deciduous. Raceme, terminal and axillary, c. 45 cm long; rachis 1.5–2 mm long, densely patently brown-hairy; bracteoles 2–3 mm long. Calyx 2–3 mm long, densely hairy; lobes triangular. Standard orbicular-obovate, 4–5 × 3–3.5 mm, retuse at apex, dark pink to purple; wings oblong, c. 4–5 × 1–1.5 mm; keels slightly incurved, c. 4–5 × 1–1.5 mm. Staminal sheath 4.5–5 mm long, anthers c. 0.5 mm long. Carpel 4–6 mm long; ovary hairy; style c. 2 mm long; stigma rounded. Pods linear, 6–25 × 2.5–3 mm, straight or slightly curved, dividing into 2–8 segments, undulating along margin, constricted between seeds, densely clothed with brown hooked hairs, and with prominent reticulate venation, 2–8seeded. Seeds reniform, 2.5–3 × 2–2.5 mm, brownish

*Fl. & Fr.:* September–November.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Muglamaram forest; Muglamaram forest and Phoolwarya forest; common. INDIA: Throughout. WORLD: Madagascar, South and Southeast Asia and tropical Africa.

*Specimens examined:* Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49513; Taraghati forest, 27th September 2013, 320 m, 24°32'32.1" N, 85°35'06.0" E, *Shyam Biswa* 54184.

*Note:* The plant collected from the two different area was observed that in one of the collections the matured leaf also have densely tomentose giving velvety in touch as compared to the other collections.

19. **PONGAMIA** Vent., nom. cons.

Old World tropical regions, Monotypic.

**Pongamia pinnata** (L.) Pierre, Fl. Forest. Cochinch.: sub t. 385. 1899; Mooney, Suppl. Bot. Bihar Orissa: 56. 1950; Sanjappa, Leg. India: 230. 1992; Paria & Chattopadhyay, Fl. Hazaribagh



1: 377. 2000; N.P. Singh & al., Fl. Bihar: 153. 2001. *Cytisus pinnatus* L., Sp. Pl. 2: 741. 1753. *Pongamia glabra* Vent., Jard. Malmaison 1: t. 28. 1803; Baker in Hook.f., Fl. Brit. India 2: 240. 1876; Haines, Forest Fl. Chota Nagpur: 333. 1910 & Bot. Bihar Orissa: 299. 1922. **Plate 20C**

Vern. Name: *Karanj* (Hindi).

Tree, to 15 m high, much branched. Bark soft, greyish-brown. Leaves compound, 9.5–25 cm long; petioles 3.5–6 cm long; stipules oblong, 1.8–2 mm long, obtuse at apex, caducous; leaflets imparipinnate, 5–7, opposite, ovate or broadly elliptic, 3–7 × 2.2–5.5 cm obtuse-cuneate at base, entire at margins, acuminate at apex, glabrous, glossy above; petiolules 5–7 mm long. Inflorescences panicles, axillary, lax, c. 12 cm long. Flowers 2–4 in fascicles; rachis puberulous; pedicels c. 5–10 mm long, pubescent; bracts lanceolate, c. 5 mm long, sparsely puberulous, caducous; bracteoles ovate, acute at apex, pubescent. Calyx c. 6 mm long, truncate or obscurely toothed, brown-pubescent, purplish. Corolla c. 1.2 cm long, pinkish white; standard suborbicular, 0.8–1.2 cm across, short-clawed and appendiculate at base, emarginate at apex; wings oblong, c. 1.2 × 0.4 cm, adhering to keel; keels falcate, c. 1 × 0.3 cm, truncate at apex, adhering apically. Stamens 10, diadelphous; vexillary stamen distinct, others connate; filaments c. 3 mm long; anthers uniform. Ovary subsessile; ovules 2; style inflexed, glabrous; stigma capitate. Pods obovoid or obliquely oblong or 4.5–6.5 × 2.5–3 cm, slightly curved, thickened at margins, apiculate at apex, glabrous, green turns brownish. Seed 1, reniform, reddish brown.

*Fl. & Fr.*: May–August.

*Habitat*: Planted along the roads and also naturalised.

*Distribution*: KWLS: RFO office forest areas and NH-31; common. INDIA: Throughout. WORLD: Australia, Bangladesh, Malaysia, Micronesia, Polynesia, Pakistan and Sri Lanka.

*Specimen examined*: RFO office forest areas, NH-31, 401 m, 24°28'46.5" N, 85°35'57.3" E, 20th August 2011, *Shyam Biswa* 49844.

## 20. **PTEROCARPUS** Jacq., nom. cons.

Tropical regions, c. 35 species, 5 in India, 1 in Jharkhand.

**Pterocarpus marsupium** Roxb., Pl. Coromandel 2(1): 9, t. 116. 1799 & Fl. Ind. 3: 234. 183; Baker in Hook.f., Fl. Brit. India 2: 239. 1876; Haines, Forest Fl. Chota Nagpur: 334. 1910 & Bot. Bihar Orissa: 297. 1922; Sanjappa, Leg. India: 232. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 378. 2000; N.P. Singh & al., Fl. Bihar: 153. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 81. 2014.

Vern. Names: *Bijasal*, *Paisar*, *Piasal*; *Bia* (Kharwari).

Tree, 15–20 m high, deciduous. Bark thick, yellowish grey; branches widely spreading. Leaves 15–24 cm long; rachis glabrous, prolonged 2–2.5 cm beyond the insertion of upper lateral leaflet; leaflets 5–7, distinctly alternate, ovate-elliptic, 7.2–11 × 5.2–7.5 cm, subcuneate at base, entire at margins, obtuse, rounded or retuse at apex, coriaceous, glabrous, shining above, slightly glaucous beneath; lateral veins numerous, close, prominent; petiolules 6–10 mm long. Racemes or panicles axillary and terminal; bracts and bracteoles small, caducous. Flowers 1.3–1.5 cm long; pedicels 1.2–1.5 mm long, articulate beneath the flower. Calyx 5-toothed, c. 6 mm long, teeth short, broadly triangular, brown-pubescent. Standard ovate to orbicular c. 1.1 cm broad, with a long

claw, golden-yellow; wing oblong to suborbicular *c.* 8 mm long, claw long, yellow; keel oblong, *c.* 6 mm long, claw long, yellow. Stamens monadelphous or staminal sheath finally split into 2 bundles of 5 stamens each; staminal-tube to 0.5 cm long; filaments of unequal length; anthers to 0.5 cm long, versatile, dehiscing longitudinally. Ovary shortlstalked; 2-ovuled; style filiform, slightly incurved; stigma small, terminal. Pods suborbicular, *c.* 3.5 cm across, glabrous; wing veined, stipe 4–5 mm long. Seed 1, oblong-subreniform.

*Fl. & Fr.*: October – January.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; common. INDIA: Bihar, Peninsula and Uttar Pradesh. WORLD: Indo-Sri Lanka.

*Specimen examined*: Taraghati forest, 320 m, 24°32'.321" N, 85°35'.060" E, 27th September 2013, *Shyam Biswa* 54183.

## 21. PUERARIA DC.

Tropical regions, and East Asia, 17 species, 7 in India, 2 in Jharkhand and 1 in KWLS.

***Pueraria tuberosa*** (Roxb. ex Willd.) DC., Ann. Sci. Nat. Paris 4: 97. 1825 & Prodr.2: 240. 1825; Baker in Hook.f., Fl. Brit. India 2: 197. 1876; Haines, Forest Fl. Chota Nagpur: 323. 1910 & Bot. Bihar Orissa: 281. 1922; Sanjappa, Leg. India: 235. 1992; N.P. Singh & al., Fl. Bihar: 154. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 214. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 82. 2014. *Hedysarum tuberosum* Roxb. ex Willd., Sp. Pl. 3(2): 1197. 1803.

### Fig. 20

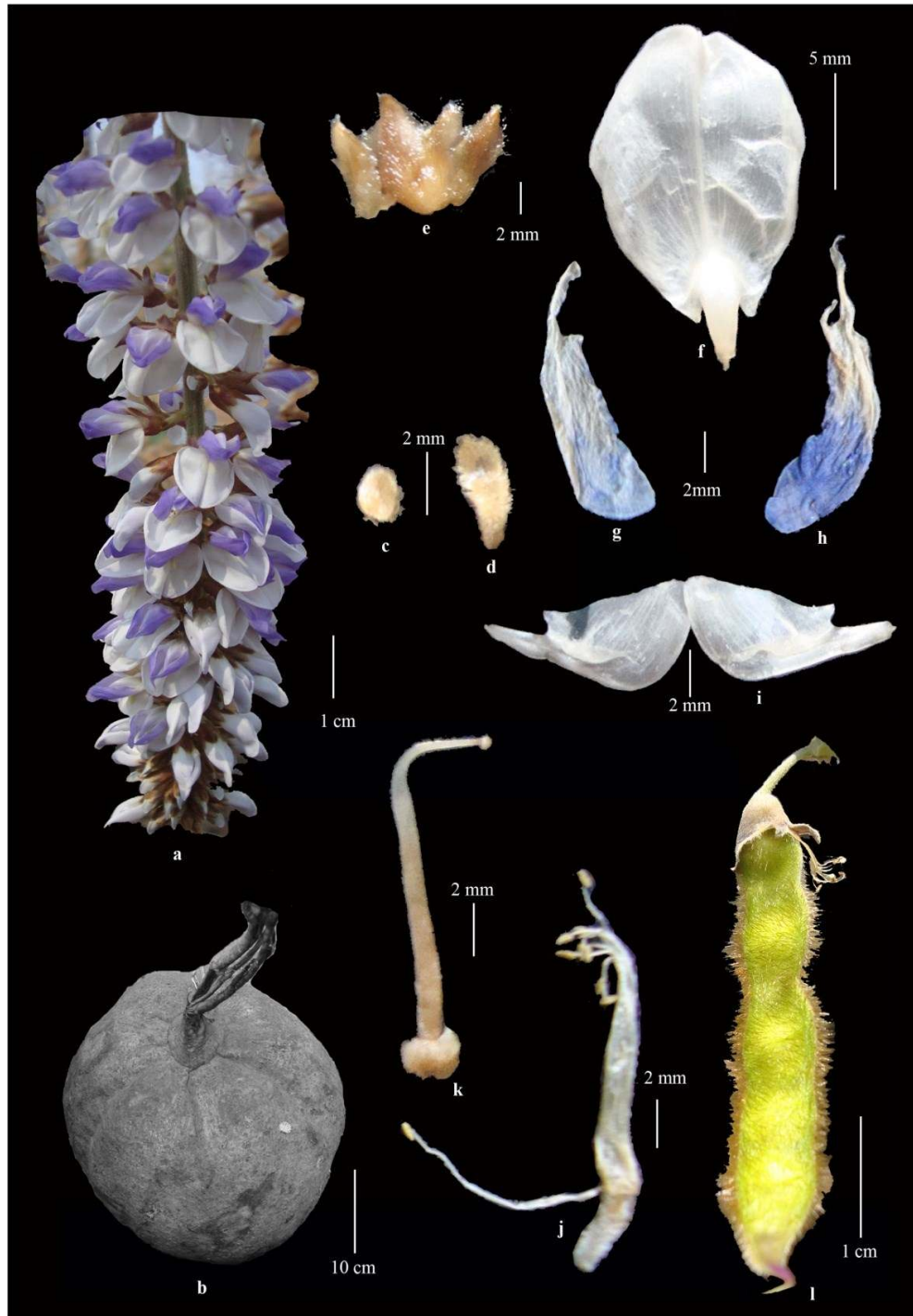
Climber, woody, flowering when leafless looks very beautiful. Tubers large several attached to the base of the stem by stout lateral roots and again ending in roots, globose shaped. Leaves compound, alternate, 3-foiolate; stipules *c.* 5 mm long; leaflets: terminal leaflet broadly ovate, rhomboid longer than broader, lateral leaflet ovate-oblong, oblique, 10–18 × 8–15 cm, cuneate or obtuse at base, entire at margins, acuminate at apex, pubescent beneath, glabrescent above; stipels small. Panicles racemes, 1.4–1.8 cm long. rachis or branches, white silk hairy. Flowers 1.4–1.8 cm long, fascicled on the tumid nodes; pedicels 2–7 mm long. Bracteoles / Epicalyx -2, orbicular *c.* 2 × 2 mm, attached opposite at base of the calyx, ciliate, Calyx 4-lobed, 7–8 mm long, green, brownish cilliate. Standard orbicular 1.3–1.5 × 0.9–1.2 cm, clawed, emarginated at apex, white with bluish ting, slightly spurred sides often revolute; wings of corolla falcately oblong 1.2–1.4 × 0.4–0.5 cm with spur; keel oblong, 1–1.2 × 0.3–0.4 cm, spurred, free, clawed, white. Stamens diadelphous 9+1, 1–1.2 cm long anthers uniform, vexillary stamen slightly connate. Carpel 8–10 mm long, ovary silky, style 3–4 mm long, puberous, stigma capitellate. Pod 1.5–4 × 0.3–0.7 cm, densely brown bearded on the sutures and densely appressed hair on the faces.

*Fl. & Fr.*: March – April.

*Habitat*: Near the river of dry deciduous mixed forests.

*Distribution*: KWLS: Bholaghat jungle, few places. INDIA: almost throughout. WORLD: Pakistan, Nepal.

*Specimen examined*: Bholaghat jungle, 412 m, 24°30'14.1" N, 85°37'19.8" E, 30th March 2013, *Shyam Biswa* 54126.



**Fig. 20.** *Pueraria tuberosa* (Roxb. ex Willd.) DC.: a. flowering twig; b. tuber; c.,d. bracteoles; e. calyx; f. standard petal; g.,h. wing petals; i. keel petal; j. staminal column; k. carpel; l. pods.

*Note:* Bracteoles / Epicalyx like two roundish  $c.2 \times 2$  mm, ciliate on opposite side attached at base of the calyx. This characteristic feature has not been noted in any literature.

## 22. **SMITHIA** Aiton, nom. cons.

Old World tropical regions, especially Asia & Madagascar, *c.*20 species, 18 in India, 3 in Jharkhand and 1 in KWLS.

**Smithia conferta** Sm., in Rees, Cycl. 33: n. 2. 1816; Haines, Bot. Bihar Orissa 253. 1922; Mooney, Suppl. Bot. Bihar Orissa: 49. 1950; Sanjappa, Leg. India: 246. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 382. 2000; N.P. Singh & al., Fl. Bihar: 157. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 84. 2014. *Smithia geminiflora* Roth, Nov. Pl. Sp. 352. 1821; Baker in Hook.f., Fl. Brit. India 2: 149. 1876, *incl.* vars.

**Plate 20D**

Herb 20–40 cm high, stem branched, ribbed, glabrous, rough. Leaves compound, even pinnate 0.2–1.1 cm long; stipules spurred below point of insertion, scarious persistent usually appendaged at the base. Leaflets linear-oblong,  $5-6 \times 1-2$  mm, acute or narrow at base, entire at margins, rounded at apex, setose along the rachis, midrib and margin, rachis ending in a bristle. Flowers *c.* 12 mm long, clustered in the axils of the close set terminal leaves of short lateral shoots, subsessile 2–7 together; bracts and bracteoles resembling the calyx in texture; bracteoles obovate obtuse  $3-4 \times 2-3$  mm ending in a long bristle. Calyx deeply 2-lipped, ovate or elliptic  $2-8 \times 3-4$  mm scarious with numerous close parallel veins with a few bristles along midrib of the upper surface and apex. Standard broadly oblong  $8-9 \times 3-4$  mm, narrow at base, emarginated at apex, yellow, wings oblong  $6-7 \times 1-1.5$ , clawed, translucent, whitish yellow; keel oblong  $6-7 \times 1-2$  mm, yellow. Stamens 5+5, staminal sheath 5.5–6.5 mm long, filiform filament *c.* 2 mm long, anther *c.* 0.5 mm, yellowish basifixed. Disk annular, ovary 5–6 mm long, many ovuled, deeply jointed, style filiform *c.* 3 mm long, stigma small. Pods moniliform, the joints connected by the dorsal suture only. Seeds reniform, angular or roundish 1–2 mm long, with lenticels or starch granules looks dotted on surface of the seeds.

*Fl. & Fr.:* November –February.

*Habitat:* Near or on the lakes or ponds.

*Distribution:* KWLS: Near Rheio Ghoghar Dam, Chattarbar; not common. INDIA: Throughout from Himalayas southwards. WORLD: Australia, Burma, Cambodia, China, Indonesia, Laos, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimens examined:* Near Rheio Ghoghar Dam, Chattarbar, 379 m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E, 26th February 2012, *Shyam Biswa* 54003; Near Rheio Ghoghar Dam, Chattarbar, 379m,  $24^{\circ}27'50.0''$  N,  $85^{\circ}33'00.0''$  E, 29th November 2012, *Shyam Biswa* 54098.

*Note:* Seeds with lenticels or starch granules looks dotted on surface of the seeds.

## 23. **SPATHOLOBUS** Hassk.

South-east Asia to central Malesia, 29 species, 3 in India, 1 in Jharkhand.

**Spatholobus parviflorus** (Roxb. ex DC.) Kuntze, Revis. Gen. Pl. 1: 205. 1891; Sanjappa, Leg. India: 151. 1992; N.P. Singh & al., Fl. Bihar: 158. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 84. 2014. *Butea parviflora* Roxb. Fl. Ind. 3: 248. 1832; Haines, Bot. Bihar Orissa 281. 1922. *Spatholobus roxburghii* Benth. ex Baker in Hook.f., Fl. Brit. India 2: 193. 1876; Haines, Forest Fl. Chota Nagpur: 331. 1910.

**Plate 20E**



Climber, twining, Stem terete, woody. Leaves compound, alternate, pinnately tri-foliolate; petioles 3.5–19 cm long swollen at base; leaflets imparipinnate, terminal leaflet rhomboid, lateral leaflet broadly ovate, 6–17.5 × 4–11.5 cm, cuneate and lateral ones asymmetric at base, entire at margins, acute to acuminate at apex, pubescent at both surfaces; petiolules 5–7 mm long, swollen. stipels linear 3–4 mm long, deciduous. Raceme large terminal and axillary panicles. Flowers *c.* 8–10 mm long; pedicels 1–1.5 mm long; bracts orbicular, 2–3 mm, densely hairy. Calyx 6–8 mm, divided to middle into lanceolate teeth, densely pale pubescent. Standard obovate 3.5–4 × 3–4 mm long, cream-coloured, densely silky; wing oblong, 2–3 × 1–1.5 mm, cream-coloured, silky; keel oblanceolate or oblong 1.5–2 × 1 mm, cream-coloured. Stamens monadelphous; filaments filiform *c.* 1–1.5 mm long, anthers *c.* 1 mm. Pods oblong not septate, 6.5–11 × 2–3.2 cm, brownish-pink, margins thickened, velvety roundish at apex flat with a orbicular terminal end.

*Fl. & Fr.*: February–March.

*Habitat*: Dry deciduous and mixed deciduous forests.

*Distribution*: KWLS: Bagitan jungle, Koderma NRF; Near Dhanarjay Nadi, Meghatari; common. INDIA: Throughout upto 1500 m. WORLD: Bangladesh, Bhutan, Burma, Cambodia Indonesia, Laos Nepal Sri Lanka, Thailand and Vietnam.

*Specimens examined*: Bagitan jungle, Koderma NRF, 389 m, 24°29'05.7" N, 85°36'04.3" E, 1st March 2011, *Shyam Biswa* 49648; Near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 2nd March 2012, *Shyam Biswa* 54055.

#### 24. **TEPHROSIA** Pers., nom. cons.

Tropical regions, *c.* 350 species, 27 in India, 7 in Jharkhand and 1 in KWLS.

**Tephrosia pumila** (Lam.) Pers., Syn. Pl. 2(2): 330. 1807; Haines, Bot. Bihar Orissa 244. 1922. Sanjappa, Leg. India: 257. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 383. 2000; N.P. Singh & al., Fl. Bihar: 158. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 218. 2002. *Galega pumila* Lam., Encycl. 2(2): 599. 1788. *Tephrosia purpurea* (L.) Pers. var. *pumila* (Lam.) Baker in Hook.f., Fl. Brit. India 2: 113. 1876.

Herb, perennial, suberect, suffrutescent, 22–60 cm high. Stems much-branched, spreading, glabrous or sparsely pilose. Leaves compound alternate, 4–8 cm long; petioles 0.5–1.5 cm long; stipules linear, 3–5 mm long; leaflets 5–10 pairs, elliptic or elliptic-oblong 0.6–2 × 0.1–0.5 cm, cuneate at base, entire at margins, rounded and mucronate at apex, glabrous above, appressed silky-hairy beneath; lateral veins 7–12 pairs, striate; petiolules 0.5–2 mm long. Racemes lax, lower flowers usually fascicled. Flowers 7–13 cm long, leaf-opposed; pedicels slender, 2.5–4 mm long; bracts subulate, 1–2 mm long. Calyx 2.5–4 mm long, thin-silky; teeth triangular, *c.* 2.5 mm long. Standard orbicular, 8–8.5 mm, sericeous bluish pink to purple; wings *c.* 7.5 × 3 mm, purple; keels *c.* 6.5 × 2.5 mm, purple. Staminal sheath 4.5–5 mm long, filaments of unequal length, *c.* 0.15 cm long; anthers *c.* 0.05 cm long. Ovary appressed-pubescent; style *c.* 3 mm long, glabrescent; stigma penicillate. Pods linear-ellipsoid or strap-shaped, 4–6 × 0.4–0.5 cm, slightly falcate, mucronate, at first thin-hairy, glabrescent later. Seeds 6–10, ovoid, 3–3.5 mm long.

*Fl. & Fr.*: February–March.

*Habitat*: On shady area of the Dry deciduous forests.

*Distribution:* KWLS: Near Meghatari Rest House, common. INDIA: Throughout up to an altitude of 1350 m. WORLD: Tropical Africa, Arabia, Indonesia, Central America, Madagascar, Malaysia, Mauritius, Philippines, Sri Lanka, Thailand, West Indies.

*Specimen examined:* Near Meghatari Rest House, 190 m, 24°34'39.6" N, 85°34'37.6" E, 9th March 2011, *Shyam Biswa* 53907.

## 25. **VIGNA** Savi, nom. cons.

Tropical regions Old World, c. 104 species, 24 in India, 11 in Jharkhand and 1 in KWLS.

**Vigna vexillata** (L.) A. Rich., Hist. Fis. Cuba 10: 191. 1845; Baker in Hook.f., Fl. Brit. India 2: 206. 1876; Haines, Forest Fl. Chota Nagpur: 328. 1910 & Bot. Bihar Orissa 290. 1922; Sanjappa, Leg. India: 277. 1992; N.P. Singh & al., Fl. Bihar: 165. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 87. 2014. *Phaseolus vexillatus* L., Sp. Pl. 2: 724. 1753. **Plate 20F**

Climber, twining, slender. Stems and branches ribbed, thorny, thorns reddish c. 1 mm long. Leaves compound, alternate; petioles 2.5–5 cm long, hairy, winged at base only; stipules ovate-lanceolate, 3–5 × 1–2 mm, auriculate or bilobed at base. Leaflets central leaflet is larger as compared to lateral two, ovate-lanceolate, 7–12 × 2.5–4 cm, rounded at base, entire at margins, acuminate at apex, appressed brownish pubescent, hair longer on veins, stipels linear-lanceolate, 5–6 mm long; petiolule of central leaflet 1–1.2 cm long, petiolule of lateral leaflet c. 1–2 mm long. Racemes 1–3-flowered, 5–30 cm long; Flowers c. 3 cm long, peduncle 2.5–15.5 cm long; bractiole linear c. 4 mm long. Calyx 10–12 mm, divided to middle into slender teeth. Standard obovate c. 2 × 2.5 cm, white or light purplish, wing blade 15 × 10 mm, white or light purplish, keel 4–5 mm broad, white or light purplish. Pods 5–10 × 0.5 cm, brown, hirsute at first. Seeds 10–20, reniform, 3–4 × 2 mm, black.

*Fl. & Fr.:* September–October.

*Habitat:* Dry deciduous forests of on open forests.

*Distribution:* KWLS: Inside the enclosure forest Koderma NRF, common. INDIA : Almost throughout. WORLD: Pantropical, Bangladesh, Bhutan, Burma, Nepal, Pakistan, Sri Lanka

*Specimen examined:* Inside the enclosure forest Koderma NRF, 390 m, 24°29'18.7" N, 85°35'50.1" E, 16th September 2010, *Shyam Biswa* 49630.

## 26. **ZORNIA** J. Gmelin.

Subtropical regions, c. 75 species, 3 in India, 1 in Jharkhand.

**Zornia gibbosa** Span., Linnaea 15: 192. 1841. Mohlenbr., Webbia 16: 139. 1961. *Zornia angustifolia* Sm. in Rees, Cyclop. 39: 200. 1819 nom. illeg. *Zornia graminea* Span., Linnaea 15: 192. 1841. **Plate 20G**

Herb, 10–25 cm high; rootstock woody. Stems terete. Leaves, compound, bi-foliolate; petioles 0.5–1.5 cm long; stipules 2 opposite to each other, linear or linear lanceolate, 1 cm long, acuminate at apex, persistent; leaflets lanceolate, linear-lanceolate or ovate-lanceolate 1–2.5 × 0.1–0.6 cm, cuneate at base, entire at margins, acuminate at apex, hairy beneath; petiolules c. 1 mm. Racemes 5–15 cm, bracts/bracteoles ovate-lanceolate 8–10 × 2–3 mm, pink gland-dotted (oil glands), margins ciliate, apiculate at apex, pellucid punctate. Flowers c. 4 mm long; pedicels 3–5 mm long. Calyx 2–2.5 mm long. Standard spatulate, 3–4 × 2–2.2 mm, with a long claw, yellow; wings oblong, 3–4 × 0.5–1 mm with a long claw; keels arrowly oblong, 3–4 × 0.5–0.8

mm, with long claw curved. Staminal sheath 2–2.5 mm long alternating with a long filament and rounded anthers and short filament and elongated anthers. Ovary *c.* 2.5 mm long; style *c.* 2 mm long, stigma capitate. Pods 15 × 2–2.5 mm, finely reticulate, septate, with spines all over, spines *c.* 1 mm long, indehiscent, 3–5 seeded.

*Fl. & Fr.*: September–October.

*Habitat*: On the grassland of Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; not common. INDIA: North India and Assam. WORLD: South Asia, China, Indo-China, Malesia and Australasia.

*Specimen examined*: Taraghati forest, 320 m, 24°32'.321" N, 85°35'.060" E, 27th September 2013, *Shyam Biswa* 54171.

## II. LEGUMINOSAE: CERCIDOIDEAE (12 genera, *c.* 335 species)

- |                                                        |                       |
|--------------------------------------------------------|-----------------------|
| 1a. Disk absent                                        | 2                     |
| 1b. Disk present                                       | <b>2. Phanera</b>     |
| 2a. Calyx splitting to mouth of hypanthium at anthesis | <b>1. Bauhinia</b>    |
| 2b. Calyx splitting only in the upper part at anthesis | <b>3. Piliostigma</b> |

### 1. BAUHINIA L.

Pantropical regions, *c.* 150 species, 18 in India, 8 in Jharkhand and 2 in KWLS.

#### Key to Species

- |                                             |                       |
|---------------------------------------------|-----------------------|
| 1a. Fertile stamens 3; pods dehiscent       | <b>1. B. purpurea</b> |
| 1b. Fertile stamens 4 or 5; pod indehiscent | <b>2. B. racemosa</b> |

**1. Bauhinia purpurea** L., Sp. Pl. 1: 375. 1753; Baker in Hook.f., Fl. Brit. India 2: 284. 1878; Haines, Forest Fl. Chota Nagpur: 329. 1910 & Bot. Bihar Orissa: 310. 1922; Sanjappa, Leg. India: 5. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 290. 2000; N.P. Singh & al., Fl. Bihar: 167. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 227. 2002; Bandyop. & al., J. Econ. Taxon. Bot. 29: 781, f. 11. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 88. 2014.

**Plate 21B**

Vern. Names: *Kaliari* (Hindi); *Kondar*.

Tree 4–5 m high. Bark intact brownish. Leaves simple, alternate, ovate to suborbicular 9–9.5 × 3.5–10 cm, deeply cordate at base, entire at margins, 1/4 or 1/2 bifid at apex, lobes rounded to subacute at apex, veins 9–13 from base raised beneath, scabrid beneath, glabrous above; petioles 1.5–3 cm long, puberulous; stipules 2.5–3 mm long. Racemes panicle, terminal or lateral, short-peduncled, few-flowered. Buds clavate, sharply 4 or 5-angled towards apex; flowers 9–10 cm broad, sweet fragrant, hairy; receptacles 7–12 mm long; bracts and bracteoles ovate, 1–2 mm long, olivaceous-tomentose; pedicel 2–2.5 cm long. Sepals coherent to a spathaceous limb, 3–3.5 cm long pinkish green, thick, jointed together at tip velvety outside. Petals 3+2, oblanceolate 4–5.5 × 1–1.3 cm, long-clawed, obtuse at apex, light pink with mid vein dark pinkish. Fertile stamens 3, 5–6 cm, light pinkish, anthers 7 × 3 mm, anthers dorsifixed, versatiles, staminodes 5 or 6, hair-like 0.5–1 cm. Carpel 7.5 cm long soft silky hair all over tips roundish Ovary olivaceous-tomentose on sutures; stipe long; stigma globular *c.* 4–5 mm. style 5–6 cm long,

glabrous. Pods strap-shaped, 25–29 × 2.5–3 cm, greenish-brown, flat, thick, not-septate. Seeds 12–20, orbicular, 4.5–5 mm.

*Fl. & Fr.*: October–November.

*Habitat*: Near the road of Dry deciduous forests.

*Distribution*: KWLS: Lokai near Birhore Tola; common. INDIA: Throughout. WORLD: Bhutan, China, Nepal and Southeast Asia.

*Specimen examined*: Lokai near Birhore Tola, 399 m, 24°29'01.4" N, 85°36'52.9" E, 22nd November 2012, *Shyam Biswa* 54077.

**2. *Bauhinia racemosa* Lam.**, *Encycl.* 1(2): 390. 1785; Baker in Hook.f., *Fl. Brit. India* 2: 276. 1878; Haines, *Forest Fl. Chota Nagpur*: 295. 1910 & *Bot. Bihar Orissa*: 308. 1922; Sanjappa, *Leg. India*: 5. 1992; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 291. 2000; N.P. Singh & al., *Fl. Bihar*: 167. 2001. **Plate 21C**

Vern. Names: *Katmouli*, *Kathul* (Kharwari).

Tree to 5 m high. Leaves simple, alternate, reniform, 1.5–6.5 × 2.6–9.5 cm, deeply cordate at base, entire at margins, to *c.* 1/3 bifid into obtuse lobes at apex, mucronate at centre, 9–11 veins at base, glabrous above, villose beneath; petioles 1–4 cm long, swollen at both ends, villose; stipules narrowly ovate, *c.* 2 mm long, densely pubescent outside. Racemes terminal, axillary, or leaf opposed, 5.5–25 long. Flowers 0.8–2 cm across, bisexual or sometimes female; pedicels 0.5–1 cm long; bracts narrowly ovate, pubescent; bracteoles minute. Calyx spathaceous. Petals oblanceolate to narrowly-oblong 0.7–1.5 × 0.1–0.3 mm, subacute at apex, white; claw 2–5 mm long. Bisexual flowers: fertile stamens 10 filaments 0.4–1 cm long, white, anthers oblong, 2–3 mm long, dorsifixed. Gynophore *c.* 1 mm long, pubescent, ovary 3–3.5 mm long green, glabrous to pubescent, style very short, stigma scarcely differentiated from style. Female flowers: reduced stamens 10, filaments as in bisexual flowers but smaller, anthers as in bisexual flowers but much smaller and pubescent. Ovary as in bisexual but 5–6 mm long. Pods narrowly oblong, 20–25 × 2–2.5 cm, curved with wavy margins, glossy slightly torulose short beak, upto 20 seeded. Seeds ovate rectangular 1 × 0.5 cm, shiny, yellowish dark brownish.

*Fl. & Fr.*: September–March.

*Habitat*: On the hill slopes of dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; Muglamaram forest; not common. INDIA: Peninsular & NE India to Punjab, Rajasthan. WORLD: Bangladesh, Burma, China, Indo-China, Pakistan, Sri Lanka, Thailand - also cultivated.

*Specimens examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49587; Muglamaram forest, 381 m, 24°30'56.7" N, 85°34'33.4" E, 4th March 2011, *Shyam Biswa* 49663.

## 2. PHANERA Lour.

Tropical regions, *c.* 125 species, 11 in India and 1 in Jharkhand.

### Key to species

1a. Trees or erect shrubs, branches without tendrils

**1. *P. roxburghiana***

1b. Climbing shrubs or lianas, branches bearing tendrils

**2. *P. vahlii***



**Phanera roxburghiana** (Voigt) Bandyop., Anand Kumar & Chakrab. Ann. Bot. Fenn. 58(4-6): 381. 2021. *Bauhinia retusa* Roxb., (Hort. Bengal. 31. 1814, nom. nud.) Fl. Ind. 2: 322. 1832, non Poir. 1811, nec Roxb. ex DC. 1825; Baker in Hook.f., Fl. Brit. India 2: 279. 1878. *Bauhinia roxburghiana* Voigt, Hort Suburb. Calcutt. 254. 1845; K. Larsen & S. Larsen, Taxon 28: 591. 1979, p.p.; Panigrahi, Taxon 35: 162. 1986; Sanjappa, Leg. India: 5. 1992. *Bauhinia emarginata* Roxb. ex G. Don, Gen. Hist. 2: 462. 1832, non Mill. 1768 non Jack 1822. *Phanera retusa* Benth. in Miq., Pl. Jungh. 263. 1852. **Plate 22A, B & C**

Vern. Name: *Katmoli*.

Tree to 5 m high. Leaves simple, alternate, reniform, 6–10.5 × 8–13.5 cm sub-cordate to truncate at base, entire at margins, retuse at apex, with or without mucronate at centre, 8–11-veined at base, glabrous; petioles 4–7.5 cm long, swollen at both ends; stipules oblong to ovate, to 1.2 × 0.5 cm, green, scarlet at margins. Racemes corymbose, terminal or axillary, 12–28 × 12–22 cm, compound. Flower buds ovate, c. 5 × 4 mm; flowers bisexual, 1.5–2 cm across. Receptacles turbinate, c. 1.5 mm long; pedicels 1 to 1.5 cm long; bracts narrowly ovate, pubescent; bracteoles similar, situated above the middle of pedicel. Calyx 2 or 3-lobed, 5–7 × 4–5 mm light green or yellowish. Petals oblong to suborbicular, 7–8 × 4–5 mm, obtuse at apex, yellowish-green with red spots; claw 1–3 mm long. Fertile stamens 3. Curved inward c. 0.5–1 cm long; filaments 0.8–1 cm long, light yellowish green; anthers ellipsoid, 2–2.5 mm long, dorsifixed, reddish-yellow. Staminodes-2, c. 2 mm long, c. 1 mm across at swollen base, fleshy, bright yellow. Disk cushion-shaped; style 5–8 mm long. Ovary 5–6 mm long, reddish, pubescent mainly along the sutures; stipes 2–3 mm long; style 4–5 mm long, curved; stigma subcapitate, minute. Pods oblong, 19 × 4.5 cm compressed, sometimes wavy at margins, acuminate at apex, reddish till ripe, finally brown, dehiscent, the fruit after dehiscing curled to form cylindrical like shape, to 8-seeded. Seeds ovate to ovate-oblong, flattened, 1.5–1.6 × 1–1.2 cm, shiny, yellowish brown to brown, sometimes with pale black patches.

Fl.: November, Fr.: February–March.

Habitat: Dry deciduous and mixed forests.

Distribution: KWLS: Phoolwarya forest road; common; INDIA: Bihar, Himachal Pradesh, Odisha, Punjab and Uttar Pradesh. WORLD: Nepal and Pakistan.

Specimen examined: Phoolwarya forest road, 392 m, 24°29'20.3" N, 85°35'46.5" E, 20th November 2012, Shyam Biswa 54062.

**Phanera vahlii** (Wight & Arn.) Benth., in Miq. Pl. Jungh. 2: 263, adnot. 1852. *Bauhinia vahlii* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 297. 1834; Baker in Hook.f., Fl. Brit. India 2: 279. 1878; Haines, Forest Fl. Chota Nagpur: 297. 1910 & Bot. Bihar Orissa: 310. 1922; Sanjappa, Leg. India: 6. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 293. 2000; N.P. Singh & al., Fl. Bihar: 168. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 228. 2002; Bandyop. & al., J. Econ. Taxon. Bot. 29: 792, f. 18A, B. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 89. 2014. **Plate 21D**

Vern. Names: *Mahu*, *Malian* (Hindi); *Choup*.

Climber/lianas, large with tendrils. Shoots and young parts clothed with fulvous- or rusty-tomentose, stem woody. Leaves suborbicular, 12.5–21.5 × 15–23 cm, deeply cordate at base, entire at margins, 1/5–1/3 bifid their length into broadly obtuse at apex, lobes entire at margins,

obtuse at apex, veins 11–15 from base, prominent beneath, rigidly subcoriaceous, glabrous or nearly so above, persistently densely tomentose beneath; petioles 6–16 cm long brownish tomentose. Racemes subcorymbose, terminal, dense, long-peduncled; Flowers 3–4.5 cm across; receptacle tubular, slender, 6–8 mm long, densely villous; pedicels 2–4 cm long; bracts linear-spathulate, 3–4 mm long, ferruginous-hairy; bracteoles 2, sub-opposite, linear, densely ferruginous-hairy, persistent. Calyx 1–1.2 cm long, splitting into 2 ovate lobes. Petals obovate with crisped margins, 1.5–2 cm long, densely villous on back, white. Fertile stamens 3; filaments *c.* 3 cm long, white, shortly connate at base, villous at base, anthers oblong *c.* 5 mm long, reduced stamens 2 shorter than the fertile stamens; staminodes 3–5. Ovary densely tomentose; style *c.* 2 mm long, hairy; stigma *c.* 1 mm in diameter, capitate. Pods oblong, 21–23 × 5–9 cm, compressed, woody, densely pubescent, brown, dehiscent, 7–13-seeded; seeds ovate to orbicular, 2–3.5 × 1–2 cm, compressed, shallowly notched near hilum, dark brownish.

*Fl. & Fr.*: August–March.

*Habitat*: On the hill slopes of dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; Dengra Pahar, near RIT institute, Chattarbar; common. INDIA: Throughout Himalayas, Andhra Pradesh, Assam, Bihar, Gujarat, Maharashtra, Odisha, Punjab, Rajasthan and West Bengal. WORLD: Bhutan and Nepal.

*Specimens examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49586; Dengra Pahar, near RIT institute, Chattarbar, 443 m, 24°27'56.7" N, 85°34'23.5" E, 13th August 2011, *Shyam Biswa* 49789.

### 3. **PILIOSTIGMA** Hochst.

Old World tropical regions 5 species 2 species in India and 1 in Jharkhand.

**Piliostigma malabaricum** (Roxb.) Benth., Pl. Jungh. in Miq. 261 1852. *Bauhinia malabarica* Roxb., Fl. Ind. 2: 321. 1832; Baker in Hook.f., Fl. Brit. India 2: 1878, incl. var. *reniformis* Royle ex Baker; Haines, Forest Fl. Chota Nagpur: 329. 1910 & Bot. Bihar Orissa: 308. 1922; Sanjappa, Leg. India: 3. 1992; N.P. Singh & al., Fl. Bihar: 167. 2001; Bandyop. & al., J. Econ. Taxon. Bot. 29: 770, f. 5. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 88. 2014. **Plate 21A**

Vern. Names: *Amlosa* (Hindi); *Katmoli*.

Tree, 15–18 m high, dioecious. Leaves simple, alternate, suborbicular, 1–7.2 × 1.8–8 cm, rounded or shallowly cordate at base, entire at margins, 1/5 or 1/6 bifid at apex, mucronate at middle, 7–9-veined at base, sparsely pubescent on veins beneath as compared to *Bauhinia racemosa*, glabrous above; lobes rounded at apex; petioles, 0.8–2.5 cm long, swollen at both ends, puberulous. Racemes slender, 2–7 cm long. Flower buds ellipsoid, rounded or subacute at apex, 5–10 mm long, pubescent; flowers 1.5–2 cm long; pedicels, 0.5–1.5 cm long. Calyx 5-lobed, 8–10 mm long acute at apex, inserted on a receptacular cup of *c.* 5 mm long. Petals oblanceolate, 15–17 × 4–5 mm, white with pinkish ting at margins, turning pale yellow later. Male flowers: fertile stamens 5+5; 5 long filaments *c.* 7 mm long, inner 5- short *c.* 2–3 mm long; anthers oblong *c.* 2 mm long. Ovary rudimentary, densely pubescent. Female flowers: Staminodes 10, 0.5–1 mm long; outer whorl longer than inner, minutely swollen at apex. Ovary *c.* 9 × 1.5 mm, densely pubescent; stipe 1.5–2 mm long; style 1.5–2 mm long, densely pubescent; stigma peltate, 2–2.5 mm across, pubescent. Pods linear-oblong, *c.* 23–33 × 2–2.5 cm, acute at both ends, beaked at apex, reddish

brown, conspicuously veined when dry, *c.* 30-seeded, indehiscent or with a tendency to dehisce tardily. Seeds oblong to suborbicular, 5–7 mm across, dark brown.

*Fl.*: September–October, *Fr.*: February–March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; Taraghati forest; common. INDIA: Throughout including tropical Himalayas. World: South and Southeast. Asia.

*Specimens examined*: Muglamaram forest, 381 m, 24°30'56.7" N, 85°34'33.4" E, 4th March 2011 *Shyam Biswa* 49666; Taraghati forest, 320 m, 24°32'32.1" N, 85°35'06.0" E, 27th September 2013, *Shyam Biswa* 54182.

*Note*: Sparsely pubescent on veins beneath as compared to *Bauhinia racemosa*.

### III. LEGUMINOSAE: DETARIOIDEAE (84 genera, *c.* 760 species)

#### TAMARINDUS L.

Tropical regions, Probably monotypic (cultigen)

***Tamarindus indica*** L., *Sp. Pl.* 1: 34. 1753; Baker in Hook.f, *Fl. Brit. India* 2:273. 1878; Haines, *Forest Fl. Chota Nagpur*: 303. 1910 & *Bot. Bihar Orissa*: 311. 1922; Sanjappa, *Leg. India*: 36. 1992; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 314. 2000; N.P. Singh & al., *Fl. Bihar*: 172. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 241. 2002.

**Plate 22H**

Vern. Name: *Imli* (Hindi).

Tree 5–20 m. Leaves 6–15cm, leaflets 10–20 pairs, oblong, 0.8–1.8 × 0.3–0.7 cm, obliquely rounded at base, entire at margins obtuse, slightly emarginated at apex, veins anastomosing, glabrous. Racemes 3–15 cm long; pedicels 1–1.5 cm. Sepals oblanceolate, 10 × 4 mm, reddish outside, yellow within, receptacular cup obconical *c.* 3mm. Petals 3, 2-vestiges, yellowish with streaked red, two lateral ones oblong, *c.* 12 × 4 mm, upper one oblanceolate, *c.* 12 × 3 mm, concave. Fertile stamens 3, 12–15 mm, staminoides 6. Pods oblong, subcylindric 5.5–15 × 1.2–3 cm, curved, indehiscent, with small dotted flakes, yellowish- brown. Seeds 5–10, oblong or rhombic *c.* 2 × 1 cm, dark brownish.

*Fl. & Fr.*: August–October

*Habitat*: Dry deciduous forests or planted

*Distribution*: KWLS: Chattarbar forest; common INDIA cultivated throughout. WORLD: a native of tropical Africa.

*Specimens examined*: Chattarbar forest, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49836.

### IV. LEGUMINOSAE: CAESALPINIOIDEAE (148 genera, *c.* 4400 species; includes genera of the mimosoid clade)

#### Key to the genera

- |                                                                                    |                   |
|------------------------------------------------------------------------------------|-------------------|
| 1a. Flowers zygomorphic; petals imbricate in buds; seeds without pleurogram        | 2                 |
| 1b. Flowers actinomorphic; petals valvate in buds; seeds usually with pleurogram   | 5                 |
| 2a. Large tree; leaves 2-pinnate calyx lobes valvate; petals fringed along margins | <b>5. Delonix</b> |
| 2b. Small tree or shrubs; leaves 1-pinnate; calyx lobes imbricate; petals entire   | 3                 |
| 3a. Trees; inflorescence in drooping racemes; pods cylindric more than 20 cm long  | <b>3. Cassia</b>  |

- 3b. Undershrubs or shrubs inflorescence in axillary racemes; pod compressed or subterete, less than 15 cm long 4
- 4a. Bracteoles present; androecium actinomorphic pods elastically dehiscent **4. Chamaecrista**
- 4b. Bracteoles absent; androecium zygomorphic; pods indehiscent **10. Senna**
- 5a. Stamens 5–10; anthers gland-tipped **6. Dichrostachys**
- 5b. Stamens 10 or more; anthers not gland-tipped; 6
- 6a. All flowers of head apparently alike, filaments free 7
- 6b. Central flower of head unlike others, slightly larger; filaments more or less connate **2. Albizzia**
- 7a. Stamens definite as many or twice as many as petals 8
- 7b. Stamens indefinite often numerous 9
- 8a. Plants unarmed; peduncles 2–5 cm long; pods straight, with continuous valves dehiscing through sutures **7. Leucaena**
- 8b. Plant bearing stipular spines or scattered prickles; peduncles 1–3.5 cm long; pod slightly curved divided transversely into 1-seeded segments, and always indehiscent persistent sutures **8. Mimosa**
- 9a. Plant unarmed, leaves transformed into phyllodes **1. Acacia**
- 9b. Plant armed leaves pinnate not transformed into phyllodes 10
- 10a. Plant armed with prickles but lacks stipular spines **9. Senegalia**
- 10b. Plant armed lacks prickles but with stipular spines **11. Vachellia**

### 1. ACACIA Mill.

Madagascar, Asia, Pacific, c. 1075 species, 92 in India, 1 in Jharkhand and KWLS.

**1. Acacia auriculiformis** A. Cunn. ex Benth., London J. Bot. 1: 377. 1842; Haines, Bot. Bihar Orissa: 330. 1922; Sanjappa, Leg. India: 45. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 277. 2000; N.P. Singh & al., Fl. Bihar: 177. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 165. 2002. **Plate 23A**

Tree, 5–8 m high; unarmed, bark smooth, white. Branchlets slightly angular, glabrous, glaucous. Phyllodes simple, alternate, sickle shaped or falcate-oblong, 8–14.5 × 1.4–3.5 cm, attenuate at base, entire at margin, acute to rounded at apex, laterally compressed with 3 prominent sub-parallel principal veins, glabrous, glossy; petioles 3–7 mm long glabrous. Inflorescences elongated spikes, axillary, 3.5–7 cm long, slender. Flowers 2–2.5 mm across. Calyx 0.5–0.6 mm long, minutely toothed. Petals 5, lanceolate, 2–3 × 0.5–1 mm, spreading, yellow. Stamens numerous; filaments 3–4 mm, basally united. Ovary subsessile, globose, c. 1 mm, pubescent; style c. 4 mm long. Pods 5–10 × 1–1.5 cm, spirally twisted, hard, woody much twisted with outer edge often sinuate, 4–6 seeded. Seeds oval or roundish, 5–6 × 4–5 mm, glossy smooth, brownish, attached with a linear long yellowish arillode/funicle.

*Fl. & Fr.*: November–March.

*Habitat*: Near the lake dry deciduous forests.

*Distribution*: KWLS: Lokai forest; very common. INDIA: Throughout. WORLD: Native of Australia.

*Specimens examined*: Lokai forest, 390 m, 24°29'02.9" N, 85°37'04.4" E, 28th February 2011, *Shyam Biswa* 49636; Near Rheio Ghoghar Dam, Chattarbar, 379m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 54104.



## 2. **ALBIZIA** Durazz.

Tropical regions, *c.* 130 species, *c.* 20 in India, 5 in Jharkhand and 2 in KWLS.

### Key to species

- 1a. Leaf rachis with a gland beneath the uppermost pair of pinnae and at the base; pinnae paripinnate 2–4 rarely 5 pairs; leaflets 3–10 pairs, oblong 3.3–3.6 long; pods linear-oblong, light yellowish brown, without beak; seed suborbicular *c.* 8 × 6 mm

#### 1. **A. lebbeck**

- 1b. Leaf rachis glabrescent, with a large gland near petiole base; pinnae 3–6 pairs with usually a gland between leaflets in upper 1–3 pairs; leaflets 4–6 pairs, rhomboid or rhomboid-oblong, 3–5.2 long; pods strap-shaped, reddish, apex acuminate or with a beak; seeds *c.* 1 cm

#### 2. **A. procera**

**1. *Albizia lebbeck*** (L.) Benth. in Hook., London J. Bot. 3: 87. 1844, p.p. '*lebbek*' & Trans. Linn. Soc. London 30: 562. 1875, p.p.; Baker in Hook.f., Fl. Brit. India 2: 298. 1878; Haines, Forest Fl. Chota Nagpur: 291. 1910 & Bot. Bihar Orissa 332. 1922; Sanjappa, Leg. India: 56. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 282. 2000; N.P. Singh & al., Fl. Bihar: 180. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 169. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 92. 2014. *Mimosa lebbeck* L., Sp. Pl. 1: 516. 1753. var. **lebbeck**

Vern. Name: *Aanjan*.

Tree, 10–30 m high, bark rough and rugose. Leaves compound, alternate, 8–15 cm long, rachis with a gland beneath the uppermost pair of pinnae and at the base; pinnae paripinnate 2–4 rarely 5 pairs, pinnae 7–17 cm long; leaflets 3–10 pairs oblong 3.3–3.6 × 1.6–1.9 cm, rounded or asymmetric at base entire at margins, rounded or emarginated at apex, puberulous both surface; petiolules 1–2 mm long. Flowers in globose head sessile, rarely subtended by bracts on 1–3 nate peduncles (which are either axillary or in the axils of rudimentary leaves which ultimately develop, rarely truly paniced and in the axils of small or large bracts) stout 1–3 together in the axils of the leaves of the young shoots, rarely sub-paniced from the late development of these; pedicels *c.* 3 mm long, pubescent. Calyx tubular, 5–6 mm long, with 5-lobed creamy white, brownish on back of sepals ciliate, cilia brownish. Corolla 5-lobed, 9–10 mm long lobes cut upto 3–4 mm, tubular, ventricose, lobes hairy at apical portion light brownish at apex. Stamens numerous; filaments 2–2.5 cm long; anthers *c.* 0.5 mm long, dorsifixed. Ovary sessile or shortly stipitate many ovuled *c.* 3 mm long, style. 2.8–3 cm long; Pods linear-oblong, 12–25 2.5–3.5 cm, flat, straight thin tardily dehiscent, light yellowish brown when mature, 5–15 seeded; seed 5–15, suborbicular 8 × 6 mm.

*Fl. & Fr.*: March–April.

*Habitat*: Along the road, naturalized.

*Distribution*: KWLS: Koderma NRF common. INDIA: throughout. WORLD: Tropical and subtropical Asia and Africa -often cultivated throughout Tropical.

*Specimen examined*: Koderma NRF, 401m, 24°28'46.5" N, 85°35'57.3" E, 5th April 2013, *Shyam Biswa* 54163.

**2. *Albizia procera*** (Roxb.) Benth. in Hook., London J. Bot. 3: 89. 1844; Baker in Hook.f., Fl. Brit. India 2: 299. 1878; Haines, Forest Fl. Chota Nagpur: 292. 1910 & Bot. Bihar Orissa: 331.

1922; Sanjappa, Leg. India: 58. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 282. 2000; N.P. Singh & al., Fl. Bihar: 181. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 93. 2014. *Mimosa procera* Roxb., Pl. Coromandel 2: 12, t. 121. 1799.

**Plate 23D**

Vern. Names: *Safed siris*, *Aajan* (Hindi); *Siris*.

Tree, 25–30 m high,; trunk smooth, whitish. Leaves alternate, bipinnate, 30–35 cm long; rachis glabrescent, with a large gland near petiole base; pinnae 3–6 pairs with usually a gland between leaflets in upper 1–3 pairs, 12–15 cm long; leaflets 4–6 pairs, short-petioluled, rhomboid or rhomboid-oblong,  $3-5.2 \times 1.2-2.5$  cm, obliquely truncate at base, entire at margins, obtuse to rounded at apex, puberulous both surface; petiolules 1.5–2 mm long. Panicles elongated, up to 30 cm long, much branched, heads 12–20-flowered. Flowers 5–6 mm long, sessile. Calyx funnel-shaped, c. 3 mm long, glabrous. Corolla c. 6 mm long, teeth pubescent, greenish white. Stamens numerous; filaments c. 1 cm long, white. Ovary stipitate, c. 2 mm long; style c. 1 cm long. Pods strap-shaped,  $10-18 \times 2.5-3.8$  cm, thin, reddish, glabrous apex acuminate or with a beak, 6–11 seeded. Seeds suborbicular, c. 1 cm across.

*Fl. & Fr.*: February–May.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Lokai forest; common. INDIA: Central and S. India, Andaman Islands, Arunachal Pradesh, Bihar, Delhi, Gujarat, Jammu & Kashmir, Meghalaya, Nagaland, Rajasthan and Uttar Pradesh. WORLD: Tropical Asia (except Malay Peninsula), NE Australia, also cultivated.

*Specimen examined*: Lokai forest, 391 m,  $24^{\circ}29'02.9''$  N,  $85^{\circ}37'04.4''$  E, 28th February 2011, Shyam Biswa 49638.

### 3. CASSIA L.

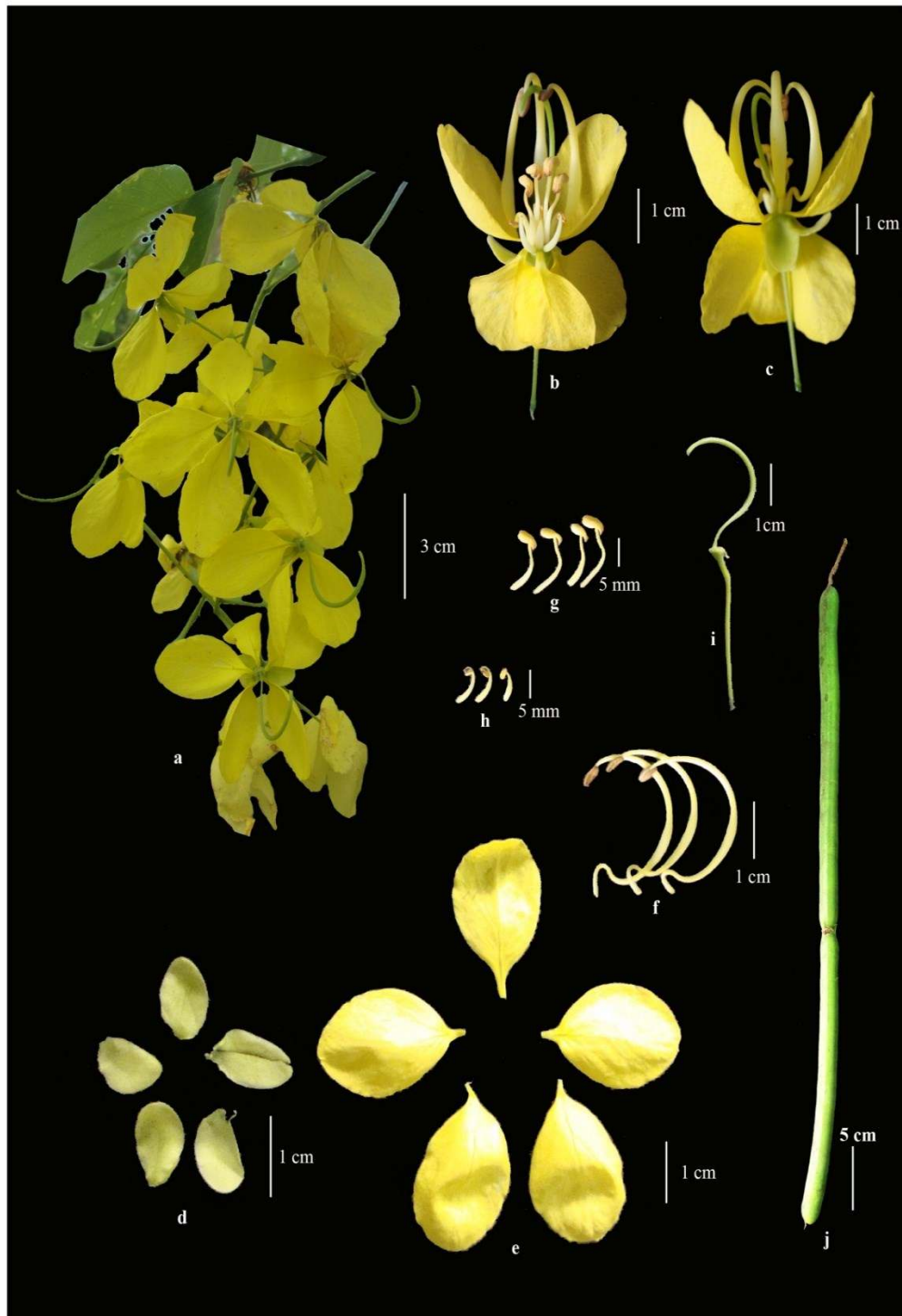
Tropical regions, 32 species, 8 in India, 6 in Jharkhand and 1 in KWLS.

**Cassia fistula** L., Sp. Pl. 1: 377. 1753; Baker in Hook.f., Fl. Brit. India 2: 261. 1878; Haines, Forest Fl. Chota Nagpur: 300. 1910 & Bot. Bihar Orissa: 302. 1922; Sanjappa, Leg. India: 15. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 300. 2000; N.P. Singh & al., Fl. Bihar: 170. 2001; V. Singh, Monogr. Ind. Subtr. Cassiini.: 25, f. 1. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 233. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 90. 2014.

**Fig. 21**

Vern. Name: *Amaltas* (Hindi).

Tree, c. 8 m high, deciduous. Leaves compound, paripinnate, 25–40 cm long; stipules linear, caducous, pubescent; rachis pubescent; petioles 3–6 cm long; rachis and petioles eglandular; leaflets 4–8 pairs, (sub) opposite, broadly ovate or ovate-oblong,  $5-12 \times 2-6$  cm, cuneate to obtuse at base, entire at margins, acute or acuminate at apex, glossy, glabrous above, pubescent beneath; lateral veins many; petiolules 0.5–1 cm long. Racemes many-flowered, to 50 cm long, pendulous, lax; bracts ovate, 7–9 mm long, caducous. Sepals ovate-elliptic,  $8-10 \times 4-6$  mm, velutinous outside, caducous, light green. Petals subequal, obovate,  $2.5-2.8 \times 1.4-1.7$  cm, short-clawed, veined, bright yellow. Stamens 10 (3+4+3), antheriferous; lower 3 larger with C or G-shaped, curved, filaments 4–6 mm long, anthers c. 2 mm long; upper 3 short with 4.5–5 cm long straight filaments and minute anthers, dorsifixed; median 4 with 10–12 mm long straight



**Fig. 21.** *Cassia fistula* L.: a. flowering twig; b.,c. flower (front & back views); d. sepals; e. petals; f.,g.,h. stamens; i. carpel and pedicel; j. pod.

filaments and 3–4 mm long anthers; anthers opening by apical pores. Carpel 4–4.5 cm, ovary appressed-pubescent. Pods cylindric, 30–50 × 1–2.5 cm, beaked, pendulous, smooth, shining, brown-black, indehiscent, many-seeded; seeds broadly ovate, *c.* 8 × 7 mm, horizontally immersed in a dark-coloured pulp and completely separated by transverse partitions, brownish.

*Fl. & Fr.*: April–July.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near Koderma RH, Koderma NRF; very common. INDIA: Throughout. WORLD: Native to South east Asia.

*Specimen examined*: Near Koderma RH, Koderma NRF, 410 m, 24°28'49.7" N, 85°36'00.5" E, 5th April 2013, *Shyam Biswa* 53921.

#### 4. CHAMAECRISTA Moench

Tropical regions to temperate America, East Asia, *c.* 330 species, 11 in India, in 3 Jharkhand and 1 in KWLS.

**Chamaecrista pumila** (Lam.) V. Singh, J. Econ. Taxon. Bot. 16(3): 600. 1992; V. Singh, Monogr. Ind. Subtr. Cassiin.: 84. 2001. *Cassia pumila* Lam., Encycl. 1(2): 651. 1783; Baker in Hook.f, Fl. Brit. India 2: 266. 1878; Haines, Forest Fl. Chota Nagpur: 302. 1910 & Bot. Bihar Orissa: 306. 1922; Mooney, Suppl. Bot. Bihar Orissa: 57. 1950; Sanjappa, Leg. India: 19. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 305. 2000; N.P. Singh & al., Fl. Bihar: 172. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 235. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 91. 2014.

Herb, 8–25 cm high, decumbent or erect. Stem terete, sparsely scattered puberulous, branches more puberulous. Leaves compound, paripinnate, stipules linear-lanceolate, 2–4 × 0.5–1 cm, margins hairy, acute at apex, 3-veined; rachis pubescent; petioles 3–6 mm long, with a stipular gland, gland *c.* 1 mm long; pinna 1.2–3.5 cm long; leaflets 3–14 pairs, (sub)opposite, rhomboid-falcate or oblong, 4–7 × 0.5–1 mm, obliquely rounded at base, entire and ciliate at margins, rounded and apiculate or at apex, glabrous above, sparsely pubescent beneath; lateral veins many; petiolules *c.* 1 mm long. Flowers *c.* 3 mm long, solitary, axillary; bracteoles-2, narrowly lanceolate or linear *c.* 2–3 mm long; pedicels 2–4 mm long. Sepals deeply 5-lobed, linear-lanceolate, 2.5–3 × *c.* 0.5 mm, subaristate, light green. Petals-5, obovate, 2.5–3 × *c.* 1 mm, yellow. Stamens 5, almost equal. Ovary densely villous. Pods oblong, 1–2.5 × 0.3–0.5 cm, beaked, flat with thickened sutures, few scattered hair, 8–11 seeded. Seeds rhomboid, *c.* 3 mm long, smooth, light brown.

*Fl. & Fr.*: September–October.

*Habitat*: Ground vegetation on shades of dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; not common. INDIA: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Dadar & Nagar Haveli, Daman & Diu, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Lakshadweep Islands, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Orissa, Pondicherr, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura Uttar Pradesh, West Bengal. WORLD: Australasia, Bangladesh, Burma, Indo-China, Malesia, Maldives and Pakistan

*Specimen examined*: Taraghati forest, 320 m, 24°32'.321" N, 85°35'.060" E, 27<sup>th</sup> September 2013, *Shyam Biswa* 54181.



## 5. **DELONIX** Raf.

East Africa to Arabia & India, Madagascar 11 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Delonix regia** (Bojer) Raf., Fl. Tellur. 2: 92.1837; Sanjappa, Leg. India: 27. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 310. 2000; N.P. Singh & al., Fl. Bihar: 174. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 239. 2002. *Poinciana regia* Bojer, Bot. Mag. 56: t. 2884. 1829; Baker in Hook.f., Fl. Brit. India 2: 260. 1878; Haines, Forest Fl. Chota Nagpur: 307. 1910 & Bot. Bihar Orissa: 313. 1922. **Plate 21E**

Vern. Name: *Gulmohar* (Hindi).

Tree, 12–18 m high, deciduous. Leaves compound, bipinnate; main rachis 25–60 cm long; pinnae 9–24 pairs, opposite, 3–9.5 cm long; leaflets 14–30, sessile, oblong, 2–7 × 1–2 mm, slightly oblique at base, entire at margin, rounded at apex, puberulous; stipules pectinate, c. 2 cm long, caducous; lobes linear. Inflorescences, racemes, 10–15 cm long, glabrous; pedicels 3–5 cm long; buds obovoid. Receptacles campanulate. Calyx tube to 5 mm long, 5-lobed; lobes lanceolate-elliptic, c. 2 × 1.5 cm, acute at apex, valvate, thick-spathaceous in bud, green outside, red inside. Petals 5, unequal, distinctly clawed, orange-red; limb 3.5–5 cm across; claw c. 2.3 cm long; 5th petal yellow or white, streaked with red inside. Stamens equal; filaments 3–4 cm long, red with white-pubescent base; anthers linear-oblong. Ovary velutinous, green. Pods strap-shaped, 31–60 × 4–5 cm, slightly curved, pendulous, terminated by persistent style, 20–50 seeded, green.; seeds oblong, c. 2.5 × 0.6 cm, compressed, brown.

*Fl. & Fr.*: April–August.

*Habitat*: Planted along the road side, naturalized.

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout. WORLD: Native of Madagascar, cultivated elsewhere.

*Specimen examined*: Lokai forest, 382 m, 24°28'57.6" N, 85°37'20.5" E, 10th August 2011, *Shyam Biswa* 49770.

## 6. **DICHROSTACHYS** (DC.) Wight & America

Tropical regions Old World especially Madagascar, 14 species, 2 in India, 1 in Jharkhand.

**Dichrostachys cinerea** (L.) Wight & Arn., Prodr. Fl. Ind. Orient. 1: 271. 1834, Baker in Hook.f., Fl. Brit. India 2: 288. 1878. *Mimosa cinerea* L., Sp. Pl. 1: 520. 1753. *Dichrostachys nutans* (Pers.) Benth. in Hook., J. Bot. 4: 353. 1841. **Plate 23E**

Vern. Name: *Sammi*.

Small tree to 5 m high. Branches modified into thorns, thorns sharp pointed. Leaves compound, alternate, bipinnate pinnae 4–8 pairs, 0.5–1.5 cm long, pinna-rachis pubescent and with glands opposite to all pairs of pinnae. Leaflets 8–16 pairs, oblong-elliptic, 2–3 × 0.5–1 mm, oblique and truncate at base, entire and ciliate at margins, acute at apex, glabrous, Stipules linear-lanceolate 3–5 mm long. Spikes 1–2 axillary, c. 2 × 1 cm. Flowers c. 2 mm across, upper ones bisexual and yellowish-orange, lower ones male and pink. Petals pink, stamens numerous exerted, filament light pinkish, anthers ovate, tipped by stalked glands, bright yellow. Pods linear c. 1.5–3.5 × 0.4–0.6 cm, curled, about 4–6 per cluster, upto 12 seeded.

*Fl. & Fr.*: February–March.

*Habitat*: Planted near the village.

*Distribution*: KWLS: Dhawjadhari Pahar near the Forest colony; cultivated. INDIA: Karnataka, Tamil Nadu. WORLD: Sri Lanka.

*Specimen examined*: Dhawjadhari Pahar near the Forest colony, 390 m, 24°29'06.6" N, 85°35'49.8" E, 29th February 2012, *Shyam Biswa* 54017.

## 7. **LEUCAENA** Benth.

Texas to Peru, 22 species, 1 in India.

**Leucaena leucocephala** (Lam.) de Wit., Taxon 10: 54. 1961. Paria & Chattopadhyay, Fl. Hazaribagh 1: 283. 2000. *Mimosa leucocephala* Lam., Encycl. 1(1): 12. 1783. *Leucaena glauca* Benth. in Hook., J. Bot. 4: 416. 1842; Baker in Hook.f, Fl. Brit. India 2: 290. 1878; Mooney, Suppl. Bot. Bihar Orissa: 59. 1950; Haines, Forest Fl. Chota Nagpur: 285. 1910 & Haines, Bot. Bihar Orissa 321. *Leucaena latisiliqua* (L.) Gillis in Taxon 23: 190. 1974; Sanjappa, Leg. India: 67. 1992; N.P. Singh & al., Fl. Bihar: 182. 2001.

**Plate 23F**

Tree or shrub, 0.5–12 m high. Leaves compound, alternate, leaf-rachis 16–26 cm long, having a petiolar gland at the base of the first pinna; pinnae 6–9 pairs, 5–8 cm long, having a gland beneath the terminal leaflets. Leaflets 12–20 pairs, obliquely oblong, 7–14 × 3–4 mm, truncate and oblique at base, entire at margins acute at apex, glabrous. Heads c. 1.5 cm across, creamy white; peduncles 2–5 cm long. Calyx c. 2 mm long. Petals oblong, c. 4 × 0.75 mm, pubescent, white. Stamens 5–6 mm long. Pods strap-shaped, 10–12 × 1.5–2 cm, borne on stalks up to 3 cm, apex rounded and beaked / acuminate, glabrous, marron-greenish; 15–25 seeded. Seeds ovate, c. 8 × 4–5 mm, glossy, transversely arranged, brown.

*Fl. & Fr.*: November–February.

*Habitat*: Near the village planted / naturalized.

*Distribution*: KWLS: Near RFO office, Koderma NRF; common. INDIA: Native of tropical America, cultivated and also naturalised throughout.

*Specimen examined*: Near RFO office, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 29th November 2012, *Shyam Biswa* 54101.

## 8. **MIMOSA** L.

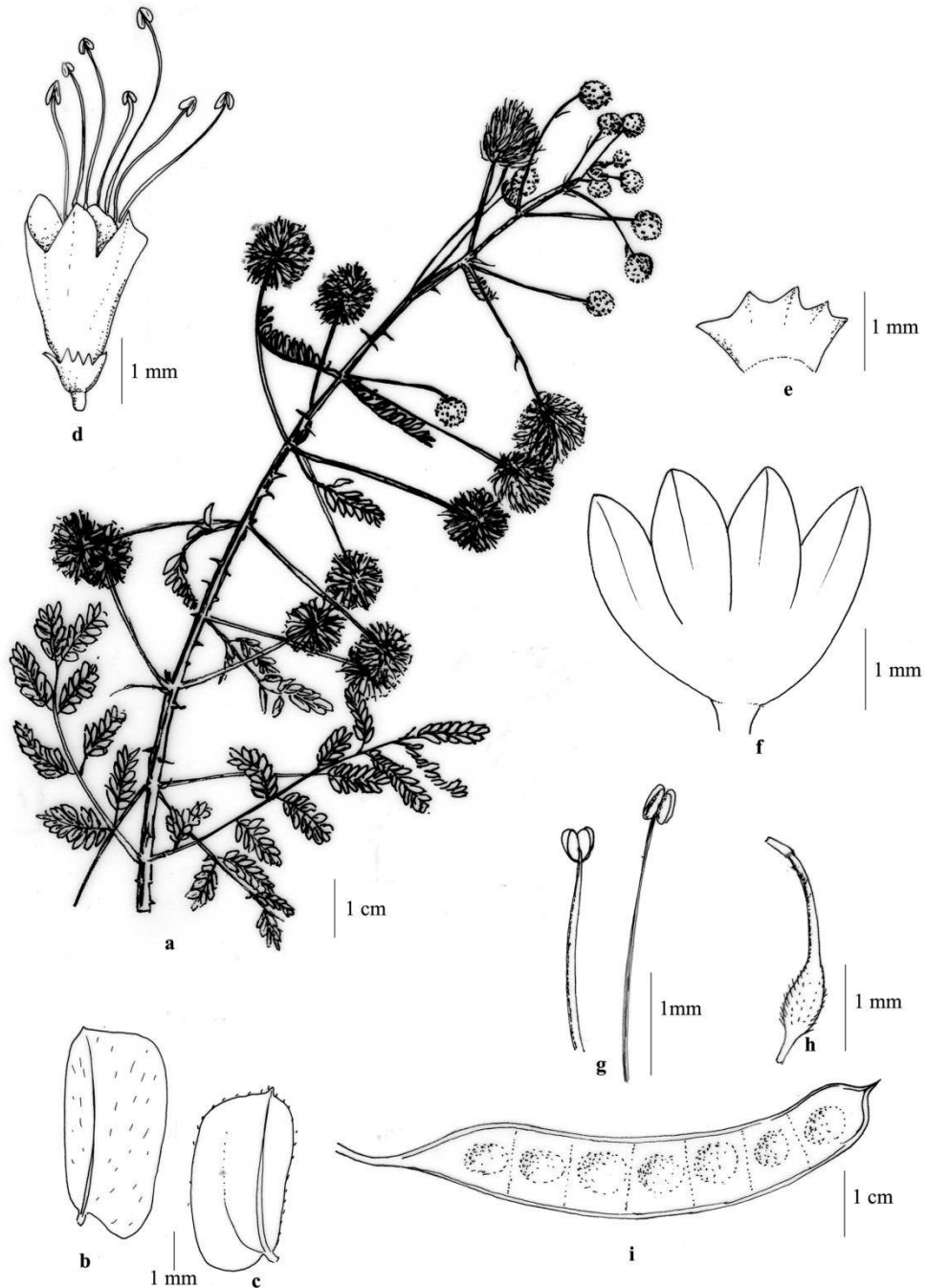
Tropical and subtropical regions, c. 510 species, 8 in India, 2 in Jharkhand and 1 in KWLS.

**Mimosa rubicaulis** subsp. **himalayana** (Gamble) H.Ohashi, Enum. Fl. Pl. Nepal 2: 126. 1979 *Mimosa himalayana* Gamble, Bull. Mis Inform. Kew 1920(1): 4. 1920; Haines, Bot. Bihar Orissa 322. 1922. *Mimosa rubicaulis auct. non*, Lam., 1783; Baker in Hook.f, Fl. Brit. India 2: 291. 1878, *p.p.*; Sanjappa, Leg. India: 68. 1992; N.P. Singh & al., Fl. Bihar: 182. 2001.

**Fig. 22; Plate 23G**

Shrub 3–5 m high, thorny. Stems and branches angular, with thorns straight or curved downwards, reddish or pinkish, pubescent. Leaves compound, alternate, 3.5–15 cm long, primary rachis hairy and with thorns curved back, petioles hairy 0.5–1.5 cm long, evenly bipinnate, pinnae 4–11 pairs, 1.5–3.5 cm long; leaflets 5–11 pairs, falcate-oblong, 4–8 × 2–3 mm, truncate at base, entire and ciliate at margins, rounded and mucronate at apex, glabrous above, strigose beneath, asymmetric,

midrib closer to upper margin and without lateral veins on that side; stipules subulate, 5–8 mm. Flower heads 1.5–2 cm across, pink, in axillary clusters of 3–4, forming a terminal leafy



**Fig. 22. *Mimosa himalayana* Gamble:** a. flowering twig; b.,c. leaflets (lower & upper views); d. flower; e. calyx; f. corolla; g. stamens; h. carpel; i. pod.

racemiform inflorescence; peduncles 1–3.5 cm long. Flowers 6–7 mm long, pinkish; bracteoles among flowers minute clavate, pubescent. Calyx campanulate 0.5–1 mm long, glabrous. Petals funnel-shaped, 4-lobed, lobes half segmented, oblong-lanceolate  $2-3 \times 0.8-1$  mm, (each lobe), pinkish. Stamens 8, exerted, 2.5–6 mm long, free attached only at base anthers roundish 0.2–0.4 mm long, dorsifixed, yellowish. Ovary oblong, *c.* 1 mm long, hairy, style 2–2.5 mm long, stigma very short. Pods linear-oblong,  $5-6.5 \times 1-1.2$  cm, flat with seed raised, septate, apex beaked, slightly curved, sparsely hairy. Seeds ovate or roundish, 5–8 mm long, compressed, brown.

*Fl. & Fr.*: September–October.

*Habitat*: On the hill slopes and scrub forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Assam, Central India, Delhi, Himalayas and Jammu & Kashmir to Arunachal Pradesh. WORLD: Afghanistan, Bhutan, Nepal, Pakistan.

*Specimen examined*: Muglamaram forest, 385 m,  $24^{\circ}29'16.0''$  N,  $85^{\circ}34'39.8''$  E, 3rd September 2010, *Shyam Biswa* 49519.

## 9. **SENEGALIA** Raf.

203 tropical regions (Mabberley, 2017); 26 in India (Sanjappa, 1992); 8 species in Jharkhand.

### Key to species

- |                                                                                                                   |                             |
|-------------------------------------------------------------------------------------------------------------------|-----------------------------|
| 1a. Tree or erect shrubs, flowers in elongated axillary spikes                                                    | <b>2. <i>S. catechu</i></b> |
| 1b. Scandent or climbing shrubs, flowers in globose head spines long and straight                                 | <b>2</b>                    |
| 2a. Pinnae 10–16 pairs; leaflets to 32 pairs; pod not flat, sutures not thickened                                 | <b>1. <i>S. caesia</i></b>  |
| 2b. Pinnae 10–20 pairs; leaflets to 45 pairs; petals white, petals cream coloured;<br>pod flat, sutures thickened | <b>3. <i>S. torta</i></b>   |

**1. *Senegalia caesia*** (L.) Maslin, Seigler & Ebinger in *Blumea* 58(1): 40. 2013. *Mimosa caesia* L., Sp. Pl. 1: 522. 1753, p.p. *Acacia caesia* (L.) Willd., Sp. Pl. 4: 1090. 1806; Haines, Bot. Bihar Orissa: 328. 1922; Sanjappa, Leg. India: 37. 1992; N.P. Singh & al., Fl. Bihar: 177. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 165. 2002. *Acacia intsia* (L.) Willd. var. *caesia* (L.) Wight & Arn. ex Baker in Hook.f., Fl. Brit. India 2: 297. 1878.

Vern. Names: *Aila* (Hindi); *Araria*.

Stragglers, *c.* 10 m high. Branchlets with internodal hooked spines, glabrous. Leaves compound, alternate, 10–15 cm long; pinnae 10–16 pairs, 3–10 cm long; leaflets not overlapping, upto 32 pairs, oblong,  $3-7 \times 1.5-2.5$  mm truncate at base, entire at margins, obtuse, apiculate or beaked at apex, puberulous, veins prominent; petioles to 6 cm long, with a convex elongate gland at base, prickled on the underside; rachis with gland at few or all in mid of pinnae, swollen at base; stipular spines absent. Panicles terminal, to 10 cm long, pubescent. Heads *c.* 1 cm across, 2 or 3 in clusters. Flowers *c.* 3 mm across. peduncles *c.* 5 cm long; rachis prickled; bracts lanceolate, 0.5–1.5 cm long, cuspidate at apex; bracteoles *c.* 1 mm long. Calyx *c.* 2.5 mm long, pubescent, 5-lobed. Petals 5, ovate, *c.* 5 mm long, cream-coloured. Stamens numerous, *c.* 5 mm long, basally connate. Ovary stipitate, oblong, to 2 mm long, pubescent; style *c.* 4 mm long. Pods 8–11  $\times$  2–3 cm, flat, stipitate, obtuse at base, horned at apex, glabrous, brownish. Seeds *c.* 8 mm long.



*Fl. & Fr.*: February–December.

*Habitat*: On the open forests of Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest, way to Muglamaram forest road; Baghi tan road, Koderma NRF; occasional. INDIA: Karnataka, Kerala, Maharashtra, Odisha and Tamil Nadu. WORLD: Malesian Archipelago, Pakistan and Sri Lanka.

*Specimens examined*: Taraghati forest, way to Muglamaram forest road, 321 m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49861; Baghi tan road, Koderma NRF, 390 m, 24°29'06.6" N, 85°36'49.8" E, 9th August 2011, *Shyam Biswa* 49758.

**2. *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb., Plant-book, ed. 3: 1021. 2008. *Mimosa catechu* L.f., Suppl. Pl. 439. 1782. *Acacia catechu* (L.f.) Willd., Sp. Pl. 4: 1079. 1806; Baker in Hook.f., Fl. Brit. India 2: 295. 1878; Haines, Forest Fl. Chota Nagpur: 289. 1910 & Bot. Bihar Orissa 329. 1922; Sanjappa, Leg. India: 38. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 278. 2000; N.P. Singh & al., Fl. Bihar: 177. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 167. 2002. *Acacia catechu* (L.f.) Willd. var. *catechuoides* (Roxb.) Prain in J. Asiat. So. Bengal 66: 508. 1898.**

**Plate 23B**

Vern. Names: *Khair* (Hindi).

Tree 2–7 m, high; trunk dark brownish. Branches with spines curved. Leaves compound, bipinnate, 15–20 cm long; leaf rachis hairy; pinnae 7–28 pairs, 1.5–3.5 cm long; leaflets 6–30 pairs, linear-oblong, 3–4 × 0.5–1 mm, truncate or rounded at base, entire and ciliate at margins, obtuse at apex, midrib prominent, glabrous; petiolules c. 0.5 mm long. Spikes solitary, axillary, narrowly cylindrical, 8–10 cm, densely flowered. Flowers 4–5 mm long. Calyx c. 1 mm long, shortly toothed. Petals 5, oblong 2–2.3 mm long, whitish. Stamens exerted, 3–4 mm long, anther roundish, dorsifixed. Pods oblong, 5–7 × 1–1.5 cm, compressed, leathery, reddish. Seeds 6–8, suborbicular, c. 5 mm diameter.

*Fl.*: August–September, *Fr.*: February–March.

*Habitat*: Dry deciduous forests and Scrub forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: South India, Assam, Bihar, Delhi, Orissa, Rajasthan, W. Bengal, Punjab to Arunachal Pradesh through Himalayas up to 1700 m. WORLD: Pakistan, Bhutan, Burma, Nepal, South China, Thailand.

*Specimen examined*: Chattarbar forest, 330 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49835.

**3. *Senegalia torta* (Roxb.) Maslin, Seigler & Ebinger in Blumea 58: 42. 2013. *Mimosa torta* Roxb., Fl. Ind 2: 566. 1832. *Acacia torta* (Roxb.) Craib, Bull. Misc. Inform. Kew 1915(9): 410. 1915; Haines, Bot. Bihar Orissa 326. 1922.; Sanjappa, Leg. India: 38. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 281. 2000; N.P. Singh & al., Fl. Bihar: 180. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 169. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 92. 2014. *Acacia pennata* Baker in Hook.f., Fl. Brit. India 2: 297. 1878 *p p. auct non* (L.) Willd.**

Vern. Name: *Araria*.

Scandent, woody, thorny, having sweet fragrant. Branches with prickles and hairy. Leaves compound, *c.* 26 cm long; leaf-rachis pubescent with prickles; pinnae 10–14 pairs, 4–12 cm long, pinna slightly sub-opposite at base; leaflets upto 35 pairs, oblong-rectangular, 3–7 × 2–2.5 mm, truncate at base, entire and ciliate at margins, obtuse, apiculate at apex, midrib raised beneath, pubescent above rusty tomentose beneath; rachis with rounded gland at base of pinna or mid of pinna at few or every pinna on above; Panicles terminal, to 10 cm long, pubescent. Heads 1–1.5 cm across, 2 or 3 in clusters; Flowers *c.* 3–5 mm long. Sepals 1.5–2 × 0.5 mm long, strigose, blackish at upper portion. Petals 5, ovate, 2–2.5 mm long, white. Stamens numerous, 3–4 mm long, basally connate, exerted; anthers *c.* 0.1 mm long, dorsifixed. Ovary oblong, to 1–2 mm long, stipitate, pubescent; style *c.* 3 mm long. Pod 10–15 × 0.2–0.3 cm, sutures thickened, glabrous when mature, flat, reddish-brown.

*Fl. & Fr.*: August – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF; not common. INDIA: Bihar, Madhya Pradesh, Peninsula regions, Punjab, Rajasthan, Uttar Pradesh and W Bengal. WORLD: Pakistan and Thailand.

*Specimen examined*: Koderma NRF, 390 m, 24°28'46.5" N, 85°35'57.3" E, 9th August 2011, Shyam Biswa 49758.

*Note*: Rachis with rounded gland at base of pinna or mid of pinna at few or every pinna on above.

#### 10. SENNA Mill.

Tropical, subtropical and temperate regions, *c.* 300 species, 43 in India, *c.* 15 in Jharkhand and 5 in KWLS.

##### Key to Species

- |                                                                                                                            |                                  |
|----------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1a. Herbs or undershrubs                                                                                                   | 2                                |
| 1b. Shrubs or trees                                                                                                        | 4                                |
| 2a. Petioles glandular, rachis with glands                                                                                 | <b>5. <i>S. tora</i></b>         |
| 2b. Petioles glandular; rachis with gland                                                                                  | 3                                |
| 3a. Pod compressed rachis glandular                                                                                        | <b>3. <i>S. occidentalis</i></b> |
| 3a. Pod compressed and hirsute                                                                                             | <b>2. <i>S. hirsuta</i></b>      |
| 4a. Trees; Pod with no wing; leaflets medium ovate oblong; flowers in racemed corymbs                                      | <b>4. <i>S. siamea</i></b>       |
| 4b. Shrubs, pod with broad wing down the middle of each valve; leaflets very large, oblong; flowers in dense spicate heads | <b>1. <i>S. alata</i></b>        |

**1. *Senna alata*** (L.) Roxb., Fl. Ind. 2: 349. 1824; Irwin & Barneby, Mem. New York Bot. Gard. 35: 460. 1982; V. Singh, Monogr. Ind. Subtr. Cassiin.: 99, f. 18. 2001. *Cassia alata* L., Sp. Pl. 1: 378. 1753; Baker in Hook.f., Fl. Brit. India 2: 264. 1878; Sanjappa, Leg. India: 14. 1992; N.P. Singh & al., Fl. Bihar: 170. 2001.

**Plate 22D**

Vern. Name: *Bara Chakundi*.

Shrub, 1–3 m high; branches pubescent. Leaves subsessile, eglandular; stipules at base, auricled, persistent, 34.5–60 cm long; leaflets 7–11 pairs, oblong, 3.5–11 × 2–5 cm obliquely truncate at base, entire at margin, obtuse or broadly rounded or slightly emarginated at apex, glabrous leaflets largest at apex smaller towards base. Racemes spicate, 15–35 cm long; bracts 2–3 cm

long, enclosing the bud, caducous, orange. Sepals obovate,  $1.5-2 \times 0.4-0.6$  cm. Petals oblong or obovate,  $1-1.5 \times c. 1$  cm, claw 2–3 mm long, bright yellow. Stamens 10, fertile 7, poricidal; lower 2 large with 4–5 mm long filaments and curved anthers of  $c. 1 \times 0.2$  cm, yellow; medium ones with  $c. 5-8$  mm long filaments and 4–5 mm long anthers, yellow; shorter ones with filaments  $c. 3$  mm long and subequal anthers 3–4 mm long, yellow; staminodes 3; filaments to 3 mm long; anthers empty,  $c. 2$  mm long. Ovary sessile, puberulent; ovules many. Pods winged, sharply tetragonal, 8–18 cm long, both valves bearing a crenate wing  $c. 7$  mm broad, 50–60-seeded. Seeds deltoid or rhombic,  $c. 10 \times 8$  mm, compressed.

*Fl. & Fr.*: August–October.

*Habitat*: Scrub forests and waste lands.

*Distribution*: KWLS: Chattarbar forest; very common. INDIA: Almost throughout. WORLD: Native of South America, now Pantropical.

*Specimen examined*: Chattarbar forest, 330 m,  $24^{\circ} 28'36.5''$  N,  $85^{\circ}32'20.5''$  E, 19th August 2011, Shyam Biswa 49837.

**2. *Senna hirsuta* (L.) H.S. Irwin & Barneby**, *Phytologia* 44(77):499. 1979. *Cassia hirsuta* L., Sp. Pl. 1: 378. 1753; Baker in Hook.f. Fl. Brit. India 2:263. 1878. Sanjappa, Leg. India: 15. 1992.

**Plate 22E**

Vern. Names: *Chakur*, *Chakund*.

Shrub or undershrub, 0.9–1.5 m high; stem corrugated or penta-angular, hirsute. Leaves compound, alternate, paripinnate 14–31.5 cm long; leaf rachis hirsute; stipules 2 opposite to each other at base, linear 1–1.5 cm, persistent; leaflets 4–5 pairs, oblong-lanceolate or ovate-lanceolate,  $2-10.5 \times 1-4$  cm obtuse to rounded at base, entire at margin, acuminate at apex, glabrous; petiolules 1–4 mm long. Racemes axillary or several in axils of apical leaves forming a leafy panicle; Flowers  $c. 4$  cm long. pedicels 1–2 cm long, peduncles and pedicels villous; bracts early caducous, subulate, hairy. Sepals oblong,  $5-7 \times 3-5$  mm. Petals obovate,  $1.1-1.3 \times 0.6-0.8$  cm, yellow. Stamens 10, fertile 6 or 7, unequal in length, large stamens: filament 5–6 mm long; anthers 6–7 mm long, smaller stamens: filament 2–3 mm long; anthers 4–5 mm long; poricidal, yellow; basifixed; staminodes 3 or 4. Ovary hirsute, subsessile; style short, glabrous; stigma small. Pods slender, flat curved,  $7-12 \times 0.5-0.7$  cm, tapering at apex, with white hirsute all over, young fruit densely cilliate, seeds numerous. Seeds rounded,  $c. 3 \times 2-2.5$  mm, smooth, light brownish.

*Fl. & Fr.*: November–March.

*Habitat*: Waste area or scrub forests.

*Distribution*: KWLS: Near the Koderma Rest House; Near RFO office, Koderma NRF; not common.

*Specimens examined*: Near the Koderma Rest House, Koderma NRF, 396 m,  $24^{\circ}29'04.4''$  N,  $85^{\circ}35'49.6''$  E, 10th March 2011, Shyam Biswa 49740; Near RFO office, Koderma NRF, 401 m,  $24^{\circ}28'46.5''$  N,  $85^{\circ}35'57.3''$  E, 29th November 2012, Shyam Biswa 54112.

**3. *Senna occidentalis* (L.) Link**, Handbuch 2: 140. 1831. *Cassia occidentalis* L., Sp. Pl. 1: 377. 1753; Baker in Hook.f. Fl. Brit. India 2: 262. 1878; Haines, Forest Fl. Chota Nagpur: 301. 1910 & Bot. Bihar Orissa: 304. 1922; Sanjappa, Leg. India: 19. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 304. 2000; N.P. Singh & al., Fl. Bihar: 172. 2001; T.K. Sharma & A.K. Sarkar in

N.P. Singh & P.S.N. Rao, Fl. Palamau: 235. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 91. 2014.

**Plate 22F**

Vern. Name: *Kasondi* (Hindi).

Herb or shrub, 0.5–1.5 m high. Leaves compound, alternate, *c.* 16 cm long, 3–4 pair paripinnate, rachis glabrescent, noded at or bulging at base, leaflets opposite lanceolate, 2–8 × 0.8–3 cm, obtuse to rounded at base, entire and hairy at margins, acute to acuminate at apex, glabrous, small white hair on margins only; petiolule 1–2 mm. Flowers 2–3 cm across, yellow; pedicel 5–8 mm long. Sepals lanceolate 6–8 × 2–3 mm, green-pinkish. Petals 1+2+2, large petal 1–1.5 × 0.6–1 cm small petal 1–1.2 × 0.5 cm, yellowish. Stamens 2-long + 2-short + staminoides, yellowish, long stamens 1–1.2 cm long, filament 5–6 mm long; anthers linear-oblong 6–7 mm long; short stamens *c.* 0.5 cm long, filament 2–3 mm long; anthers linear-oblong 4–5 mm long; basifixed, yellow. Pod linear 9–9.5 × 0.5–1 cm, tapering at base, rounded and beaked at apex, upto 25 seeded, dehiscing by margin ruptures at the coners, sparsely puberulous, greenish central portion maroon. Seeds somewhat semicircular, *c.* 4 × 3 mm, blackish brown.

*Fl. & Fr.*: November–December.

*Habitat*: On open areas near the villages.

*Distribution*: KWLS: Baghitan forest; common. INDIA: naturalised throughout. WORLD: a native of South America, now a pantropical weed.

*Specimen examined*: Baghitan forest, 392 m, 24°29'20.3" N, 85°35'50.7" E, 20th November 2012, *Shyam Biswa* 54069.

**4. *Senna siamea*** (Lam.) H.S. Irwin & Barneby, Mem. New York Bot. Gard. 35: 98. 1982; Larsen & Hou in Hou & al., Fl. Males. 12: 685. 1996; V. Singh, Monogr. Ind. Subtr. Cassiini.: 193, f. 42. 2001. *Cassia siamea* Lam., Encycl. 1: 648. 1785; Baker in Hook.f., Fl. Brit. India 2: 264. 1878; Haines, Forest Fl. Chota Nagpur: 301. 1910 & Bot. Bihar Orissa: 203. 1922; Sanjappa, Leg. India: 20. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 306. 2000; N.P. Singh & al., Fl. Bihar: 173. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 236. 2002.

Vern. Names: *Chakundi*, *Chirkundi*.

Tree, *c.* 10 m high. Leaves 15–24 cm long, eglandular; stipules subulate, *c.* 1 mm long, caducous; petioles 1.5–3 cm long; leaflets 5–16 pairs, elliptic or elliptic-oblong, obtuse or rounded at base, entire at margins, rounded or slightly emarginate with a short mucronate at apex, 3–5.5 × 1–2 cm, glabrous and shiny above, finely pubescent beneath, strongly veined; petiolules 2–4 mm long. Racemes axillary, dense, many-flowered, or sometimes several racemes forming a terminal panicles, 15–30 cm long. Flowers *c.* 3 mm long; peduncles 5–7 cm long; bracts obovate, 5–6 mm long, appendiculate; pedicels 2–2.5 cm long, grey-pubescent; bracteoles absent. Sepals 2+3 ovate, concave, unequal, hairy on outside; outer 2, 4–5 mm long; inner 3, 8–10 mm long. Petals elliptic-obovate, short-clawed, 1.2–1.8 × 6–8 cm, bright yellow. Stamens 10; upper 3 reduced to staminodes, 2–4 mm long; remaining 7 perfect, poricidal; lower 2 or 3 larger with 9–10 mm long filaments and anthers 6–7 mm long; one median and other 3 or 4 with 2–4 mm long filaments and anthers 5–6 mm long. Ovary fine-pubescent. Pods strap-shaped, 13–14 × 1–1.5 cm, long-stipitate, flat, dehiscent 20–30 seeded. Seeds oval, 1–1.5 × 0.5–0.6 cm, flat, brown.

*Fl. & Fr.*: August–October.



*Habitat:* On dry deciduous sal forests.

*Distribution:* KWLS: Chattarbar forest; very common. INDIA: Andaman & Nicobar Islands, Arunachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Odisha, Punjab, Sikkim, Tamil Nadu and Tripura. WORLD: South and Southeast Asia; widely cultivated in Tropical.

*Specimen examined:* Chattarbar forest, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, Shyam Biswa 49834.

**5. *Senna tora* (L.) Roxb., Fl. Ind. 2: 340. 1832; Larsen & Hou in Hou & al., Fl. Males. 12: 689. 1996; V. Singh, Monogr. Ind. Subtr. Cassiin.: 222, f. 49. 2001. *Cassia tora* L., Sp. Pl. 1: 376. 1753; Baker in Hook.f., Fl. Brit. India 2: 263. 1873, p.p.; Haines, Forest Fl. Chota Nagpur: 302. 1910 & Bot. Bihar Orissa: 304. 1922; Sanjappa, Leg. India: 22. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 309. 2000; N.P. Singh & al., Fl. Bihar: 174. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 238. 2002.**

**Plate 22G**

Vern. Name: *Panevar* (Hindi).

Herb, to 1.5 m high. Leaves compound, alternate, pari-pinnate, 6.5–10 cm long; stipules linear, 4–5 mm long, caducous; rachis with a linear gland *c.* 1–2 mm between all except uppermost pair of leaflets; petioles 1.5–4 mm long; leaflets 3–4 pairs, obovate or obovate-oblong, *c.* 1.5–4.8 × 1.3–2.5 cm, obliquely cuneate-rounded at base, entire at margins, obtuse, broadly rounded or retuse and mucronate or apiculate at apex, upper ones largest, glabrous above, pubescent beneath; petiolules 1–2 mm long. Flowers axillary, solitary or in pairs; pedicels 4–8 mm long (upto 17 mm in fruits). Sepals obovate, 4.5–6 × 2–4 mm. Petals obovate, 8–12 × 5–8 mm, short-clawed, obtuse or rounded at apex, yellow. Fertile stamens 7 (3 larger, 4 smaller), nearly equal, poricidal; filaments 1.5–4 mm long; anthers 1.5–3 mm long; staminodes 3. Ovary densely pubescent. Pods shortly stipitate, linear, terete or subtetragonous, 13–20 × 0.4–0.5 cm, much curved when young, obliquely septate, uniseriate; 15–30 seeds. Seeds rhombohedral, 3–4 mm long, brown.

*Fl. & Fr.:* September – December

*Habitat:* On open areas in the forests.

*Distribution:* KWLS: Muglamaram forest; very common. INDIA: Andaman, Arunachal Pradesh, Goa, Gujarat, Jammu and Kashmir, Kerala, Nicobar Islands, Rajasthan, Sikkim, Tamil Nadu and Tripura. WORLD: A native of South America, now a Pantropical weed.

*Specimen examined:* Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, Shyam Biswa 49504.

#### 11. **VACHELLIA** Wight & Arn.

*c.* 160 tropical regions (Mabberley, 2017); 26 in India (Sanjappa, 1992); 8 species in Jharkhand.

#### **Key to species**

1a. Pods turgid and 2-seriate seeds, thick cylindric, not sinuate between seeds **1. *V. farnesiana***

1b. Pods, thin flat with 1-seriate seeds, compressed, deeply sinuate between seeds or moniliform

**2. *V. nilotica***

**1. *Vachellia farnesiana* (L.) Wight & Arn.** in Prodr. Fl. Ind. Orient. 1: 272. 1834. *Mimosa farnesiana* L., Sp. Pl. 1: 521. 1753. *Acacia farnesiana* (L.) Willd., Sp. Pl. 4: 1083. 1806; Baker in Hook.f., Fl. Brit. India 2: 292. 1878; Haines, Bot. Bihar Orissa: 324. 1922; Sanjappa, Leg. India: 39. 1992; N.P. Singh & al., Fl. Bihar: 178. 2001.

Vern. Name: *Kadam-kesar* (Birhore).

Shrub or small tree to 8 m high; branches with stipular spines, 0.5–2 cm long. Leaves compound, bipinnate, *c.* 5 in a cluster, 2–7 cm long; pinnae 4–6 pairs, 1–2.5 cm long; leaflets 10–15 pairs, overlapping, elliptic or oblong,  $3-5 \times c.1$  mm, slightly oblique, truncate or rounded at base, entire at margins, obtuse or subacute at apex, glabrous; petioles with a gland near middle, *c.* 1.5 cm long; rachis eglandular, stiff-pubescent; stipular spines unequal, straight, *c.* 2 cm long. Heads globose, 8–12 mm in diam., 2 or 3 in axillary clusters; peduncles with involucre of bracteoles at base, pubescent. Flowers *c.* 2 mm across. Calyx *c.* 1.5 mm long, 5-toothed. Petals 5, 2–3 mm long, yellow. Stamens 4–5 mm, orange yellow. Pods terete, cylindrical,  $6-7 \times 1-1.2$  cm, slightly curved, horned at apex, woody, glabrous with fine linings, reddish brown. Seeds to 16, subglobose, *c.*  $4 \times 5$  mm, smooth, glabrous dark brown.

*Fl. & Fr.*: September – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Lokai forest near Birhore Tola; common. INDIA: Throughout. WORLD: A native of tropical America, cosmopolitan in the Tropical regions.

Specimen examined: Lokai forest near Birhore Tola, 382m  $24^{\circ}28'57.6''$  N,  $85^{\circ}37'20.5''$  E, 24th February 2012, *Shyam Biswa* 53932.

**2. *Vachellia nilotica* subsp. *indica* (Benth.) Kyal. & Boatwr. in Bot. J. Linn. Soc. 172: 515. 2013. *Acacia nilotica* (L.) Willd. ex Delile subsp. *indica* (Benth.) Brenan in Kew Bull. 12: 84. 1957. Sanjappa, Leg. India: 42. 1992; Paria & Chattopadhyay, Fl. Hazaribagh 1: 279. 2000; N.P. Singh & al., Fl. Bihar: 179. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 167. 2002. *Acacia arabica* (Lam.) Willd. var. *indica* Benth. in Hook., London J. Bot. 1: 500. 1842. *Acacia arabica auct. non* (Lam.) Willd., 1805: Baker in Hook.f., Fl. Brit. India 2: 293. 1878; Haines, Forest Fl. Chota Nagpur: 287. 1910 & Bot. Bihar Orissa 324. 1922. **Plate 23C****

Vern. Name: *Babul* (Hindi).

Tree *c.* 7–11 m high. Branches with stipular thorns, straight, sharp. Leaves compound, *c.* 5 in a cluster, 2–7 cm long; pinnae 2–6 pairs, 1–2.5 cm long; leaflets 10–20 pairs, oblong, *c.*  $4-6 \times 1-1.5$  mm, truncate and oblique at base, entire at margins, rounded at apex, glabrous; petioles *c.* 1.5 cm long, with 1–2 petiolar gland; stipular spinescent, straight, *c.* 2 cm long. Heads globose, *c.* 10 mm across, 2 or 3 in axillary clusters; peduncles with involucre of bracteoles at base, densely stiff-pubescent. Flowers *c.* 2 mm across. Calyx *c.* 1–2 mm long, 5-toothed, pubescent or subglabrous. Petals 5, 2.5–3.5 mm long, yellow. Pedicels 1.5–2 cm long (in fruit). Pods 9–12 beaded, moniliform, *c.*  $8-12.5 \times 0.7-1.4$  cm, stalk at base 1.5–2 cm long, whitish tomentose, whitish-green; 9–12 seeded. Seeds *c.* 20, 2-seriate, globose, *c.* 0.5 mm across.

*Fl. & Fr.*: February – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout plains and hills. WORLD: Tropical Africa, Arabia, Egypt, Nepal, Pakistan and Sri Lanka.

Specimen examined: Lokai forest, 382 m,  $24^{\circ}29'02.9''$  N,  $85^{\circ}37'04.4''$  E, 28th February 2011, *Shyam Biswa* 49642.

### 30. POLYGALACEAE Hoffmanns. & Link, nom. cons.

Subcosmopolitan, 19 genera and c. 925 species; 4 genera 31 species in India.

#### POLYGALA L.

Subcosmopolitan, c. 325 species, 27 in India, 10 in Jharkhand and 3 in KWLS.

#### Key to species

- 1a. Leaves obovate; petals pinkish, large petal with tip fimbriate, if ciliate dense, purplish or pinkish **2. P. crotolarioides**
- 1b. Leaves linear; petals yellowish, large petal with tip ciliate not dense, yellowish **2**
- 2a. Leaves linear or linear-lanceolate, to 5 mm wide; petals yellowish or dull orange; stigma hooded **3. P. linarifolia**
- 2b. Leaves oblong-elliptic, 10–25 mm wide; petals white with purple or violet tips; stigma bilobed **1. P. arvensis**

**1. Polygala arvensis** Willd., Sp. Pl. ed.4. 3(2): 876. 1803; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 460, f. 87. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 502. 2000; N.P. Singh & al., Fl. Bihar: 48. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 85. 2002. *Polygala chinensis* auct. non L. 1753: Bennett in Hook.f., Fl. Brit. India 1: 204. 1872, p.p.; Haines, Bot. Bihar Orissa: 41. 1921. **Plate 24A**

Herb, procumbent or erect, 5–30 cm high. Stems and branches hairy. Leaves alternate, subsessile, oblong, linear or linear-lanceolate, 1.5–2.5 × 2–2.5 mm, narrowed towards base, entire at margins, acute and mucronate at apex, glabrous, hairy at margins and on midrib; petioles 1–2 mm long. Flowers 5–6 mm long, solitary or in 3–15 in 0.5–2 cm long, axillary or lateral racemes, rarely subcapitate; bracts oblong-ovate, c. 1.5 × 1 mm, ciliate at margins, acute at apex, persistent; pedicels 1.5–2 mm long. Sepals persistent; outer sepals broadly ovate to ovate-lanceolate, 1.5–2 × c. 1 mm, acuminate, acute or mucronate at apex, pubescent outside, white-hyaline and ciliate at margins, 1-veined; wings sepals obliquely ovate or falcate, c. 4 × 2 mm, narrowed at base, straight at upper margin, rounded at lower margin, acute or acuminate at apex, sparsely puberulous or glabrous, persistent. Petals yellow; middle lobe keeled, auricled at base, with a crest of shortly multifid or notched, to 1 mm long appendages; lateral lobes of petals suborbicular or broadly obovate, 3–4 mm long. Stamens 8, monadelphous; staminal sheath free, 4–4.5 mm long; free portion of filaments to 2 mm long, united at same level. Ovary obovoid, c. 1 mm across, hairy along margins; style curved, 4–5 mm long, flat, dilated and hooked at apex forming a hood with lateral broad capitate stigma at its concavity. Capsules ovoid, orbicular or obliquely obcordate, 4–5 × 2.5–4 mm, compressed, emarginate at apex, narrowly winged along margins, glabrous on walls, patently hairy along margins. Seeds oblong-ellipsoid, 2.5–3 × c. 1.5 mm, white-silky pilose; caruncle hood-shaped, 3-fid almost to base with short appendages.

*Fl. & Fr.*: July – December.

*Habitat*: On hillslopes and on dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure, Koderma NRF; common. INDIA: Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Karnataka, Kerala, Punjab, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Myanmar, Nepal, and Southeast Asia to North Australia.

*Specimen examined*: Inside the enclosure, Koderma NRF, 398 m, 24°29'03.0" N, 85°36'01.7" E, 11th August 2011, *Shyam Biswa* 53920.

**2. *Polygala crotalarioides*** Buch.-Ham. ex DC., Prodr. 1: 327. 1824; A.W. Benn. in Hook.f., Fl. Brit. India 1: 201. 1872; Haines, Bot. Bihar Orissa: 42. 1921; Mooney, Suppl. Bot. Bihar Orissa: 23. 1950; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 466. 1993; N.P. Singh & al., Fl. Bihar: 48. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 86. 2002. **Plate 24B**

Herb, 10–20 cm high; rootstock woody. Stems and branches terete or slightly angular, hairy. Leaves alternate, obovate or oblanceolate,  $2-5.5 \times 0.9-2.5$  cm, cuneate at base, entire at margins, obtuse or rounded or slightly emarginate at apex, sparsely hairy, white-dotted all over. Inflorescence raceme, minute-hairy; bracteoles linear-lanceolate or subulate, *c.* 1 mm long. Flowers irregular, papilionaceous, 5–6 mm long; pedicels 1–2 mm long. Sepals 2+3; inner 2 large, usually petaloid and persistent, oblong-ovate,  $4-5 \times 2-3$  mm, light green; 3 outer smaller, linear-lanceolate or subulate, *c.*  $2 \times 1$  mm, light greenish. Petals 3; keel petal  $5-6.5 \times 4-5$  mm, white with tip fimbriate, purplish or pinkish; lateral petals 2, concave, *c.*  $3 \times 1.5-2$  mm, curved, white with purple veins, hairy at base. Stamens 8, monodelphous; filaments 1–1.5 mm free and united for their lower half; anthers oval-shaped, opening by pores. Ovary 1.5–2 mm long, 2-loculed; styles slender, 3–4 mm long, glabrous; stigma oval-shaped, *c.* 1 mm long; ovules 1 in each locule, pendulous. Capsules loculicidal, orbicular, *c.* 2 mm, retuse at apex, ciliate, greenish, 2-loculed, 2-seeded. Seeds subroundish, *c.*  $3 \times 2$  mm, hairy, brownish, strophiolate; caruncle deeply 3-fid, *c.* 1 mm long, whitish.

*Fl. & Fr.*: May – August.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Suggi Pahar, near Lakshmania; occasional. INDIA: Assam, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Manipur, Meghalaya, Odisha, Tripura and Uttar Pradesh. WORLD: Bhutan, China, Myanmar, Nepal, Pakistan, Vietnam and Thailand to East Asia.

*Specimen examined*: Suggi Pahar, near Lakshmania, 271 m,  $24^{\circ}33'20.0''$  N,  $85^{\circ}35'14.6''$  E, 15th August 2011, *Shyam Biswa* 49803.

**3. *Polygala linarifolia*** Willd., Sp. Pl. ed. 4. 3: 877. 1803; R.N. Banerjee in B.D. Sharma & N.P. Balakr., Fl. India 2: 476, f. 92. 1993; N.P. Singh & al., Fl. Bihar: 49. 2001. *Polygala chinensis* L. var. *linarifolia* (Willd.) Chodat, Mém. Soc. Phys. Genève 31(2): 386. 1893. **Plate 24C**

Annual. Stems erect, terete, tomentose. Leaves alternate, subsessile, linear or narrowly lanceolate,  $1.5-4.5 \times 0.05-0.4$  cm, cuneate at base, entire at margins, acute to apiculate at apex; midrib prominent, few ciliate on veins beneath and on margins; petioles *c.* 1 mm long. Inflorescence raceme, *c.* 2 cm long. Flowers papilionaceous, 5–7 mm long; pedicels 1.5–3 mm long, drooping hairy; bracteoles linear, *c.* 1 mm long, ciliate. Sepals 2+3; outer 3 smaller, oblong-ovate,  $1.5-2 \times c. 0.5$  mm, tapering at base, acute to apiculate at apex, ciliate at margins, single vein prominent; inner wing sepals 2, ovate-lanceolate,  $4-5 \times 2.5-3$  mm, broader between the half, 3–5-veined from base, green, ciliate outside, glabrous inside. Petals 2+1; lateral lobes obovate,  $4-5 \times 2-2.5$  mm, yellowish; mid lobes,  $4-6 \times 2.5-3$  mm, with a tri-frimbiate at the mid of apex, yellowish. Stamens 8, monadelphous; upper free portion 1.5–2 mm long; lower tubular portion 2.5–3 mm long. Carpels 4–6 mm long; ovary obovate, 0.5–1.5 mm long, subsessile, ciliate at margins; style 3–4 mm long, slender, glabrous; stigma *c.* 1 mm, hooded. Capsules obcordate, 3–4 mm across, unequal and emarginate at apex, narrowly winged, surface glabrous but ciliate at margins;



caruncles 3-lobed, *c.* 1 mm long, whitish. Seeds oval or roundish,  $2.5-3 \times 1.5-1.8$  mm, long hairy all over, dark brownish.

*Fl. & Fr.*: April – August.

*Habitat*: Dry deciduous forests on hillslopes.

*Distribution*: KWLS: Inside the enclosure, Koderma NRF; occasional. INDIA: Andhra Pradesh, Assam, Bihar, Goa, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. WORLD: China, Malesia, Nepal, Thailand and Vietnam.

*Specimen examined*: Inside the enclosure, Koderma NRF, 398 m,  $24^{\circ}29'03.0''$  N,  $85^{\circ}36'01.7''$  E, 11th August 2011, *Shyam Biswa* 49777.

### 31. ROSACEAE Juss., nom. cons.

Subcosmopolitan, *c.* 85 genera and *c.* 3000 species; *c.* 40 genera and 432 species in India.

#### POTENTILLA L.

North temperate and boreal and a few in South temperate, *c.* 330 species, *c.* 40 in India, 3 in Jharkhand and 1 in KWLS.

**Potentilla supina** L., Sp. Pl. 1: 497. 1753; Hook.f., Fl. Brit. India 2: 359. 1878, excl. *Potentilla amurensis* Maxim.; Haines, Bot. Bihar Orissa: 340. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 275. 2000; N.P. Singh & al., Fl. Bihar: 108. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 242. 2002.

#### Plate 24D

Herb, prostrate; roots slender, fibrous. Stems slender, angular, densely to sparsely pilose. Radical leaf and lower cauline leaves 3–5-pinnate; radical leaves to 5 cm long; cauline leaves *c.* 3.5 cm long; leaflets oblong to obovate,  $3-10 \times 2-6$  mm, cuneate or acute at base, deeply incised or obtusely serrate at margins, acute to obtuse at apex, pilose on both surfaces; petioles 3–6 cm long, sparsely adpressed pilose. Inflorescence a corymbose cyme, terminal, with axillary flowers on lower part of flowering stem. Flowers *c.* 5 mm across; pedicels 3–6 mm long, densely pubescent. Sepals triangular-ovate, 2–3 mm long, acute at apex; epicalyx segments oblong-elliptic or elliptic-lanceolate, nearly equalling or slightly longer than sepals, acute at apex. Petals obovate, *c.*  $2.5 \times 2$  mm, emarginate at apex, yellow. Stamens *c.* 20. Carpels many; style short, subterminal; stigma dilated. Achenes cylindric, *c.*  $1 \times 0.5$  mm, smooth.

*Fl. & Fr.*: March – May.

*Habitat*: Near river banks.

*Distribution*: KWLS: Near the bank of Dhanarjay Nadi, Meghatari; uncommon; INDIA: Almost throughout. WORLD: Widespread in Northern hemisphere and subtropical regions.

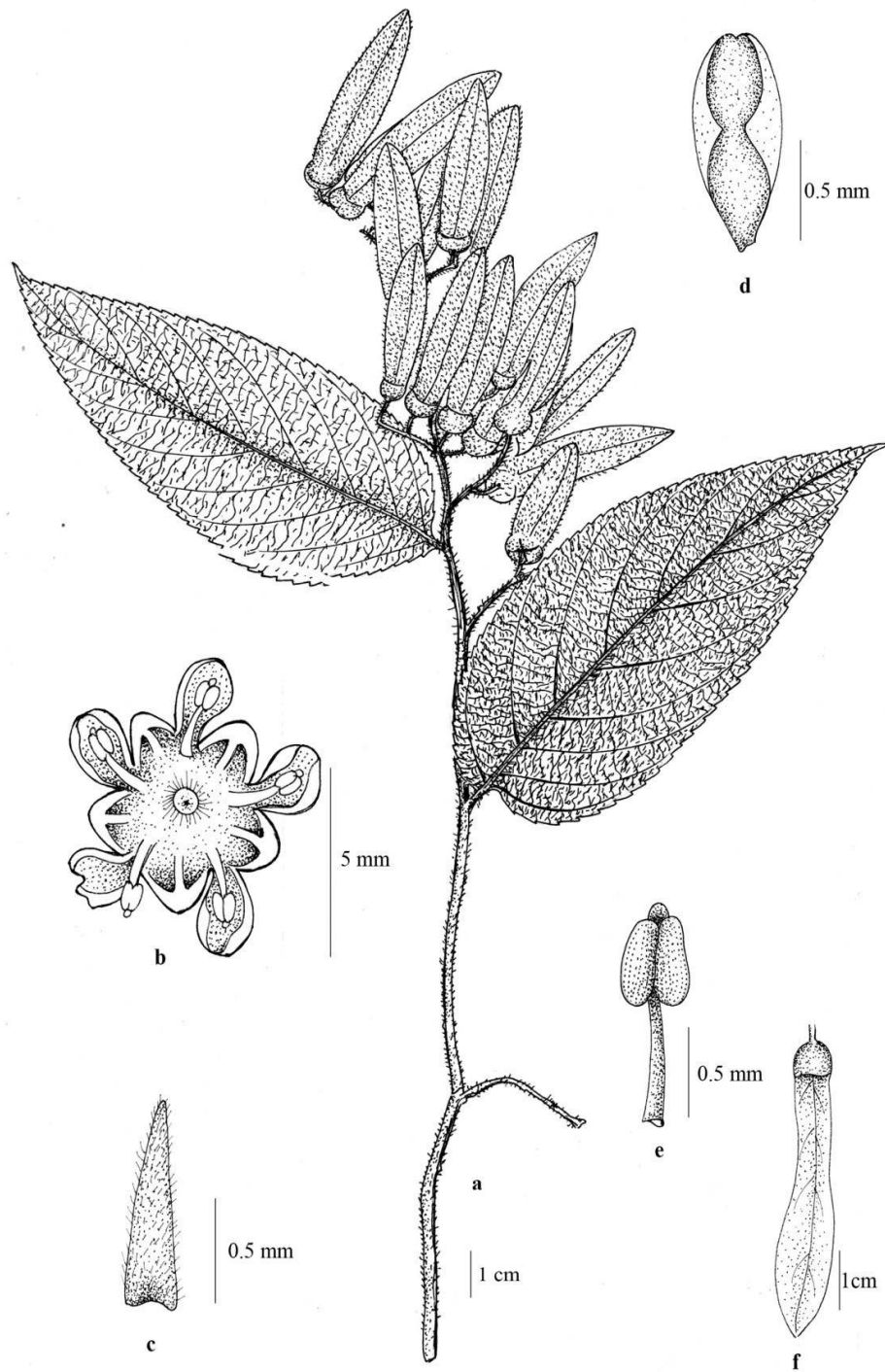
*Specimen examined*: Near the bank of Dhanarjay Nadi, Meghatari, 189 m,  $24^{\circ}34'58.1''$  N,  $85^{\circ}35'21.4''$  E, 31st March 2013, *Shyam Biswa* 54136.

### 32. RHAMNACEAE Juss. nom. cons.

Cosmopolitan, 57 genera, *c.* 950 species; 15 genera and 68 species in India.

#### Key to genera

- |                                                                                                                         |                     |
|-------------------------------------------------------------------------------------------------------------------------|---------------------|
| 1a. Leaves strongly 3-veined at base; flowers in cymes, sometimes aggregated into panicles; fruits globose without wing | <b>2. Ziziphus</b>  |
| 1b. Leaves pinnately veined throughout; flowers in fascicles or racemes, often forming terminal panicles; fruits winged | <b>1. Ventilago</b> |



**Fig. 23.** *Ventilago denticulata* Willd.: a. fruiting twig; b. flower; c. sepal; d. petal; e. stamen; f. fruit.

## 1. VENTILAGO Gaertn.

Old World tropical regions, *c.* 40 species, 4 in India, 2 in Jharkhand and 1 in KWLS.

**Ventilago denticulata** Willd. in Neue Schriften Ges. Naturf. Freunde Berlin 3: 417. 1801; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 217. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 487. 2000; N.P. Singh & al., Fl. Bihar: 107. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 148. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 61. 2014. *Ventilago calyculata* Tul. in Ann. Sci. Nat., Bot. sér. 4, 8: 124. 1857; M.A. Lawson in Hook.f., Fl. Brit. India 1: 631. 1875; Haines, Bot. Bihar Orissa: 193. 1921. **Fig. 23; Plate 24E**

Liana. Stems terete, ribbed, hairy all over. Leaves simple, alternate, ovate, oblong or elliptic-ovate, 2.5–12 × 2.4–7.5 cm, rounded or cordate to oblique at base, serrate or crenate at margins, acute or emarginate or roundish at apex, white short-hairy on both surfaces, more so on veins beneath; petioles 0.5–1.1 cm long, hairy. Inflorescence a panicle, axillary and terminal. Flowers 5–8 mm in diameter; pedicels *c.* 3 mm long, densely pubescent. Calyx lobes triangular, *c.* 1 × 1 mm, pubescent outside. Petals 5, spatulate, *c.* 1 mm long. Stamens 5, adnate to base of petal, *c.* 1.5 mm long; anthers ovoid or oblong, *c.* 0.5 mm long, basifixed. Disk weakly lobed, pubescent. Ovary superior, partly immersed in disk, 2-loculed; style short, deeply 2-fid, pubescent. Fruit a samara (a winged drupe), 1-seeded, indehiscent. Seed subglobose, *c.* 6 × 5 mm, lower half enclosed by cup-shaped calyx tube; wing oblong, 3–4.5 × 0.8–1 cm, pubescent.

*Fl. & Fr.*: November – February.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Taraghati forest, way to Muglamaram forest road; near Dhanarjay Nadi, Meghatari; common. INDIA: Almost throughout, chiefly in dry and dense forests and on rocky soils. WORLD: Native of tropical Asia.

*Specimens examined*: Taraghati forest, way to Muglamaram forest road, 321 m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49858; Near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 26th November 2012, *Shyam Biswa* 54089.

## 2. ZIZIPHUS Mill.

Tropical and subtropical regions, *c.* 100 species, 17 in India, 4 in Jharkhand and 3 in KWLS.

### Key to species

- 1a. Small tree; drupes woody, more than 1 cm in diam **3. Z. xylocarpus**
- 1b. Shrub or straggling shrub; drupes fleshy, less than 1 cm in diam 2
- 2a. Undershrub or shrub; leaves pubescent or glabrous shiny above, tomentose to densely brown or white-silky-tomentose beneath, drupes 3–5 mm in diam., turning yellow or orange when ripe **1. Z. jujuba**
- 2b. Straggling shrub; leaves greyish pubescent above, densely ferruginous-tomentose beneath; drupes, 6–8 mm in diam., black when ripe **2. Z. oenopolia**

**1. Ziziphus jujuba** (L.) Gaertn., Fruct. Sem. Pl. 1: 203. 1788, non Mill., 1768; M.A. Lawson in Hook.f., Fl. Brit. India 1: 632. 1875; Haines, Forest Fl. Chota Nagpur: 269. 1910 & Bot. Bihar Orissa: 194. 1921. *Ziziphus mauritiana* Lam., Encycl. 3: 319. 1789; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 233. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 488. 2000; N.P. Singh & al., Fl. Bihar: 108. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 149. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 61. 2014. **Plate 24F**

Vern. Names: *Jharberi* (Hindi); Bair.

Under shrub or large shrubs or small tree, to 15 m high; bark vertically fissured deeply, dark grey or nearly black, reddish and fibrous inside; branches drooping, rusty-tomentose when young; nodes slightly swollen around leaf-scars; stipules spinescent; spines solitary or in pairs, straight or one of them recurved 3–10 mm long. Leaves simple, alternate, variable, broadly elliptic or obovate-orbicular,  $0.8\text{--}9.6 \times 0.6\text{--}4$  cm, oblique or rounded at base, faintly denticulate or entire at margins, obtuse at apex, pubescent or glabrous shiny above, tomentose to densely brown or white-silky-tomentose beneath, 3-veined at base. Inflorescences a fascicle, 15–20-flowered, dense; peduncle to much reduced, to 0.5 mm long. Flowers 3–5 mm across; pedicels 4–5 mm long, hairy with few stellate hair. Calyx glabrous inside, pubescent outside, divided about halfway down; lobes 5, ovate, 1.2–1.5 mm long. Petals 5, spatulate, concave, 1.5–2 mm long, light green. Stamens 5, enclosed in the petals; filaments 1.5–2 mm long, slightly dilated at the base, anthers *c.* 0.5 mm long. Ovary embedded in 10-lobed disk, 2-loculed; styles 2, connate to middle; stigmas bifid. Drupes globose, 3–5 mm, fleshy, smooth, turning yellow or orange when ripe; fruiting pedicels 5–8 mm long, pilose; endocarp thick-leathery, 2-loculed, 1 or 2-seeded. Seeds  $2\text{--}4 \times 2\text{--}3$  mm, compressed, shiny, red-brown.

*Fl. & Fr.*: August – September.

*Habitat*: Scrub forests and Dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; Near Koderma Rest House, Koderma NRF; very common. INDIA: Throughout. WORLD: Afghanistan, Australia, China, Pakistan, Sri Lanka and Tropical Africa.

*Specimens examined*: Chattarbar forest, 379 m,  $24^{\circ}28'01.9''$  N,  $85^{\circ}32'13.1''$  E, 3rd September 2010, *Shyam Biswa* 49524; Koderma Rest House, Koderma NRF, 396 m,  $24^{\circ}29'04.4''$  N,  $85^{\circ}36'00.0''$  E, 20th August 2011, *Shyam Biswa* 49845.

**2. *Ziziphus oenopolia* (L.) Mill.**, Gard. Dict. ed. 8: 3. 1768; M.A. Lawson in Hook.f., Fl. Brit. India 1: 634. 1875; Haines, Forest Fl. Chota Nagpur: 270. 1910 & Bot. Bihar Orissa: 196. 1921; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 236, f. 53. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 490. 2000; N.P. Singh & al., Fl. Bihar: 108. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 150. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 61. 2014. *Rhamnus oenopolia* L., Sp. Pl.: 194. 1753. **Plate 24G**

Vern. Name: *Makai* (Hindi).

Shrub, straggling, armed with spines; branchlets fasciculate, strigose, often densely rusty-tomentose, fluted; nodes slightly swollen around leaf-scars; spines solitary or in pairs, recurved, 3–4 mm long. Leaves obliquely elliptic-ovate or ovate-lanceolate,  $2.5\text{--}3.6 \times 1.5\text{--}2.1$  cm, obliquely cuneate at base, acute or acuminate at apex, greyish pubescent above, densely ferruginous-tomentose beneath, 3-veined at base. Inflorescence a fascicle or pendunculate cyme, axillary, to 1.2 cm long, 5–8-flowered. Flowers 3–3.5 mm across; pedicels *c.* 2 mm long, pilose. Calyx lobes thickened at margins, 1.5–2 mm long, glabrous inside, apparently hairy outside, brown. Petals 5, obovate, emarginate at apex, 0.8–1 mm long, green. Stamens 5, 0.7–0.9 mm long. Disk 10-lobed, pitted or grooved, glabrous; lobes opposite each calyx lobe, emarginate. Ovary glabrous; style 2-cleft, united above the middle; stigma obtuse. Drupes 1–3 together,



globose or ovoid, 6–8 mm in diameter, shiny, black when ripe; pedicels 3–4 mm long; endocarp cartilaginous with mealy acrid pulp. Seeds 1 or 2, globose, 5–6 mm, shiny.

*Fl. & Fr.*: September – March.

*Habitat*: Scrub forests and dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure of Koderma NRF; common. INDIA: Throughout the hotter and dry forest localities and open bushy places. WORLD: Australia, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka and Thailand.

*Specimen examined*: Inside the enclosure forest of Koderma NRF, 397 m, 24°29'02.0" N, 85°35'59.6" E, 1st March 2012, *Shyam Biswa* 54024.

**3. *Ziziphus xylopyrus* (Retz.) Willd., Sp. Pl. ed. 4, 1(2): 1104. 1798; M.A. Lawson in Hook.f., Fl. Brit. India 1: 634. 1875; Haines, Bot. Bihar Orissa: 195. 1921; Bhandari & Bhansali in N.P. Singh & al., Fl. India 5: 243, f. 54. 2000; N.P. Singh & al., Fl. Bihar: 109. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 151. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 62. 2014.**

**Plate 25A**

Vern. Names: *Kakor* (Hindi); *Goot*.

Tree, 4–7 m high; young shoots rusty tomentose; spines on younger branches, and on the base of the petioles, straight or curved, 2–5 mm long; nodes swollen at leaf scars. Leaves simple, alternate, broadly elliptic or orbicular, rarely ovate, 4.5–7.5 × 2.7–5.5 cm, obliquely subcordate at base, serrate at margins (each serration marked by a deciduous glandular mucro), acuminate or obtuse with a mucro at apex, hairy beneath, 3-veined at base; primary lateral veins prominent; veinlets transversely reticulate; petioles 2–7 mm long, fulvous-tomentose. Inflorescences a dichotomous cyme, axillary, dense, condensed, to 2.5 cm long; peduncles c. 1.5 cm long. Flowers 4–6 mm across; buds ovoid, densely pubescent; pedicels 3–4 mm long, tomentose. Calyx lobes ovate, 2–2.5 mm long, acute or acuminate at apex, thickened, keeled at middle, glabrous inside, pubescent outside. Petals 5, 1.5–2 mm long, spatulate, distinctly triangular above, slightly bent, creamish white. Stamens 5, c. 2 mm long. Disk 10-lobed, pitted or grooved, rarely 5-lobed, glabrous. Ovary globose, nearly hidden by disk, glabrous, 3-loculed, rarely 2 or 4-loculed; styles 3, free. Drupes globose, 1.5–2.5 cm, woody, slightly rugose, tomentose; pedicels to 10 mm long; endocarp thin and hard; seeds oblong, to 8 × 5 mm, sulcate in middle.

*Fl. & Fr.*: September – December.

*Habitat*: Scrub forests and dry deciduous forests.

*Distribution*: KWLS: Way to Basraon forest; inside the enclosure forest of Koderma NRF; common. INDIA: Throughout, except Eastern India. WORLD: Nepal and Sri Lanka.

*Specimens examined*: Way to Basraon forest, 337 m, 24°34'33.6" N, 85°38'34.0" E, 6th September 2010, *Shyam Biswa* 49575; inside the enclosure forest of Koderma NRF, 390 m, 24°29'18.7" N, 85°35'15.1" E, 8th September 2010, *Shyam Biswa* 49599.

### **33. ULMACEAE** Mirb., nom. cons.

North Temperate to Tropical America, 7 genera and c. 50 species; 6 genera and 22 species in India.

#### **HOLOPTELEA** Planch.

Tropical regions, 2 species and 1 in India.

**Holoptelea integrifolia** (Roxb.) Planch. in Ann. Sci. Nat., Bot. ser. 3, 10: 259. 1848; Hook.f., Fl. Brit. India 5: 481. 1888; Haines, Forest Fl. Chota Nagpur: 389. 1910 & Bot. Bihar Orissa: 807. 1924. *Ulmus integrifolia* Roxb., Pl. Coromandel 1: 56. 1795 & Fl. Ind. 2: 68. 1832. Paria & Chattopadhyay, Fl. Hazaribagh 1: 77. 2000; N.P. Singh & al., Fl. Bihar: 473. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 568. 2001. **Plate 25B**

Vern. Names: *Chilbil* (Kharwari); *Chiral*, *Chirata*.

Tree, to 20 m high, deciduous; bark smooth, whitish grey; branchlets pubescent. Leaves simple, alternate, elliptic or ovate, 3–10 × 2.5–5.5 cm, rounded or subcordate at base, entire at margins, acute to acuminate at apex; lateral veins 4–7 pairs; stipules lateral, scarious; petioles stout, 5–12 mm long. Inflorescence a short raceme or fascicle on leafless branches. Flowers polygamous, 5–8 mm across; pedicels *c.* 1 cm long, jointed. Tepals 4 or 5, hairy, light purplish green. Stamens 4–8, pubescent; anthers *c.* 1 mm long. Female flowers with longer pedicels; ovary superior, compressed, long-stipitate, 2-winged, 1-loculed; ovule 1; style 2-fid. Samaras broadly elliptic or orbicular, *c.* 2.8 × 2.5 cm; wings papery, notched, glabrous, reticulate-veined, yellowish brown. Seed one.

*Fl. & Fr.*: March – May.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Baghitan forest. INDIA: Almost throughout. WORLD: Cambodia, Laos, Myanmar; Nepal, Sri Lanka and Vietnam.

*Specimen examined*: Baghitan forest, 402 m, 24°29'06.6" N, 85°36'12.8" E, 3rd March 2011, Shyam Biswa 49655.

*Note*: Tree is leafless during flowering period.

### 34. MORACEAE Link, nom. cons.

Tropical and subtropical regions, a few temperate regions, 38 genera and *c.* 1150 species; 13 genera 122 species in India.

#### Key to genera

- 1a. Flowers neither enclosed in nor on broad fleshy receptacles; male and female flowers in catkin-like spike **3. Morus**
- 1b. Flowers crowded on or enclosed in broad fleshy receptacles **2**
- 2a. Inflorescence a cauliflorous head; flowers on the outside of globose or clavate receptacles; filaments inflexed; fruits very large **1. Artocarpus**
- 2b. Inflorescence a syconium; flowers enclosed within the fleshy receptacles (hypanthodium); filaments straight in buds; fruits small **2. Ficus**

#### 1. ARTOCARPUS J.R. Forst. & G. Forst., nom. cons.

Indomalesia, *c.* 45 species, 18 in India, 2 in Jharkhand and KWLS.

#### Key to species

- 1a. Syncarps 20–25 cm in diam., tuberculate, brown **1. A. heterophyllus**
- 1b. Syncarps to 10 cm in diam., smooth, yellow **2. A. lakucha**

**1. Artocarpus heterophyllus** Lam., Encycl. 3: 209. 1789; Paria & Chattopadhyay, Fl. Hazaribagh 1: 81. 2000; N.P. Singh & al., Fl. Bihar: 475. 2002; T.K. Sharma & A.K. Sarkar in

N.P. Singh & P.S.N. Rao, Fl. Palamau: 571. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 201. 2014. *Artocarpus integrifolia* auct. non L.f., 1782: King in Hook.f., Fl. Brit. India 5: 541. 1888; Haines, Forest Fl. Chota Nagpur: 393. 1910 & Bot. Bihar Orissa: 825. 1924. **Plate 25C**

Vern. Name: *Kathal* (Hindi).

Tree, to 10 m high. Leaves simple, alternate, obovate-oblong, 6–12 × 3–7.5 cm, cuneate or attenuate at base, entire at margins, rounded to slightly acuminate at apex, glabrous; lateral veins 6–7 pairs, raised beneath; petioles 1–2 cm long. Inflorescence axillary, usually on main branches or trunks; peduncles 1.5–4 cm long, glabrous. Male inflorescence terminal at branches apex or axillary, with few sterile and fertile flowers, cylindric to clavate, 3–4.5 cm long. Female inflorescence borne on main trunk and old branches, cylindric or oblong, tubercled and larger in size than male. Fruits oblong-globose, cylindric or somewhat clavate, 30–100 × 20–50 cm; fruiting perianth numerous, fleshy, tuberculate, externally brown, pulp yellowish. Seeds reniform, c. 3 × 2 cm, light brownish or whitish yellow.

*Fl. & Fr.*: March – July.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Inderwa Chittarpur near the road; common. INDIA: Native. WORLD: cultivated throughout the tropical regions.

*Specimen examined*: Chittarpur near the road, Inderwa, 375 m, 24°30'33.9" N, 85°39'42.2" E, 5th March 2011, *Shyam Biswa* 49680.

**2. *Artocarpus lacucha*** Roxb. ex Buch.-Ham., Mem. Wern. Nat. Hist. Soc. 5: 333. 1826; Ranjan, Fl. Parasnath Wildlife Sanct.: 201. 2014. *Artocarpus lakoocha* Roxb., Fl. Ind. 3: 524. 1832; King in Hook.f., Fl. Brit. India 5: 543. 1888; Haines, Forest Fl. Chota Nagpur: 393. 1910 & Bot. Bihar Orissa: 824. 1924; Mooney, Suppl. Bot. Bihar Orissa: 137. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 82. 2000; N.P. Singh & al., Fl. Bihar: 475. 2001. **Plate 25D**

Vern. Names: *Denyo* (Hindi); *Dauha*, *Dhembha*.

Tree, monoecious. Leaves simple, alternate, oblong or elliptic-obovate, 4–35 × 2–20 cm rounded or cuneate at base, dentate at margins, acute to acuminate at apex, pubescent above, brownish tomentose beneath, more so on veins; lateral veins 6–10 pairs; petioles 1–5 cm long, tomentose; stipules lanceolate, 10–15 mm long, hairy. Male inflorescence ovoid, 2–2.5 cm long, subsessile, orange-yellow; anthers exserted, 2-celled, longitudinally dehiscent. Female inflorescence subglobose; peduncles 2–5 cm long. Syncarps globose, 2–6 cm in diam., irregularly lobed, almost smooth, yellow on maturity.

*Fl. & Fr.*: April – October.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF; not common. INDIA: Andaman and Nicobar Islands, Assam, Bihar, Karnataka, Kerala, Maharashtra, Nagaland, Sikkim and Tamil Nadu. WORLD: China, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Thailand and Vietnam.

*Specimen examined*: Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 5th April 2013, *Shyam Biswa* 54162.

*Note*: Male receptacles soft and spongy, yellowish. Female receptacles are hard and green.

## 2. FICUS L.

Tropical and subtropical regions, mostly in Indomalaysia to Australia, c.850 species; 105 in India, 27 in Jharkhand and 7 in KWLS.

### Key to species

- 1a. Figs on terminal branchlets, opposite or alternate; peduncles sessile or very short 2
- 1b. Figs on trunk or on branches, in clusters; peduncles not sessile, longer than above 6
- 2a. Plant with many prop roots **3. F. benghalensis**
- 2b. Plants without prop roots 3
- 3a. Leaves sharply caudate or acuminate at apex 4
- 3b. Leaves not sharply caudate or acuminate at apex 5
- 4a. Leaves glossy above, long-caudate at apex, acumen >2 cm long; fig c.10 mm in diam. **7. F. religiosa**
- 4b. Leaves not glossy, short-caudate at apex, acumen <1.5 cm long; figs 5–6 mm in diam. **2. F. arnottiana**
- 5a. Leaves puberulous beneath; figs to 6 mm in diam., pubescent, green turns reddish **1. F. altissima**
- 5b. Leaves tomentose beneath; figs to 12 mm in diam.; green turns brownish, whitish villose/tomentose **5. F. mollis**
- 6a. Leaves alternate, entire at margins, not hispid, smooth; figs not pubescent **6. F. racemosa**
- 6b. Leaves opposite, serrulate or minutely toothed at margins, hispid, rough; figs pubescent **4. F. hispida**

**1. Ficus altissima** Blume, Bijdr. Fl. Ned. Ind. 9: 444. 1825; King, Ann. Roy. Bot. Gard. Calcutta 1: 30, t. 30, 31, 82s, 82 s.l. 1887 & in Hook.f., Fl. Brit. India 5: 504. 1888; Brandis, Indian Trees: 600. 1906; L.B. Chaudhary & al., Taiwania 57: 210. 2012. **Plate 25E**

Vern. Name: *Bat* (Hindi).

Tree, 9–12 m high; prop roots absent. Leaves simple, alternate, elliptic, 11–19.2 × 7.2–12.5 cm, broadly cuneate or rounded at base, entire at margins, acute to bluntly apiculate at apex, glabrous, 3-veined at base; lateral veins 5 pairs, raised beneath; petioles 2.5–3.5 cm long, glabrous or pubescent. Figs axillary, globose to subglobose, 1.2–1.7 cm in diam., pubescent, green, turning reddish on maturity, enclosed by a deciduous sheath when young; basal bracts 3, obtuse at apex, 2–3 mm long, pubescent. Male, gall, and female flowers within same fig. Male flowers scattered and female flowers sessile.

*Fl. & Fr.*: September – October.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; Bhagitan forest and Bholaghat forest; occasional. INDIA: Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Deccan Peninsula, Meghalaya, Mizoram, Sikkim and West Bengal. WORLD: Bangladesh, Bhutan, China, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Thailand and Vietnam.

*Specimen examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49570; Bhagitan forest road, Koderma NRF, 402 m,



24°29'16.0" N, 85°35'54.0" E , 3rd March 2011, *Shyam Biswa* 49662; Bholaghat forest road, 402 m, 24°29'05.0" N, 85°36'06.1" E, 28th February 2011, *Shyam Biswa* 49634.

**2. *Ficus arnottiana*** (Miq.) Miq., Ann. Mus. Bot. Lugduno-Batavi 3: 287. 1867; King in Hook.f., Fl. Brit. India 5: 513. 1888; Haines, Forest Fl. Chota Nagpur: 399. 1910 & Bot. Bihar Orissa: 833. 1924; Brandis, Indian Trees: 602. 1906; L.B. Chaudhary & al., Taiwania 57: 207. 2012. *Urostigma arnottianum* Miq., London J. Bot. 6: 564. 1847. **Plate 25F**

Vern. Names: *Pakar*, *Pakad*.

Tree, to 15 m high. Leaves simple, alternate, broadly ovate, 5.5–9.5 × 5–8.2 cm, cordate at base, entire at margins, short-acuminate or caudate at apex (acumen 0.5–1.5 cm long), glabrous, 3 or 5-veined at base; lateral veins 5 or 6 pairs; petioles 4–6.5 cm, glabrous. Figs globose, 5–6 mm with pointed tip, glabrous, green with reddish orange apically, purple-black when ripe. Male flowers few near the mouth of receptacle, sessile; tepals 3; stamen 1. Gall and female flowers similar, sessile or shortly pedicellate; style elongate; stigma flat.

*Fl. & Fr.*: February – June.

*Habitat*: Dry deciduous forests on hillslopes.

*Distribution*: KWLS: Dhawjadhari Pahar; not common. INDIA: Throughout. WORLD: Nepal and Sri Lanka.

*Specimen examined*: Dhawjadhari Pahar, 411 m, 24°28'47.7" N, 85°35'49.6" E, 29th February 2012, *Shyam Biswa* 54018.

**3. *Ficus benghalensis*** L., Sp. Pl.: 1059. 1753; King in Hook.f., Fl. Brit. India 5: 499. 1888; Haines, Forest Fl. Chota Nagpur: 401. 1910 & Bot. Bihar Orissa: 834. 1924; Brandis, Indian Trees: 600. 1906; Paria & Chattopadhyay, Fl. Hazaribagh 1: 84. 2000; N.P. Singh & al., Fl. Bihar: 476. 2002; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 574. 2002; L.B. Chaudhary & al., Taiwania 57: 210. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 202. 2014. **Plate 26A & B**

Vern. Names: *Bat* (Hindi); *Barh* (Kharwari).

Tree, to 18 m high with numerous aerial roots from branches forming additional props, well-branched. Leaves simple, alternate, ovate, 13.5–21 × 10.5–15 cm, subcordate or rounded at base, entire at margins, obtuse to acute or bluntly apiculate at apex, glabrous and shiny above, finely puberulous beneath when young, 3-veined at base; lateral veins 5 or 6 pairs, raised beneath; petioles 2–3.5 cm long, glabrous; stipules ovate-lanceolate, 2–2.5 cm long. Figs solitary or in axillary pairs, sessile, globose or subglobose, 1.5–2 cm in diam., finely pubescent, greenish turning reddish on maturity; basal bracts 3, rounded, c. 5 mm. Male flowers numerous near ostiole; tepals 4, free; stamen 1. Gall flowers: perianth as in male; style short. Female flowers: perianth shorter than male.

*Fl. & Fr.*: March – May and December – January.

*Habitat*: Near village and in dry deciduous forests.

*Distribution*: KWLS: Dhodhakola forest, near Chotamore; common. INDIA: Planted in all parts, wild in the sub-Himalayan forests and on the lower slopes of hills in Deccan region and Andaman

Islands. WORLD: Bangladesh, Malesia, Nepal, Pakistan, Sri Lanka; introduced and widely cultivated in tropics and elsewhere.

*Specimens examined*: Dhodhakola forest, near Chotamore, 380 m, 24°33'08.8" N, 85°38'31.0" E, 5th March 2011, *Shyam Biswa* 49681; Baghi Tan forest road, 389 m, 24°29'05.7" N 85°36'04.3" E 1st March 2011 *Shyam Biswa* 49647.

**4. *Ficus hispida*** L.f., Suppl. Pl.: 442. 1782; King in Hook.f., Fl. Brit. India 5: 522. 1888; Brandis, Indian Trees: 606. 1906; Haines, Forest Fl. Chota Nagpur: 396. 1910 & Bot. Bihar Orissa: 837. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 85. 2000; N.P. Singh & al., Fl. Bihar: 478. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 577. 2002; L.B. Chaudhary & al., Taiwaniana 57: 205. 2012. *Ficus oppositifolia* Roxb., Pl. Coromandel 2: 14, t. 124. 1799. **Plate 26C**

Vern. Names: *Kat gulasia* (Hindi); *Dumar* (Kharwari); *Jungli Dumar*.

Tree, to 12 m high; bark grey; branchlets hispid-pubescent. Leaves simple, oblong-elliptic, 14–18 × 7.5–12 cm, subcordate at base, serrulate or minutely toothed at margins, shortly acuminate at apex, rough, hispid-pubescent above, hispid-scabrid beneath, 3-veined at base; lateral veins 5–8 pairs, prominent beneath; petioles 1.5–4.5 cm long, with a subnodal gland, densely hispid; stipules ovate-lanceolate, 0.8–1.2 cm long, pubescent outside. Figs dioecious, obovoid or subpyriform, 1.5–2 cm in diam., narrowed at base, faintly ribbed, sticky pubescent outside, yellowish when ripe; peduncles 1–1.5 cm long, pubescent; bracts triangular, c. 2 mm long; mouth slightly raised, closed by 5 or 6 apical bracts. Male flowers numerous near ostiole; perianth lobes 3; stamens 1. Gall flowers pedicellate; perianth absent; ovary smooth. Female flowers sessile or minutely stalked; perianth thin or absent; style clavate.

*Fl. & Fr.*: September – March.

*Habitat*: Dry deciduous forest s and dry deciduous mixed forests.

*Distribution*: KWLS: Near the base of the Rishi Dhurwasa Pahar; common. INDIA: Throughout, to 3500 m. WORLD: Australia, Bhutan, China, Malesia, Nepal, Sri Lanka and Vietnam.

*Specimen examined*: Near the base of the Rishi Dhurwasa Pahar, 189 m, 24°34'58.1" N, 85°34'55.8" E, 11th September 2010, *Shyam Biswa* 49605.

**5. *Ficus mollis*** Vahl, Symb. Bot. 1: 82. 1790; N.P. Singh & al., Fl. Bihar: 479. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 578. 2002; L.B. Chaudhary & al., Taiwaniana 57: 212. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 203. 2014. *Ficus. tomentosa* Roxb. ex Willd., Sp. Pl. 4: 1136. 1806; King in Hook.f., Fl. Brit. India 5: 501. 1888; Haines, Forest Fl. Chota Nagpur: 401. 1910 & Bot. Bihar Orissa: 834. 1924. **Plate 26D**

Vern. Names: *Bat* (Hindi); *Barun* (Kharwari).

Tree, 5–12 m high; trunk whitish with numerous blackish lenticels/spots. Leaves simple, alternate, elliptic-oblong, 5.3–14.6 × 2.6–8.5 cm, subcordate at base, entire at margins, acute to bluntly apiculate at apex, glabrous above, tomentose beneath, 2 or 3-veined at base; lateral veins 4 or 5 pairs; petioles 2–4 cm long, slightly peltate (petiole fixed on lamina 0.5–1 cm above base), tomentose. Figs globose, 0.7–1.2 cm, tomentose, whitish green turning brown on maturity.

Flowers in axillary pairs, subglobose, tomentose; orifice circular, slightly raised; basal bracts 3, ovate, 3–4 mm long, acute at apex, often split, velvety tomentose. Male flowers: tepals 4; stamen 1. Gall flowers sessile or pedicellate; tepals 4. Female flowers sessile; tepals 4.

*Fl. & Fr.*: March – August.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Bagitan jungle, Koderma NRF; not common. INDIA: Andaman and Nicobar Islands, Bihar, Central and Southern provinces, Jharkhand, Maharashtra, Rajasthan, Uttar Pradesh. WORLD: Sri Lanka.

*Specimens examined*: Bagitan jungle, Koderma NRF, 390 m, 24°29'05.7" N, 85°35'54.0" E, 1st March 2011, *Shyam Biswa* 49649; Dhodhakola, near Pasia village, 386 m, 24°33'41.6" N, 85°40'00.3" E, 17th August 2011, *Shyam Biswa* 49827; Dipluswa Nala, 186 m, 24°34'25.1" N, 85°35'19.4" E, 31st March 2013, *Shyam Biswa* 54131.

**6. *Ficus racemosa* L.**, Sp. Pl. 2: 1060. 1753; N.P. Singh & al., Fl. Bihar: 480. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 579. 2002; L.B. Chaudhary & al., Taiwania 57: 203. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 204. 2014. *Ficus glomerata* Roxb., Pl. Coromandel 2: 13, t. 123. 1799; King in Hook.f., Fl. Brit. India 5: 535. 1888; Haines, Forest Fl. Chota Nagpur: 395. 1910 & Bot. Bihar Orissa: 835. 1924. **Plate 26E**

Vern. Names: *Dumar* (Hindi); *Gular* (Kharwari).

Tree, 8–12 m high; young shoots pubescent; trunk smooth, greyish brown. Leaves simple, alternate, ovate-elliptic or ovate-oblong, 3–9.5 × 2.4–4.5 cm, acute or rounded at base, entire at margins, acute at apex, glabrous; lateral veins 4–8 pairs; petioles 0.3–2 cm long, pubescent; stipules 1–3 cm long, often persistent on young shoots. Figs in large clusters on main branches and trunk, subglobose to pyriform, 2.5–3 cm in diam.; orifice plain or slightly sunken, closed by apical bracts; peduncles 3–12 mm long. Male flowers sessile; tepals 3, membranous, inflated enclosing stamens. Gall flowers pedicelled; ovary red-spotted. Female flowers subsessile; perianth 4 or 5-lobed; style subterminal, elongate.

*Fl. & Fr.*: February – March.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Lokai forest; common. INDIA: Almost throughout from the outer Himalaya to plains and low hills. WORLD: Australia, Bangladesh, China, Malesia, Myanmar, Nepal, Pakistan, Sri Lanka and Vietnam.

*Specimens examined*: Lokai forest, 397 m, 24°29'02.9" N, 85°37'04.4" E, 28th February 2011, *Shyam Biswa* 49639; Phutlaiya Nala, 345 m, 24°30'35.4" N, 85°39'35.9" E, 5th March 2011, *Shyam Biswa* 49676.

**7. *Ficus religiosa* L.**, Sp. Pl. 2: 1059. 1753; King in Hook.f., Fl. Brit. India 5: 513. 1888; Brandis, Indian Trees: 601. 1906; Haines, Forest Fl. Chota Nagpur: 400. 1910 & Bot. Bihar Orissa: 833. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 86. 2000; N.P. Singh & al., Fl. Bihar: 480. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 580. 2002; L.B. Chaudhary & al., Taiwania 57: 208. 2012. **Plate 26F**

Vern. Name: *Peepal* (Hindi).

Tree, to 15 m high, often epiphytic. Leaves simple, alternate, broadly ovate,  $8-11.5 \times 6-9.5$  cm, cordate or truncate at base, entire at margins, very long caudate-acuminate at apex, (acumen 2–3.5 cm long), 2 or 3 pairs of veins at base; lateral veins 5–7 pairs, glabrous; petioles slender, 4–8 cm long, glabrous. Figs globose, c. 10 mm, reddish when ripe; bracts 5–6 mm long, at the base of the fig covering almost half of the fig. Male, gall, and female flowers within same fig. Male flowers: few, near apical pore, sessile; perianth 2 or 3-lobed; stamen 1. Gall flowers: pedicellate; perianth 3 or 4-lobed; ovary globose. Female flowers: sessile; perianth 4-lobed; ovary globose, smooth.

*Fl. & Fr.*: March – September.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Near the river Phutlaiya Nala; common. INDIA: Wild in sub-Himalayan regions, cultivated throughout. WORLD: Bangladesh, China, Indochina, Myanmar, Nepal, Pakistan, Sri Lanka. Introduced and cultivated elsewhere.

*Specimen examined*: Near the river Phutlaiya Nala, 343 m,  $24^{\circ}30'33.9''$  N,  $85^{\circ}39'31.8''$  E, 5th March 2011, *Shyam Biswa* 49675.

### 3. MORUS L.

Almost throughout the world, especially in tropical and subtropical Africa and Asia, 13 species, 3 in Jharkhand (1 cultivated) and 1 in KWLS.

**Morus indica** L., Sp. Pl. 2: 986. 1753; Haines, Forest Fl. Chota Nagpur: 392. 1910 & Bot. Bihar Orissa: 821. 1924. *Morus australis* Poir in Lam., Encycl. 4: 380. 1797; K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 580. 2002.

**Plate 26G**

Vern. Name: *Tut* (Hindi).

Tree, 8–10 m high. Leaves simple, alternate, ovate to ovate-suborbicular,  $2.5-12 \times 2-8.4$  cm, cordate and oblique at base, deeply serrate at margins, acuminate at apex, glabrous, only pubescent on veins, 3-veined at base; petioles 0.8–4 cm long. Flowers monocious or dioecious, spicate; peduncles 0.2–1.2 cm long. Male catkins 1–2.5 cm long. Male flowers: Sepals 4, free, broadly ovate, obtuse at apex, glabrous to hairy; stamens 4, inflexed in buds; anthers exerted. Female catkins ovoid, 2–10 mm long. Female flowers: sepals suborbicular, glabrous or ciliate at margins; ovary c.  $3 \times 1.5$  mm, included, straight, 1-loculed; style 2-fid, 2.5–3 mm long; ovule pendulous. Fruiting spikes or heads, many achenes enclosed in the succulent perianth. Sorosis ovoid or cylindrical, 0.5–2.5 cm long, green, white or reddish turning purplish black when ripe, sweet and edible. Seeds subglobose with copious albumen, fleshy.

*Fl. & Fr.*: January – March.

*Habitat*: Planted near villages.

*Distribution*: KWLS: Near the village, Meghatari; common. INDIA: Almost throughout. WORLD: Bhutan, China, Japan, Korea, Malaysia, Myanmar, Nepal, Oceanic Islands, and Africa, Australasia and North and South Americas.

*Specimen examined*: Near the village, Meghatari, 190 m,  $24^{\circ}34'39.6''$  N,  $85^{\circ}34'37.6''$  E, 9th March 2011, *Shyam Biswa* 49730, 49731, 49732.



### 35. CUCURBITACEAE Juss. nom. cons.

Tropical and a few in subtropical and temperate regions, 122 genera and c. 940 species; 39 genera c. 100 species in India.

#### Key to genera

- |                                                                                                       |                         |
|-------------------------------------------------------------------------------------------------------|-------------------------|
| 1a. Petals free                                                                                       | <b>4. Luffa</b>         |
| 1b. Petals united                                                                                     | 2                       |
| 2a. Petals fimbriate at their margins                                                                 | <b>6. Trichosanthes</b> |
| 2b. Petals with entire margins                                                                        | 3                       |
| 3a. Male flowers with usually a large enveloping bract; calyx with 2 or 3 incurved scales at its base | <b>5. Momordica</b>     |
| 3b. Male flowers with no enveloping bract; calyx without scales at its base                           | 4                       |
| 4a. Flowers less than 1 cm in diam.                                                                   | <b>3. Diplocyclos</b>   |
| 4b. Flowers more than 1 cm in diam.                                                                   | 5                       |
| 5a. Corolla campanulate, white                                                                        | <b>1. Coccinia</b>      |
| 5b. Corolla rotate or rarely campanulate but then segments almost free, white                         | <b>2. Cucumis</b>       |

#### 1. COCCINIA Wight & Arn.

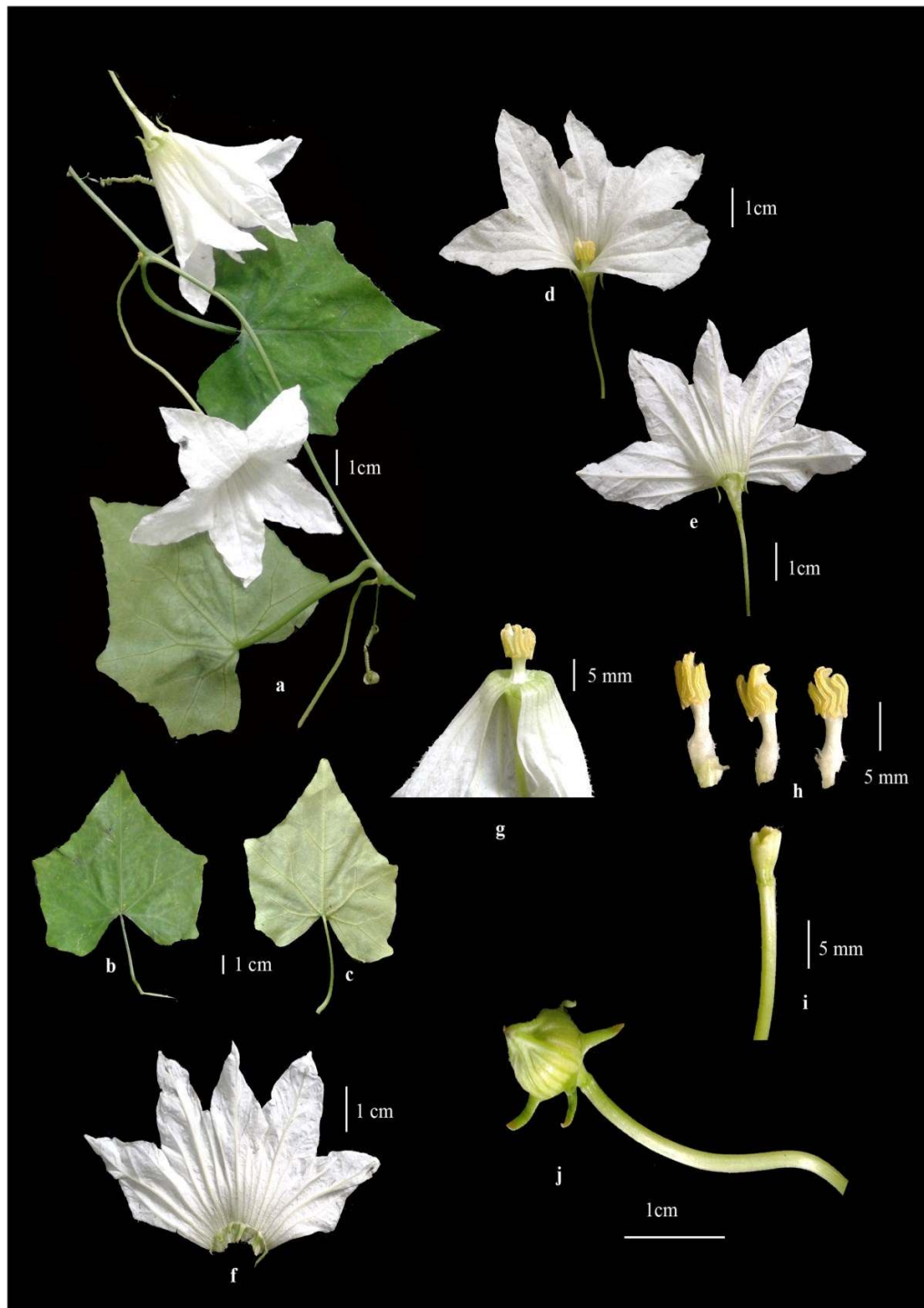
Tropical regions, c. 30 species and 1 in India.

**Coccinia grandis** (L.) Voigt, Hort. Suburb. Calcutt.: 59. 1845; Chakrav., Fasc. Fl. India 11: 24, ff. 1–9. 1982; Paria & Chattopadhyay, Fl. Hazaribagh 1: 229. 2000; N.P. Singh & al., Fl. Bihar: 214. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 276. 2002; S.S. Renner & A.K. Pandey, PhytoKeys 20: 63. 2013. *Bryonia grandis* L., Mant. Pl.: 126. 1767. *Coccinia indica* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 347. 1834. *Cephalandra indica* Naudin, Ann. Sci. Nat., Bot. sér. 5, 5: 16. 1859; C.B. Clarke in Hook.f., Fl. Brit. India 2: 621. 1879, excl. syn.; Haines, Forest Fl. Chota Nagpur: 174. 1910 & Bot. Bihar Orissa: 399. 1922. **Fig. 24**

Vern. Names: *Kundru* (Hindi); *Jungli Kundri*, *Banroi*.

Climber, herbaceous, much-branched with perennial rootstock. Stems angular, ribbed, glabrous; tendrils simple or rarely 2-fid, slender, striate. Leaves simple, alternate, ovate or orbicular, 5–7-angled or lobed, 4–6.5 × 4.2–8 cm, deeply cordate at base, distantly denticulate at margins with few glistening glands on lower surface towards base, acute at apex with a small apiculation, glossy and dark green above, pale beneath; primary lateral veins ending in glandular denticulations at margins; petioles 1–2 cm long. Flowers 4–4.5 × 6–7 cm, white, ebracteate. Male flowers: pedicels 2.5–5 cm long, striate; calyx tube campanulate, 5–8 mm long; lobes spreading, subulate-oblong, c. 5 mm long; corolla campanulate, 4–4.5 cm long, white; lobes spreading, ovate-oblong, papillose-hairy inside; filaments 3–4 mm long, connate, hairy at base; anthers c. 5 mm long, connivent, reflexed; connective not produced; pistillode absent. Female flowers: pedicels 0.5–3 cm long; staminodes 3, subulate, 2–3 mm long, villous at base; ovary fusiform, 1–1.5 cm long; style 6–7 mm long; stigmas 3, 5–6 mm, densely papillose. Fruits ellipsoid-oblong, c. 5 × 2.5 cm, rounded at ends, green with white streaks when unripe, bright scarlet when ripe. Seeds ovoid, 5–6 × 2.5–3 mm, yellowish.

*Fl. & Fr.*: August – December.



**Fig. 24. *Coccinia grandis* (L.) Voigt:** a. flowering twig; b.,c. leaf (upper & lower view); d.,e. flower (front & back views); f. corolla; g. corolla and androecium; h. stamens; i. pedicel; j. flower bud.

*Habitat*: On hedges or cultivated.

*Distribution*: KWLS: Koderma NRF; common. INDIA: Almost throughout. WORLD: Africa, China, Japan, Malaysia, Myanmar, Pakistan and Sri Lanka.

*Specimen examined*: Koderma NRF, 390 m, 24°29'06.6" N, 85°36'49.8" E, 8th August 2011, *Shyam Biswa* 49754.

## 2. CUCUMIS L.

Old World tropical regions, 52 species, 11 in India, 3 in Jharkhand and 1 in KWLS.

**Cucumis melo** L., Sp. Pl. 2: 1011. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 2: 620. 1879; Haines, Forest Fl. Chota Nagpur: 173. 1910 & Bot. Bihar Orissa: 392. 1922; Chakrav., Fasc. Fl. India 11: 32, ff. 1–10. 1982; Paria & Chattopadhyay, Fl. Hazaribagh 1: 231. 2000; N.P. Singh & al., Fl. Bihar: 214. 2001; S.S. Renner & A.K. Pandey, PhytoKeys 20: 68. 2013. *Cucumis callosus* (Rottler) Cogn. in Engl., Pflanzenr. IV, 275, 2: 129. 1924. *Cucumis melo* var. *agrestis* Naudin, Ann. Sci. Nat., Bot. sér. 4, 11: 73. 1859; Chakrav., Fasc. Fl. India 11: 35. 1982. **Plate 27A & B**  
Vern. Name: *Lata*.

Herb, prostrate. Stems branched, terete, with scabrous hairs and small thorns. Leaves simple, alternate, triangular, ovate, 3–5(–7)-lobed, 2–3.5 × 2.5–4 cm, cordate at base, serrate or dentate at margins, obtuse at apex, scabrid, prominently 5-veined at base; petioles 1.5–4 cm long, scabrid. Flowers rotate, small, solitary or rarely in pairs or three; peduncles 5–10 mm long, densely hispid; pedicels 0.5–1 cm long, hairy. Male flowers: 2 or 3; calyx teeth narrowly triangular, c. 1 mm, connate below, coarsely pubescent; corolla yellow; lobes obovate, 1–1.5 cm long, connate. Anthers c. 2.5 mm long; appendages c. 1.5 mm long. Female flowers: ovary ellipsoid, softly hairy; style c. 2 mm long; stigmas c. 2 mm long. Fruits ellipsoid, oblong-globose, 2–3.5 × 1.5–3 cm, smooth, generally green with dark green stripes, many-seeded. Seeds obovoid, 5–6 × 2–2.5 mm, yellowish white.

*Fl. & Fr.*: September – November.

*Habitat*: Dried up sandy river bed.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Andhra Pradesh, Assam, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Rajasthan, Tamil Nadu, Tripura and Uttar Pradesh. WORLD: Widely cultivated throughout the world.

*Specimens examined*: Near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 13th September 2010, *Shyam Biswa* 49615; 27th November 2012, *Shyam Biswa* 54092.

## 3. DIPLOCYCLOS (Endl.) T. Post & Kuntze

Tropical Africa, 4 species and 1 in India

**Diplocyclos palmatus** (L.) c. Jeffrey, Kew Bull. 15: 325. 1962; Paria & Chattopadhyay, Fl. Hazaribagh 1: 236. 2000; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 278. 2002; S.S. Renner & A.K. Pandey, PhytoKeys 20: 73. 2013. *Bryonia palmata* L., Sp. Pl. 2: 1012. 1753, excl. syn. *Coccinia palmata* M. Roem., Fam. Nat. Syn. Monogr. 2: 93. 1846. *Diplocyclos palmatus* var. *walkeri* (Chakrav.) Babu, Herb. Fl. Dehra Dun: 198. 1977. *Bryonopsis laciniosa* (L.) Naudin var. *walkeri* Chakrav., Rec. Bot. Surv. India 17: 183. 1959. **Plate 27C**

Climber. Stems terete, glabrous. Leaves simple, alternate, deeply 3-lobed, suborbicular in outline, 3–6 × 5.5–7 cm, cordate or cuneate at base, entire or shallowly serrate at margins, acute or

acuminate at apex, becoming roughened with small white pustules above; petioles 2–6 cm long. Flowers 5 or 6 in sessile clusters, *c.* 8 mm across. Calyx teeth *c.* 2.5 mm long, connate beneath. Corolla 3–4 mm long; anthers *c.* 1.2 mm long, curved. Ovary at first *c.* 5 mm. Fruits globose, 1.5–2 cm, smooth, green, turning red with whitish stripes or blotches. Seeds 5–6 × 3–3.5 mm, pale-coloured.

*Fl. & Fr.*: November – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near Koderma Rest House; Taraghati forest; not common. INDIA: Andhra Pradesh, Arunachal Pradesh, Bihar, Jharkhand, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Maharashtra, Manipur, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh. WORLD: Australia, Bhutan, China, Indonesia, Japan, Nepal, Pakistan, Philippines, Peninsular Malaysia, Papua New Guinea, Sri Lanka and Thailand.

*Specimens examined*: Near Koderma Rest House, 394 m, 24°29'06.6" N, 85°35'49.8" E, 2nd March 2011, *Shyam Biswa* 49654; Taraghati forest, 333 m, 24°32'02.2" N, 85°34'47.0" E, 21st November 2012, *Shyam Biswa* 54072.

#### 4. LUFFA Mill.

Tropical regions, 7 species, 4 in India, 3 in Jharkhand and 2 in KWLS.

**Luffa cylindrica** (L.) M. Roem., *Fam. Nat. Syn. Monogr.* 2: 63. 1846; Chakrav., *Fasc. Fl. India* 11: 70. 1982; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 240. 2000; N.P. Singh & al., *Fl. Bihar*: 217. 2001; S.S. Renner & A.K. Pandey, *PhytoKeys* 20: 79. 2013. *Momordica cylindrica* L., *Sp. Pl.* 2: 1009. 1753. *Luffa aegyptiaca* Mill., *Gard. Dict.*, ed. 8. 1768; C.B. Clarke in Hook.f., *Fl. Brit. India* 2: 614. 1879; Haines, *Forest Fl. Chota Nagpur*: 168. 1910 & *Bot. Bihar Orissa*: 397. 1922; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 278. 2002.

**Fig. 25; Plate 27D**

Vern. Names: *Ghia-torui* (Hindi); *Ninwa*.

Climber. Tendrils slightly pubescent, bi-furcate at ends. Stems 5-angled, ribbed, finely hairy to glabrous. Leaves simple, alternate, palmately 3–5-lobed (lobes triangular, lanceolate), 4.5–8.5 × 5.5–11 cm, orbicular-cordate or cordate at base, dentate at margins, acute-apiculate, 5–7 veined at base, scabrous, dark green; petioles 1.5–6.5 cm long, ribbed, scabrous. Flowers 6.5–8 cm across, bright yellow; pedicels 7–10 cm long. Male flowers: 15–20 in racemes, axillary, 12–25 cm long; stamens 5, curved; filaments 6–8 mm long; anthers *c.* 2 mm long. Female flowers: in the same axil as males; probract ovate with 3–7 glistening glands on the upper surface, fleshy; calyx tube short, broadly campanulate, slightly pubescent, 5-lobed; lobes triangular-lanceolate, 8–12 × 3–5 mm; petals 5, spatulate or obovate-cuneiform, 3.5–4 × 2–3 cm, glabrous, bright yellow with 3 prominent veins. Ovary cylindrical, finely appressed-hairy. Fruits cylindrical and fusiform, 15–25 × *c.* 2.5 cm, smooth. Seeds elliptic-ovoid, 10–12 × 6–8 mm, with *c.* 1 mm wide margins, dull black.

*Fl. & Fr.*: September – October.

*Habitat*: An escape from cultivation.



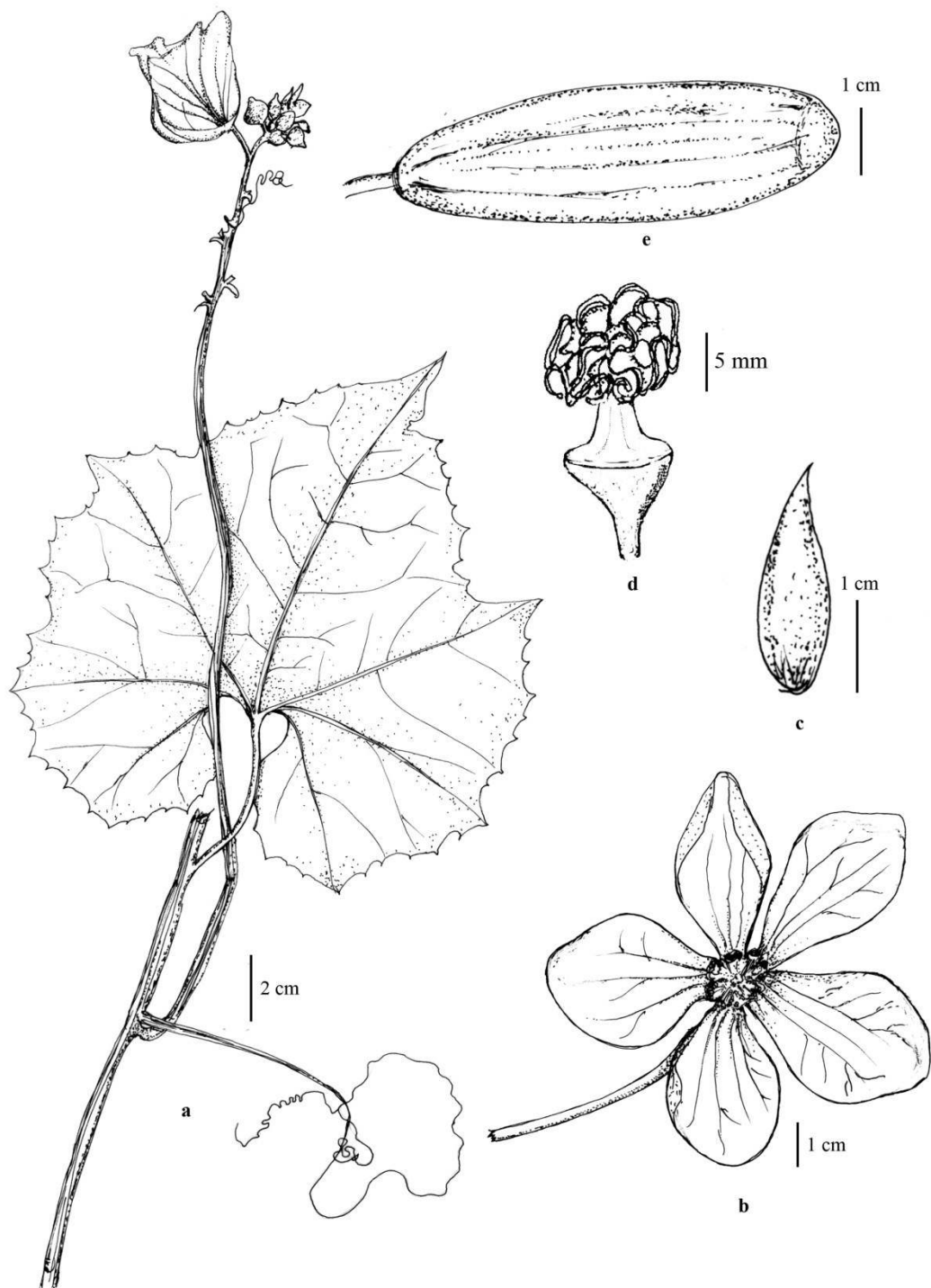


Fig. 25. *Luffa cylindrica* (L.) M. Roem.: a. habit; b. flower; c. sepal; d. stamens; e. fruit.

*Distribution:* KWLS: Inside the enclosure forest, Koderma NRF; common. INDIA: Native and cultivated throughout India. WORLD: Egypt and Sudan; cultivated widely elsewhere.

*Specimen examined:* Inside the enclosure forest, Koderma NRF, 390 m, 24°29'18.7" N, 85°35'15.1" E, 8th September 2010, *Shyam Biswa* 49598.

## 5. **MOMORDICA** L.

Old World tropical regions, c.40 species, 8 in India, 3 in Jharkhand and 2 in KWLS.

### Key to species

- 1a. Monoecious; bracts small near middle of slender male peduncle; fruits covered with triangular tubercles **1. *M. charantia***
- 1b. Dioecious; bracts large near top of male peduncle and embracing the flower; fruit covered densely with soft spines **2. *M. dioica***

**1. *Momordica charantia*** L., Sp. Pl. 2: 1009. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 2: 616. 1879; Haines, Forest Fl. Chota Nagpur: 170. 1910 & Bot. Bihar Orissa: 394. 1922; Chakrav., Fasc. Fl. India 11: 89, ff. 8–10. 1982; Paria & Chattopadhyay, Fl. Hazaribagh 1: 242. 2000; N.P. Singh & al., Fl. Bihar: 218. 2001; S.S. Renner & A.K. Pandey, PhytoKeys 20: 81. 2013. T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 280. 2002. **Plate 27E**

Vern. Name: *Jungli Karela* (Hindi).

Climber. Stems ribbed, hairy; tendrils leaf-opposed, thin, coiled, unbranched. Leaves simple, alternate, 3–7-lobed, broadly ovate or suborbicular, 6–7 × 6–9 cm long, cuneate or cordate at base, serrate or dentate at margins, acute at apex, sparsely hairy on veins; petioles 3.5–6.5 cm long, ribbed. Male flowers: peduncles 3–5 cm long, with a suborbicular bract 5–15 mm long; calyx lobes ovate, c. 8 × 2.5 mm, united in lower half; corolla yellow; lobes oblong, 1.5–2 × 1–1.2 mm, connate in lower third; stamens c.4 mm long. Female flowers: peduncles 5–10 cm long, bracteate near base; ovary ovoid, c. 7 mm long, muricate. Fruits ellipsoid, 8–20 cm long, tuberculate. Seeds oblong, c. 12 × 6 mm, subcompressed, sculptured, embedded in red pulp.

*Fl. & Fr.:* August – October.

*Habitat:* An escape from cultivation.

*Distribution:* KWLS: Suggi Pahar, near Suggi mining area; common. INDIA: Large-fruited forms cultivated all over India as vegetable; small wild forms occur in forest pockets in the Western and Eastern Ghats, Chhattisgarh (Bastar) and all over Central and South India. WORLD: Native to tropical and subtropical Africa; naturalized in parts of tropical Asia.

*Specimen examined:* Suggi Pahar, near Suggi mining area, 290 m, 24°32'58.9" N, 85°35'16.1" E, 15th August 2011, *Shyam Biswa* 49806.

**2. *Momordica dioica*** Roxb. ex Willd., Sp. Pl. 4(1): 605. 1805; C.B. Clarke in Hook.f., Fl. Brit. India 2: 617. 1879 (excl. syn.); Haines, Forest Fl. Chota Nagpur: 170. 1910 & Bot. Bihar Orissa: 394. 1922; Chakrav., Fasc. Fl. India 11: 94. 1982; Paria & Chattopadhyay, Fl. Hazaribagh 1: 244. 2000; N.P. Singh & al., Fl. Bihar: 219. 2001; S.S. Renner & A.K. Pandey, PhytoKeys 20: 82. 2013; Ranjan, Fl. Parasnath Wildlife Sanct.: 103. 2014. **Plate 27F & G**

Vern. Names: *Khakshi*, *Khakaha* (Hindi); *Jungli khakshi*, *Kikeda*, *Phoolaiya*.

Climber, dioecious, tendrillar; roots tuberous. Stems ribbed, glabrous. Leaves simple, alternate ovate, unlobed or 3–5-lobed,  $3-7.5 \times 2.5-6.5$  cm, cordate or cuneate at base, entire or dentate at margins, acute and apiculate at apex, veined at base, glabrous; petioles 1.5–3.5 cm long, ribbed, glabrous; tendrils simple, glabrous. Male flowers: peduncles 3–9 cm long; bracts sheathing, surrounding the flowers, ovate, *c.*  $3 \times 5$  cm, hairy; calyx lobes oblong, *c.*  $15 \times 7$  mm; corolla lobes  $2-3 \times 1.5-2$  cm, yellow; stamens 3, rarely 2, inserted at the mouth of calyx tube. Female flowers: bracts absent; peduncles 1.5–2.8 cm long; calyx lobes narrowly triangular, *c.* 6 mm long; corolla lobes similar to male; ovary ovoid-ellipsoid, densely coarse-hairy. Fruits ellipsoid,  $3-4.5 \times 2-3$  cm, densely soft-echinate. Seeds ovoid,  $6-7 \times 5-6$  mm, emarginate with a narrow neck, irregularly corrugated.

*Fl. & Fr.*: September – October.

*Habitat*: Shady places in dry deciduous forests or on hedges.

*Distribution*: KWLS: Near Meghatari village; Lokai forest; common. INDIA: Deccan plateau and Central India. WORLD: Bangladesh, China, Myanmar, Nepal, Pakistan and Sri Lanka.

*Specimens examined*: Near Meghatari village, 212 m,  $24^{\circ}35'23.8''$  N,  $85^{\circ}35'05.8''$  E, 12th September 2010, *Shyam Biswa* 49612; Lokai forest, 400 m,  $24^{\circ}29'17.5''$  N,  $85^{\circ}36'37.4''$  E, 15th September 2010, *Shyam Biswa* 49624, 49756.

## 6. TRICHOSANTHES L.

Indomalesia to Pacific, *c.* 100 species, 22 in India, 4 in Jharkhand and 3 in KWLS.

### Key to species

- |                                                                    |                           |
|--------------------------------------------------------------------|---------------------------|
| 1a. Fruits globose                                                 | 2                         |
| 1b. Fruits ovoid-conical                                           | 2. <b>T. cucumerina</b>   |
| 2a. Leaves broadly ovate-cordate, 3–5 deeply lobed                 | 3. <b>T. tricuspidata</b> |
| 2b. Leaves broadly ovate, 3–5-lobed to about the middle or unlobed | 1. <b>T. bracteata</b>    |

**1. *Trichosanthes bracteata*** (Lam.) Voigt, Hort. Suburb. Calcutt.: 58. 1845; Chakrav., Fasc. Fl. India 11: 109, ff. 24. 1982; N.P. Singh & al., Fl. Bihar: 219. 2001; S.S. Renner & A.K. Pandey, PhytoKeys 20: 89. 2013. *Modecca bracteata* Lam., Encycl. 4: 210. 1797. *Trichosanthes palmata* Roxb., Fl. Ind. 3: 704. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 2: 606. 1879; Haines, Bot. Bihar Orissa: 387. 1922.

**Plate 28A**

Vern. Name: *Indrayan* (Hindi).

Climber, large; tendrils 2 or 3-cleft. Leaves simple, alternate, broadly ovate, usually palmately 3–5-lobed to about the middle or unlobed,  $7-14 \times 5-11.5$  cm, deeply cordate at base, dentate at margins, acute to acuminate at apex. Male flowers: 5–10, in axillary racemes of 15–23 cm long; petals wedge-shaped, *c.* 2.5 cm long, fringed, exceeding the calyx teeth. Female flowers: solitary, axillary. Fruits globose, 5–7 cm, smooth, green, red when ripe. Seeds many, oblong, *c.*  $1.2 \times 0.5$  cm, blackish green.

*Fl. & Fr.*: September – October.

*Habitat*: Dry deciduous mixed forests.

*Distribution:* KWLS: Near Dhanarjay Nadi, way to Dipluswa Nala, Meghatari; occasional. INDIA: Peninsular region, Meghalaya, Uttarakhand and West Bengal. WORLD: China and Nepal.

*Specimen examined:* 189 m, 24°34'58.1" N, 85°35'21.4" E, 13th September 2010, *Shyam Biswa* 49615.

**2. *Trichosanthes cucumerina* L.**, Sp. Pl. 2: 1008. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 2: 609. 1879; Haines, Forest Fl. Chota Nagpur: 166. 1910 & Bot. Bihar Orissa: 388. 1922; Chakrav., Fasc. Fl. India 11: 112. 1982; Paria & Chattopadhyay, Fl. Hazaribagh 1: 247. 2000; N.P. Singh & al., Fl. Bihar: 220. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 283. 2002; S.S. Renner & A.K. Pandey, PhytoKeys 20: 91. 2013; Ranjan, Fl. Parasnath Wildlife Sanct.: 103. 2014.

**Fig. 26; Plate 28B**

Vern. Names: *Chachinga* (Hindi); *Jungli Baraya*

Climber, annual, monoecious. Stems slender, ribbed, sparsely pubescent; tendrils slender, 3-fid, with small hair. Leaves simple, alternate, reniform to suborbicular in outline, 5–7-lobed, 4–10.3 × 5–11.5 cm, deeply cordate at base, dentate at margins, acute at apex, puberulous above, pubescent or somewhat scabrous beneath; lobes obovate, distantly denticulate at margins, obtuse or subacute at apex; petioles 1–5 cm long. Male peduncles in pair, 8–15-flowered, one is 1-flowered, and the other is laxly racemed, ebracteate or minutely bracteate. Male flowers: pedicels erect, filiform, 0.7–1.5 cm long; calyx tube 2–3 × *c.* 2.5 cm; lobes lanceolate, 1.2–1.5 mm long, erect or spreading; corolla 2–3 × *c.* 1.5 cm; lobes lanceolate, *c.* 7 × 2 mm, fimbriate at margins, white; staminal filaments slender, *c.* 1.5 mm long. Female flowers: peduncles 3–10 mm long; ovary fusiform, 1-loculed; ovules numerous; style slender; stigma 3, bifid. Fruits ovoid-conical, rostrate, 4–5 × 2.5–3.2 cm, tapering at ends, green with white stripes when young, turning red on maturity. Seeds 8–10, ovate-oblong, 1–1.2 × 0.6–6.5 cm, corrugate.

*Fl. & Fr.:* September – November.

*Habitat:* Scrub forests or mixed dry deciduous forests.

*Distribution:* KWLS: Near the base of Rishi Dhurwasa Pahar; near NH-31, Koderma NRF; very common. INDIA: Throughout. WORLD: Australia, Bangladesh, Malaysia, Myanmar and Sri Lanka.

*Specimens examined:* Near the base of Rishi Dhurwasa Pahar, 212 m, 24°35'23.8" N, 85°34'55.8" E, 11th September 2010, *Shyam Biswa* 49606; near NH-31, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 21st November 2012, *Shyam Biswa* 54075.

**3. *Trichosanthes tricuspidata* Lour.**, Fl. Cochinch. 2: 589. 1790; Paria & Chattopadhyay, Fl. Hazaribagh 1: 248. 2000; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 283. 2002; S.S. Renner & A.K. Pandey, PhytoKeys 20: 97. 2013. *Trichosanthes tricuspidata* Lour. var. *strigosa* Sunit Mitra & S. Bandyop., J. Bombay Nat. Hist. Soc. 95: 374. 1998; N.P. Singh & al., Fl. Bihar: 220. 2001.

**Plate 28C & D**

Climber, large; tendrils 2 or more, commonly 3-cleft. Stems robust, branched, angular-striate, grooved, glabrous. Leaves simple, alternate, broadly ovate-cordate, 3–5-lobed, 9–11 × 8–10.5 cm, cordate at base, dentate at margins, apiculate or acute at apex, glabrous, pellucid-punctate and deep green above, thin-leathery; petioles *c.* 5 cm long, striate, punctate, glabrous. Male flowers:



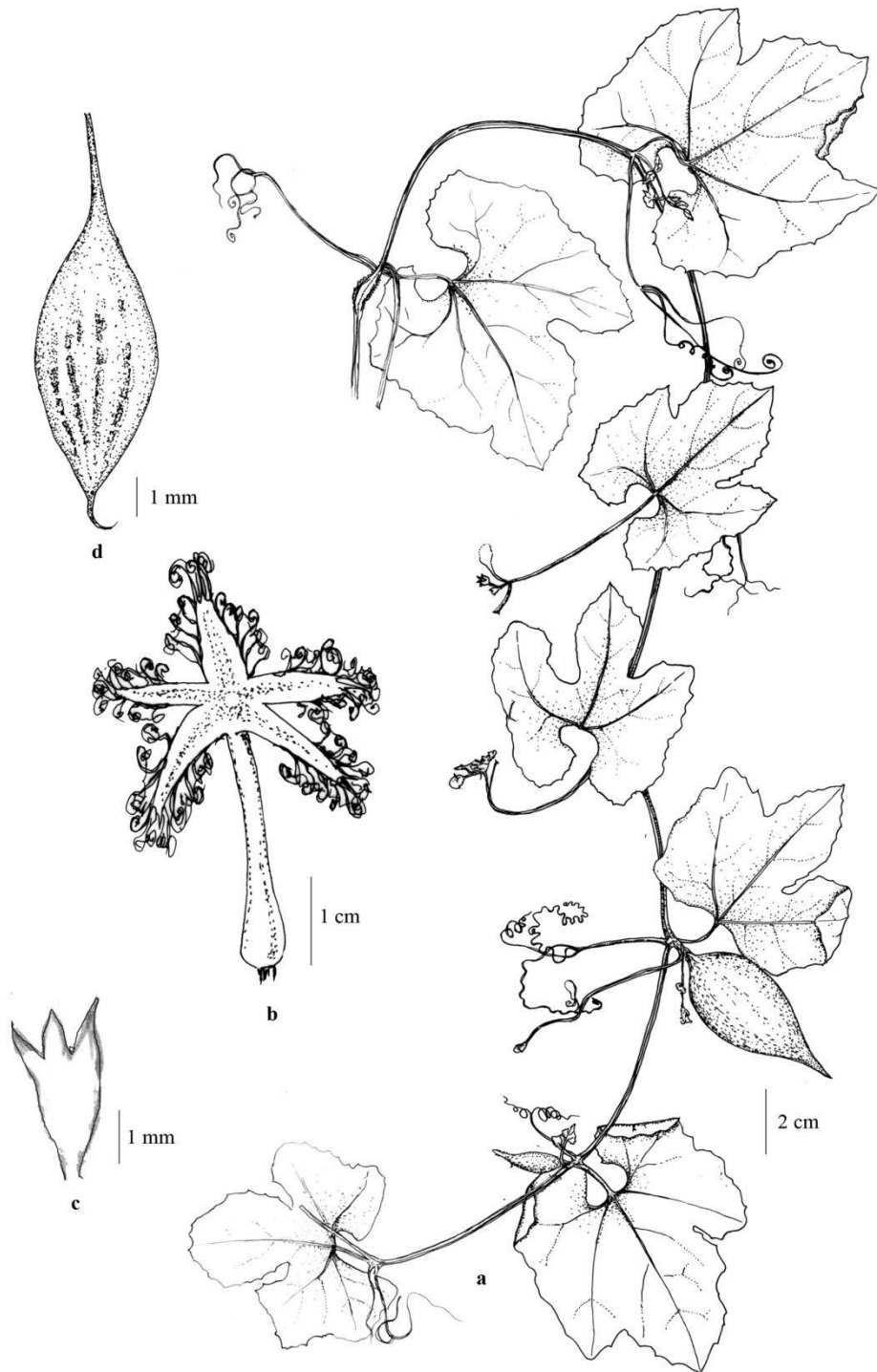


Fig. 26. *Trichosanthes cucumerina* L.: a. fruiting twig; b. flower; c. calyx; d. fruit.

5–10 in axillary raceme of 12–15 cm long; peduncles stout, striate and grooved, glabrous; pedicels short; bracts obovate-oblong, *c.* 4 × 2–2.5 cm; calyx tube narrowly funnel-form, *c.* 6 × 1 cm; segments narrowly lanceolate, *c.* 1 × 0.3 cm; petals wedge-shaped, 1.5–2 cm long, fringed. Female flowers: solitary, axillary; pedicels 5–10 mm long; petals as in male; ovary ovoid, *c.* 1 cm long, glabrous or glabrescent. Fruits ellipsoid or globose, 6–7 × *c.* 4.5 cm, bright red when rip; exocarp leathery, smooth, coarsely wrinkled on drying; pulp green-black; fruiting pedicels 1–2 × 0.3–0.4 cm. Seeds obovate-elliptic or oblong, 9–10 × 5–6 mm, entire, compressed, dark brown.

*Fl. & Fr.*: August – October.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Koderma NRF; rare. INDIA: West Bengal. WORLD: Myanmar, Thailand and Vietnam.

*Specimen examined*: Koderma NRF, 390 m, 24°29'06.6" N, 85°36'49.8" E, 9th August 2011, *Shyam Biswa* 49761.

### 36. CELASTRACEAE R. Br., nom. cons.

Tropical and temperate (fewer) regions, *c.* 100 genera and *c.* 1300 species; 16 genera and 102 species in India.

#### ELAEODENDRON Jacq.

Tropical & Subtropical regions *c.* 40 species, 2 in India, 1 in Jharkhand.

**Elaeodendron glaucum** (Rottb.) Pers., Syn. Pl. 1: 241. 1805; M.A. Lawson in Hook.f., Fl. Brit. India 1: 623. 1875, p.p.; Haines, Forest Fl. Chota Nagpur: 266. 1910 & Bot. Bihar Orissa: 189. 1921. *Cassine glauca* (Rottb.) Kuntze, Revis. Gen. Pl. 1: 114. 1891; Paria & Chattopadhyay, Fl. Hazaribagh 1: 447. 2000; N.P. Singh & al., Fl. Bihar: 102. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 145. 2002. *Mangifera glauca* Rottb., Nye Saml. Kongel. Danske Vidensk. Selsk. Skr. 2: 534, t. 4, f. 1. 1783. *Cassine albens* sensu Ramam. in N.P. Singh & al., Fl. India 5: 80, f. 17. 2000, non (Retz.) Kosterm. 1986.

**Fig. 27; Plate 28E**

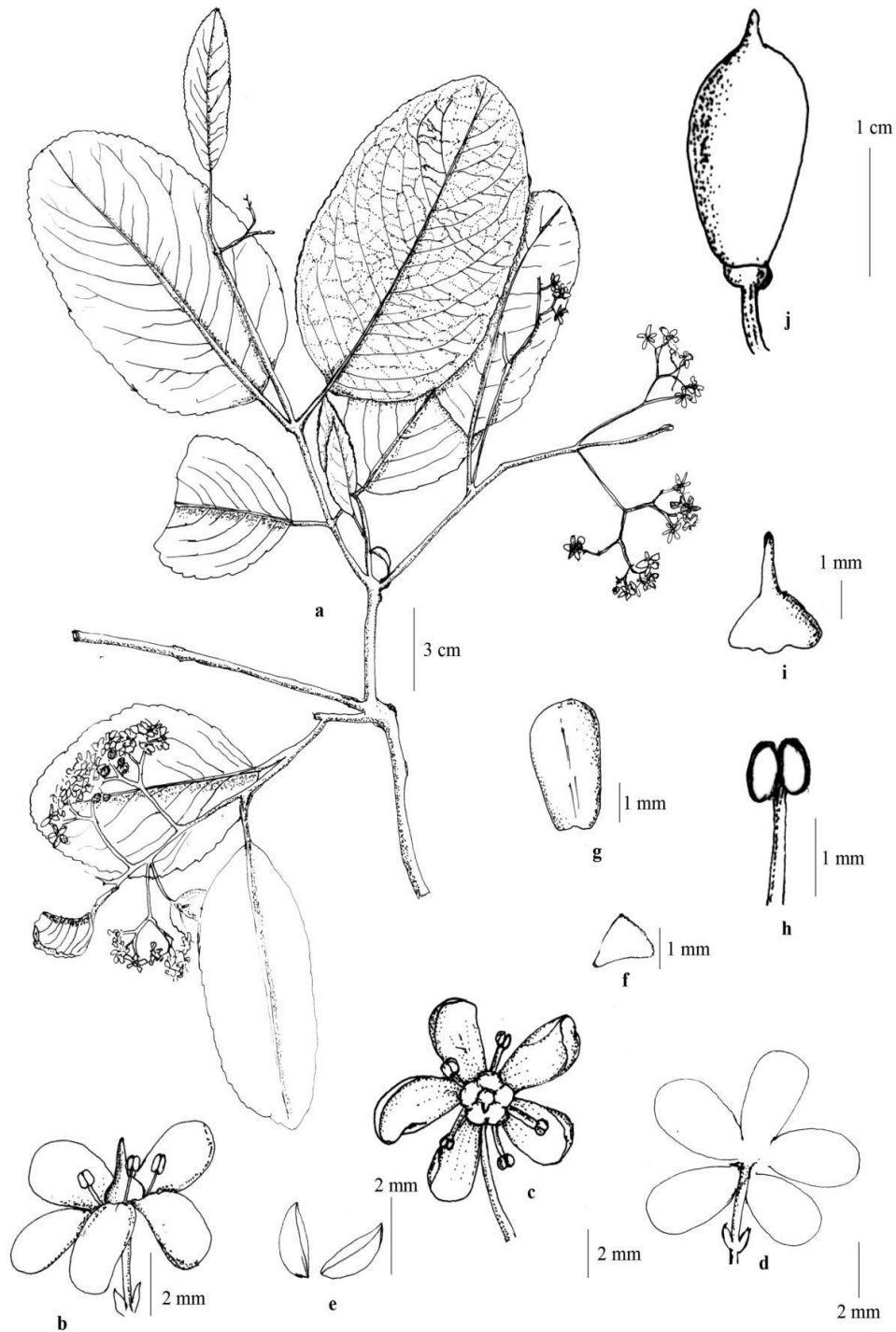
Vern. Names: *Jamrasi* (Hindi); *Ratan Gurur*.

Tree, 10–15 m high. Leaves simple, opposite or subopposite, broadly elliptic to elliptic-oblong or ovate-oblong, 2.5–13.5 × 2–8 cm, sub-cuneate, rounded or obtuse at base, crenulate or subentire at margins, rounded or acute to subacute or (rarely obcordate) at apex, subcoriaceous, shiny above glabrous, deep green; petioles 0.5–2 cm long. Cymes, axillary, 4.5–7 cm long, dichotomously branched, few-flowered. Flowers bisexual or sometimes polygamous, 7–8 mm across. Calyx 5-lobed, unequal, orbicular, 1–5 mm long. Petals 5, oblong, 3–3.5 × 1.5–2 mm, spreading, reflexed, greenish or florescent green. Stamens 5, inserted below the edge of cushion-like disk; filaments 1.5–2 mm long, recurved; anthers orbicular, basifixed, yellowish-green. Ovary conical or dome-shaped, angular, 2-loculed dark green; ovules 2 in each locule, basal; stigma not lobed. Drupes obovoid, 0.5–2 cm long, with persistent style, woody, 1-seeded.

*Fl. & Fr.* September–February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near Dipluswa Nala, Meghatari; Taraghati forest, way to Muglamaram forest road and Meghatari NRF, border of Dhodhakola, common. INDIA: Himachal Pradesh,



**Fig. 27. *Elaeodendron glaucum* (Rottb.) Pers.:** a. flowering twig; b.,c.,d. flower; e. bracts; f. sepal; g. petal; h. stamen; i. carpel; j. fruit.

Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Uttar Pradesh and West Bengal. WORLD: Sri Lanka.

*Specimens examined*: Near Dipluswa Nala, Meghatari, 186m, 24°34'25.1" N, 85°35'19.4" E, 31st March 2013, *Shyam Biswa* 49611; Taraghati forest, way to Muglamaram forest road, 321 m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49848; Meghatari NRF, border of Dhodhakola, 236 m, 24°34'31.7" N, 85°35'31.4" E, 25th November 2012, *Shyam Biswa* 554087.

### 37. OXALIDACEAE R. Br., nom. cons.

Tropical to temperate (few) regions, 5 genera and c. 565 species; 2 genera and c. 20 species in India.

#### Key to genera

1a. Leaves pinnately compound, to 12 pairs

1. **Biophytum**

1b. Leaves digitately compound, trifoliolate

2. **Oxalis**

#### 1. BIOPHYTUM DC.

Tropical regions, c. 50 species, c. 12 in India, 3 in Jharkhand and 1 in KWLS.

**Biophytum sensitivum** (L.) DC., Prodr. 1: 690. 1824; Edgew. & Hook.f., Fl. Brit. India 1: 436. 1874; Haines, Bot. Bihar Orissa: 156. 1921; Manna in Hajra & al., Fl. India 4: 238, f. 57. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 543. 2000; N.P. Singh & al., Fl. Bihar: 88. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 130. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 54. 2014. *Oxalis sensitiva* L., Sp. Pl. 1: 434. 1753. **Plate 28F**

Vern. Names: *Lakchana* (Hindi); *Lajjapati*.

Annual, 5–15 cm high. Stems terete, ribbed, pubescent, crowded at apex. Leaves compound, whorled; rachis 2–13.5 × 0.5–3 cm, hairy; petioles short; leaflets sessile, opposite, to 12 pairs, oblong or oblong-obovate, 2–16 × 1–11 mm, decreasing in size from upwards to downwards, rounded, oblique, unequal at base, entire at margins, obtuse to rounded at apex. Umbels several-flowered. Flowers 4–5 mm long; peduncles 2–7 cm long, hairy; bracts several, lanceolate, c. 2 mm long, densely crowded at apex of peduncle; pedicels 3–6 mm long, hairy. Sepals lanceolate, 3–4 × 0.8–1 mm, acute at apex, hairy. Petals 5, lanceolate, c. 3 × 1–2 mm, yellow. Stamens 10, free; outer 5 smaller, 2–2.5 mm long; anthers c. 0.3 mm long. Carpels 1.5–2 mm long; ovary 0.5–0.7 mm long; ovules 2–5 per locule; styles 5; stigma bifid, flattened. Capsules loculicidal, ellipsoid, 5-grooved, 3–4 × 2–3 mm, covered with persistent calyx. Seeds conical to oval, c. 1 mm long, tubercled, glossy, light reddish brown.

*Fl. & Fr.*: September – January.

*Habitat*: Dry deciduous scrub forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Throughout. WORLD: Africa, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49503.

#### 2. OXALIS L.

Cosmopolitan, c. 500 species, c. 10 in India and 1 in Jharkhand.



**Oxalis corniculata** L., Sp. Pl. 1: 435. 1753; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 436. 1874; Haines, Bot. Bihar Orissa: 157. 1921; Manna in Hajra & al., Fl. India 4: 242, f. 60. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 545. 2000; N.P. Singh & al., Fl. Bihar: 88. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 131. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 54. 2014. **Plate 28G**

Vern. Name: *Amrul* (Hindi).

Herb, 5–20 cm high; roots bulbous or tuberous. Stems diffuse with procumbent branches, pubescent. Leaves compound, trifoliate; petioles slender, 1.5–7 cm long, pubescent; stipules indistinct, sometimes conspicuous,  $c. 3 \times 1$  mm; leaflets obcordate or elliptic-obcordate,  $0.5\text{--}2 \times 0.2\text{--}1.3$  cm, tapering at base, ciliate at margins, rounded or emarginate at apex, glabrous. Inflorescence cymose to pseudo-umbellate; peduncles to 20 cm long. Flowers *c.* 6 mm long; pedicels 6–10 mm long, hairy. Sepals 5, lanceolate, 2.5–3 mm long, green. Petals 5, oblong, 4–6 mm long, yellow. Stamens 10, united; longer ones *c.* 3 mm long; shorter ones *c.* 2 mm long; anthers oblong, 0.3–0.5 mm long, dehiscing longitudinally, dorsifixed. Carpels *c.* 3 mm long; ovary ellipsoid to cylindric,  $c. 2 \times 1$  mm, puberulous; stigma minutely bifid; styles 4 or 5; ovules 5–11 per locule in a row. Capsules linear, cylindric,  $1\text{--}2 \times 0.2\text{--}0.4$  cm, hairy. Seeds 5–11 per locule, suborbicular or ovoid,  $1\text{--}1.5 \times c. 1$  mm, light yellowish brown.

*Fl. & Fr.*: October – March.

*Habitat*: Shade localities near river.

*Distribution*: KWLS: near Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Cosmopolitan.

*Specimen examined*: Near Dhanarjay Nadi, Meghatari, 182 m,  $24^{\circ}34'32.9''$  N,  $85^{\circ}34'48.4''$  E, 7th March 2011, *Shyam Biswa* 53919.

### 38. PUTRANJIVACEAE Meisn.

Tropical to east Asia and South Africa, 2 genera and 210 species; 2 genera and 21 species in India

#### PUTRANJIVA Wall.

Tropical Asia, 3 species, 1 in India

**Putranjiva roxburghii** Wall., Tent. Fl. Nepal.: 61. 1826; Hook.f., Fl. Brit. India 5: 336. 1887; Haines, Bot. Bihar Orissa: 136. 1921. *Drypetes roxburghii* (Wall.) Hurus., J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 6: 335. 1954; N.P. Singh & al., Fl. Bihar: 455. 2001.

Vern. Name: *Pitanjali* (Birhore).

Tree, to 12 m high; branches generally pendent; branchlets terete, pubescent. Leaves simple, alternate, elliptic-oblong or elliptic-lanceolate,  $2\text{--}10 \times 1\text{--}4$  cm, oblique at base, shallowly crenate-serrate or serrulate at margins, shortly acuminate or acute at apex, glabrous, coriaceous; lateral veins 8–12 pairs; petioles slender, 5–8 mm long, pubescent. Flowers unisexual. Male flowers: in axillary fascicles, 2–2.5 mm across; tepals 3–5, oblong, *c.* 2 mm long, imbricate. Stamens 2–4, 1.5–2 mm long; filaments thick, more or less connate towards base; anthers hairy. Female flowers: solitary or 2 or 3, axillary; bracts lanceolate; pedicels to 1.5 cm long; tepals 5 or 6, oblong, unequal, 2–2.5 mm long, puberulous; ovary superior, globose, *c.* 3 mm, tomentose, 3-loculed; ovules 2 in each locule; styles 3, spreading, puberulous; stigma crescent-shaped,

glandular. Drupes ellipsoid or ovoid-ellipsoid,  $1.5-2 \times 1-1.2$  cm, glabrous, with pointed ends, brownish. Seed 1, crustaceous.

*Fl. & Fr.*: March – February.

*Habitat*: Dry deciduous forest.

*Distribution*: KWLS: Lokai forest, near Birhore Tola; not common. INDIA: Native, throughout, cultivated as an ornamental. WORLD: Indomalesia.

*Specimen examined*: Lokai forest, near Birhore Tola, 382 m,  $24^{\circ}28'57.6''$  N,  $85^{\circ}37'20.5''$  E, 24th February 2012, *Shyam Biswa* 53931.

### 39. ELATINACEAE Dumort., nom. cons.

Temperate and especially tropical regions, 2 genera and 34 species; 2 genera and 8 species in India.

#### BERGIA L.

Subtropical regions, 24 species, 5 in India and 2 in Jharkhand and 1 in KWLS.

**Bergia ammannioides** Roxb. ex Roth, Nov. Pl. Sp.: 219. 1821; Dyer in Hook.f., Fl. Brit. India 1: 251. 1874; Haines, Bot. Bihar Orissa: 50. 1921, (*ammanoides*); Mooney, Supp. Bot. Bihar Orissa 26.1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 160. 2000; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 92. 2002; Jayasri Bhattacharya in B.D. Dingu & M. Sanjappa N. P. Balakrishnan Fl. India 3: 33. 1993.

**Plate 29A**

Herb, prostrate or decumbent. Stems terete, glandular-pubescent, pinkish. Leaves opposite, lanceolate,  $0.5-1.2 \times 0.2-0.4$  cm, tapering at base, dentate at margins, acute at apex, hairy. Flowers few in fascicles, axillary, sessile or short pedicelled, minute, 5-merous; pedicels *c.* 2 mm long. Sepals 5, ovate-oblong concave, 1–1.5 mm long. Petals 5, ovate, or oblong 1–2.5 mm long, imbricate, rose-coloured. Stamens 5, subfiliform, *c.* 1 mm long, free; anthers versatile. Ovary ovoid, 5-loculed; styles 0.5–1 mm long; stigma capitate. Capsules ovoid, 3–4 mm across (open condition), septicidal, 5-valved. Seeds numerous, minute, brown.

*Fl. & Fr.*: September – March.

*Habitat*: On fallow fields or in open grassland.

*Distribution*: KWLS: Bherwa tan Koderma NRF on the fallow crop field; occasional. INDIA: Andhra Pradesh, Bihar, Jammu & Kashmir, Karnataka, Kerala Madhya Pradesh, Maharashtra, Orissa, Punjab, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. WORLD: Australia, Philippines, Tropical Africa and Tropical Asia from Iran to South China.

*Specimen examined*: Bherwa tan Koderma NRF, on the fallow crop field, 397 m,  $24^{\circ}28'43.6''$  N,  $85^{\circ}36'26.7''$  E, 3rd March 2012, *Shyam Biswa*, 54047.

*Note*: The species have only been reported from Bihar, Haines has mentioned doubtless in Bihar and Orissa.

### 40. VIOLACEAE Batsch., nom. cons.

Cosmopolitan, 24 genera and *c.* 700 species; 3 genera 41 species in India

#### HYBANTHUS Jacq., nom. cons.

Tropical and subtropical regions *c.* 100 species, 2 in India, 1 in Jharkhand.

**Hybanthus enneaspermus** (L.) F. Muell., *Fragm.* 10: 81. 1876; S.P. Banerjee & Pramanik in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 343, f. 64. 1993; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 220. 2000; N.P. Singh & al., *Fl. Bihar*: 43. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 75. 2002; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 33. 2014. *Viola enneasperma* L., *Sp. Pl.* 2: 937. 1753. *Ionidium suffruticosum* (L.) Roem. & Schult., *Syst. Veg.* 5: 394. 1819; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 185. 1872; Haines, *Bot. Bihar Orissa*: 33. 1921.

**Plate 29B**

Vern. Name: *Ratanpuras* (Hindi).

Herb, annual or perennial, diffuse or semi-erect, 10–30 cm high, woody at base. Stems angular, more or less pubescent. Leaves simple, alternate, linear-lanceolate, 0.5–3 × 0.2–0.7 cm, decurrent at base, entire to remotely serrate at margins, acute at apex, glabrous, pellucid-punctate; stipules subulate, 1–2 mm long, gland-tipped. Flower solitary, axillary, 6–8 mm across; pedicel filiform, c. 7 mm long. Sepals triangular to lanceolate, subequal, 2–4 mm long, glabrous or ciliate. Petals purple-rose; posterior pair 2.5–3.5 mm long; middle pair 2.8–4 mm long; anterior one 5–15 mm long, clawed; claw c. 3.5 mm long; limb ovate or orbicular, 1.5–5 mm wide. Stamens 2–3 mm long; anterior stamen with a small recurved appendage, glabrous or hairy. Ovary to 1.2 mm wide. Capsules subglobose, 4–5 mm across, green, 3-lobed, c. 10-seeded. Seeds c. 2 mm long, ribbed, straw-coloured or off-white.

*Fl. & Fr.*: Throughout the year.

*Habitat*: Shade localities in dry deciduous forests.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; common. INDIA: Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Pantropical.

*Specimens examined*: Near the Phulwarwaria jungle, Koderma NRF, 390 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49536; Phulwarwaria jungle, Koderma NRF, 393 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49546.

#### 41. PASSIFLORACEAE Juss. ex Roussel, nom. cons.

Tropical, subtropical and temperate regions, c. 25 genera and c. 725 species; 3 genera and 24 species in India

##### PASSIFLORA L., nom. cons.

Tropical and subtropical regions, c. 430 species, 23 in India, 2 in Jharkhand and 1 in KWLS.

**Passiflora foetida** L., *Sp. Pl.* 2: 959. 1753; Haines, *Bot. Bihar Orissa*: 384. 1922; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 223. 2000; N.P. Singh & al., *Fl. Bihar*: 212. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 27. 2002.

**Plate 29C**

Vern. Name: *Bindiram* (Hindi).

Climber, tendrillar, foetid. Stems terete, slender, spreading, pubescent, purplish green or pinkish green; nodes dense glandular-pubescent. Leaves simple, alternate, 3-lobed, broadly ovate, 3.5–7.2 × 3.8–7.8 cm, cordate at base, denticulate to sparsely glandular-hairy at margins, obliquely acute and glandular at apex, sparsely pubescent above, sparsely glandular-pubescent beneath, basally 3–5-veined; petioles to 5 cm long, glandular-pubescent; stipules semi-auriculate, 3–5 mm across,

divided into filiform segments with glandular apices. Flowers solitary or rarely 2, axillary, 3–4 cm across; pedicels to 3 cm long, glabrous. Involucral bracts 3, bipinnatifid, 2–3 cm long, with glandular-tipped segments. Calyx lobes ovate-lanceolate, 7–9 mm long, acuminate at apex. Petals oblong, shorter than calyx lobes, white. Corona in many series; 2 outer series filiform, *c.* 1 cm long; inner series 2–3 mm long. Gynophore 5–6 mm long. Stamens 5, coherent at base; filaments flat; anthers oblong, 6–8 mm long. Ovary shortly stipitate, ellipsoid, *c.* 6 mm long, glabrous; styles 3, 5–6 mm long; stigmas capitate. Berries subglobose or ellipsoid, 2–2.5 × 2–2.2 cm, enclosed in glandular involucral bracts, smooth, glossy, green, turning yellow. Seeds many, ovoid or oblong, 5–7 × 2–3 mm.

*Fl. & Fr.*: September – March.

*Habitat*: Scrub and dry deciduous forest.

*Distribution*: KWLS: Near the enclosure forest of Koderma NRF; common. INDIA: Throughout. WORLD: Native to tropical America, now Pantropical.

*Specimens examined*: Near the enclosure forest of Koderma NRF, 399 m, 24°29'01.2" N, 85°36'06.8" E, 14th September 2010, *Shyam Biswa* 49621; Koderma NRF, near the Koderma Rest House, 396 m, 24°29'04.4" N, 85°36'00.0" E, 10th March 2011, *Shyam Biswa* 49746.

## 42. SALICACEAE Mirb., nom. cons.

Tropical to temperate (especially in northern regions), a few in Australia and New Zealand to Arctic regions, 54 genera and *c.* 1200 species; 2 genera 64 species in India.

### Key to genera

- |                                                                                                                      |                      |
|----------------------------------------------------------------------------------------------------------------------|----------------------|
| 1a. Shrubs or trees; trunk without spines; flowers in axillary fascicles, bisexual                                   | <b>1. Casearia</b>   |
| 1b. Trees or shrubs; trunk bearing compound spines at least when young; flowers in short axillary racemes, unisexual | <b>2. Flacourtia</b> |

### 1. CASEARIA Jacq.

Tropical regions, *c.* 180 species, 12 species in India, 2 in Jharkhand and 1 in KWLS.

**Casearia tomentosa** Roxb., Fl. Ind. 2: 421. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 2: 593. 1879; Haines, Forest Fl. Chota Nagpur: 161. 1910 & Bot. Bihar Orissa: 39. 1921; R.L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 397. 1993; N.P. Singh & al., Fl. Bihar: 46. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 80. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 35. 2014. *Casearia elliptica* Willd., Sp. Pl. 2: 628. 1800; Raizada, Indian Forester 92: 304. 1966; Paria & Chattopadhyay, Fl. Hazaribagh 1: 215. 2000. *Guidonia tomentosa* (Roxb.) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 46(2): 92. 1877.

### Plate 29D

Small tree or shrub, to 8 m high. Stems branched, lenticellate, hairy, grey-whitish; branchlets tomentose or pubescent. Leaves simple, alternate, oblong or ovate-lanceolate or elliptic, 2–8 × 0.8–3.6 cm, rounded, somewhat oblique at base, serrate or crenate to subentire at margins, obtuse, acute to short acuminate at apex, sparsely but soft, pubescent more dense along midrib and beneath; secondary veins 8–12; petioles 0.3–1 cm long, pubescent; stipules caducous. Flowers in axillary fascicles, 4–5 mm across, bisexual; pedicels 2–3 mm long, pubescent. Sepals 5, broadly elliptic, 2–3 × 1–2 mm, pubescent outside, more so on mid portion, glabrous inside. Stamens 8, free, adnate to sepals at base, *c.* 2 mm long, glabrous; staminodes clavate, connate below to form



a perigynous ring adnate to calyx tube, *c.* 1 mm long, villous pubescent at apex; anthers *c.* 0.5 mm long, basifixed, introse, yellow. Carpels 3, 1.5–2 mm long; ovary ovoid, *c.* 1 mm long, glabrous; style short; stigma globular or discoid. Capsules ellipsoid, 1.5–2.5 cm long, light green. Seeds with a scarlet aril.

*Fl. & Fr.*: March – July.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Meghatari, near the village; Basraon forest, near the village. INDIA: Sub-Himalayan tracts to Peninsular India. WORLD: Pakistan and Sri Lanka.

*Specimens examined*: Meghatari, near the village, 212 m, 24°35'23.8" N, 85°34'55.8" E, 2nd March 2012, *Shyam Biswa* 54041; Basraon forest, near the village, 337 m, 24°34'33.6" N, 85°38'34.0" E, 2nd March 2013, *Shyam Biswa* 54143.

## 2. **FLACOURTIA** Comm. ex L' Her.

Tropical and South Africa to Fiji, *c.* 15 species, 6 in India, 1 in Jharkhand.

**Flacourtia indica** (Burm.f.) Merr., *Interpr. Herb. Amboin.*: 377. 1971; R.L. Mitra in B.D. Sharma & N.P. Balakr., *Fl. India* 2: 402. 1993; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 217. 2000; N.P. Singh & al., *Fl. Bihar*: 46. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 81. 2002; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 36, f. 2. 2014. *Gmelina indica* Burm.f., *Fl. Ind.*: 132, t. 39, f. 5. 1768. *Flacourtia ramontchii* L'Her., *Strip. Nov.* 3: 59, tt. 30–30b. 1786; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 193. 1872; Haines, *Forest Fl. Chota Nagpur*: 159. 1910. *Flacourtia sepiaria* Roxb., *Pl. Coromandel* 1: 48, t. 68. 1796; Hook.f. & Thomson in Hook.f., *Fl. Brit. India* 1: 194. 1872; Haines, *Bot. Bihar Orissa*: 36. 1921.

### Plate 29E & F

Vern. Name: *Goothi*.

Small tree or shrub. Stems with lenticels and straight sharp thorns; thorns 0.7–3.5 cm long, hairy, lenticellate; twigs pubescent. Leaves simple, alternate, obovate or orbicular, 2–6 × 1.6–4.8 cm, rounded or slightly cordate at base, crenate-serrate at margins except at base, obtuse to rounded at apex, pubescent on both surfaces, more so beneath, especially on veins; petioles 0.3–1.2 cm long, pubescent; lateral veins 3 or 4, reticulate. Flowers solitary, dioecious, axillary; pedicels 3–7 mm long. Male flowers 4–5 mm long; sepals 4, imbricate, triangular, 0.8–1 × 1–1.5 mm, truncate at base, ciliate at margins, acute or obtuse at apex; petals 0; stamens many, on a dome-shaped disk; filaments 1.5–2 mm long; anthers *c.* 0.5 mm long, versatile, dorsifixed. Disk 2–2.5 mm wide. Carpels 0. Female flowers: ovary imperfectly 2–8 -loculed; ovules 2, superposed in each locule; styles 4–6, small; stigma capitellate. Berries roundish, 8–10 mm, glabrous. Seeds oval, 3–3.5 × 1–2.5 mm, smooth, glabrous, brownish.

*Fl. & Fr.*: March – April.

*Habitat*: Scrub forest and in dry deciduous forests on hillslopes.

*Distribution*: KWLS: Muglamaram forest; mid of Dhawjadhari Pahar; common. INDIA: Throughout in dry thickets, scrub jungles and mixed forests, to 1200 m. WORLD: Widespread in Southeast Asia and tropical Africa.

*Specimens examined*: Muglamaram forest, 380 m, 24°30'56.7" N, 85°34'33.4" E, 4th March 2011, *Shyam Biswa* 49664; mid of Dhawjadhari Pahar, 570 m, 24°28'52.4" N, 85°35'39.1" E, 4th April 2013, *Shyam Biswa* 54156.

*Note:* It is observed during the present study that most of the plants in the open habitats shrubby and thorny in nature, whereas those growing on hillslopes are slightly arboreal and without thorns.

### 43. EUPHORBIACEAE Juss., nom. cons.

Cosmopolitan, 229 genera and c. 6500 species; c. 70 genera and c. 410 species in India.

#### Key to genera

- |                                                                                                                                                                                           |                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1a. Locules of ovary 2-ovuled                                                                                                                                                             | 6                             |
| 1b. Locules of ovary 1-ovuled                                                                                                                                                             | 2                             |
| 2a. Calyx lobes valvate or imbricate in bud; petals present in male or both sexes                                                                                                         | 3                             |
| 2b. Calyx lobes valvate in bud; petals absent; styles long, often 2-multi-fid                                                                                                             | 5                             |
| 3a. Leaves not lobed or obscurely 3-lobed; flowers in spikes or racemes; stamens more than 8                                                                                              | 4                             |
| 3b. Leaves 3–5-lobed; flowers in terminal 2 or 3-chotomous cymes; stamens 8                                                                                                               | <b>4. <i>Jatropha</i></b>     |
| 4a. Trees or shrubs; racemes terminal; stamens bend in bud                                                                                                                                | <b>2. <i>Croton</i></b>       |
| 4b. Herbs or undershrubs; racemes axillary; stamens erect in bud                                                                                                                          | <b>1. <i>Chrozophora</i></b>  |
| 5a. Leaves palmately lobed, palmi-veined, stamens many; capsules prickly                                                                                                                  | <b>7. <i>Ricinus</i></b>      |
| 5b. Leaves not lobed; capsule not prickly                                                                                                                                                 | <b>5. <i>Mallotus</i></b>     |
| 6a. Inflorescences cyathiate, usually with a single terminal pistillate floret and 4 or 5 lateral monochasia or dichasia of male flowers; perianth reduced or absent; styles mostly bifid | <b>3. <i>Euphorbia</i></b>    |
| 6b. Inflorescences mostly racemose or spicate (if capitate, not cyathiate); male flowers usually with developed calyx; styles mostly undivided                                            | <b>6. <i>Microstachys</i></b> |

#### 1. *CHROZOPHORA* Neck. ex Juss., nom. & typ. cons.

Mediterranean, tropical regions, c. 10 species, 4 in India, 2 in Jharkhand and 1 in KWLS.

***Chrozophora rottleri*** (Geiseler) Spreng., Syst. Veg. 3: 850. 1826; Haines, Bot. Bihar Orissa: 103. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 546. 2000; N.P. Singh & al., Fl. Bihar: 453. 2001; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 167. 2007; N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 181. 2012. *Croton rottleri* Geiseler, Croton Monogr.: 54. 1807. *Chrozophora tinctoria* sensu Hook.f., Fl. Brit. India 5: 409. 1887, p.p., non Juss., 1824. **Plate 30A**

Vern. Name: *Shadevi* (Hindi).

Herb, 20–60 m high. Leaves simple, alternate, obscurely 3-lobed, broadly ovate or suborbicular, 2–4 × 1.5–3 cm, rounded or cuneate at base, entire, wrinkled or undulate-crenate at margins, obtuse to rounded at apex, densely stellate-tomentose more beneath, with 2 glands below at midvein base; veins raised beneath; petioles 1–4 cm long; stipules subulate, stellate-tomentose, deciduous. Inflorescence axillary racemes; bracts linear, c.3 mm long, caducous. Male flowers: subsessile; calyx 5-lobed; lobes 2.5–3.5 mm long, stellate-hairy. Petals 5, elliptic oblong or ovate-lanceolate, 3–4 mm long, yellow. Stamens 5–15 in 2 series; filaments connate at base; inner longer, thick, c.2 mm long, erect in bud; anthers oblong, c.1 mm long. Disk of 5 free glands. Female flowers: pedicels 1.5–3 mm long; calyx 5-lobed; lobes narrow, 1.5–2 mm long. Petals 5, narrow, 1.2–2 mm long, yellow. Disk of 5 short glands alternating with petals. Ovary globose, c.3 mm, 3-loculed; ovules 3, axile; styles 3, 2-fid, dilated, stigmatiferous. Capsules depressed-

globose, 3-lobed, *c.* 8 mm across, stellate-tomentose, purplish red. Seeds globose, *c.* 3 mm, ash-coloured.

*Fl. & Fr.*: March – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Khararia jungle, Meghatari, near Chirkundi Village; common. INDIA: Andaman and Nicobar Islands, Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Punjab, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Afghanistan, Bangladesh, Indonesia (Java), Myanmar, Pakistan, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Khararia jungle, Meghatari, near Chirkundi Village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49718.

## 2. CROTON L.

Tropical and subtropical regions, 800–1200 species, 16 in India, 4 in Jharkhand and 2 in KWLS.

### Key to species

- |                                                                    |                                   |
|--------------------------------------------------------------------|-----------------------------------|
| 1a. Herb; leaves never above 5 cm long, thin                       | <b>1. <i>C. bonplandianus</i></b> |
| 1b. Tree or shrub; leaves usually more than 10 cm long, coriaceous | <b>2. <i>C. Persimilis</i></b>    |

**1. *Croton bonplandianus*** Baill., *Adansonia* 4: 339. 1863–1864; Croizat, *J. Bombay Nat. Hist. Soc.* 41: 573. 1940, “*bonplandianum*”; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 458. 2000; N.P. Singh & al., *Fl. Bihar*: 454. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 545. 2002; N.P. Balakr. & Chakrab., *Fam. Euphorb. India*: 212. 2007; Chakrab. & N.P. Balakr. in N.P. Balakr. & al., *Fl. India* 23: 231. 2012. *Croton sparsiflorus* Morong, *Ann. New York Acad. Sci.* 7: 221. 1893; Haines, *Bot. Bihar Orissa* 105. 1921. **Plate 30B**

Herb, 20–50 cm high, perennial by rootstock. Stems terete; branches glabrous. Leaves simple, alternate, elliptic or narrowly ovate or oblong-lanceolate to linear, 2–4 × 0.4–1.4 cm, acute at base, shallowly serrate-dentate at margins, acute to acuminate at apex, stellate-hairy, densely so in young leaves, 3-veined at base; petioles 2–5 mm long, stellate-hairy. Inflorescences 2–6 cm long, rarely unisexual; bracts 2.5–3 mm long. Male flowers: pedicels 1–3 mm long; flowers 3.5–4 mm across. Sepals 5, oblong to ovate, *c.* 1 mm long. Petals narrowly oblong to spatulate, 1.5–2 × 0.5–1 mm, off-white. Stamens 10–12; filaments *c.* 1 mm long, white; anthers *c.* 0.5 mm long, white. Female flowers: 2.5–3 mm across; pedicels 0.5–1.5 mm long, with 1 or 2 sessile glands at base. Sepals 5, lanceolate, 1.3–1.5 mm long; petals obsolete/ absent; ovary oblong, *c.* 1.5 mm across, tomentose, 3-loculed; styles *c.* 2 mm long, bifid. Capsules oblong to ellipsoid, 4–6 × 3–4 mm, trigonous, shallowly lobed, stellate-hairy. Seeds oblongoid, smooth, brown.

*Fl. & Fr.*: March – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Khararia jungle, Meghatari, near Chirkundi Village; common. INDIA: Almost throughout. WORLD: Native of tropical South America, now widespread in South and Southeast Asia (Pakistan, Nepal, Bhutan, Bangladesh, Myanmar, Sri Lanka, Thailand, Malaysia, Borneo and Celebes).

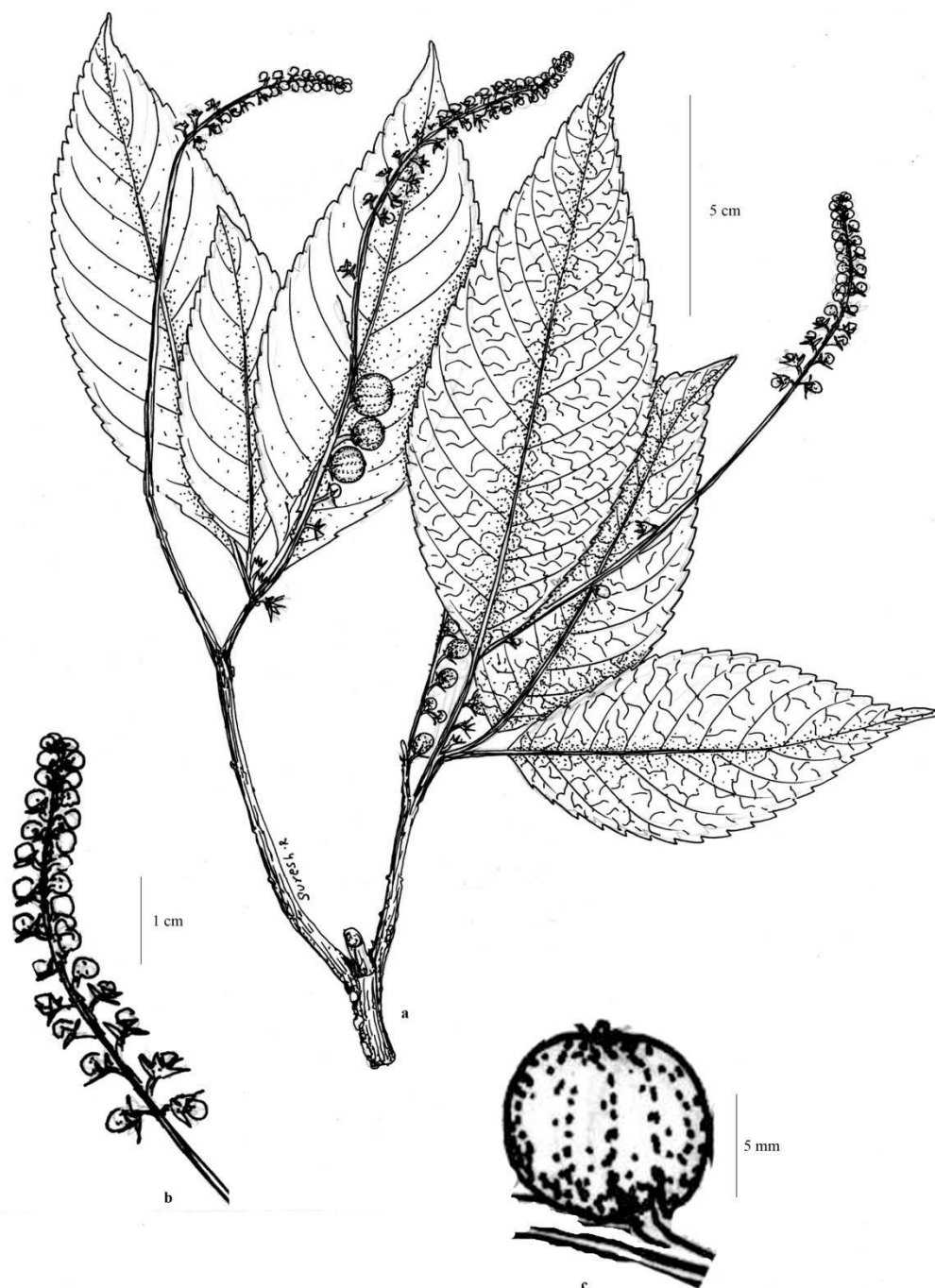


Fig. 28. *Croton persimilis* Müll.Arg.: a. flowering and fruiting twig; b. raceme; c. fruit.



*Specimen examined:* Khararia jungle, Meghatari, near Chirkundi Village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49720.

**2. *Croton persimilis*** Müll.Arg., Linnaea 34: 116. 1865; Chakrab. & N.P. Balakr., J. Econ. Taxon. Bot. 30: 298, f. 1. 2006; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 215. 2007; Chakrab. & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 240. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 194. 2014. *Croton oblongifolius* Roxb., Fl. Ind. 3: 685. 1832, nom. illeg.; Hook.f., Fl. Brit. India 5: 386. 1887, "*oblongifolium*"; Haines, Forest Fl. Chota Nagpur: 228. 1910 & Bot. Bihar Orissa: 104. 1921; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 546. 2002. *Croton roxburghii* N.P. Balakr., Bull. Bot. Surv. India 3: 39. 1961, nom. illeg. non *Croton roxburghii* Wall. 1840; Paria & Chattopadhyay, Fl. Hazaribagh 1: 459. 2000; N.P. Singh & al., Fl. Bihar: 454. 2001.

**Fig. 28; Plate**

**30C**

Vern. Names: *Mashondha Maisonda*; *Bhain swan* (Kharwari).

Tree or shrub, 5–10 m high. Stems and branches ribbed, glabrous. Leaves simple, alternate, crowded towards ends of the branchlets, lanceolate or oblong-lanceolate, 15–29 × 4.5–10 cm, cuneate at base, serrate or crenate-serrate at margins, acute to obtuse at apex, coriaceous, glabrous when mature; lateral veins to 14 pairs, raised beneath; petioles 1.7–5.5 cm long, glabrous. Flowers solitary or fascicled in terminal or axillary racemes, 5.5–21.5 cm long; bracts at raceme base, linear, 5–6 mm long; bracteoles at flower base, spatulate, 1–2 mm long; pedicels 3–4 mm long. Male flowers 5–7 mm across, deciduous. Sepals/outer tepals 5, ovate, 2.5–3 × 1–1.5 mm, with flaky stellate hair outside, inner surface with a few long hair. Petals/inner tepals 5, oblong or oblanceolate, 2.5–3 × 1–1.5 mm, obtuse, woolly or villous. Stamens 10–12; filaments 2.5–3 mm long; villous on lower half, bend in bud; anthers c. 1 mm long. Female flowers 3–5 mm across. Sepals/outer tepals 5, ovate, 2–3 × 1–1.5 mm, stellate on outer surface, inner glabrous. Petals smaller, linear. Ovary subglobose, 3–5 × 3–4 mm, tomentose; styles c. 4 mm long, forked. Capsules subglobose, 8–10 × 6–8 mm, slightly 3-lobed, clothed with small orbicular scales, splitting into 3 bivalved cocci. Seeds oblongoid or ellipsoid, c. 1.5 mm long, brown.

*Fl. & Fr.:* March – April.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Bagitan jungle, Koderma NRF; Basraon forest, near the village; common. INDIA: Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Nagaland, Odisha, Uttar Pradesh, Sikkim, Tamil Nadu and West Bengal. WORLD: Bangladesh, Bhutan, China, Myanmar, Nepal, Thailand and Vietnam.

*Specimen examined:* Bagitan jungle, Koderma NRF, 388 m, 24°29'05.7" N, 85°36'04.3" E, 1st March 2011, *Shyam Biswa*, 49646; Basraon forest, near the village, 337 m, 24°34'33.6" N, 85°38'34.0" E, 2nd March 2013, *Shyam Biswa* 54142.

### 3. EUPHORBIA L.

Cosmopolitan, especially subtropical regions, c. 1900 species, 82 in India, 18 in Jharkhand and 7 in KWLS.

#### Key to species

- |                     |   |
|---------------------|---|
| 1a. Herbs           | 2 |
| 1b. Shrubs or trees | 4 |

|                                       |                             |
|---------------------------------------|-----------------------------|
| 2a. Plants erect                      | 3                           |
| 2b. Plant prostrate                   | 5. <i>E. thymifolia</i>     |
| 3a. Flowers sessile                   | 2. <i>E. hirta</i>          |
| 3b. Flowers pedicellate               | 1. <i>E. dracunculoides</i> |
| 4a. Plant spiny/thorny                | 3. <i>E. nivulua</i>        |
| 4b. Plants not spiny                  | 5                           |
| 5a. Floral leaves present, bright red | 4. <i>E. pulcherrima</i>    |
| 5b. Floral leaves absent              | 6. <i>E. tithymaloides</i>  |

**1. *Euphorbia dracunculoides*** Lam., Encycl. 2: 428. 1788; Hook.f., Fl. Brit. India 5: 262. 1887; Haines, Bot. Bihar Orissa: 145. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 463. 2000; N.P. Singh & al., Fl. Bihar: 456. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 548. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 266. 2007; Binojk. & N.P. Balakr., Genus Euphorbia India: 213, f. 30. 2010 & in N.P. Balakr. & al., Fl. India 23: 305. 2012. *Euphorbia angustifolia* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.: 62. 1825; Hook.f., Fl. Brit. India 5: 265. 1887.

**Plate 30D**

Annual, 15–30 cm high, glaucous. Stems many, dichotomously branched; branches terete, weak. Leaves simple, alternate, sessile, linear or linear-oblong to linear-lanceolate, 2–4 × 0.2–0.4 cm, narrowed or attenuate at base, entire at margins, acute at apex; midrib prominent; lateral veins indistinct. Pseudoumbels 3 or 4-rayed, with 3 or 4 leaves, usually resembling the stem leaves or a little broader; rays 1–4 cm long, 2–5 times bifid; leaves opposite, linear-lanceolate, 0.5–2 × 0.2–0.5 cm, oblique at base, entire at margins, acute at apex, glabrous. Cyathia terminal, solitary, on main stem as well as on pseudoumbels and rays; peduncles 0.5–2.5 mm long; involucre campanulate or crescent-shaped, c. 2 × 1.5 mm, glabrous outside, villous inside, yellowish, 5-lobed; lobes broadly triangular or ovate; glands 4, transversely oblong, semilunate, 2-horned, c. 1.5 × 1 mm. Male florets: pedicels c. 2 mm long; filaments pubescent; anthers subglobose; bracteoles filiform, laciniate, hairy. Female florets: gynophore c. 3 mm long, glabrous; ovary subovoid, c. 3 mm long, glabrous; styles c. 1 mm long, connate at base, each deeply bifid; stigma capitate. Capsules subglobose, 3–4 × 4–5 mm, roundly trigonous, smooth, glabrous. Seeds 3, ovoid or ellipsoid, 2–3 × 1.5–2 mm, shallowly tuberculate-rugulose, brownish.

*Fl. & Fr.*: August – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Khararia jungle, Meghatari, near Chirkundi Village; common. INDIA: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Afghanistan, Arabia, Egypt to Africa, China and Pakistan.

*Specimen examined*: Khararia jungle, Meghatari, near Chirkundi Village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49713.

**2. *Euphorbia hirta*** L., Sp. Pl. 1: 454. 1753; Haines, Bot. Bihar Orissa: 147. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 466. 2000; N.P. Singh & al., Fl. Bihar: 457. 2001; T.K. Sharma & A.K. Sarkar, Fl. Palamau: 551. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 256. 2007; Binojk. & N.P. Balakr., Genus Euphorbia in India 156, f. 16. 2010 & in N.P. Balakr. & al.,

Fl. India 23: 287. 2012. Ranjan, Fl. Parasnath Wildlife Sanct.: 194. 2014. *Euphorbia pilulifera* L., Sp. Pl. 1: 454. 1753; Hook.f., Fl. Brit. India 5: 250. 1807. **Plate 30E**

Vern. Name: *Dudhi* (Hindi).

Herb, prostrate or erect-decumbent, 10–30 cm high. Stems terete, branched from base, hispid. Leaves simple, opposite, decussate, elliptic-lanceolate or oblong, 1–3 × 0.5–1.4 cm, obliquely or cuneate at base, serrulate at margins, acute at apex, sparsely puberulous above, more beneath; petioles 2–3 mm long, hairy; stipules subulate, 1–2 mm long. Cyathia 15–20 aggregated in a dense, axillary, pedunculate clusters; peduncles simple or dichotomously branched, 1–6 mm long; involucre subsessile, campanulate, 0.5–1 × 0.5–0.6 mm, appressed-hairy outside; lobes deltoid, c. 1 mm long, acute; glands 4, cupular, 0.5–0.8 mm across; limbs minute or as large as the gland, rounded, hyaline, white with purple tinge. Male flowers 4–6; pedicels c. 0.5 mm long; anthers subglobose, c. 0.2 mm long, longitudinally dehiscent. Female flowers laterally pendulous; ovary c. 0.8 mm across, 3-loculed; styles 3, bifid halfway, erect, c. 0.4 mm long; stigma capitate. Capsules trigonous, 1–1.2 × 1–1.2 mm, smooth, adpressed-pubescent. Seeds subglobose-tetragonal or ovoid-quadrangular, c. 0.8 × 0.5 mm, with few shallow transverse ridges and furrows on each face, grey when mature, otherwise pinkish.

*Fl. & Fr.*: Throughout.

*Habitat*: On the dried up river beds or near the river or pond

Distribution: KWLS: Near the river Dhanarjay Nadi, Meghatari; common. INDIA: Almost throughout. WORLD: Throughout tropical and subtropical regions.

*Specimen examined*: Near the river Dhanarjay Nadi, Meghatari, 185 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49692.

**3. *Euphorbia nivulia*** Buch.-Ham. in Trans. Linn. Soc. London 14: 286. 1825; Hook.f., Fl. Brit. India 5: 255. 1887; Haines, Forest Fl. Chota Nagpur: 213. 1910 & Bot. Bihar Orissa: 142. 1921; N.P. Singh & al., Fl. Bihar: 458. 2001; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 276. 2007; Binojk. & N.P. Balakr., Genus Euphorbia India: 315, f. 63, t. 18. 2010 & in N.P. Balakr. & al., Fl. India 23: 324. 2012. *Euphorbia nerifolia* Roxb., Fl. Ind. 2: 467. 1832, non L. 1753. **Plate 30F**

Shrub or small tree, 2–4.5 m high with milky latex; main stem woody; branches whorled, subterete, conical, projecting, straight, brown or black; spines 2, divaricate or inserted on flat corky areas, 3–5 mm long. Leaves simple, alternate, subsessile, whorled at ends of branches, oblanceolate to subspathulate, 11–19 × 3–5 cm, narrowly cuneate at base, entire at margins, obtuse or apiculate at apex, fleshy, glabrous, deciduous; midrib stout and prominent beneath; lateral veins indistinct. Cyathia in axils of fallen leaves, solitary, in diads or triads; the primary and secondary peduncles c. 2.5 cm long, yellow; involucre cup-shaped, c. 6 × 5 mm; bracts 2, broadly ovate, c. 3 × 2 mm; lobes 5, broadly orbicular, lacinate at margins; glands 5, broadly oblong, c. 4 × 3 mm, reddish yellow; bracteoles fimbriate, c. 1.5 mm long. Male florets: in 5 fascicles of 6 or 7 flowers each; pedicels c. 3 mm long; filaments c. 1 mm long; anthers subglobose, c. 1 mm long, yellow. Female florets: gynophores c. 1 mm long; ovary subglobose; styles connate up to middle, each minutely bifid at tip; stigma papillose. Capsules globose, c. 5 mm, trigonous, glabrous; cocci compressed, keeled. Seeds ovoid or subquadrangular, c. 4 × 3 mm, smooth.

*Fl. & Fr.*: February – April.

*Habitat.*: Dry deciduous forests.

*Distribution*: KWLS: Chattarbar jungle; common. INDIA: Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Myanmar, Pakistan and Sri Lanka.

*Specimen examined*: Chattarbar jungle, 405 m, 24°28'13.1" N, 85°32'21.0" E, 3rd April 2013, *Shyam Biswa* 54155.

**4. *Euphorbia pulcherrima*** Willd. ex Klotzsch in Otto & A. Dietr., Allg. Gartenzeitung 2: 27. 1834; Haines, Forest Fl. Chota Nagpur: 214. 1910 & Bot. Bihar Orissa: 144. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 468. 2000; N.P. Singh & al., Fl. Bihar: 459. 2001; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 279. 2007; Binojk. & N.P. Balakr., Genus Euphorbia India: 360, f. 75, t. 19. 2010 & in N.P. Balakr., Fl. India 23: 331. 2012. *Poinsettia pulcherrima* (Willd. ex Klotzsch) Graham, Edinburgh New Philos. J. 20: 412. 1836; Hook.f., Fl. Brit. India 5: 239. 1886.

**Plate 31A**

Shrub or small tree, to 3 m high. Stems woody, branched. Leaves simple, alternate, elliptic-ovate to lanceolate, 8–15 × 4–7 cm, cuneate or acute at base, entire or sinuate-toothed or undulate at margins, acuminate at apex, sparsely hairy above, pubescent beneath; lateral veins 12–18 pairs; petioles 3–4 cm long, reddish green; floral leaves alternate or whorled, elliptic to elliptic-lanceolate or oblanceolate, 7–12 × 2.5–4.8 cm, tapering at ends, entire at margins, glabrous, bright red; petioles 1–3 cm long, reddish; stipules sessile, small, glandular, caducous. Cyathia in terminal, dichotomous pseudodichasia; peduncles 2–5 mm long; involucre turbinate, 5–7 × 6–8 mm; lobes broadly oblong, lacerate, crimson at margins; gland solitary, cupular, 2–4 × 3–6 mm, bright yellowish. Male florets 8–12 in fascicles; bracteoles 4–6 mm long, laciniate, crimson at apex; pedicels 3–4 mm long. Stamens hammer-shaped; filaments red; anthers subglobose. Female florets: gynophore 6–8 mm long; ovary subobovoid, *c.* 4 × 3 mm; styles *c.* 4 mm long, connate up to middle, each bipartite; stigma simple. Fruits subglobose, 1–1.5 × 0.5–1 cm, 3-lobed, smooth, glabrous, on exserted and deflexed red pedicels. Seeds ovoid, 7–10 × 6–9 mm, pale grey.

*Fl. & Fr.*: November – February.

*Habitat*: Near village, planted.

*Distribution*: KWLS: Near RFO Office, Koderma NRF; common. INDIA: Grown as ornamental garden plant in almost all states. WORLD: Native to Mexico; cultivated in tropical and subtropical regions.

*Specimen examined*: Near RFO Office, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 29th November 2012, *Shyam Biswa* 54102.

**5. *Euphorbia thymifolia*** L., Sp. Pl. 1: 454. 1753; Hook.f., Fl. Brit. India 5: 252. 1887; Haines, Bot. Bihar Orissa: 147. 1921; Binojk. & N.P. Balakr., Genus Euphorbia in India 130, f. 9. 2010 & in N.P. Balakr., Fl. India 23: 299. 2012. Ranjan, Fl. Parasnath Wildlife Sanct.: 195. 2014. *Euphorbia microphylla* Lam., Encycl. 2: 423. 1788; Paria & Chattopadhyay, Fl. Hazaribagh 1: 468. 2000; N.P. Singh & al., Fl. Bihar: 459. 2001; T.K. Sharma & A.K. Sarkar, Fl. Palamau: 552. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 261. 2007.

**Plate 31B**

Herb, prostrate, numerous horizontally spreading branches from taproot. Stems slender, terete, hairy, pinkish. Leaves simple, subsessile or with short petiole, opposite, oblong or elliptic-oblong, 2–6 × 1–3 mm, obliquely rounded or subcordate at base, minutely crenulate at margins, obtuse or



rounded at apex, glabrous beneath, sparsely pubescent, 1-veined; stipules intrapetiolar, subulate, to 1 mm long, long-ciliate at margins. Cyathia in axillary fascicles or in upper axils, subtended by several, minute leaves, reddish. Involucres campanulate to turbinate, 0.6–1 cm across, puberulous, 4-lobed; lobes ovate-acute, *c.* 1.8 mm long, ciliate; glands 4, stipitate. Male flowers 1–4, ebracteolate; stalks *c.* 0.5 mm long; anthers globose, *c.* 0.2 mm, dehiscing vertically. Female flowers laterally pendulous; ovary subglobose, *c.* 0.6 × 0.5 mm, pubescent; styles 3, forked from base, erect, *c.* 0.7 mm long. Capsules subglobose, *c.* 1.5 mm across, obscurely keeled, hirsute, often subglabrous. Seeds *c.* 0.8 × 0.3 mm, 4-angled with 5 or 6 shallow transverse furrows.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near NH-31 Koderma NRF; common. INDIA: Throughout. WORLD: Africa, America and Asia.

*Specimen examined*: Near NH-31 Koderma NRF, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49842.

**6. *Euphorbia tithymaloides* L.**, Sp. Pl. 1: 453. 1753. *Pedilanthus tithymaloides* (L.) Poit., Ann. Mus. Natl. Hist. Nat. 19: 390, t. 19. 1812; Hook.f., Fl. Brit. India 5: 239. 1887; Haines, Bot. Bihar Orissa: 149. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 474. 2000; N.P. Singh & al., Fl. Bihar: 464. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 559. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. Ind.: 281. 2007; Binojk. & N. P. Balakr. in N.P. Balakr., Fl. India 23: 338. 2012.

**Plate 31C**

Vern. Name: *Sarpgandha*.

Herb or undershrub, 20–80 cm high, succulent, with milky latex. Stems terete, zigzag with alternate, erecto-patent branches, pubescent at first, later glabrous, deciduous. Leaves simple, alternate, distichous, ovate or elliptic-ovate, 11–13 × 5.6–6.7 cm, attenuate at base, entire at margins, subacute or obtuse with a mucro at apex, glabrous above, sparsely puberulous beneath, often variegated; petioles 3–5 mm long, glabrous. Cymes sessile or shortly stalked, dense, 1–2.5 cm long, on leafless stems, terminal or on short lateral shoots, on 0.3–2 cm long stalks; bracts petaloid, caducous before anthesis, *c.* 7 mm long, densely hairy outside. Cyathia bright red; tube 1–1.5 cm long; involucre obliquely bilateral, zygomorphic; outer 2 involucral lobes 2.5–3 mm long, more than half way connate; inner 3 lobes linear; glands 4 in pairs, the 2 upper ones smaller; ligule oblong-linear from a broad base, entire or emarginate, 2–4 mm long. Male florets: *c.* 25; pedicels *c.* 1.5 mm long. Stamens 1–1.5 cm long; anthers reniform, *c.* 1 mm long. Female floret: solitary, raised above by an erect pedicel; ovary *c.* 1.5 mm across, 3-loculed; styles stout, cylindrical, *c.* 7 mm long; stigmas 3, each bifid, rounded.

*Fl. & Fr.*: March – May.

*Habitat*: Planted as hedge.

*Distribution*: KWLS: Near the Koderma Rest House and inside the enclosure forest of Koderma NRF. INDIA: Grown in gardens as a hedge plant. WORLD: Native to tropical America, now grown in most of the tropical countries.

*Specimen examined*: Near the Koderma Rest House, Koderma NRF, 396 m, 24°29'04.4" N, 85°35'49.6" E, 10th March 2011, *Shyam Biswa* 49741; inside the enclosure, Koderma NRF, 397 m, 24°29'02.0" N, 85°35'59.6" E, 11th August 2011, *Shyam Biswa* 49779.

#### 4. **JATROPHA** L., nom. cons.

Tropical and subtropical regions, 156 species, 11 in India, 4 in Jharkhand and 1 in KWLS.

**Jatropha gossypifolia** L., Sp. Pl. 2: 1006. 1753; Hook.f., Fl. Brit. India 5: 383. 1887; Haines, Forest Fl. Chota Nagpur: 230. 1910 & Bot. Bihar Orissa: 101. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 472. 2000; N.P. Singh & al., Fl. Bihar: 461. 2001; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 224. 2007; Chakrab. & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 252. 2012.

**Plate 31D**

Vern. Name: *Bherenda* (Hindi).

Shrub, to 2.5 m high. Stems and leaves purplish red or green when young; branchlets glandular-hairy. Leaves simple, alternate or spiral, palmately 3–5-lobed or palmatipartite, 5–12 cm long, subcordate at base, densely hairy on main veins beneath, glandular-ciliate with viscid glands at margins; primary veins 3–5; lobes obovate, 4–10 × 2–5 cm, broadest at the middle, acute at apex, central lobes largest, laterals smaller; petioles 4–14 cm long, purplish red, glandular-hairy. Inflorescence a corymbose cyme. Flowers 7–8 mm across, bright red; bracts lanceolate, 9–11 mm long, glandular-ciliate; pedicels to 5 mm long. Male flowers: sepals oblong-ovate, *c.* 6 × 2 mm, glandular-ciliate; petals 5, reddish, base light greenish; stamens 8, monadelphous; inner filaments slightly longer than outer; anthers *c.* 0.5 mm long. Female flowers: sepals and petals as in male; ovary globose, *c.* 2 mm, fluorescent green; styles 3, *c.* 1.5 mm long, connate at base; stigma bifid. Fruits oblong-ovoid, 3-lobed, 3-coccous, *c.* 1.5 cm long, reticulate verruculose, reddish green.

*Fl. & Fr.*: September – October.

*Habitat*: Scrub forests and near village.

*Distribution*: KWLS: Near the enclosure wall Koderma NRF; common. INDIA: Almost throughout. WORLD: Native to New World, introduced, planted and often naturalised in many tropical countries.

*Specimen examined*: Near the enclosure wall, Koderma NRF, 399 m, 24°29'01.2" N, 85°36'06.8" E, 14th September 2010, *Shyam Biswa* 53924.

#### 5. **MALLOTUS** Lour.

Old World tropical regions, *c.* 140 species, 17 in India, 3 in Jharkhand and 1 in KWLS.

**Mallotus philippensis** (Lam.) Müll.Arg., Linnaea 34: 196. 1865; Hook.f., Fl. Brit. India 5: 442. 1887, "*philippinensis*"; Haines, Forest Fl. Chota Nagpur: 232. 1910 & Bot. Bihar Orissa: 106. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 473. 2000; N.P. Singh & al., Fl. Bihar: 463. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 557. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 150. 2007; Susila & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 159. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 196. 2014. *Croton philippensis* Lam., Encycl. 2: 206. 1786.

**Plate 31E**

Vern. Names: *Kamala* (Hindi); *Rhodhi*, *Rori* (Kharwari); *Sinduri*.

Tree, dioecious, evergreen, 6–12 m high, much-branched; bark smooth, grey; branchlets, young leaves and inflorescences rusty pubescent. Leaves simple, alternate, ovate or ovate-lanceolate, 3.5–21 × 2–11 cm, truncate to subcordate at base, entire at margins, acute to acuminate at apex,

glabrous above, pubescent and red-glandular beneath, 3-veined at base; lateral veins 4–6 pairs; petioles 0.7–8 cm long, thickened at ends, fulvous-pubescent, often red-glandular. Flowers small, usually dioecious; male clustered and female solitary, in the bracts of simple paniced spikes or racemes. Male racemes axillary and dense paniced at the end of branchlets or clustered in erect, terminal racemes of 15–25 cm long. Flowers sessile or shortly pedicellate, 4–4.5 mm across; bracts broadly ovate, 1.2–1.5 mm long, acute at apex; sepals 4, free, obovate, 3–5 mm long, acute, recurved, whitish yellow. Petals and disk absent. Stamens 20–30; filaments free; anthers with 2 unequal cells, *c.* 0.7 mm long, dorsifixed, longitudinally dehiscent. Pistillode minute or absent. Female flowers sessile, 3–4 mm across, in short racemes of 5–7.5 cm long; calyx lobes 3 or 4, lanceolate, thicker than male. Ovary tomentose, red-glandular, 2–4-loculed; ovules solitary in each locule; styles 3, spreading, free, plumose, stigmatiferous, yellowish red; stigma 3. Capsules 3-lobed or globose, 5–7 × 10–12 mm, pubescent, densely covered with red glands, 3-valved. Seeds subglobose, 5–6 mm, brownish.

*Fl. & Fr.*: September – February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Bishnutikar, Muralaya Pahar, Meghatari, Taraghati forest, way to Muglamaram forest road; common. INDIA: Almost throughout in tropical areas of all states. WORLD: Bangladesh, Bhutan, China, Japan, Indochina, Myanmar, Nepal, Sri Lanka, Thailand, and from Malesia to Northern Australia.

*Specimens examined*: Bishnutikar, Muralaya Pahar, Meghatari, 189 m, 24°34'58.1" N, 85°35'05.8" E, 10th September 2010, *Shyam Biswa* 49603; Taraghati forest, way to Muglamaram forest road, 321 m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49846.

## 6. **MICROSTACHYS** A. Juss.

Tropical regions, *c.* 15 species and 1 in India.

**Microstachys chamaelea** (L.) Müll.Arg., Linnaea 32: 95. 1893; Esser, Blumea 44: 176. 1999; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 293. 2007; Chakrab. & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 348. 2012. *Tragia chamaelea* L., Sp. Pl. 2: 1391. 1753. *Sebastiania chamaelea* (L.) Müll.Arg. in DC., Prodr. 15(2): 1175. 1866; Hook.f., Fl. Brit. India 5: 475. 1888; Haines, Bot. Bihar Orissa: 118. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 483. 2000; N.P. Singh & al., Fl. Bihar: 467. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 564. 2002.

Herb, erect or ascending, 30–50 cm high, with milky latex. Stems terete, glabrous; branchlets angled, puberulous. Leaves simple, alternate, linear to linear-lanceolate, 1.5–8 × 0.3–0.6 cm, cuneate or rounded at base, minutely crenulate-dentate at margins, rounded or obtuse and apiculate at apex, glabrous above, sparsely puberulous beneath; lateral veins 15–30 pairs; petioles to 3 mm long; stipules linear, 0.5–2 × 0.2–0.5 mm, densely pilose. Inflorescences to 3 cm long; flowers spirally arranged; bracts triangular to lanceolate. Male flowers: *c.* 1.5 mm across; bracts linear-lanceolate, 1–1.5 mm long, ciliate at margins, completely covered by glands; calyx lobes 5, ovate, fimbriate, 1.5–2 mm long; stamens 3; anthers exserted, 0.2–0.3 mm long. Female flowers: solitary, axillary in upper leaf-axils or below the male flowers in the spikes, *c.* 1 mm across; calyx lobes 3, ovate; ovary 3-lobed, echinate; styles 3, shortly connate, spreading, *c.* 2.5 mm long. Fruits ellipsoid, 3-lobed, with 2 vertical rows of soft prickles, 5–6 mm long, light green with a

flush of red between warts. Seeds oblong-ellipsoid,  $c. 2.5 \times 2$  mm, truncate at base, rounded at apex, brown, yellowish mottled.

*Fl. & Fr.*: August – December.

*Habitat*: Dry deciduous hill forests.

*Distribution*: KWLS: Suggi Pahar, near Piparahia; not common. INDIA: Andaman Islands, Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Africa, Australia, China to Malesia, Pacific Islands and Sri Lanka.

*Specimen examined*: Suggi Pahar near Piparahia, 270 m,  $24^{\circ}33'20.0''$  N,  $85^{\circ}35'14.6''$  E, 15th August 2011, *Shyam Biswa* 49802.

## 7. RICINUS L.

Probably native to Northeast Africa, monotypic; now widely cultivated and naturalised in many tropical and subtropical regions of the world.

**Ricinus communis** L., Sp. Pl. 2: 1007. 1753; Hook.f., Fl. Brit. India 5: 457. 1887; Haines, Forest Fl. Chota Nagpur: 234. 1910 & Bot. Bihar Orissa: 112. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 482. 2000; N.P. Singh & al., Fl. Bihar: 466. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 563. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. India: 154. 2007; Susila & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 166. 2012. **Plate 31F**

Vern. Names: Arandi (Hindi); *Rarori*.

Small tree or shrub, monoecious, 3–5 m high, glabrous with glaucous young parts. Stems woody, terete, branched. Leaves simple, alternate to opposite, narrowly peltate at base, suborbicular,  $10\text{--}17\text{--}(60) \times 13.5\text{--}20\text{--}(70)$  cm, palmately divided beyond the middle into 5–10 lobes, lobes oblong-ovate to lanceolate, coarse teeth at margins, acute to acuminate at apex, thin-coriaceous, pale glaucous beneath; petioles 6–14(–40) cm long, bearing at apex 1–3 scattered nectaries on upper side adjoining the blade; stipules ovate-lanceolate, 1–3.5 cm long, early caducous. Inflorescences terminal or leaf-opposed, paniculate, 11–14(–40) cm long, with 3–25-flowered male cymes below and 1–7-flowered female cymes above; peduncles  $c. 10$  cm long, later becoming elongated to 50 cm. Male flowers: pedicels 8–15 mm long; calyx spathaceous, splitting into 3–5 lobes; lobes ovate-lanceolate, 5–9 mm long, yellowish green to pale yellow; petals and disk absent; stamens numerous, crowded and connate into  $c. 8$  mm long cluster of stipitate phalanges; anthers globose to ovoid. Female flowers: 8–9 mm across, green; pedicels 2.5–4 mm long, elongating in fruit; calyx spathaceous, split into 5–7 unequal lobes; lobes lanceolate, 5–6 mm long, green to reddish, caducous; ovary globose,  $c. 4$  mm, densely echinate with soft spines, each ending in a translucent stinging hair; styles 3, entire or bifid; stigmas 4–6 mm long, papillose-plumose on inner surface. Schizocarps 3-lobed, ellipsoid to subglobose,  $1.2\text{--}2.2 \times 1.2\text{--}1.8$  cm, reddish brown to blackish purple, marked with various shades of white, grey or brown, covered with 3–6 mm long, brown or dark brown soft spines. Seeds ellipsoid to ovoid,  $9\text{--}14 \times 5\text{--}6$  mm, shiny, dark brown and white or mottled grey and brown along margins.

*Fl. & Fr.*: March – April.

*Habitat*: Moist localities near the river.



*Distribution:* KWLS: Khararia jungle, near the Dhanarjay Nadi, Meghatari; common. INDIA: Throughout.

*Specimen examined:* Khararia jungle, near Dhanarjay Nadi, Meghatari, 180 m, 24°34'53.4" N, 85°35'16.5" E, 9th March 2011, *Shyam Biswa* 49735.

#### 44. PHYLLANTHACEAE Martinov, nom. cons.

Tropical and subtropical regions, 53 genera and *c.* 2000 species; 17 genera and 146 species in India.

##### Key to genera

- 1a. Trees or shrubs; ovary 1 or 2-loculed 2
- 1b. Herbs; ovary 3- or more-loculed **3. Phyllanthus**
- 2a. Trees; sepals of male flowers valvate; stamens often 5; ovary often 2-loculed **2. Bridelia**
- 2b. Shrubs; sepals of male flowers imbricate; stamens 2; ovary often 1-loculed **1. Antidesma**

##### 1. ANTIDESMA L.

Old World tropical and subtropical regions, especially Asia, *c.* 170 species, 15 in India, 5 in Jharkhand and 1 in KWLS.

**Antidesma acidum** Retz., Observ. Bot. 5: 30. 1788; Airy Shaw, Kew Bull. 26: 352. 1972; Paria & Chattopadhyay, Fl. Hazaribagh 1: 454. 2000; N.P. Singh & al., Fl. Bihar: 449. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 542. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. Ind.: 303. 2007; Chakrab. & M. Gangop. in N.P. Balakr. & al., Fl. India 23: 356. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 192. 2014. *Stilago diandra* Roxb., Pl. Coromandel 2: 35, t. 166. 1802. *Antidesma diandrum* B. Heyne ex Roth, Nov. Pl. Sp.: 369. 1821; Hook.f., Fl. Brit. India 5: 361. 1887, p.p.; Haines, Forest Fl. Chota Nagpur: 226. 1910 & Bot. Bihar Orissa: 138. 1921. *Antidesma ghaesembilla* sensu Hook.f., Fl. Brit. India 5: 357. 1887, non Gaertn. 1788.

##### Plate 32A

Vern. Name: *Amari* (Hindi).

Shrub, 1–3 m high, deciduous; trunk rough. Leaves simple, alternate, obovate, oblanceolate, 2.5–10 × 5–5.5 cm, cuneate or acute at base, entire at margins, acute to acuminate at apex, glabrous above, sparsely pilose beneath; midrib raised beneath; lateral veins 4–7 pairs; petioles 1–6 mm long. Male inflorescence axillary and terminal, simple, 1 or 2-branched, 2–12 cm long; bracts 0.5–1 mm long, ciliate. Male flowers: pedicels 0.5–1.5 mm long. Calyx cup-shaped, 0.8–1 × 1–1.3 mm; segments 4 or 5, deltoid or suborbicular, 0.3–0.5 mm long; disk cushion-shaped, enclosing the base of filaments, pubescent. Stamens 2, 1.2–2.5 mm long; anthers *c.* 0.6 mm long. Female inflorescence simple or rarely once branched, 1.5–5 cm long; bracts 0.5–1 mm long, ciliate. Female flowers: pedicels 0.5–2 mm long. Calyx urceolate, 1–1.5 × *c.* 1.2 mm; segments 4, triangular or deltoid, *c.* 0.5 mm long; disk annular, ovoid *c.* 1 mm, glabrous. Ovary often 1-loculed; styles terminal, 0.5–1 mm long. Drupes ellipsoid to suborbicular, 3–6 × 2–5 mm with short terminal persistent, 3-fid style at apex, glabrous, smooth, green turn blackish when mature.

*Fl. & Fr.:* November – December.

*Habitat:* Open areas.

*Distribution:* KWLS: Baghitan forest; common. INDIA: Throughout. WORLD: Bangladesh, Bhutan, Cambodia, China, Indonesia (Java), Laos, Myanmar, Nepal, Thailand and Vietnam.

*Specimen examined:* Baghitan forest, 392 m, 24°29'20.3" N, 85°35'50.7" E, 20th November 2012, *Shyam Biswa* 54067.

## 2. **BRIDELIA** Willd., nom. & orth. cons.

Old World tropical regions, 37 species, 14 in India, 5 in Jharkhand and 1 in KWLS.

**Bridelia retusa** (L.) Spreng., Syst. Veg. 3: 48. 1826; Hook.f., Fl. Brit. India 5: 268. 1887; Haines, Bot. Bihar Orissa: 119. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 455. 2000; N.P. Singh & al., Fl. Bihar: 452. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 544. 2002; N.P. Balakr. & Chakrab., Fam. Euphorb. Ind.: 319. 2007; Chakrab. & M. Gangop. & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 380. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 193. 2014. *Clutia retusa* L., Sp. Pl. 2: 1042. 1753, "*Chutia*". **Plate 32B**

Vern. Names: *Kadрупala* (Hindi); *Kaaz*.

Tree, to 15 m high; trunk fissured. Leaves simple, alternate, oblong or elliptic, 6–15.5 × 2.5–6.5 cm, rounded at base, entire to shallowly crenate at margins, retuse, acute or obtuse at apex, glossy above, glaucous beneath, glabrous or sparsely puberulous on midrib above; lateral veins 12–23 pairs, terminating at margins; petioles 6–13 mm long, glabrous; stipules lanceolate to linear-lanceolate, 5–15 × 2–4 mm. Inflorescence on terminal, leafless panicles or lateral leafless branches or on main leafy branches. Flowers mostly unisexual, 7–10 mm across. Male flowers: pedicels 1.5–2 mm long. Calyx 3.5–6 mm across; lobes triangular, 1.5–2.5 × 1–1.6 mm. Petals suborbicular, *c.* 1 × 1 mm, toothed or lobed, greenish white; disk flat, *c.* 2 mm across, entire. Stamens 5; filaments connate at base, forming *c.* 1.5 mm long staminal column; filaments *c.* 1 mm long; anthers ovoid, *c.* 0.8 mm long. Pistillode conical, *c.* 1 mm long. Female flowers: pedicels 0.5–2 mm long (to 3 mm in fruit), scattered pilose to glabrous. Calyx 4–5.5 mm across (to 7 mm across in fruits). Sepals narrowly triangular-acuminate, *c.* 2 × 1–1.5 mm. Petals suborbicular or oblong, 1–2 mm across, undulate; outer disk disciform, to 2.5 mm across; inner disk conical-cupular. Ovary ovoid, depressed, 1.5–2 mm across, 2-locular; styles 0.8–1.5 mm long, shortly connate below and shortly bifid above. Drupes subglobose, 5–8 × 6–9 mm, shortly beaked at apex, shallowly 2-lobed, glabrous, green with white dots, turn blackish when mature, 2-loculed. Seeds 1 or 2.

*Fl.*: August – October; *Fr.*: November – January.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Throughout. WORLD: Bangladesh, Bhutan, Cambodia, China, Indonesia (Sumatra), Laos, Malay Peninsula, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49501.

## 3. **PHYLLANTHUS** L.

Tropical and subtropical regions, 750–800 species, 53 in India, 9 (1 cultivated) in Jharkhand and 3 in KWLS.

### Key to species

- 1a. Leaves white-hispidulous beneath along margins; female flowers subsessile; fruits tuberculate on up to 0.5 mm long pedicels; fruits sessile, coarsely warted **3. *P. urinaria***

- 1b. Leaves glabrous or at least not white-hispidulous beneath along margins; female flowers pedicellate; fruits smooth, on more than 1 mm long pedicels 2
- 2a. Proximal leaves of leaf-bearing branchlets double the size of the distal leaves; female flowers 2.5–3 mm across; pedicels 1–2 mm long **1. P. airyshawii**
- 2b. All leaves of branchlets more or less of the same size; female flowers 1.5–2 mm across; pedicels 5–8 mm long **2. P. simplex**

**1. *Phyllanthus airy-shawii*** Jean F. Brunel & Jacq. Roux, *Nordic J. Bot.* 4: 470, f. 3. 1984; R.L. Mitra & M.P. Nayar, *Taxon* 37: 470. 1988; N.P. Singh & al., *Fl. Bihar*: 465. 2000; Chakrab. & M. Gangop. & N.P. Balakr. in N.P. Balakr. & al., *Fl. India* 23: 481. 2012; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 197. 2014. *Phyllanthus debilis* Klein ex Willd., *Sp. Pl.* 4: 582. 1805; Hook.f., *Fl. Brit. India* 5: 299. 1887; Haines, *Forest Fl. Chota Nagpur*: 222. 1910 & *Bot. Bihar Orissa*: 126. 1921; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 477. 2000; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 561. 2002; N.P. Balakr. & Chakrab., *Fam. Euphorb. Ind.*: 385. 2007. **Plate 32C**

Herb, 15–50 cm high, slender. Stems terete, straight with many spreading or erect branches, glabrous. Leaves simple, alternate, obovate, 0.8–2 × 0.8–1.2 cm, cuneate or rounded at base, entire at margins, broadly acute at apex, thin, green above, pale green beneath; petioles *c.* 2 mm long; stipules lanceolate or linear-lanceolate, 2–4 mm long, scarious with setaceous tip. Flowers short-pedicelled in small, bracteate axillary clusters; bracts lanceolate, 0.8–1 mm long. Male flowers: a few in lower leaf-axils, *c.* 1.5 mm across. Tepals 6, 2-seriate, obovate, 1–1.2 mm long, scarious except midrib, subacute at ends; Stamens 3, exserted; filaments erect, connate into a distinct column; anthers broadly oblong, transversely dehiscent; disk-glands 6, stellately arranged, yellowish. Female flowers: numerous in upper leaf-axils, 2.5–3 mm across; pedicels 1–2 mm long. Tepals 6, spreading, obovate-oblong or oblong-spathulate, 2–2.2 mm long, green with white margins. Ovary *c.* 1 mm across, 6-lobed; styles 3, bifid; stigmas obtuse; disk annular, crenulate. Capsules depressed-globose, 3–4 mm across, smooth, 3-valved. Seeds 3-gonous, rounded and irregularly ribbed on back, 1–1.5 mm long.

*Fl. & Fr.*: September – February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Andhra Pradesh, Assam, Bihar, Jharkhand, Kerala, Madhya Pradesh, Meghalaya, Odisha, Sikkim, Uttaranchal, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Myanmar and Thailand.

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49506.

**2. *Phyllanthus urinaria*** L. *Sp. Pl.* 2: 982 1753; Hook.f., *Fl. Brit. India* 5: 293. 1887; Haines, *Bot. Bihar Orissa* 125. 1921; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 480. 2000; N.P. Singh & al., *Fl. Bihar*: 466. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 562. 2002. N.P. Balakr. & Chakrab., *Fam. Euphorb. Ind.*: 389. 2007; Chakrab. & M. Gangop. & N.P. Balakr. in N.P. Balakr. & al., *Fl. India* 23: 490. 2012; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 198. 2014.

Herb, annual or sometimes perennial, decumbent or erect, *c.* 20 cm high. Stems terete, glabrous, sometimes puberulous or hispid. Leaves simple, alternate, very close to clustering at apex, broadly oblong, obovate or oblong-oblongate, 0.7–2 × 0.3–1 mm, rounded at base, entire or whitish small-ciliate at margins, rounded and minute apiculate at apex; lateral veins *c.* 6 pairs, distinct, glabrous, whitish green beneath; stipules of the cataphylls lanceolate, *c.* 2 mm long, auriculate-sagittate, acuminate at apex; those of leaves triangular-lanceolate, *c.* 1 mm long, unequal, not auriculate, stramineous. Female cymules 1-flowered, at proximal axils; male cymules 5–7-flowered, at the distal axils or vice versa. Male flowers: pedicels articulate above middle. Sepals 6, obovate, *c.* 0.5 mm long, obtuse at apex, glabrous, pale yellow; disk-glands 6, rounded, papillose. Stamens 3; filaments united into a short column; anthers sessile but not fused together, erect, vertically dehiscent. Female flowers: pedicels very short and thick or sessile; sepals 6, oblong-lanceolate, *c.* 1 mm long, obtuse or subacute at apex, subglabrous, yellowish with a reddish olive midrib; disk flat, irregularly 9-lobed. Ovary subglobose, *c.* 1 mm across, verruculose; styles 3, very short, closely appressed to top of ovary, bifid, the segments recurved. Fruits subglobose, 2–2.5 mm across, sparingly beset with short transverse rows of flattened, triangular tubercles, stramineous or reddish. Seeds *c.* 1 × 1 mm, yellowish brown.

*Fl. & Fr.*: August – December.

*Habitat*: Shade localities in dry deciduous mixed forests.

*Distribution*: KWLS: Lokai forest; not common. INDIA: Almost throughout. WORLD: Native of southern Asia, but now widespread in tropical and subtropical regions.

*Specimen examined*: Lokai forest, 390 m, 24°29'18.7" N, 85°35'50.1" E, 10th August 2011, *Shyam Biswa* 49773.

**3. *Phyllanthus virgatus*** G.Forst., Fl. Ins. Austr. 65 (1786). Paria & Chattopadhyay, Fl. Hazaribagh 1: 481. 2000; N.P. Singh & al., Fl. Bihar: 466. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 562. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 198. 2014. *Phyllanthus simplex* Retz., Observ. Bot. 5: 29. 1789; Hook.f., Fl. Brit. India 5: 295. 1887; Haines, Bot. Bihar Orissa: 125. 1921; N.P. Balakr. & Chakrab., Fam. Euphorb. Ind.: 380. 2007; Chakrab. & M. Gangop. & N.P. Balakr. in N.P. Balakr. & al., Fl. India 23: 476. 2012. *Macraea oblongifolia* Wight, Icon. Pl. Ind. Orient. 5(2): 27, t. 1902, f. 1. 1852. *Phyllanthus simplex* var. *oblongifolius* (Wight) Müll.Arg., Linnaea 32: 32. 1863 & in DC., Prodr. 15 (2): 391. 1866; Hook.f., Fl. Brit. India 5: 295. 1887.

**Plate 32D**

Vern. Name: *Bhuinaonra* (Hindi).

Herb, perennial, erect or decumbent-ascending, 15–40 cm high. Stems terete, glabrous, reddish. Leaves simple, alternate, oblong or linear-oblong, 0.6–3 × 0.2–0.6 cm, rounded at base, entire at margins, acute to rounded and apiculate at apex, glabrous; petioles 0.5–1 mm long; stipules peltate, triangular, 1–1.2 mm long. Flowers axillary, usually 3-nate, 2 males and 1 female or sometimes female solitary in upper axils. Male flowers: smaller than female, 0.7–0.8 mm across; pedicels *c.* 1 mm long. Tepals 6, oblong, *c.* 0.5 × 0.3 mm, obtuse at apex; Stamens 3; included; filaments free; anthers *c.* 0.2 mm long, transversely dehiscent. Disk- glands 6. Female flowers: 1.5–2 mm across; pedicels 5–8 mm long. Tepals oblong, *c.* 1 mm long, mucronate at apex. Ovary *c.* 1 mm long; styles 3, horizontally spreading, *c.* 0.7 mm long, recurved; disk annular, crenulate. Capsules globose, 0.5–2 × 2–3 mm, slightly 3-lobed, smooth, glabrous, green. Seeds triquetrous, *c.* 1.5 × 1 mm, minutely tubercled, reddish brown.



*Fl. & Fr.*: September – February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Almost throughout. WORLD: Sri Lanka (and India) to Southeast Asia.

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49520.

#### 45. COMBRETACEAE R. Br., nom. cons.

Tropical and subtropical regions, 17 genera and *c.* 525 species; 8 genera and 48 species in India.

##### Key to genera

- 1a. Climbing shrubs; petals present
- 1b. Trees; petals absent

**1. Combretum**

**2. Terminalia**

##### 1. COMBRETUM Loebl., nom. cons.

Tropical regions, *c.* 240 species, 10 in India, 5 in Jharkhand and 1 in KWLS.

**Combretum roxburghii** Spreng., Syst. Veg. 2: 331. 1825; Ranjan, Fl. Parasnath Wildlife Sanct.: 95, f. 11. 2014. *Combretum album* Pers., Syn. Pl. 1: 411. 1805. *Combretum decandrum* Roxb., Pl. Coromandel 1: 43, t. 59. 1796; C.B. Clarke in Hook.f., Fl. Brit. India 2: 452. 1878; Haines, Forest Fl. Chota Nagpur: 365. 1910 & Bot. Bihar Orissa: 357. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 430. 2000; N.P. Singh & al., Fl. Bihar: 195. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 250. 2002.

**Plate 33A**

Climber; branches rusty-tomentose when young. Stems woody. Leaves simple, opposite, oblong, 5–12.5 × 3.5–5.5 cm, rounded at base, entire at margins, abruptly acuminate at apex, coriaceous, glossy above, glabrous or somewhat sparsely appressed-hairy beneath, whitish-yellow at apex when young; petioles 4–7 mm long. Spikes many in large axillary and terminal panicles, 1.2–3 cm long, rusty-villous. Flowers 5-merous, 5–6 mm long; bracteoles linear, 4–5 mm long, subpersistent, tomentose. Calyx densely villous outside; tube urceolate, 4-lobed; lobes triangular, *c.* 1.5 mm long. Petals ovate-oblong, acuminate at apex, not much longer than calyx, hairy. Stamens 8(4+4), opposite and alternating with calyx lobes; anthers reddish. Ovary *c.* 3 mm long, 1-loculed; ovules 2–5, pendulous; style subulate or filiform, *c.* 4 mm long, puberulous. Disk short-hairy. Fruits oblongoid or ellipsoid, subquadrate, *c.* 3.5 cm long, nearly smooth with 5 membranous wings, pinkish green.

*Fl. & Fr.*: November – March.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Near the river Dhanarjay Nadi, Meghatari and Dhab forest; very common. INDIA: Andaman and Nicobar Islands, Andhra Pradesh, Bihar and West Bengal. WORLD: China, Myanmar, Nepal, Thailand and Vietnam.

*Specimens examined*: Near the river Dhanarjay Nadi, Meghatari, 184 m, 24°34'39.3" N, 85°35'56.0" E, 7th March 2011, *Shyam Biswa* 49712; Near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 2nd March 2012, *Shyam Biswa* 54040; Dhab forest, 22nd November 2012, *Shyam Biswa* 54080.

*Note:* The juvenile leaves and young flower buds that emerge at the apices of twigs and the young branches after the deciduous period during October–November are whitish-yellow or pale in colour.

## 2. **TERMINALIA** L., nom. cons.

Tropical regions, c. 200 species, 12 in India, 6 in Jharkhand and 4 in KWLS.

### Key to species

- |                                                                                             |                                  |
|---------------------------------------------------------------------------------------------|----------------------------------|
| 1a. Flowers in globose heads; ovules 2; fruits 2-winged                                     | <b>5. <i>T. anogeissiana</i></b> |
| 1b. Flowers in spikes, racemes or panicles; fruits either not winged or with 3- or 5-winged | 2                                |
| 2a. Fruits winged                                                                           | 3                                |
| 2b. Fruit not winged                                                                        | 4                                |
| 3a. Bark smooth, peeling off; leaves glabrous                                               | <b>2. <i>T. arjuna</i></b>       |
| 3b. Bark rough, deeply fissured, not peeling off; leaves tomentose beneath                  | <b>1. <i>T. alata</i></b>        |
| 4b. Foliar gland present; petioles 3–7 cm long; fruits oblong-ellipsoid, glabrous           | <b>4. <i>T. chebula</i></b>      |
| 4a. Foliar gland absent; petioles 1–2.5 cm long; fruits obovoid, tomentose                  | <b>3. <i>T. bellirica</i></b>    |

**1. *Terminalia alata*** B. Heyne ex Roth, Nov. Pl. Sp.: 379. 1821; Ranjan, Fl. Parasnath Wildlife Sanct.: 95. 2014. *Pentaptera tomentosa* Roxb. ex DC., Prodr. 3: 14. 1828. *Terminalia tomentosa* (Roxb. ex DC.) Wight & Arn., Prodr. Fl. Ind. Orient. 1: 314. 1834, nom. illeg.; C.B. Clarke in Hook.f., Fl. Brit. India 2: 447. 1878; Haines, Forest Fl. Chota Nagpur: 362. 1910 & Bot. Bihar Orissa: 353. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 432. 2000; N.P. Singh & al., Fl. Bihar: 195. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 251. 2002.

**Plate 32F & 33B**

Vern. Names: *Asan*, *Saj* (Hindi).

Tree, 15–20 m high, deciduous; bark rough, fissured, corrugated, dark grey, not peeling off; branchlets silky-pubescent. Leaves simple, subopposite, alternate towards apex, broadly ovate-oblong or elliptic-oblong, 15–25 × 6–10 cm, truncate-subcordate and oblique at base, slightly crenulate at margins, obtuse or subacute at apex, coriaceous, glabrous or few hair above, persistently soft-tomentose beneath; lateral veins 10–20 pairs, parallel, arcuate, prominent, raised beneath; petioles c. 1 cm long; glands subsessile, turbinate, present on midrib at base of leaf-blade. Spikes paniculate, 4.5–10 cm long, pubescent. Flowers 3–5 mm across; bracteoles linear-lanceolate, c. 2 mm long, hairy, caducous. Calyx 3–4 mm long, hairy or glabrous outside; lobes c. 1.5 mm long, slightly hairy inside, light greenish-white. Petals absent. Stamens 10; filaments 3–4 mm long; anthers whitish. Ovary terete, c. 2 mm long, 1-loculed; ovules 2 or 3, pendulous; style to 3 mm long. Drupes ovoid, 3.5–5 × 2.5–3.5 cm, 5-winged; wings broad, equal, c. 1.5 cm, thin-coriaceous, marked with horizontal striations, glabrous, green turns reddish-brown.

*Fl. & Fr.*: August – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Bagitan forest; common. INDIA: Throughout. WORLD: Myanmar, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Bagitan forest, 398 m, 24°29'03.6" N, 85°36'13.7" E, 8th August 2011, *Shyam Biswa* 49753.

**2. *Terminalia arjuna*** (Roxb. ex DC.) Wight & Arn., Prodr. Fl. Ind. Orient.: 314. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 2: 447. 1878; Haines, Forest Fl. Chota Nagpur: 362. 1910 & Bot. Bihar Orissa: 353. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 433. 2000; N.P. Singh & al., Fl. Bihar: 196. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 250. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 95. 2014. *Pentaptera arjuna* Roxb. ex DC., Prodr. 3: 14. 1828.

**Plate 33C**

Vern. Name: *Arjun* (Hindi).

Tree, 24–30 m high; branches long, horizontally spreading or inclined; bark pale, smooth, peeling or flaking off in pieces; branchlets pubescent. Leaves simple, alternate or subopposite, oblong or elliptic-oblong, 3.5–12.5 × 1.7–3.5 cm, rounded or subcordate, slightly oblique at base, entire at margins, obtuse or subacute at apex, thick-coriaceous, pale dull green above, pale brown beneath, glabrous, midrib and lateral veins raised beneath; petioles with 1 or 2 glands close to base of leaf-blade, 3–7 mm long, glabrous. Spikes paniculate, c. 10 cm long; peduncles c. 5 cm long. Flowers sessile, c. 4 mm across; bracteoles linear, c. 1 mm long. Calyx 3.5–4 cm long, glabrous; lobes triangular. Petals absent. Stamens 10, 2-seriate, alternate, much-exserted. Ovary ferruginous-tomentose. Drupes ovoid or obovoid-oblongoid, 4–4.5 × c. 2.3 cm, 5-angled, glabrous, 5-winged; wings narrow and very thick, c. 1 cm across, greenish with pink spots turn reddish-brown when mature.

*Fl. & Fr.*: May – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near Dhanarjay Nadi way to Dipluswa Nala, Meghatari; common. INDIA: Sub-Himalayan areas of N.W. Province, Andhra Pradesh and Tamil Nadu. WORLD: Sri Lanka.

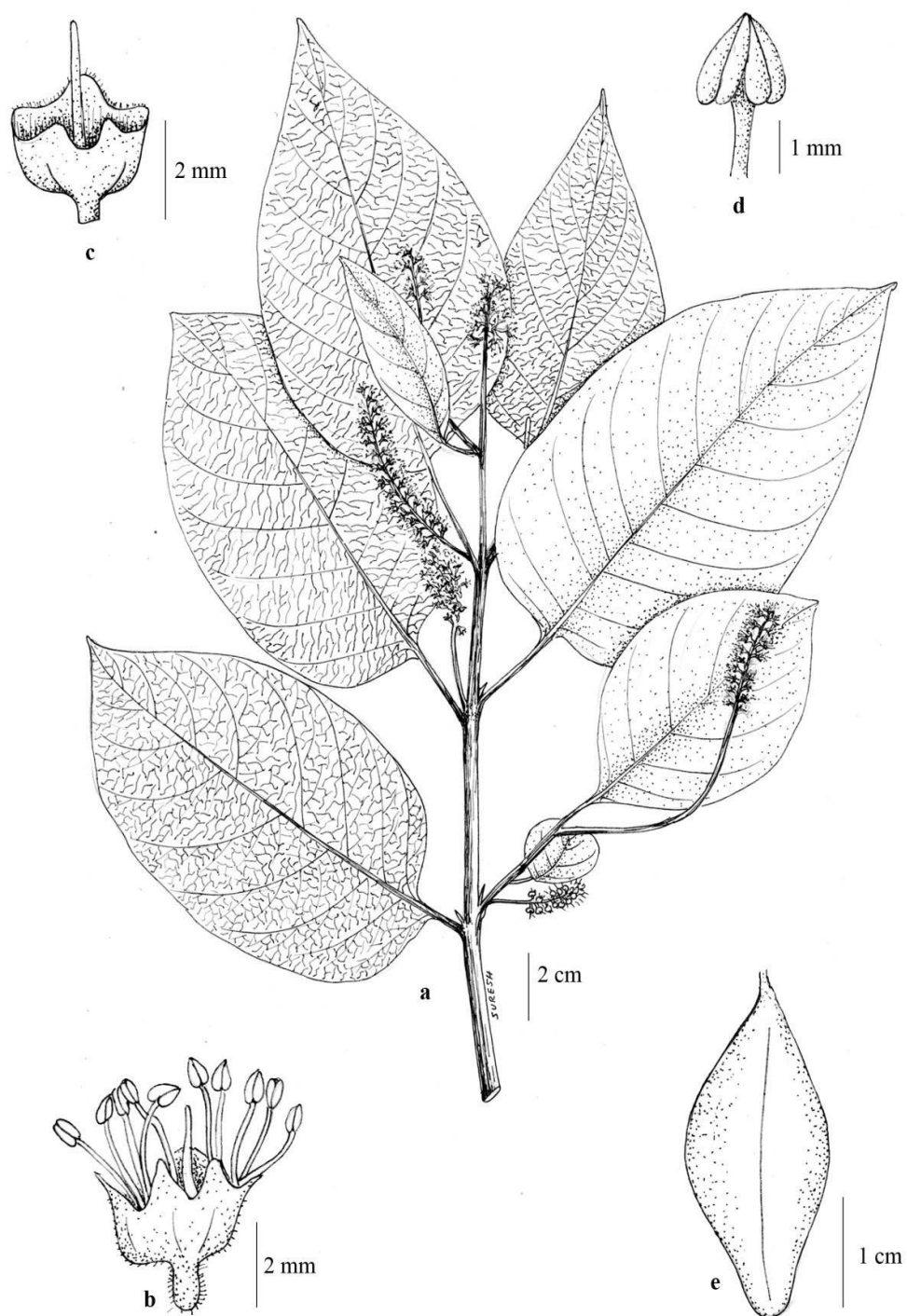
*Specimen examined*: Near Dhanarjay Nadi, way to Dipluswa Nala, Meghatari, 205 m, 24°34'26.2" N, 85°35'21.4" E, 13th September 2010, *Shyam Biswa* 49616.

**3. *Terminalia bellirica*** (Gaertn.) Roxb., Pl. Coromandel: 54, t. 198. 1805; C.B. Clarke in Hook.f., Fl. Brit. India 2: 445. 1878; Haines, Forest Fl. Chota Nagpur: 361. 1910 & Bot. Bihar Orissa: 352. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 434. 2000; N.P. Singh & al., Fl. Bihar: 196. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 252. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 96. 2014. *Myrobalanus bellirica* Gaertn., Fruct. Sem. Pl. 2: 90, t. 97, ff. a–d. 1791.

**Fig. 29; Plate 33D & E**

Vern. Name: *Bahera* (Hindi).

Tree with butteresses, 12–18 m high; branchlets with persistent leaf-scars, ferruginous-tomentose when young. Leaves simple, alternate, crowded at ends of branchlets, broadly elliptic or roundish, 10–18.5 × 8.5–14 cm, obtuse to rounded and slightly oblique at base, entire at margins, subacute to obtuse at apex, rufo-sericeous when young, glabrous later; veins raised beneath; foliar glands absent; petioles 3–7 cm long, glabrous. Inflorescences a simple spike, solitary, axillary, 4–10 cm



**Fig. 29. *Terminalia bellirica* (Gaertn.) Roxb.:** a. flowering twig; b. flower; c. calyx and carpel; d. stamen; e. fruit.



long, staminate towards apex, bisexual at base. Flowers sessile, 3.5–4 mm across; bracteoles minute, early caducous. Calyx to 2.5 mm long; tube ferruginous-tomentose outside, 5-lobed; lobes triangular, recurved, *c.* 1.5 mm long. Stamens 10, exserted; filaments 2.5–3 mm long, glabrous. Style 3–3.5 cm long, glabrous. Drupes obovoid or orbicular, 2.5–3 × 1.5–2 cm, obscurely 5-ridged, finely tomentose, brownish.

*Fl. & Fr.*: February – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near Chirkundi Village, Dhanarjay Nadi; common. INDIA: Throughout. WORLD: Malaysia, Myanmar, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Near Chirkundi Village, Dhanarjay Nadi, 210m, 24°34'47.8" N, 85°35'56.0" E, 2nd March 2012, *Shyam Biswa* 54042.

**4. *Terminalia chebula*** Retz., *Observ. Bot.* 5: 31. 1789; C.B. Clarke in Hook.f., *Fl. Brit. India* 2: 446. 1878; Haines, *Forest Fl. Chota Nagpur*: 361. 1910 & *Bot. Bihar Orissa*: 352. 1922; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 436. 2000; N.P. Singh & al., *Fl. Bihar*: 196. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 253. 2002; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 97. 2014.

**Fig. 30; Plate 33F**

Vern. Name: *Harra* (Hindi).

Tree, 12–24 m high; branchlets rusty-villous or glabrescent. Leaves simple, subopposite, elliptic-oblong or oblong-lanceolate, 4.5–16 × 2.5–8.2 cm, attenuate to rounded at base, entire at margins, subacute to acute at apex, glabrous or very few hair above, densely tomentose beneath; midrib raised beneath; lateral veins 7–9 pairs; petioles with usually 1–4 or rarely 6 sessile glands on petiole at base of leaf-blade, 1–2.5 cm long, pubescent. Inflorescences a spike, usually branched (or paniculate) or simple, 5–7 cm long; peduncles to 1.5 cm long. Flowers 0.5–1.5 cm across; bracteoles linear, 3–4 mm long, hairy, conspicuous in buds but soon deciduous before blooming. Calyx 3–4 mm long, glabrous outside, hairy inside, 5-lobed; lobes triangular, *c.* 1.5 mm long. Stamens 10, much-exserted. Ovary *c.* 2 mm across. Drupes oblong-ellipsoid, 2.5–3.5 × *c.* 2.2 cm, faintly angled, glossy, glabrous, yellowish green or reddish green.

*Fl. & Fr.*: April – December.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure forest, Koderma NRF; common. INDIA: Bihar, Madhya Pradesh, Odisha, Uttar Pradesh and Peninsular India. WORLD: Myanmar and Sri Lanka.

*Specimens examined*: Inside the enclosure forest, 390 m, 24°29'18.7" N, 85°35'15.1" E, 8th September 2010, *Shyam Biswa* 49596; Koderma NRF, 398 m, 24°29'06.6" N, 85°36'49.8" E 9th August 2011, *Shyam Biswa* 49766.

**5. *Terminalia anogeissiana*** Gere & Boatwr., *Bot. J. Linn. Soc.* 184(3): 319 (2017). *Conocarpus latifolia* Roxb. ex DC., *Prodr.* 3: 16. 1828. *Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill. & Perr., *Fl. Seneg. Tent.* 7: 280. 1832; C.B. Clarke in Hook.f., *Fl. Brit. India* 2: 450. 1878; Haines, *Forest Fl. Chota Nagpur*: 363. 1910 & *Bot. Bihar Orissa*: 355. 1922; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 428. 2000; N.P. Singh & al., *Fl. Bihar*: 193. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 248. 2002.

**Plate 32E**

Vern. Names: *Dhaura* (Hindi); *Saaya*, *Sewatha*, *Dewtha*.



**Fig. 30. *Terminalia chebula* Retz.:** a. flowering twig; b. leaf glands; c. branch with lenticels; d. twig with juvenile flower buds; e. flower buds; f. twig with flowers; g. flower; h. fruits.

Tree, 10–20 m high, deciduous; branchlets glabrous; bark smooth, whitish. Leaves simple, alternate or subopposite, broadly elliptic or oblong or oblong-elliptic, 5.5–10.5 × 4.5–6.7 cm, obtuse to rounded at base, entire at margins, obtuse to rounded or retuse at apex, coriaceous glabrous; midrib prominently raised beneath; petioles 0.8–1.5 cm long, hairy. Heads axillary and terminal, globose, 1.5–2 cm; peduncles 1 or more from same axil, branched. Flowers 2–4 mm in diameter; pedicels *c.* 5 mm long, pinkish. Calyx 3–4 mm long, pubescent, greenish-yellow turning light pinkish-yellow later; lobes triangular, 1–2 mm long, persistent. Petals absent. Stamens 10, exserted; filaments *c.* 4 mm long, thick, glabrous; anthers oblong, apiculate, bright yellow. Ovary densely tomentose; style thickened at base. Drupes suborbicular, 5–6 × 2–3 mm, compressed, 2-winged with persistent calyx tube, pubescent from middle above, yellowish brown. Seed 1, 2–3 mm long.

*Fl. & Fr.*: September – January.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; common. INDIA: Bihar, Lower Himalayas, Odisha and Peninsular India. WORLD: Pakistan and Sri Lanka.

*Specimen examined*: Taraghati forest, 320 m, 24°32'.321" N, 85°35'.060" E, 27th September 2013, Shyam Biswa 53334.

#### 46. LYTHRACEAE J. St.-Hil., nom. cons.

Tropical with few temperate regions, 31 genera and *c.* 600 species; 11 genera 53 and species in India.

##### Key to genera

- |                                                                                                         |                         |
|---------------------------------------------------------------------------------------------------------|-------------------------|
| 1a. Trees or shrubs; flowers and fruits more than 5 mm long                                             | 2                       |
| 1b. Herbs; flowers and fruits less than 3 mm long                                                       | 3                       |
| 2a. Hypanthium tubular, almost oblique at mouth; petals subulate; fruits included within the hypanthium | <b>5. Woodfordia</b>    |
| 2b. Hypanthium cupular, truncate at mouth; petals obovate or spatulate; fruits exserted from hypanthium | <b>2. Lagerstroemia</b> |
| 3a. Plants aquatic, submerged; leaves rhomboid or ovate                                                 | <b>4. Trapa</b>         |
| 3b. Plant semiaquatic, not submerged; leaves linear or lanceolate                                       | 4                       |
| 4a. Flowers solitary or in spicate; fruit dehiscent opening in valves                                   | <b>3. Rotala</b>        |
| 4b. Flowers in axillary cymose clusters; fruit dehiscent opening irregularly                            | <b>1. Ammannia</b>      |

##### 1. AMMANNIA L.

Cosmopolitan, *c.* 25 species, 18 in India, 3 in Jharkhand and 1 in KWLS.

**Ammannia baccifera** L., Sp. Pl. 1: 120. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 2: 569. 1879; Haines, Bot. Bihar Orissa: 379. 1922; N.D. Paria & S.P. Chattopadhyay, Fl. Hazaribagh 1: 400. 2000; N.P. Singh & al., Fl. Bihar: 204. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 261. 2002. **Plate 34A**

Vern. Name: *Dadmari* (Hindi).

Herb, 5–20 cm high. Stems quadrangular, pinkish. Leaves simple, opposite, linear-oblong or elliptic-lanceolate, 0.4–2.5 × 0.2–0.5 cm, narrowed at base, entire at margins, subacute or obtuse at apex, glabrous. Flowers in dense cymose clusters, axillary, 4- or 5-merous, minute; pedicels *c.* 1 mm long; bracts filiform, shorter than pedicels. Flower buds 4-angled two pyramids placed base

to base with the four corners somewhat subulate-mucronate or 8-angled. Hypanthium broadly campanulate, 1–2 mm long. Sepals 4, broadly triangular, 1–2 mm long, acute at apex, pinkish. Petals absent. Stamens 4 or 5; filaments *c.* 0.5 mm long. Ovary 4-(or 5)-loculed; style to 0.5 mm long, persistent; stigma capitate. Capsules depressed-globose, *c.* 2 × 2–3 mm, slightly longer than calyx-tube, imperfectly circumscissile above middle, reddish. Seeds many, oval, *c.* 0.5 × 0.3 mm, pinkish.

*Fl. & Fr.*: February – March.

*Habitat*: Near fallow crop fields and in marshy localities.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; Bherwa tan, Koderma NRF on the fallow crop fields; common. INDIA: Almost throughout. WORLD: Afghanistan, Africa, Australia, Bhutan, Cambodia, Caribbean Islands, China, Laos, Malaysia, Nepal, Philippines, Thailand and Vietnam.

*Specimens examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49892; Bherwa tan, Koderma NRF on the fallow crop fields, *c.* 397 m, 24°28'43.6" N, 85°36'26.7" E, 3rd March 2012, *Shyam Biswa* 54044.

## 2. LAGERSTROEMIA L.

Tropical Asia to Australia, 53 species, *c.* 10 in India, 5 in Jharkhand (2 cultivated), and 1 in KWLS.

**Lagerstroemia parviflora** Roxb., Pl. Coromandel 1(3): 48, t. 66. 1796; C.B. Clarke in Hook.f., Fl. Brit. India 2: 575. 1879; Haines, Forest Fl. Chota Nagpur: 355. 1910 & Bot. Bihar Orissa: 375. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 405. 2000; N.P. Singh & al., Fl. Bihar: 207. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 263. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 100. 2014. **Plate 34B**

Vern. Name: *Bakli* (Hindi).

Tree, 5–20 m high, deciduous; younger branches slightly pubescent. Bark smooth, white. Leaves simple, alternate, ovate-elliptic or broadly elliptic-oblong, 3–9.2 × 1.5–4 cm, obtuse to rounded at base, entire at margins, acute at apex, thin-coriaceous, shiny above, glaucous beneath; midrib raised beneath; petioles 4–5 mm long. Racemes or panicles 6–20 cm long, axillary; flower buds globose, 2–3 cm, puberulent; bracts elliptic-oblong, leafy; bracteoles 2; pedicels 0.5–1.5 cm long. Calyx cup-shaped, minutely puberulent, smooth, 4-lobed; lobes triangular, 4–7 mm long, equal to tube. Petals orbicular, undulate, 4–6 mm, white; claw *c.* 2 mm long. Stamens numerous, inserted at base of calyx tube. Ovary globose, glabrous; style bent, 6–7 mm long. Capsules oblong-ellipsoid, 2–3 × 0.8–1.5 cm, glabrous; stalks 2.5–5 cm long, rounded at apex; fruiting calyx 5–7 mm long. Seeds *c.* 2 × 0.8 cm, off-whitish brown.

*Fl. & Fr.*: September – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF; common. INDIA: Foothills of Western Himalayas, Deccan Plateau up to north Nilgiris, from about 300 to 1000 m. WORLD: Myanmar.

*Specimen examined*: Koderma NRF, 390 m, 24°29'18.7" N, 24°29'18.7" E, 28th September 2013 *Shyam Biswa* 54195.



### 3. **ROOTALA** L.

Temperate to tropical regions, 44 species, 5 in Jharkhand and 1 in KWLS.

**Rotala densiflora** (Roth ex Roem. & Schult.) Koehne, Bot. Jahrb. Syst. 1(2): 164. 1880; N.P. Singh & al., Fl. Bihar: 208. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 266. 2002. *Ammannia densiflora* Roth ex Roem. & Schult., Syst. Veg. 3: 304. 1818; Haines, Bot. Bihar Orissa: 378. 1922. *Ammannia pentandra* sensu C.B. Clarke in Hook.f., Fl. Brit. India 2: 568. 1879, non Roxb., 1820. **Plate 34C**

Herb, erect or decumbent, 10–20 cm high, robust with numerous spreading branches. Stems and branches glabrous, pinkish. Leaves simple, opposite, sessile, lower leaves lanceolate or linear-lanceolate, *c.* 2 × 0.5–0.7 cm, truncate or amplexicaul at base, entire at margins, acute at apex, glabrous; upper leaves or at terminal ends linear or linear-lanceolate, 3–10 × 1–3 mm, smaller becoming bractiform. Flowers solitary, sessile, with broadly campanulate hypanthium; flower buds depressed, acutely 5-angled; bracteoles 2, acicular. Calyx 5-lobed; lobes acuminate, 2–2.5 mm long. Petals 5, obovate or oblong, *c.* 2 × 1 mm, retuse at apex, attached at the upper part of calyx, pink. Stamens 5, *c.* 2 mm long, attached inside the disk; filaments flat; anthers blackish, dorsifixed. Ovary subglobose, 2 mm long, 3-lobed; style short. Capsules globose, *c.* 3 mm, 3-valved. Seeds obovate.

*Fl. & Fr.*: December – February.

*Habitat*: On the grasslands near marshy localities.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; not common. INDIA: Almost throughout. WORLD: Australia, China, Indonesia (Kalimantan), Nepal, Pakistan, Sri Lanka and Central Asia.

*Specimen examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49889.

### 4. **TRAPA** L.

Eurasia, monotypic.

**Trapa natans** L. var. **bispinosa** (Roxb.) Makino Bot. Mag. (Tokyo): 137. 1907; Paria & Chattopadhyay, Fl. Hazaribagh 1: 412. 2000; N.P. Singh & al., Fl. Bihar: 211. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 272. 2002. *Trapa bispinosa* Roxb., Pl. Coromandel 3: 29. 1815; C.B. Clarke in Hook.f., Fl. Brit. India 2: 590. 1879, p.p.; Haines, Forest Fl. Chota Nagpur: 357. 1910 & Bot. Bihar Orissa: 383. 1922.

Herb, aquatic, rooted or floating. Stems submerged, slender, unbranched, pinkish; internodes elongated; adventitious roots developing from leaf scars. Floating leaves 1–5 × 1–7 cm, acute at base, entire at the basal end or margins, dentate to crenate at the apical end/margins, acute at apex, glabrous, glossy, dark green above, densely pubescent and greenish purple beneath; stipules linear, *c.* 3 mm long; petioles 1.5–12 cm long, woolly, with a fusiform swelling at the upper end; submerged leaves pinnatisect, *c.* 5 cm; segments filiform. Flowers tubular; pedicels 2.5–3.5 cm long, villous. Sepals ovate, *c.* 7 mm long, 2 out of 4 persistent, villous. Petals oblong, *c.* 1.5 cm long, with an elongated narrow base, wavy at margins, white. Disk *c.* 3 mm across, edges dissected; styles *c.* 4 mm long; stigma rounded. Nuts quadrangular, 2–4 cm long, beak surrounded by long stiff hairs, bi-horned; horns *c.* 2 cm long, pointing upwards, reflexed barbed below the tip.

*Fl. & Fr.*: February – December.

*Habitat*: In ponds or lakes.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar.

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49893.

## 5. **WOODFORDIA** Salisb.

Northeast Africa, South Arabia and Madagascar to China & Timor 2 species, 1 in Jharkhand.

**Woodfordia fruticosa** (L.) Kurz, J. Asiat. Soc. Bengal 40: 56. 1871; Haines, Bot. Bihar Orissa: 374. 1922; Mooney, Suppl. Bot. Bihar Orissa: 67. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 411. 2000; N.P. Singh & al., Fl. Bihar: 209. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 268. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 100. 2014. *Lythrum fruticosum* L., Syst. Nat., ed. 10, 2: 1045. 1759. *Woodfordia floribunda* Salisb., Parad. Lond.: t. 42. 1806; C.B. Clarke in Hook.f., Fl. Brit. India 2: 572. 1879. **Fig. 31; Plate 34D**

Vern. Names: *Dawi* (Hindi); *Phool dhawai*.

Shrub or small tree, 2–3 m high, straggling; branches long, spreading; bark brown, peeling off. Leaves simple, opposite or subopposite, sessile, ovate-lanceolate or oblong-lanceolate or lanceolate, 4–9 × 1.5–3 cm, rounded at base, entire at margins, acute or subacuminate at apex, finely grey-pubescent beneath. Cymes 3–15-flowered. Flowers numerous, 1.5–2 cm long, bright scarlet or reddish orange; pedicels *c.* 5 mm long, glandular-pubescent. Hypanthium long-tubular, 1–1.5 cm long, oblique at mouth. Sepals oblong-ovate or deltate, 2–5 mm long. Petals 6, subulate, 1–2 mm long. Stamens 12 of two different lengths, inserted below middle of hypanthium; filaments 1.5–2 mm long, reddish, declinate; anthers *c.* 1 mm long, dorsifixed, red or orange. Ovary sessile, oblongoid, *c.* 5 × 2 mm, 2-loculed; ovules many, axile; style filiform, *c.* 1 cm long. Fruits ellipsoid, *c.* 1 cm long, included within calyx, dry, thin-walled, irregularly breaking. Seeds narrowly cuneate-obovoid, *c.* 0.8 mm long, smooth, brown.

*Fl. & Fr.*: February – May.

*Habitat*: On hillslopes and near river.

*Distribution*: KWLS: Lokai forest; very common. INDIA: Throughout. WORLD: Africa, Baluchistan, China and Madagascar.

*Specimen examined*: Lokai forest, 382 m, 24°28'57.6" N, 85°37'20.5" E, 28th February 2011, *Shyam Biswa* 49640.

## 47. **ONAGRACEAE** Juss., nom. cons.

Cosmopolitan, 22 genera and 656 species; 6 genera and 49 species in India.

### **LUDWIGIA** L.

Cosmopolitan, 82 species, 7 in India, 5 in Jharkhand and 2 in KWLS.

#### **Key to species**

- 1a. Leaves elliptic or lanceolate; flowers 2–3.2 cm across; petals acute at apex, faintly veined; capsules terete **L. perennis**
- 1b. Leaves linear; flowers 1–1.5 cm across; petals emarginate at apex, distinctly veined; capsules 4-angular **L. decurrens**



**Fig. 31. *Woodfordia fruticosa* (L.) Kurz:** a. flowering twig; b. flower; c. stamen; d. carpel; f. fruit.

**1. *Ludwigia decurrens*** Walter, Fl. Carol.: 89. 1788; Raven in Reinwardtia 6: 347. 1963; Barua, Rheedeia 20: 60, f. 2. 2010. *Jussiaea decurrens* (Walter) DC., Prodr. 3: 56. 1828. **Plate 34E**

Annual, 60–120 cm high, glabrescent. Stems erect, 4-winged, woody at base, glabrous. Leaves simple, alternate, linear,  $2.2\text{--}6 \times 0.4\text{--}0.6$  cm, attenuate or narrowly cuneate at base, entire at margins, acute or sub-acuminate at apex, sparsely short-hairy; lateral veins 9–17 pairs; petioles *c.* 0.5 mm long. Flowers 2–3.2 cm across, showy, 4-merous; pedicels quadrangular, 1–1.5 mm long; bracteoles 2, minute. Sepals 4, ovate-lanceolate or ovate-acuminate,  $8\text{--}10 \times 2\text{--}3$  mm, purple at margins. Petals obovate,  $1\text{--}1.6 \times 1.2\text{--}1.3$  cm, emarginate at apex, distinctly veined, bright yellow. Stamens 8, one slightly shorter; filaments *c.* 3 mm long, light yellow; anthers *c.* 1 mm long, pale yellow. Disk not elevated; nectary sunken, C-shaped, white-hairy, surrounding the base of each epipetalous stamen. Ovary *c.* 7 mm long, 4-angled, 4-loculed; ovules 3 per locule; style thick, *c.* 2 mm long; stigma globose, *c.* 1.5 mm. Capsules  $3.5\text{--}4 \times 0.4\text{--}0.6$  cm, sharply 4-angled or narrowly winged, puberulent when young but turning glabrous after maturity, greenish to pinkish, irregularly loculicidal; seeds pluriseriate in each locule, free, globose to ellipsoid, *c.*  $0.5 \times 0.2$  mm, brown.

*Fl. & Fr.*: September – October.

*Habitat*: Moist sandy localities, near river banks.

*Distribution*: KWLS: Phutlaiya Nala; rare. INDIA: Assam and West Bengal. WORLD: Native to New World; Africa, Japan, Argentina to North-eastern United States.

*Specimen examined*: Phutlaiya Nala, 343 m,  $24^{\circ}30'33.9''$  N,  $85^{\circ}39'31.8''$  E, 28th September 2013, Shyam Biswa 54189.

*Note*: It is addition to the angiospermic flora of Jharkhand state from KWLS.

**2. *Ludwigia perennis*** L., Sp. Pl. 1: 119. 1753; Paria & Chattopadhyay, Fl. Hazaribagh 1: 425. 2000; N.P. Singh & al., Fl. Bihar: 210. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 271. 2002; Barua, Rheedeia 20: 65, f. 5. 2010; Ranjan, Fl. Parasnath Wildlife Sanct.: 102. 2014. *Ludwigia parviflora* Roxb., Fl. Ind. 1: 440. 1820; C.B. Clarke in Hook.f., Fl. Brit. India 2: 588. 1876; Haines, Bot. Bihar Orissa: 382. 1922. *Jussiaea perennis* (L.) Brenan in Kew Bull. 8: 163. 1953. **Plate 34F**

Vern. Names: *Banlunga*, *Dakichak* (Hindi).

Herb, erect, 10–40 cm high. Stems terete, with short-hairs turning glabrous when mature; reddish. Leaves simple, alternate, elliptic or lanceolate,  $1\text{--}3 \times 0.5\text{--}1.2$  cm, narrowly cuneate or tapering at base, entire or faintly crenate at margins, acute at apex, glabrous; lateral vein 6–14 pairs; petioles 2–8 mm long. Flowers 1–1.5 cm across; pedicels *c.* 2 mm long; bracteoles absent. Sepals 4, deltoid to ovate-lanceolate, *c.*  $4 \times 1.5$  mm, glabrous, 3-veined, persistent. Petals 4, elliptic, *c.*  $3 \times 2$  mm, rounded at apex, deciduous, yellow; midrib prominent; lateral veins faint. Stamens 4, opposite sepals, pale yellow to cream-coloured; filaments *c.* 1 mm long; anthers *c.* 0.5 mm long. Disk slightly elevated, glabrous; nectary elliptic, opposite petals, alternating stamens. Ovary 4.5–6.6 mm long, 4-ridged, puberulent, 4-loculed; ovules 3 per locule; style thick, *c.* 1 mm long; stigma globose, *c.* 1.5 mm. Capsules linear, terete,  $1.5\text{--}2 \times c. 0.2$  cm, with 4 longitudinal ribs, glabrous, green to pinkish. Seeds many in the segmented two rows, oval or globose, *c.*  $3 \times 2$  mm, smooth, glossy, brownish.



*Fl. & Fr.*: August – September.

*Habitat*: Moist localities near river.

*Distribution*: KWLS: near Rishi Dhurwasha Pahar, Meghatari; common. INDIA: Throughout. WORLD: Tropical Asia to subtropical China and Tropical Australia, Afghanistan, Africa, Japan, New Caledonia and Sri Lanka.

*Specimen examined*: Near Rishi Dhurwasha Pahar, Meghatari, 226 m, 24°35'24.54" N, 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 49815.

#### 48. MYRTACEAE Juss., nom. cons.

Tropical and subtropical regions and temperate Australia, 131 genera and c.5500 species; 14 genera and 146 species in India

##### Key to genera

- |                                                                           |                      |
|---------------------------------------------------------------------------|----------------------|
| 1a. Leaves opposite; flowers in terminal or axillary cymes; fruit a berry | <b>2. Syzygium</b>   |
| 1b. Leaves alternate; flowers in axillary umbels; fruit a capsule         | <b>1. Eucalyptus</b> |

##### 1. EUCALYPTUS L'Hér.

Australia, c. 680 species, many cultivated in India, 8 in Jharkhand, 1 in KWLS

**Eucalyptus tereticornis** Sm., Spec. Bot. New Holland: 41. 1793; Haines, Bot. Bihar Orissa: 366. 1922; N.P. Singh & al., Fl. Bihar: 198. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 256. 2002. **Plate 34G**

Tree, 10–20 m high. Leaves simple, alternate, linear-lanceolate, 16.5–22 × 2.2–4 cm, cuneate or acute at base, entire at margins, acuminate at apex, curved, coriaceous, green with pinkish dots; venation obscure; petioles 1.5–2.5 cm long. Flowers 5–8, in axillary umbels of 2–3 cm across; peduncles slender, terete, 1–1.5 cm long. Hypanthium cup-shaped, 2.5–3 × c. 5 mm, base slender, stalk-like; calyptra conical, 6–10 × c. 5 mm. Stamens 5–6 mm long, cream-coloured; anthers c. 1 mm long. Capsules hemispheric, c. 7 mm wide, with 4 exserted ascending valves.

*Fl. & Fr.*: November – April.

*Habitat*: Escaped and naturalized in the dry deciduous scrub forest and planted along the roads.

*Distribution*: KWLS: Lokai forest; common. INDIA: Planted almost throughout. WORLD: New Guinea to East and Southeast Australia, planted or cultivated elsewhere.

*Specimen examined*: Lokai forest, 388 m, 24°29'13.9" N, 85°37'17.6" E, 28th November 2012, *Shyam Biswa* 54095.

##### 2. SYZYGIUM Gaertn., nom. cons.

Southeast Africa to Pacific, c. 1200 species, c. 100 in India, 11 in Jharkhand (2 cultivated) and 1 in KWLS.

**Syzygium cumini** (L.) Skeels, U.S.D.A. Bur. Pl. Industr. Bull. 248: 25. 1912; Mooney, Suppl. Bot. Bihar Orissa: 65. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 417. 2000; N.P. Singh & al., Fl. Bihar: 199. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 258. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 97. 2014. *Myrtus cumini* L., Sp. Pl. 1: 471. 1753. *Eugenia jambolana* Lam., Encycl. 3: 198. 1798; Duthie in Hook.f., Fl. Brit. India 2: 499. 1879; Haines, Forest Fl. Chota Nagpur: 351. 1910 & Bot. Bihar Orissa: 36. 1922. **Plate 34H**

Vern. Names: *Jamun*, *Jam* (Hindi).

Tree, 25–33 m high; bark smooth, fissured when old, dark grey. Leaves simple, opposite, elliptic, oblong or ovate-oblong, 7–15 × 2.2–6.6 cm, cuneate at base, entire at margins, abruptly acuminate or acute at apex, coriaceous, glabrous, glossy above; midrib prominent beneath; secondary veins and intermediate ones fine, numerous and close, with pinkish small dots; petioles 0.8–2.2 cm long. Cymes terminal or axillary, ramiflorous, to 10 cm long. Flowers sessile. Hypanthium cup-shaped or funnel-shaped; tube 3–5 × 2–3 mm, tapering into a stalk-like base; lobes shallow, persistent. Petals elliptic, *c.* 2 mm long, cream-coloured. Stamens numerous, 2–5 mm long, creamy-white. Ovary *c.* 2 mm long, 2-loculed; ovules many per locule; style filiform, 2–4 mm long. Berries oblong or broadly ellipsoid, 1–2 × 0.5–1.8 cm, crowned with truncate calyx-limb, juicy, sweet, reddish, shining dark purplish or black when ripe. Seed 1.

*Fl. & Fr.*: March – August.

*Habitat*: Mixed dry-deciduous forests and near the streams.

*Distribution*: KWLS: Near Rajdah Nala, Meghatari; common. INDIA: Throughout. WORLD: Australia, Bhutan, China, Indonesia, Laos, Malaysia, Nepal, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Near Rajdah Nala, Meghatari, 210 m, 24°34'47.8" N, 85°35'16.5" E, 8th March 2011, *Shyam Biswa* 49723.

#### 49. **BURSERACEAE** Kunth, nom. cons.

Tropical regions, especially America and Northeast Africa, 18 genera and *c.* 640 species, 8 genera and 22 species in India.

##### Key to genera

- 1a. Bark peeling off in thin flakes; stems without galls; leaflets 7–15; stigma capitate;  
fruits angled **1. *Boswellia***
- 1b. Bark not peeling; stems more often with galls; leaflets 19–33; stigma 5-lobed;  
fruits smooth **2. *Garuga***

##### 1. **BOSWELLIA** Roxb. ex Colebr.

Tropical Africa and Asia, 24 species, 3 in India and 1 in Jharkhand.

***Boswellia serrata*** Roxb. ex Colebr., *Asiat. Res.* 9: 379, t. 5. 1807; A.W. Benn. in Hook.f., *Fl. Brit. India* 1: 528. 1875; Haines, *Forest Fl. Chota Nagpur*: 240. 1910 & *Bot. Bihar Orissa*: 172. 1921; Chithra & A.N. Henry in Hajra & al., *Fl. India* 4: 432. 1997; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 512. 2000; N.P. Singh & al., *Fl. Bihar*: 95. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 139. 2002. *Boswellia glabra* Roxb., *Pl. Coromandel* 3: 4, t. 207. 1811. *Boswellia serrata* Roxb. ex Colebr. var. *glabra* (Roxb.) A.W. Benn. in Hook.f., *Fl. Brit. India* 1: 528. 1875. **Plate 35A**

Vern. Name: *Salai*.

Tree, 10–15 m high; bark papery, peeling off in thin flakes, whitish grey or light reddish. Leaves imparipinnate, at the end of branchlets, whorled, 25–30 cm long; leaflets 19–33, lanceolate or ovate-lanceolate, 1–5 × 1–1.5 cm, oblique, obtuse or retuse at base, crenate-serrate at margins, acute, obtuse, retuse, or mucronate at apex. Flowers in small racemes or panicles, crowded near apex, usually appearing when the tree is without or with few leaves. Calyx cupular, 5-toothed, 2–3 × *c.* 2 mm, persistent, hairy, reddish brown or pinkish. Petals 5, oblong-ovate, 4–4.5 × 2–2.5 mm, free, imbricate, thickened at base, inflexed at apex, hairy beneath, white with dark pink central

portion. Disk annual, crenate, scarlet. Stamens 10 (5+5), inserted at the base of disk, 5 long and 5 shorter; anthers 1.5–2 mm long, hairy, introrse. Carpels *c.* 3 mm long; ovary 1–1.5 mm long, 3-loculed; ovules 2 in each locule, pendulous; stigma 3-lobed. Capsules trigonous, 1.2–2.4 × 1–1.4 cm, 3-valved, 3-winged. Seeds winged at margins.

*Fl.*: February – March; *Fr.*: April – June.

*Habitat*: Dry deciduous forests on hills.

*Distribution*: KWLS: At the summit Dhawjadhari Pahar; common. INDIA: Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, Tamil Nadu.

**Endemic.**

*Specimen examined*: At the summit of Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 29th February 2012, *Shyam Biswa* 54022.

## 2. **GARUGA** Roxb.

Himalayas, Indomalesia to West Pacific, 4 species, 2 in India and 1 in Jharkhand.

**Garuga pinnata** Roxb., Pl. Coromandel 3: 5, t. 208. 1811; A.W. Benn. in Hook.f., Fl. Brit. India 1: 528. 1875; Haines, Forest Fl. Chota Nagpur: 240. 1910 & Bot. Bihar Orissa: 170. 1921; Chithra & A.N. Henry in Hajra & al., Fl. India 4: 448. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 514. 2000; N.P. Singh & al., Fl. Bihar: 95. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 140. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 57. 2014.

**Plate 35B**

Vern. Names: *Jiga*, *Kekad* (Hindi).

Tree, to 12 m high; bark smooth or flaky, pale grey; branchlets pubescent when young. Leaves imparipinnate, 16–35 cm long; leaflets 7–15, elliptic or oblong to lanceolate, 4.5–11 × 1.5–3.8 cm, obliquely rounded or cuneate at base, serrate at margins, long-acuminate at apex, puberulous more on veins; petiolules 0.5–2 mm long; stipules spatulate to linear, 0.5–1 cm long, deciduous; stipels wanting. Inflorescence a panicle, axillary, much-branched, crowded at ends of branchlets, 5–15 cm long, densely tomentose. Flowers 5-merous, *c.* 1 cm long, pubescent; flowers appearing when the tree is leafless or before the appearance of juvenile leaves. Calyx campanulate, *c.* 7 mm long, 5-toothed; lobes ciliate at margins, hairy outside, light yellowish. Petals 5, oblong or linear-oblong, 8–10 mm long, hairy at margins, white or creamy. Stamens 10 in two whorls, inserted on receptacle, coiled together forming a bunch or cluster; filaments 6–7 mm long (1.4–1.5 cm long, when stretched); anthers 2-loculed, dehiscing longitudinally. Carpels *c.* 2 cm long when stretched; ovary globose, stalked, pilose, 4 or 5-loculed; style pilose; stigma 5-lobed. Drupes obovoid or subglobose, 1–1.5 cm across, yellowish. Pyrenes 1–4, rarely 5.

*Fl.*: March – April; *Fr.*: June – July.

*Habitat*: Dry deciduous forests on the hills and near foot-hills.

*Distribution*: KWLS: Dhawjadhari Pahar; Dipluswa Nala, Meghatari; common. INDIA: Throughout. WORLD: Bangladesh, Cambodia, China, Laos, Malesia, Myanmar, Philippines, Thailand and Vietnam.

*Specimens examined*: Dhawjadhari Pahar, 425 m, 24°28'59.3" N, 85°35'42.4" E, 5th September 2010, *Shyam Biswa* 49567; Dipluswa Nala, Meghatari, 186 m, 24°34'25.1" N, 85°35'19.4" E, 31st March 2013, *Shyam Biswa* 54129.

**50. ANACARDIACEAE** R. Br., nom. cons.

Tropical, sub-tropical, Mediterranean, temperate regions of North America, 69 genera and c. 850 species; 19 genera and 67 species in India.

**Key to genera**

- |                                                                              |                      |
|------------------------------------------------------------------------------|----------------------|
| 1a. Leaves simple                                                            | 2                    |
| 1b. Leaves compound, trifoliolate or pinnate                                 | 4                    |
| 2a. Leaves obovate; parts of flowers altered in fruits                       | <b>4. Semecarpus</b> |
| 2b. Leaves oblong-elliptic; parts of flowers not altered in fruits           | 3                    |
| 3a. Stamens 8–10; carpels 5 but only 1 fertile; drupe small, globose         | <b>1. Buchanania</b> |
| 3b. Stamen 1; carpels solitary; drupe large, oblong or ellipsoid             | <b>3. Mangifera</b>  |
| 4a. Leaflets with a distinct intramarginal vein; drupe 2–5-loculed, seed-2–5 | <b>5. Spondias</b>   |
| 4b. Leaflets without intramarginal veins; drupe 1-loculed, seed-1            | <b>2. Lannea</b>     |

**1. BUCHANANIA** Spreng.

Indomalaysia, West Pacific, c.25 species, 8 in India, 1 in Jharkhand.

**Buchanania lanzan** Spreng., J. Bot. (Schrader) 2: 234. 1800; D. Chandra & S.K. Mukh. in N.P. Singh & al., Fl. India 5: 443, fig. 93. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 517. 2000; N.P. Singh & al., Fl. Bihar: 117. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 159. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 66. 2014. *Buchanania latifolia* Roxb., Fl. Ind. (Ed. Carey) 2: 385. 1832; Hook.f., Fl. Brit. India 2: 23. 1876; Haines, Forest Fl. Chota Nagpur: 258. 1910 & Bot. Bihar Orissa: 221. 1921.

**Plate 35C & D**

Vern. Names: *Pial* (Hindi); *Piyar*, *Piar* (Kharwari).

Tree, 6 to 10 m high; bark grey to black, crocodile skin like or tessellated with golden coloured sticky gum when cut ; branchlets with prominent leaf scars, glabrescent with age. Leaves simple, alternate, oblong or elliptic-oblong, 15.2–21 × 7–11 cm, rounded at base, entire at margins, obtuse to rounded or emarginate at apex, glabrescent above, tomentose beneath, midrib and lateral veins raised and prominent beneath; petioles 1.2–2 cm long, pubescent. Panicles dense, pyramidal, 5–15 cm long. Flowers sessile, bisexual c. 4 mm in diameter, white; bracts small, caducous. Calyx 3–5-lobed; lobes ovate, obtuse at apex, 1–1.5 mm long, persistent. Petals 5, ovate, sub-acute at apex, 2–2.5 mm long, white. Disk fleshy, 5-lobed. Stamens 10, spreading, as long as petals. Ovary with 5 or 6 free carpels, situated within the disk, only 1 carpel fertile. Drupes globose or subglobose, 0.7–1 × 1–1.5 cm, reddish-green, hairy, with 2-valved bony stone, black; seeds gibbous, acute at one end with thick cotyledons.

*Fl. & Fr.*: February – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Bagitan jungle, Koderma NRF; Dhanarjay Nadi, Meghatari; common. INDIA: Hot, drier parts. WORLD: Myanmar.

*Specimens examined*: Bagitan jungle, Koderma NRF, 392 m, 24°29'26.8" N, 85°35'39.4" E, 1st March 2011, *Shyam Biswa* 49650; Near the bank of Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 31st March 2013 *Shyam Biswa* 54133.



2. **LANNEA** A. Rich., nom. cons.

Tropical Africa, Indomalesia, c. 40 species and 1 in India.

**Lannea coromandelica** (Houtt.) Merr., J. Arnold Arbor. 19: 353. 1938; D. Chandra & S.K. Mukh. in N.P. Singh & al., Fl. India 5: 463, fig. 99. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 518. 2000; N.P. Singh & al., Fl. Bihar: 117. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 160. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 67. 2014. *Dialium coromandelicum* Houtt., Nat. Hist. 2(2): 39, pl. 5, fig. 239. 1774. *Lannea grandis* (Dennst.) Engl, in Engl. & Prantl, Nat. Pflanzenfam. Nachtr. 1: 213. 1897. *Odina wodier* Roxb., Fl. Ind. (Eds. Carey & Wall.) 2: 293. 1824; Hook.f., Fl. Brit. India 2: 29. 1876; Haines, Forest Fl. Chota Nagpur: 256. 1910 & Bot. Bihar Orissa: 223. 1921.

**Plate 35E**

Vern. Names: *Mohin*, *Docka*, *Jhingam* (Hindi).

Tree, 12–15 m high, tree leafless in flowering, bark light coloured and smooth in young trees, rough & dark on old ones with blaze bright crimson, streaked or flushed pale pink or white. Leaves compound, alternate, imparipinnate, 10–25 cm, leaflets 5–9 foliolate, clustered at the ends of the thick twigs, elliptic-oblong or ovate 4–11 × 2.5–4.5 cm, cuneate at base, entire at margins, acuminate at apex, petiolule short or sometimes sessile. Inflorescence terminal at apex of branches / branchlets. Flowers, dioecious or polygonous-dioecious clustered on the rachis of simple or branched spike or racemes, flowers yellowish green, fasciated on the rachides of numerous racemes towards the ends of the base twigs, pedicel c. 2 mm with stellate hair. Calyx 4-lobed, ovate-triangular, 1–1.5 mm long, obtuse at apex, imbricate. Petals 4, ovate-oblong, 2–3 × 1–1.5 mm, yellowish or yellowish-light green. Stamens 8, c. 2.5 mm long, anthers c. 0.5 mm, dorsifixed, yellowish-brown; reduced to staminodes in female flowers. Ovary oblong, 4-loculed (1 or 2 locule fertile) c. 0.6 mm; styles 4; ovary reduced to pistillode in male flowers. Drupe, oblong, 0.6–1.2 × 0.3–0.7 cm, oblique curved, green turning purple red when ripe; seed 1, compressed.

*Fl. & Fr.*: March – May.

*Habitat*: Dry deciduous forests near the rivers.

*Distribution*: KWLS: Dipluswa Nala, Meghatari; common. INDIA: Throughout the hotter parts. WORLD: Bangladesh, Malesia, Myanmar, Nepal, Pakistan and Sri Lanka.

*Specimen examined*: Dipluswa Nala, Meghatari, 186m, 24°34'25.1" N, 85°35'19.4" E, 31st March 2013, *Shyam Biswa* 54132.

3. **MANGIFERA** L.

Indomalesia 40–60 species, 6 in India, 1 in Jharkhand.

**Mangifera indica** L., Sp. Pl. 1: 200. 1753; Hook.f., Fl. Brit. India 2: 13. 1876; Haines, Forest Fl. Chota Nagpur: 258. 1910 & Bot. Bihar Orissa: 220. 1921; D. Chandra & S.K. Mukh. in N.P. Singh & al., Fl. India 5: 466, fig. 100. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 519. 2000; N.P. Singh & al., Fl. Bihar: 118. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 161. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 67. 2014.

Vern. Name: *Aam* (Hindi).

Tree, 10–25 m high, with widely spreading branches; bark longitudinally fissured, grey. Leaves simple, alternate, crowded at end of branches, simple, elliptic-oblong or oblong-lanceolate, 6.5–16.5 × 1.5–5.2 cm, acute, equal or unequal at base, entire or sometimes undulate at margins, acute, acuminate or sub-obtuse at apex, subcoriaceous; lateral veins 10–30 pairs, raised on both surfaces; petioles 1.8–4.5 cm long, convex below, grooved or flat above. Panicles terminal, dense, c. 35 cm long, pubescent. Flowers polygamous; pedicels 1–3 mm long. Calyx 4 or 5-lobed; lobes ovate or oblong, 1–1.5 mm long, acute at apex, concave, pubescent outside. Petals 4 or 5, ovate-oblong or elliptic, 2–3 × c. 1 mm, subacute at apex, reflexed, glabrous with 2 or 3 strong orange ridges inside, pale yellow, imbricate. Disk 5-lobed. Stamen fertile 1, c. 2 mm long, inserted at disk; filaments subulate; anthers purple; staminodes 3 or 4, slender, gland-tipped. Ovary oblique; ovules pendulous; style subulate, eccentric; stigma obscure. Drupes pyriform, 5–20 × 3–7 cm, fleshy, thick hard stone with fibrous coat, yellow to yellowish green when ripe.

*Fl. & Fr.*: March – July.

*Habitat*: Cultivated and planted.

*Distribution*: KWLS: Bagitan forest; common. INDIA: Throughout the hotter parts. WORLD: Bangladesh, Malesia, Myanmar and Nepal.

*Specimen examined*: Bagitan forest, 402 m, 24°29'13.9" N, 85°36'35.0" E, 29th March 2013, Shyam Biswa 54119.

#### 4. SEMECARPUS L.f.

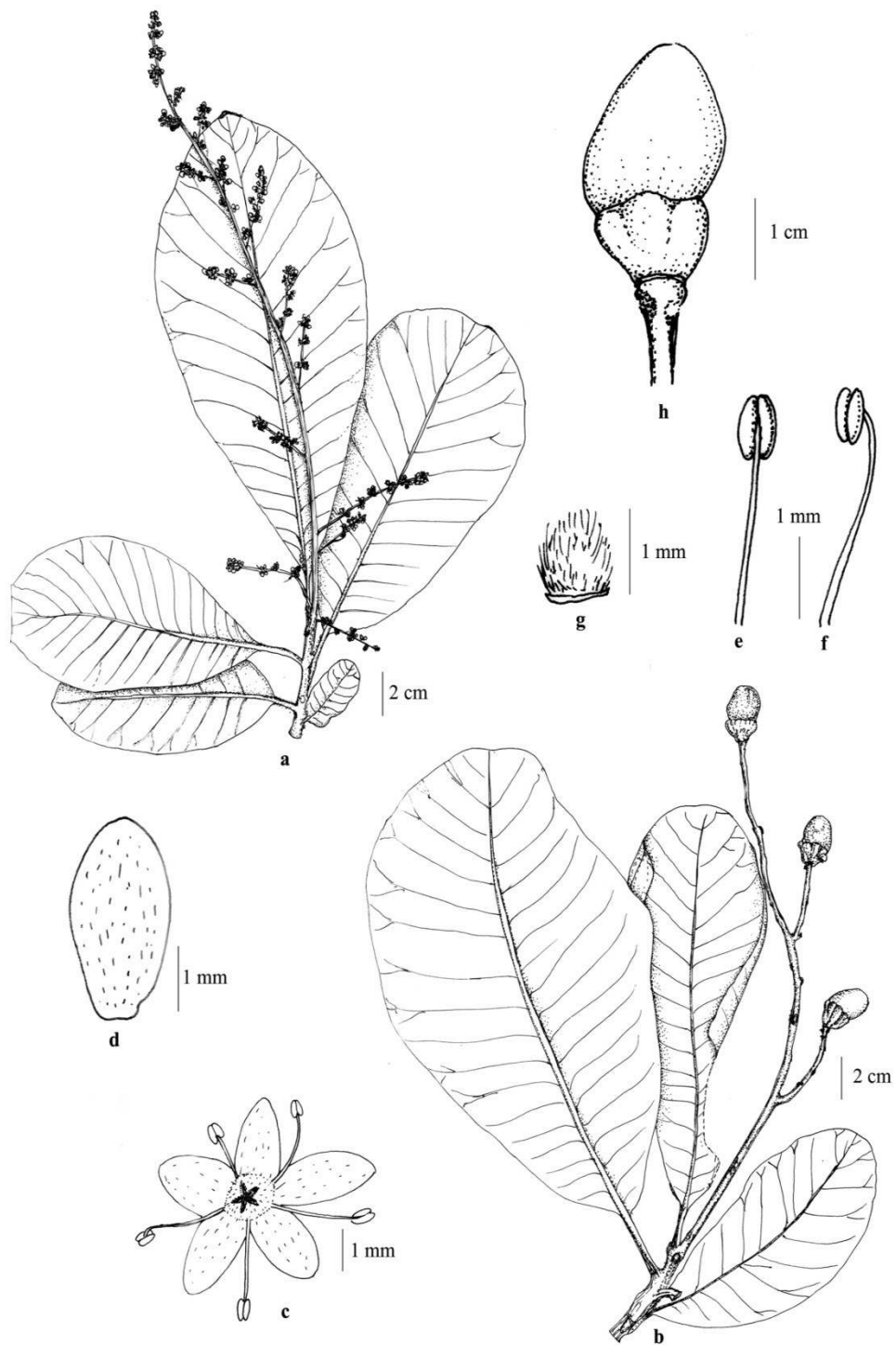
Indomalesia to New Caled and Fiji, c. 75 species, 8 in India, 7 in India, 1 in Jharkhand.

**Semecarpus anacardium** L.f., Suppl. Pl.: 182. 1782 (1781); Hook.f., Fl. Brit. India 2: 39. 1876; Haines, Forest Fl. Chota Nagpur: 257. 1910 & Bot. Bihar Orissa: 222. 1921; D. Chandra & S.K. Mukh. in N.P. Singh & al., Fl. India 5: 500, fig. 111. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 520. 2000; N.P. Singh & al., Fl. Bihar: 118. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 161. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 67. 2014.

**Fig. 32; Plate 35F**

Vern. Name: *Bhelwa* (Hindi & Kharwari).

Tree, 6–10 m high, exude a dark blackish acrid juice; young parts finely pale-pubescent. Leaves simple, alternate, obovate-oblong, 11–32.5 × 5.5–15 cm, rounded, subcordate or subcuneate at base, entire at margins, obtuse to rounded or slightly retuse-emarginate at apex, thick-coriaceous, opaque above, sparsely pubescent above, pubescent beneath, more on the veins; lateral veins 16–25 pairs, slightly arched; petioles 1–4.5 cm long, finely pubescent. Panicles erect, terminal, 12–30 cm long. Flowers 5–6 mm in diameter, subsessile; pedicels accrescent, 0.5–0.7 cm long in fruits. Calyx lobes 5, deltoid, ovate, acute at apex, c. 1 mm long, pubescent outside. Petals 5, oblong, 2–3 × 1–1.5 mm, acute at apex, yellowish. Disk intrastaminal, 1.5–2.5 mm, villous. Stamens 5, inserted at disk base, filaments c. 3 mm long, reddish. Ovary subglobose, densely hairy, rudimentary in male. Drupes obliquely ovoid or oblong, 2.5–3 × 1.5–2.5 cm, smooth, shining, green, black on ripening; hypocarp equal to drupe, orange-coloured.



**Fig. 32. *Semecarpus anacardium* L.f.:** a. flowering twig; b. fruiting twig; c. flower; d. petal; e.,f. stamens; g. ovary; h. fruit.

*Fl. & Fr.*: September – March.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest and Muglamaram forest road; common. INDIA: Throughout the hotter parts. WORLD: Africa, China, Malaya, Myanmar and Singapore.

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49511; Muglamaram forest road, 321m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49855.

## 5. SPONDIAS L.

Indomalesia to South East Asia and Tropical America, c. 10 species, 4 in India, 1 in Jharkhand.

**Spondias pinnata** (L.f.) Kurz, Prelim. Rep. Forest Pegu App.: A. 44. & B. 42. 1875; D. Chandra & S.K. Mukh. in N.P. Singh & al., Fl. India 5: 507, fig. 113. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 520. 2000; N.P. Singh & al., Fl. Bihar: 118. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 161. 2002. *Mangifera pinnata* L.f., Suppl. Pl.: 156. 1782 (1781). *Spondias mangifera* Willd., Sp. Pl. 2: 751. 1799, nom illeg.; Hook.f., Fl. Brit. India 2: 42. 1876; Haines, Forest Fl. Chota Nagpur: 259. 1910 & Bot. Bihar Orissa: 224. 1921.

Vern. Name: *Amara* (Hindi).

Tree, upto 30 m high; bark smooth, white or brownish grey. Leaves compound, alternate, imparipinnate, 10–25 cm long, glabrous; rachis 6–20 cm long; petioles 4–5.5 cm long; leaflets 7–11, opposite, elliptic-oblong, 4–12 × 2.5–4 cm, obliquely rounded-obtuse to abruptly cuneate-subattenuate at base, crenate, serrate or entire at margins, abruptly acuminate at apex, coriaceous; lateral veins 12–25 pairs, horizontal, joining with an intra-marginal vein; petiolules c. 1 cm long, those of terminal one c. 2.5 cm long. Panicles terminal, rarely axillary, to 40 cm long, glabrous. Flowers sessile or subsessile, c. 6 mm in diameter, 5-merous; floral bracts ovate to linear, 1–3 mm long. Calyx lobes 5, triangular-ovate, c. 0.5 mm long, imbricate, caducous. Petals 5, valvate, ovate-oblong, 2.5–3 mm long, greenish white. Stamens 10, inserted below the disk, 1–1.5 mm long; filaments free, subulate; anthers broadly ovoid. Disk fleshy, 10-crenated. Ovary subglobose, c. 0.8 mm across, situated inside the disk; ovule 1 in each locule, styles c. 0.5 mm. Pistillode in male flowers with five styles. Drupes in panicles, ellipsoid, 4–6 × 3–4 cm, yellow, sour; pyrenes woody with tuberculate, fibrous surface, 1–5-loculed.

*Fl. & Fr.*: March – November.

*Habitat*: Dry deciduous forests and also on the hill slopes of Dry deciduous mixed forest

*Distribution*: KWLS: Meghatari NRF, border of Dhodhakola; common. INDIA: Throughout, wild and cultivated. WORLD: Indonesia (Java), Myanmar, Malay Peninsula, Nepal, Pakistan, Philippines, Sri Lanka and Thailand.

*Specimen examined*: Meghatari NRF, border of Dhodhakola, 236 m, 24°34'31.7" N, 85°35'31.4" E, 25th November 2012, *Shyam Biswa* 53923.

## 51. SAPINDACEAE Juss., nom. cons.

Tropical and subtropical regions, few temperate regions, 131 genera and c. 1450 species; 21 genera and c. 55 species in India.



### Key to genera

- 1a. Herbs climbing; leaves biternate; inflorescences with tendrils at base; petals present;  
fruits inflated, sac-like **1. Cardiospermum**
- 1b. Trees, not climbing; leaves compound, with 2–4 pairs of leaflets; petals absent;  
fruits globose or subglobose, but not inflated **2**
- 2a. Leaflets glossy above, acuminate at apex, reddish when young; calyx very shallowly  
4 (–5)-lobed; fruits with tortoise-shell-like fissures, with scattered conical prominents,  
reddish; aril fleshy, whitish, sweet, edible **2. Litchi**
- 2b. Leaflets not glossy above, obtuse or mucronate at apex; calyx 5 or 6-lobed almost to base;  
fruits smooth with a sharp point and often somewhat muricate; aril pulpy,  
yellowish orange **3. Schleicheria**

### 1. CARDIOSPERMUM L.

Tropical regions, 12 species, 2 in India, 1 in Jharkhand.

**Cardiospermum halicacabum** L., Sp. Pl. 1: 366. 1753; Hiern in Hook.f., Fl. Brit. India 1: 670. 1875; Haines, Forest Fl. Chota Nagpur: 262. 1910 & Bot. Bihar Orissa: 211. 1921; P.C. Pant in N.P. Singh & al., Fl. India 5: 356. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 505. 2000; N.P. Singh & al., Fl. Bihar: 115. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 157. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 66. 2014. **Plate 36A**

Vern. Names: *Kanphutki*, *Lataphatkari* (Hindi).

Climber, herbaceous. Stems and branches slender, 5- or 6-grooved, glabrous or sparsely hairy, green. Leaves biternate, 5–6.5 cm long; petioles 2–3.5 cm long; leaflets subsessile, ovate or ovate-lanceolate, 1–4.5 × 0.6–2 cm, rounded at base, sparsely serrate or pinnately parted at margins, acute to acuminate at apex, thin-membranous, sparsely villous on midrib and lateral veins beneath, subglabrous or sparsely pilose above. Inflorescence a cyme, axillary, bearing tendrils basally, 3-flowered; peduncles *c.* 6.5 cm long; pedicels 2–3 mm long. Bracts linear, *c.* 1 mm long. Flowers unisexual. Sepals 4; outer 2, ovate, 1–1.5 mm long; inner 2, oblong-ovate, 3–4 mm long, glabrous. Petals 4, 1.5–3 mm long, white: upper 2 with crested, inflexed appendages. Male flowers: Stamens 8, 4 shorter, *c.* 2 mm long; 4 slightly longer, *c.* 3 mm long; filaments hairy; pistillodes present. Female flowers: Ovary obovoid, 2–2.5 mm long, hairy; style 3-fid, lobes bearing inner stigmatic surface; staminodes 8. Capsules turbinate-obtriangular, 1–1.5 × 2–3 cm, shortly stalked, winged at angles, inflated, sac-like, 3-loculed. Seed 1 in each locule, globose, 4–5 mm, smooth, glossy, glabrous, black; aril cordate, 3–4 mm long, white.

*Fl. & Fr.*: March – September.

*Habitat*: Scrub forests and dry deciduous forests.

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Lokai forest, 400 m, 24°29'17.5" N, 85°36'37.4" E, 15th September 2010, *Shyam Biswa* 49623.

### 2. LITCHI Sonn.

China to Malesia, monotypic.

**Litchi chinensis** Sonn., Voy. Indes Orient. 3: 255. 1782; P.C. Pant in N.P. Singh & al., Fl. India 5: 387. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 508. 2000; N.P. Singh & al., Fl. Bihar:

116. 2001. *Nephelium litchi* Cambess. in Mem. Mus. Hist. Nat. Paris 18: 30. 1829; Hiern in Hook.f., Fl. Brit. India 1: 687. 1875; Haines, Bot. Bihar Orissa: 214. 1921.

Vern. Name: *Leechi* (Hindi).

Tree, to 30 m high. Leaves compound, alternate, paripinnate, 14–24 cm long; leaflets 2–4 pairs, opposite or sub-opposite, oblong or elliptic-lanceolate, 5–11 × 1.7–3.2 cm, obliquely cuneate at base, entire at margins, acuminate at apex, coriaceous, glossy, glabrous above, lateral veins inconspicuous; petiolules 3–6 mm long. Thyrses terminal, golden tomentose, 15–28 cm long; bracts and bracteoles small. Flowers unisexual. Calyx cupular, c. 1.5 mm long, with very short lobes, greenish white. Petals absent. Male flowers: stamens 6–8, exserted, 4–5 mm long; filaments filiform, pilose. Female flowers: ovary shortly stalked, obcordiform, 2(or 3)-lobed, 2(or 3)-loculed; ovules 1 per locule; style inserted between ovary lobes; stigma 2- or 3-lobed. Fruits deeply parted into 2 or 3 schizocarps, usually only 1 or 2 developed, ovoid or subglobose, c. 3.5 cm long; pericarp leathery (crustaceous when dry), abaxially with tortoise-shell-like fissures, with scattered conical prominents, reddish; aril fleshy, whitish, sweet, edible. Seeds c. 2.5 cm long, smooth, dark brown.

*Fl. & Fr.*: March – June.

*Habitat*: Cultivated near the villages.

*Distribution*: KWLS: Near Koderma village; planted; INDIA: Cultivated in large scale in orchards, mostly in northern India. WORLD: Native of China.

*Specimen examined*: Near Koderma village, 401m, 24°28'46.5" N, 85°35'57.3" E, 27th March 2013, *Shyam Biswa* 54115.

### 3. **SCHLEICHERA** Willd., nom. cons.

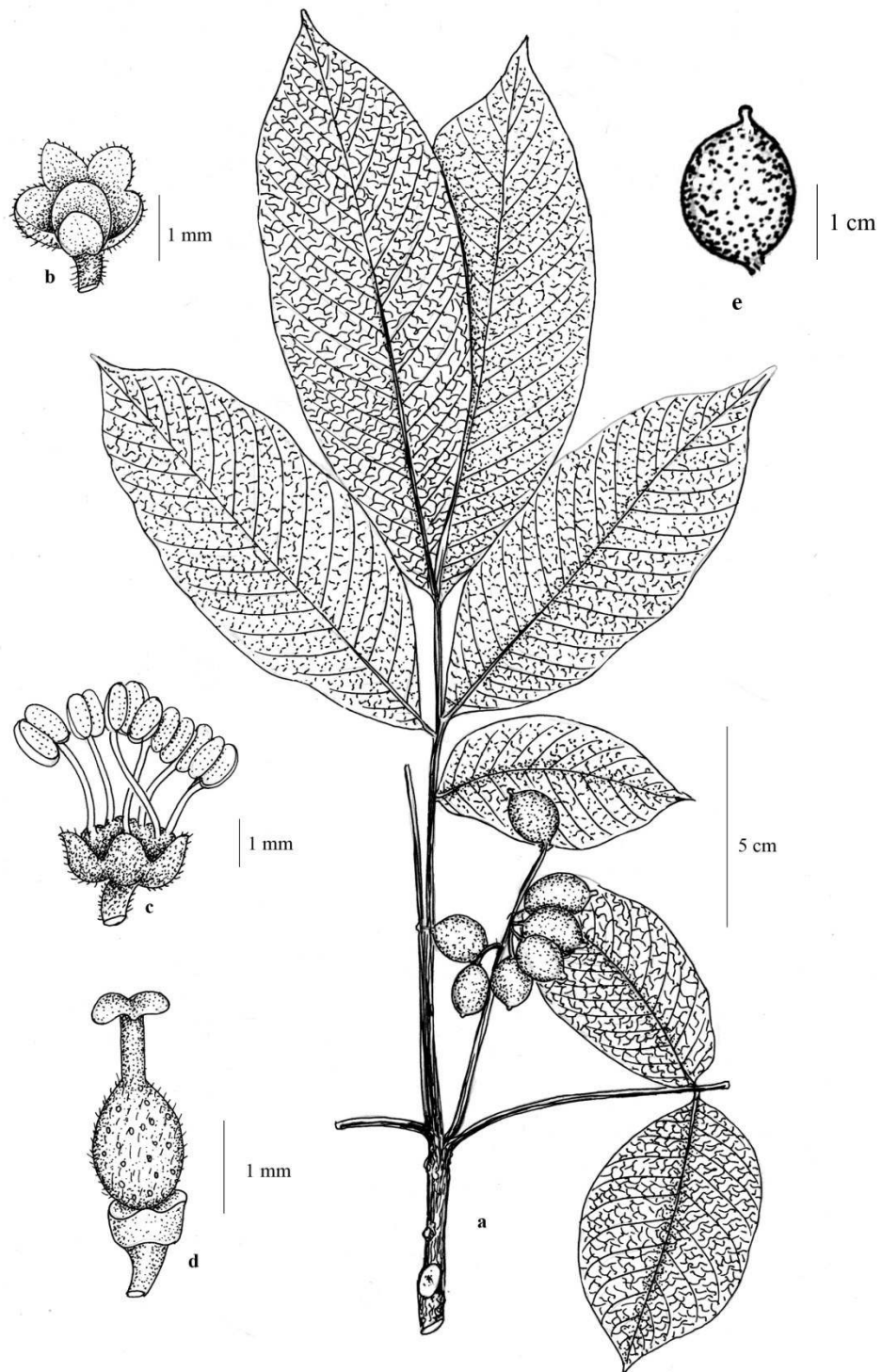
Indomalesia, monotypic.

**Schleichera oleosa** (Lour.) Oken, Allg. Naturgesch. 3: 1431. 1841; P.C. Pant in N.P. Singh & al., Fl. India 5: 384. 2000; Paria & Chattopadhyay, Fl. Hazaribagh 1: 511. 2000; N.P. Singh & al., Fl. Bihar: 116. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 158. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 66. 2014. *Pistacia oleosa* Lour., Fl. Cochinch. 2: 615. 1790. *Schleichera trijuga* Willd., Sp. Pl. 4: 1096. 1806; Hiern in Hook.f., Fl. Brit. India 1: 681. 1875; Haines, Forest Fl. Chota Nagpur: 261. 1910 & Bot. Bihar Orissa: 213. 1921.

**Fig. 33; Plate 36B**

Vern. Name: *Kusum* (Hindi).

Tree, 7.5–15 m high, deciduous; bark thin, blaze pink-mottled yellow darkening to brown. Leaves compound, paripinnate; rachis to 15 cm long; leaflets 2–4 pairs, opposite or subopposite, elliptic-obovate, 7.5–20 × 2.5–10 cm, truncate or tapering at base, entire at margins, obtuse or mucronate at apex, thin-coriaceous, glabrous, bright red when young; petiolules c. 2 mm long. Inflorescence a raceme or panicle, axils of fallen or young leaves near branch apex, to 15 cm long, greyish pubescent. Flowers small, polygamo-dioecious, fascicled on the rachis of simple or branched racemes; pedicels slender, 1–3 mm long, hairy. Calyx cupular, 6-lobed, 3–4 mm in diameter; lobes ovate-oblong, c. 1.5 mm long, acute at apex, valvate, cream-yellow. Petals absent. Racemes paniced in the male and appear with the new foliage, which is coloured afresh green or bright red. Disk annular, slightly hairy. Stamens 8, inserted within disk, with slender filaments, 6–7 mm long, free, hairy more in the lower half; anthers 1–1.5 × c. 1 mm. Ovary ovoid, narrowed into a



**Fig. 33.** *Schleicheria oleosa* (Lour.) Oken: a. fruiting twig; b. calyx; c. flower; d. carpel; e. fruit.

rigid style, glabrous (or a villous pistillode in male), 3-loculed; stigma 3- or 4-lobed; lobes reflexed. Fruits ovoid, 1–2 × 0.7–1.3 cm, toughly coriaceous, with a sharp point and often somewhat muricate, indehiscent, usually 1-loculed. Seeds 1 or 2, ovoid, 1.2–1.5 cm long, compressed, smooth, brown, enclosed in pulpy yellowish orange aril.

*Fl. & Fr.*: March – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Phoolwarya forest; throughout few trees only seen in patches. INDIA: Throughout. WORLD: Myanmar, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Phoolwarya forest, 404 m, 24°29'04.8" N, 85°35'46.2" E, 26th March 2013, *Shyam Biswa* 54114.

*Note*: Tree looks very beautiful, when is in flowering stage, all the juvenile leaves are bright red-coloured, and the tree looks distinct in the forest.

## 52. RUTACEAE Juss., nom. cons.

Cosmopolitan, especially tropical regions, 158 genera and c. 1900 species; 27 genera and 76 species in India.

### Key to genera

- |                                                                                 |                   |
|---------------------------------------------------------------------------------|-------------------|
| 1a. Trees, armed; leaves 3-foliolate; ovules many in each locule                | <b>1. Aegle</b>   |
| 1b. Shrubs, unarmed; leaves more than 3-foliolate; ovules 1 or 2 in each locule | <b>2. Murraya</b> |

### 1. AEGLE Corrêa, nom. cons.

Indomalesia, 3 species and 1 in India.

**Aegle marmelos** (L.) Corrêa, Trans. Linn. Soc. London 5: 223. 1800; Hook.f., Fl. Brit. India 1: 516. 1875; Haines, Forest Fl. Chota Nagpur: 247. 1910 & Bot. Bihar Orissa: 167. 1921; K.N. Nair & M.P. Nayar in Hajra & al., Fl. India 4: 264. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 530. 2000; N.P. Singh & al., Fl. Bihar: 89. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 133. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 56. 2014. *Crateva marmelos* L., Sp. Pl. 1: 444. 1753.

**Plate 36C & D**

Vern. Name: *Bel* (Hindi).

Tree, to 12 m high, armed with spines; spines straight, 1–2.5 cm long, strong. Leaves alternate, pinnately 3-foliolate; rachis to 6.5 cm long; slightly swollen at base; leaflets lanceolate or ovate-lanceolate, 3.5–9 × 2–6 cm, cuuneate or rounded at base, crenate at margins, acute or subacuminate at apex, glabrous, the terminal one largest; petiolules of lateral leaflets 1–5 mm long, that of terminal leaflet 1–2 cm long. Panicles 4–5 cm long, peduncle and pedicels minutely pubescent; pedicels 2–5 mm long. Calyx cup-shaped, 1–1.5 mm long, puberulent. Petals elliptic-oblong, 1–1.4 cm long, glandular, greenish white. Stamens 30–50, in 2 or 3 series, unequal, dull white; filaments 4–7 mm long, glandular. Ovary light green, 8–20-loculed, each with many ovules in 2 series; style stout; stigma longitudinally furrowed. Berries subglobose or broadly ovoid, 3–9 × 2.5–8 cm, 8–20-loculed; pericarp woody, greenish or yellowish; pulp orange or yellowish. Seeds many in a clear mucilaginous pulp, ovate, 8–10 mm long, woolly pubescent.

*Fl. & Fr.*: September – July.

*Habitat*: Dry deciduous forests on hillslopes.

*Distribution:* KWLS: Lokai forest; common. INDIA: Andhra Pradesh, Andaman Islands, Bihar, Himachal Pradesh, Jammu, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Native to India; cultivated in Southeast Asia, Malesia, tropical Africa and United States.

*Specimen examined:* Lokai forest, 398 m, 24°29'158" N, 85°37'038" E, 29th September 2013, *Shyam Biswa* 54193.

## 2. **MURRAYA** J. König, nom. cons.

Indomalesia to Pacific, 3 species, 2 in India, 2 in Jharkhand (1 cultivated) and 1 in KWLS.

**Murraya paniculata** (L.) Jack, Malayan Misc. 1(5): 31. 1820; K. Narayanan & M.P. Nayar in Hajra & al., Fl. India 4: 352, f. 92. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 539. 2000; N.P. Singh & al., Fl. Bihar: 92. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 136. 2002. *Chalcas paniculata* L., Mant. Pl.: 68. 1767. *Murraya exotica* L., Mant. Pl.: 563. 1771; Hook.f., Fl. Brit. India 1: 502. 1875; Haines, Forest Fl. Chota Nagpur: 244. 1910 & Bot. Bihar Orissa: 164. 1921.

**Plate 36E**

Vern. Names: *Kamini*, *Marchula* (Hindi); *Ban Thilli*.

Shrub or small tree, 2–5 m high; bark smooth, yellow-white; branches slender, glabrous. Leaves compound, alternate, 9–15 cm long; leaflets 3–7, rarely 1, ovate or ovate-elliptic, 1.5–6 × 1.5–3.5 cm, obliquely cuneate at base, entire or obscurely crenate at margins, acuminate with a notched at apex, glandular, glossy and darker above; petiolules 1–5 mm long. Flowers bisexual, in lateral or terminal corymbs; pedicels 5–8 mm long. Sepals oblong, *c.* 2 mm long, glandular, persistent. Petals oblong-lanceolate, 1.2–2 × *c.* 0.5 cm, subobtusate at apex, white. Stamens 10; filaments linear, tapering, 8–10 mm long, flat; anthers ellipsoid-oblong, *c.* 1 mm long, yellow. Disk annular, *c.* 1 mm, lobed, glabrous. Ovary hirsute, 2-loculed; ovule 1 in each locule; style *c.* 1.2 cm long, jointed, deciduous. Berries ellipsoid, 1.2–1.5 cm long, seated on the persistent calyx, smooth, red or orange-yellow when ripe. Seeds 1 or 2, flat, woolly.

*Fl. & Fr.:* March – July.

*Habitat:* Rocky localities near in dry deciduous mixed forests.

*Distribution:* KWLS: Dipluswa Nala, Meghatari; not common. INDIA: Throughout. WORLD: Australia, Bhutan, Madagascar, Mauritius, Melanesian Islands, Myanmar, New Caledonia, Nepal, Philippines, Taiwan, Thailand and Vietnam.

*Specimen examined:* Dipluswa Nala, Meghatari, 186 m, 24°34'25.1" N, 85°35'19.4" E, 31st March 2013, *Shyam Biswa* 54134.

## 53. **SIMAROUBACEAE** DC., nom. cons.

Tropical regions, 13 genera and *c.* 95 species; 9 genera and 16 species in India.

### **AILANTHUS** Desf., nom. cons.

Asia to Australia, 5 species, 4 in India, 1 in Jharkhand.

**Ailanthus excelsa** Roxb., Pl. Coromandel 1: 24, t. 23. 1795; A.W. Benn. in Hook.f., Fl. Brit. India 1: 518. 1875; Haines, Forest Fl. Chota Nagpur: 238. 1910 & Bot. Bihar Orissa: 1237. 1924; R.K. Basak in Hajra & al., Fl. India 4: 410. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 522.



2000; N.P. Singh & al., Fl. Bihar: 94. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 138. 2001.

Vern. Names: *Ghorkaranj* (Kharwari); *Ghorkrond*.

Tree, 15–40 m high, deciduous; bark light-coloured. Leaves alternate, imparipinnate, 20–40 cm long; leaflets 17–25, alternate or sub-opposite, variable in shape, somewhat rhomboid, 7–12.5 × 4–6.5 cm, unequal or oblique at base, coarsely and irregularly toothed or sublobate at margins, acute or acuminate at apex, tomentose when young; secondary or lateral veins 12–20 pairs; petiolules 2–3. Inflorescence terminal or axillary panicles or cymes. Flowers usually unisexual. Male flowers lax in much-branched panicles, foetid during anthesis, greenish yellow, large; pedicels slender, 0.6–1.2 cm long. Calyx 5-lobed; lobes ovate-triangular, *c.* 2 mm long. Petals 5, ovate-lanceolate, 3–4 × *c.* 2 mm, reflexed. Stamens 10; filaments glabrous, subulate, reduced or absent in female flowers; anthers *c.* 1 mm long. Carpels 2–5, free, rudimentary or absent in male flowers; ovary sparsely hairy; styles connate; stigma curling. Samaras oblong to lanceolate, 4–5.5 × 1–1.5 cm, acute, tapering at ends, strongly reticulate, brownish. Seeds suborbicular, *c.* 10 × 4–6 mm.

*Fl. & Fr.*: March – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Baghi tan forest; near the Forest Rest House, Koderma NRF; common. INDIA: Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Australia, Pakistan and Sri Lanka.

*Specimens examined*: Baghi tan forest, 398 m, 24°29'03.6" N, 85°36'13.7" E, 10th March 2011, *Shyam Biswa* 49749; near the Forest Rest House, Koderma NRF, 401 m, 24°28'46.6" N, 85°36'57.3" E, 3rd March 2012, *Shyam Biswa* 54165.

#### 54. MELIACEAE Juss., nom. cons

Tropical and subtropical regions, *c.* 50 genera and *c.* 650 species; 23 genera and 97 species in India.

##### Key to genera

- |                                                                    |                       |
|--------------------------------------------------------------------|-----------------------|
| 1a. Leaves 3-foliolate; fruit a berry                              | <b>4. Walsura</b>     |
| 1b. Leaves 1-, 2-or 3-pinnate; fruit a capsule or drupe            | <b>2</b>              |
| 2a. Ovules many in each locule; fruits a capsule; seeds winged     | <b>3. Soyimida</b>    |
| 2b. Ovules 1 or 2 in each locule; fruits a drupe; seeds not winged | <b>3</b>              |
| 3a. Petals white; stigma 3-fid; drupes 1-seeded                    | <b>1. Azadirachta</b> |
| 3b. Petals purplish; stigma capitate; drupes 3–8-seeded            | <b>2. Melia</b>       |

##### 1. AZADIRACHTA A. Juss.

Indomalesia, 2 species and 1 in India.

**Azadirachta indica** A. Juss., Mém. Mus. Hist. Nat. Paris 19: 221, t. 13, f. 5. 1830; Haines, Forest Fl. Chota Nagpur: 251. 1910 & Bot. Bihar Orissa: 176. 1921; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 478. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 524. 2000; N.P. Singh & al., Fl. Bihar: 97. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 142.

2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 57. 2014. *Melia azadirachta* L., Sp. Pl. 1: 385. 1753; Hiern in Hook.f., Fl. Brit. India 1: 544. 1875.

Vern. Name: *Neem* (Hindi).

Tree, to 15 m high; branches glaucous. Leaves imparipinnate, 12–25 cm long, crowded near branch apex; rachises to 5 cm long; leaflets opposite, subopposite or alternate, lanceolate or oblong-lanceolate or falcate, 1.5–5 × 0.5–2 cm, oblique and cuneate at base, serrate at margins, acuminate at apex, subcoriaceous; petiolules 1–2 mm long; terminal leaflet with 0.5–1.5 cm long petiolule. Panicles axillary, c. 20 cm long. Flowers 5-merous, c. 5 mm across; bracts lanceolate, minute, caducous; pedicels c. 5 mm long. Calyx lobes 5, ovate, c. 0.8 mm long, connate at base, ciliolate at margins. Petals oblanceolate or oblong-obovate, c. × 1.5 mm, attenuate at base, tomentose, white. Disk absent. Stamens 10, monadelphous; staminal tube c. 4 mm long, glabrous. Ovary globose, 3-loculed; style c. 3 mm long; stigma 3-fid. Drupes ovoid, c. 1.5 × 1 cm, green, turning yellow when ripe, 1-seeded. Seeds ellipsoid, 7–8 mm long.

*Fl. & Fr.*: April – August.

*Habitat*: Near villages.

*Distribution*: KWLS: Meghatari, near village; common. INDIA: Throughout. WORLD: Bangladesh, Bhutan, Myanmar, Nepal, Pakistan and Sri Lanka.

*Specimen examined*: Meghatari near village, 212 m, 24°35'23.8" N, 85°34'55.8" E, 1st April 2013, *Shyam Biswa* 54167.

## 2. MELIA L.

Old World tropical regions, 3 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Melia azedarach** L., Sp. Pl. 1: 384. 1753; Hiern in Hook.f., Fl. Brit. India 1: 544. 1875; Haines, Forest Fl. Chota Nagpur: 252. 1910 & Bot. Bihar Orissa: 177. 1921; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 494. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 525. 2000; N.P. Singh & al., Fl. Bihar: 98. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 143. 2002.

**Plate 36F**

Vern. Names: *Gar neem*, *Bakain*.

Tree, 6–15 m high. Leaves 2- or 3-pinnate, 12–40 cm long; leaflets ovate or elliptic, 1.5–2.5 × 0.7–1.2 cm, rounded at base, serrate at margins, acuminate at apex, scattered stellate-hairy beneath when young, glabrous later. Panicles axillary. Flowers 1–1.2 × 1.8–2 cm; pedicels jointed, 1.5–2 mm + 3–3.5 mm, rough towards calyx, smooth at lower end. Calyx 6-lobed; lobes almost free, ovate, c. 2 × 1–1.5 mm, glandular-hairy at margins and outside. Petals 6, linear-oblanceolate or oblanceolate, 9–10 × 2–2.5 mm, ciliate at base margins, spreading, purplish. Staminal tube cylindrical, 8–10 mm long, 10-ribbed with bifid filiform appendages at mouth; anthers 10, 1.5–2 mm long; appendages c. 1 mm long. Ovary ovoid, 1–1.5 mm across, 6-loculed; stigma capitate. Drupes ovoid-ellipsoid, 1.5–2 × c. 1 cm, smooth, yellow. Stone c. 1 × 0.7 cm, 5–7-ribbed.

*Fl. & Fr.*: February – December.

*Habitat*: Dry deciduous forest and often planted.

*Distribution:* KWLS: Lokai forest; common. INDIA: Almost throughout, often planted. WORLD: Australia, Bhutan, China, Indonesia, Laos, Nepal, Pacific islands (Solomon Islands), Papua New Guinea, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined:* Lokai forest, 397 m, 24°29'02.9" N, 85°37'04.4" E, 28th February 2011, Shyam Biswa 49635.

### 3. **SOYMIDA** A. Juss.

India (naturalized in Sri Lanka), 1 species.

**Soyimida febrifuga** (Roxb.) A. Juss., Mém. Mus. Hist. Nat. 19: 251, t. 22, f. 26. 1830; Hiern in Hook.f., Fl. Brit. India 1: 567. 1875; Haines, Forest Fl. Chota Nagpur: 250. 1910 & Bot. Bihar Orissa: 175. 1921; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 501. 1997; Paria & Chattopadhyay, Fl. Hazaribagh 1: 526. 2000; N.P. Singh & al., Fl. Bihar: 98. 2001. *Swietenia febrifuga* Roxb., Pl. Coromandel: 18, t. 17. 1795. **Plate 36G**

Vern. Name: *Ratan ragor* (Birhore).

Tree, to 15 m high, deciduous; bark dark brown, splitting into oblong flakes on old trees, wood is extremely hard and reddish; branches divaricate, glabrous with persistent leaf scars. Leaves paripinnate, clustered near branch apex, *c.* 40 × 15 cm; leaflets 3–6 pairs, opposite, sometimes alternate, sessile, broadly oblong or ovate-oblong, *c.* 9.5 × 5 cm, obliquely rounded-obtuse at base, entire or wavy at margins, obtuse at apex, thick-coriaceous, glabrous, greyish green; petioles *c.* 6 cm long. Panicles axillary and terminal. Flowers *c.* 5 × 8–10 mm; bracts linear; bracteoles ovate, *c.* 1 mm long; peduncles *c.* 3 mm long; pedicels *c.* 2 mm long. Calyx 5-lobed; lobes ovate, 1.5–2 × 0.5–0.8 mm, ciliate at margins, pubescent. Petals 5, obovate, 4–4.5 × 2–3 mm, clawed, spreading, curved inwards, lateral margins fimbriate, white or whitish light orange. Staminal tube copular, 4–5 mm long, 10-cleft or sometimes nearly free and spreading; lobes fleshy, apex minutely 2-lobed, with anthers in the sinus. Disk flat. Ovary ovoid, 1–1.5 mm long, glabrous, 5-loculed; ovules many, pendulous, 2-seriate; style *c.* 1 mm long, thick; stigma sessile, discoid, to 2 mm, 5-angled. Capsules obovoid, 2.5–6 cm long, 5-valved. Seeds oblong, to 5 cm long, winged.

*Fl. & Fr.:* April – July.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Dhodhakola forest; common. INDIA: Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and Uttar Pradesh. WORLD: Sri Lanka.

*Specimen examined:* Dhodhakola forest, 389 m, 24°32'48.8" N, 85°40'04.4" E, 2nd April 2013, Shyam Biswa 54144.

### 4. **WALSURA** Roxb.

Indomalesia (to Sulawesi), 16 species, 7 in India, 1 in Jharkhand.

**Walsura trifoliolata** (A. Juss.) Harms in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 19b(1): 119. 1940, '*trifolia*'; S.S. Jain & Bennet in Hajra & al., Fl. India 4: 522. 1997. *Heynea trifoliolata* A. Juss., Bull. Sci. Nat. Geol. 23: 238. 1830, '*trifolia*'. *Walsura piscidia* Roxb., Fl. Ind. 2: 387. 1832; Hiern in Hook.f., Fl. Brit. India 1: 564. 1875; Haines, Forest Fl. Chota Nagpur: 253. 1910 & Bot. Bihar Orissa: 178. 1921. **Plate 36H**

Tree, bushy, 2–5 m high. Leaves alternate, 3-foliate; rachis to 6 cm long; leaflets oblong or oblong-elliptic, 4–10.5 × 1.7–3.6 cm, tapering or obtuse at base, entire at margins, acuminate, or rounded at apex, glabrous, shining above; petiolules of lateral leaflets 2–5 mm long, that of terminal leaflet 1.2–3 cm long. Panicles corymbosely branched, 2.5–9 cm long, tomentose; bracts *c.* 2 mm long, caducous; pedicels to 3 mm long. Calyx 5-toothed; teeth ovate, *c.* 1 mm long, acute, pubescent. Petals 5, oblong-lanceolate or oblong-elliptic, 2–3 × *c.* 1 mm, acute at apex, white. Staminal tube *c.* 2 mm long, hairy inside; filaments fused about half their length below, upper free half, 2-fid at apex; anthers 10, *c.* 0.8 mm long, slightly hairy, inserted between appendages. Disk annular, large. Ovary sunk in disk, 2 or 3-loculed; stigma 2-dentate. Berries ovoid, *c.* 1.8 × 1.5 cm, brownish tomentose, orange-yellow when ripe.

*Fl. & Fr.*: February – April.

*Habitat*: On the hillslopes, dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; not common; INDIA: Andhra Pradesh, Bihar, Daman and Diu, Goa, Karnataka, Kerala, Maharashtra, Odisha and Tamil Nadu. WORLD: Sri Lanka.

*Specimens examined*: Dhawjadhari Pahar, 411 m, 24°28'47.7" N, 85°35'49.6" E, 29th February 2012, *Shyam Biswa* 54021; mid of Dhawjadhari Pahar, 570 m, 24°28'52.4" N, 85°35'39.1" E, 4th April 2013, *Shyam Biswa* 54157.

## 55. MALVACEAE Juss., nom. cons.

Cosmopolitan, especially tropical regions, 113 genera and *c.* 5000 species; 22 genera and 93 species in India.

### Key to genera

- |                                                                                         |                       |
|-----------------------------------------------------------------------------------------|-----------------------|
| 1a. Filaments united into a column or cup                                               | 2                     |
| 1b. Filaments free                                                                      | 10                    |
| 2a. Stamens numerous; anthers 1-celled                                                  | 3                     |
| 2b. Stamens usually 15; anthers 2-celled                                                | 8                     |
| 3a. Herbs; leaves simple; stamens monadelphous                                          | 4                     |
| 3b. Trees; leaves digitately compound; stamens in 5 or 6 bundles in 2 series            | <b>3. Bombax</b>      |
| 4a. Staminal tube antheriferous at apex                                                 | 5                     |
| 4b. Staminal tube antheriferous throughout                                              | 6                     |
| 5a. Epicalyx present                                                                    | <b>8. Malva</b>       |
| 5b. Epicalyx absent                                                                     | <b>10. Sida</b>       |
| 6a. Plants devoid of peltate scales                                                     | 7                     |
| 6b. Plants with peltate scales on young twigs                                           | <b>2. Azanza</b>      |
| 7a. Pedicels articulated; styles as many as carpels; capsules septicidal                | <b>7. Hibiscus</b>    |
| 7b. Pedicels inarticulated; styles twice the number of carpels; capsules schizocarpic   | <b>12. Urena</b>      |
| 8a. Shrubs; fruits follicles, twisted                                                   | <b>6. Helictres</b>   |
| 8b. Herbs or undershrubs; fruits capsule, not twisted                                   | 9                     |
| 9a. Flowers in umbellate cyme; petals reddish                                           | <b>1. Ayenia</b>      |
| 9b. Flowers in capitate cyme; petals yellow or pink                                     | <b>9. Melochia</b>    |
| 10a. Trees or shrubs; fruits drupes                                                     | <b>5. Grewia</b>      |
| 10b. Herbs or undershrubs; fruits capsules                                              | 11                    |
| 11a. Basal serration of leaves appendaged; capsules linear-oblong, not prickled, smooth | <b>4. Corchorus</b>   |
| 11b. Basal serration of leaves not appendaged; capsules subglobose, spinescent          | <b>11. Triumfetta</b> |

1. **AYENIA** L.

Tropical and subtropical regions, 217 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

**Ayenia herbacea** (Roxb.) T.K.Paul, Pleione 18(3): 395. 2024. *Byttneria herbacea* Roxb., Pl. Coromandel 1: 28, t. 29. 1795; Masters in Hook.f., Fl. Brit. India 1: 376. 1874; Haines, Forest Fl. Chota Nagpur: 208. 1919 & Bot. Bihar Orissa: 83. 1921, '*Buettneria*'; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 412, f. 115. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 173. 2000; N.P. Singh & al., Fl. Bihar: 72. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 111. 2002.

**Plate 37A**

Herb, 30–60 cm high with woody rootstock. Stems angular, branched, hairy. Leaves simple, alternate, ovate-lanceolate, lanceolate or ovate, 0.5–4.5 × 0.2–1.2 cm, rounded at base, serrate or irregularly dentate at margins, acute to acuminate at apex, 3–5-veined at base, sparsely hairy, more on veins and margins; petioles 1–10 mm long, pubescent; stipules subulate, 1.5–2 mm long. Cymes axillary, 2 or 3-flowered; peduncles 0.2–1 cm long; pedicels 4–6 mm long, hairy; bracts/epicalyx 2–6, 1–2 mm long, hairy. Sepals narrowly ovate-lanceolate, 4–5 × c. 1.5 mm, connate at base, long-acuminate at apex, 3-veined, reflexed. Petals 5–6 mm long, claw slender; limb subulate, with hood and 2-fid appendages which enter inside the staminal cup covering the stamens, dark pinkish or maroon. Staminal cup with an inner series of 5 stamens and an outer series of 5 staminodes alternating with stamens; anther lobes reinform, divergent; staminodes ovate, acute. Ovary 5-loculed, sparsely hairy; style terete, c. 1 mm long; stigma 5-lobed. Capsules globose, septicidally 5-valved, 3–5 mm, shortly prickly. Seeds 1 in each locule, c. 3 × 2 mm, flat, muricate.

*Fl. & Fr.*: August – April.

*Habitat*: Undergrowth in deciduous forest and shady places.

*Distribution*: KWLS: Near the Dumaria village, Koderma NRF; Bagitan jungle, Koderma NRF; common. INDIA: Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Nagaland, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. **Endemic**.

*Specimens examined*: Near the Dumaria village, Koderma NRF, 394 m, 24°29'36.6" N, 85°35'49.8" E, 9th August 2011, *Shyam Biswa* 49763; Bagitan jungle, Koderma NRF, 398 m, 24°29'33.1" N, 85°35'48.6" E, 20th November 2012, *Shyam Biswa* 54070.

*Uses*: The rootstock is ground and rubbed on swelling of the legs by the Kols. It is also used in combination with Bael fruit, hesel gum and banyan root in cholera and diarrhoea. It is given in the female complaint, known in Santali as pordhol (Haines, 1921).

2. **AZANZA** Alef.

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

**Azanza lampas** Alef., Bot. Zeitung (Berlin) 19: 297. 1861. *Hibiscus lampas* Cav., Diss. 3: 154, t. 56, f. 2. 1787. *Thespesia lampas* (Cav.) Dalzell & A. Gibson, Bombay Fl.: 19. 1861; Masters in Hook.f., Fl. Brit. India 1: 345. 1874; Haines, Forest Fl. Chota Nagpur: 191. 1910 & Bot. Bihar Orissa: 70. 1921; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 350, f. 98. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 208. 2000; N.P. Singh & al., Fl. Bihar: 69. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 106. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 44. 2014.

**Plate 38E**

Vern. Name: *Jangli-bhendi* (Hindi).



Shrub, 1–2 m high, young parts brown-tomentose. Stems terete, hairy. Leaves simple, alternate, palmately 3-lobed or entire,  $5.5\text{--}15.2 \times 3\text{--}12.5$  cm, cordate or rounded at base, entire at margins, acuminate or caudate at apex, mid-lobe broadest and longest, palmately 5-veined at base, brownish or golden hairy above, softly pubescent beneath, velvety in touch; petioles 2–6.5 cm long, hairy. Inflorescence axillary or terminal, solitary or 2 or 3-nate. Flowers large, 10–12 cm in diam.; pedicels 1.5–2 cm long, swollen above. Epicalyx 5–8, filiform, 3.5–7 mm long, deciduous. Calyx truncate, usually with narrow linear lobes, 4–12 mm long, rarely entire. Petals *c.*  $7 \times 5$  cm, bright yellow with a central purplish or crimson blotch. Staminal column *c.* 3.5 cm long; stamens numerous, monadelphous; free filaments *c.* 0.5 cm long. Carpels *c.* 3 cm long; ovary 5-loculed; style *c.* 3 cm long; stigma clavate. Capsules oblongoid or ovoid, 2.5–3 cm long, woody, 5-valved, dehiscent widely. Seeds 8–15 in each locule, obovoid, *c.* 5 mm long, angular, more or less densely appressed, short, simple hairy, glabrescent, black.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the Dumaria village, Koderma NRF; Phutlaiya Nala; occasional. INDIA: Throughout. WORLD: Tropical East Africa and South and Southeast Asia.

*Specimens examined*: Near the Dumaria village, Koderma NRF, 394 m,  $24^{\circ}29'36.6''$  N,  $85^{\circ}35'49.8''$  E, 9th August 2011, *Shyam Biswa* 49769; Phutlaiya Nala, 328 m,  $24^{\circ}30'36.3''$  N,  $85^{\circ}39'30.1''$  E, 28th September 2013, *Shyam Biswa* 54177.

### 3. **BOMBAX** L., nom. cons.

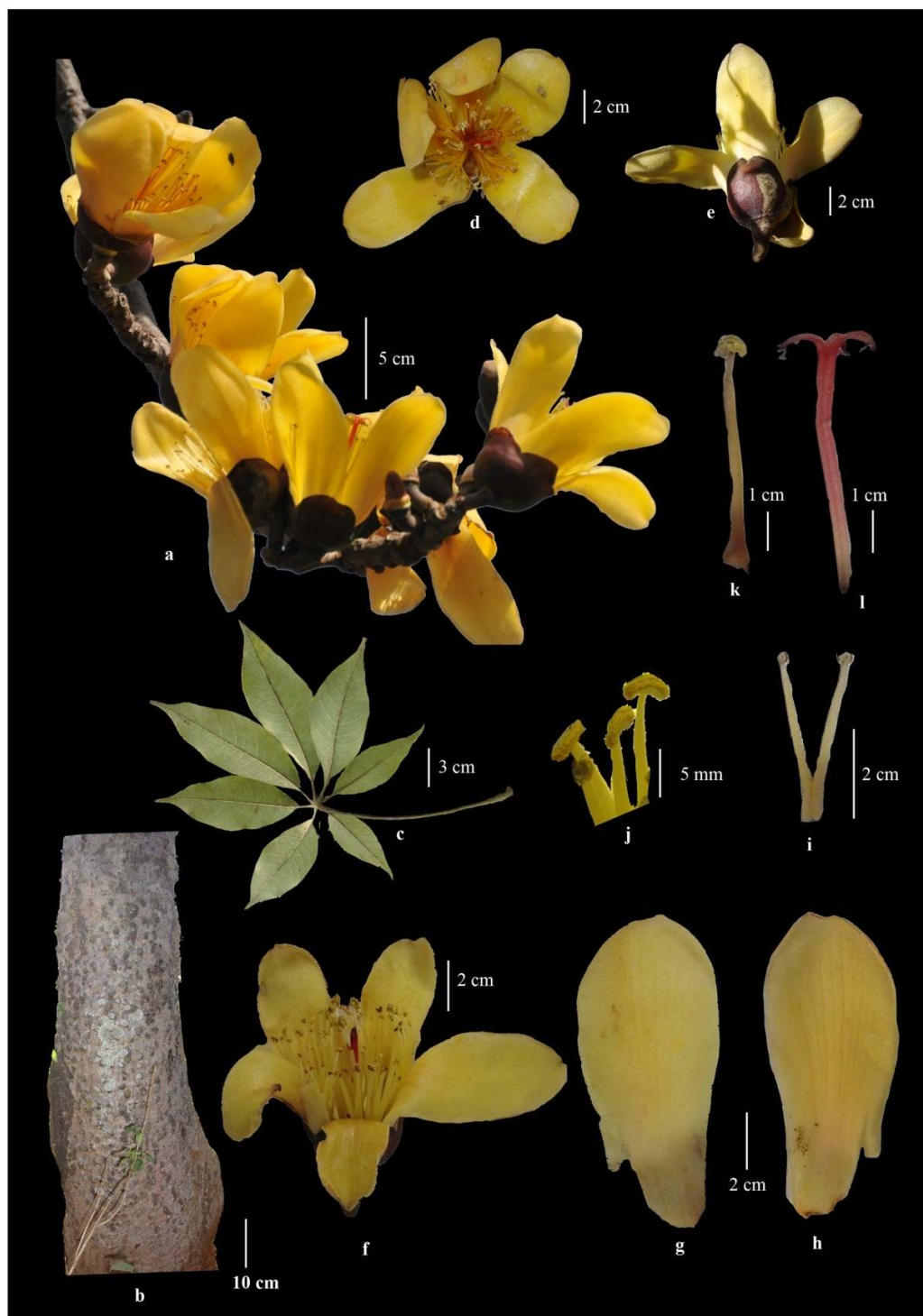
Old World tropical regions, 8 species, 2 in India and 1 in Jharkhand.

**Bombax ceiba** L., Sp. Pl. 1: 511. 1753; M.P. Nayar & M.C. Biswas in B.D. Sharma & Sanjappa, Fl. India 3: 398, f. 111. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 183. 2000; N.P. Singh & al., Fl. Bihar: 71. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 109. 2002, p.p.; Ranjan, Fl. Parasnath Wildlife Sanct.: 45. 2014. *Bombax malabricum* DC., Prodr. 1: 479. 1824; Masters in Hook.f., Fl. Brit. India 1: 349. 1874; Haines, Forest Fl. Chota Nagpur: 192. 1910 & Bot. Bihar Orissa: 74. 1921.

**Fig. 34, 35**

Vern. Name: *Simul* (Hindi).

Tree, 30–40 m high; trunk large, buttressed with greyish bark; trunk and branches with sharp, conical prickles when young. Leaves in seeding are simple, ovate, acuminate, digitate, 5–7-foliolate; petioles 12–25 cm long; leaflets lanceolate to elliptic,  $6\text{--}18 \times 2\text{--}6$  cm, tapering at base, entire at margins, caudate or acuminate at apex, glossy above, puberulous to glabrous beneath; petiolules 2–2.5 cm long. Inflorescence solitary or clustered towards tips of leafless branchlets. Flowers large, 11–14 cm long; pedicels 1–2 cm long, glabrous or tufted puberulous. Calyx campanulate, 2.5–3 cm long, coriaceous, glabrous to sparsely puberulous outside, silky inside, purplish green, irregularly 2–5-lobed. Petals 5, imbricate, obovate, elliptic-obovate or oblong,  $10\text{--}15 \times 4.5\text{--}5$  cm, fleshy, tomentellous outside, bright red or bright yellow. Stamens 65–80 in 5 or 6 bundles in 2 series, 4–5.5 cm long; the central bundle with 15 stamens (5 larger and 10 shorter), and 5 bundles in the centre series with 10 stamens; filaments red or yellow; anthers involute, reniform, bilocular, on longer filaments of central bundles 0.5–0.8 mm long and the rest



**Fig. 34. *Bombax ceiba* L.:** a. flowering twig; b. trunk; c. leaf; d, e, f. flower; g, h. petals (lower & upper views); i, j, k. stamens; l. carpel.



**Fig. 35. *Bombax ceiba* L.:** a. flowering twig; b. trunk; c. flower and flower buds; d. flower; e. calyx; f. petals; g. androecium; h. stamens; i. carpel; j. fruit.

unilocular, *c.* 0.5 mm long. Ovary 5-loculed; carpels 5–6 mm long, ovary conical, minutely puberulous or glabrous, styles 5–6 cm long; stigmas 5-fid, lobes spreading 1.5–2 cm across. Capsules loculicidally 5-valved, oblong to ovoid, 11–18 cm long, cuneate at ends, velvety valves silky inside. Seeds numerous, pyriform, smooth, dark brown.

*Fl. & Fr.*: September – May.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout, up to 1500 m. WORLD: Bangladesh, Bhutan, China, Indonesia, Laos, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines and Sri Lanka; introduced elsewhere.

*Specimen examined*: Lokai forest, 398 m, 24°29'.158" N, 85°37'.038" E, 29th September 2013, *Shyam Biswa* 54180.

*Note*: Observed in Tilaya forest only one tree bearing yellow flowers, in the same locality about 10–20 m far another tree bearing the red flowers.

#### 4. **CORCHORUS** L.

Tropical regions, *c.* 70 species, 8 in India, 6 in Jharkhand and 1 in KWLS.

**Corchorus olitorius** L., Sp. Pl. 1: 529. 1753; Masters in Hook.f., Fl. Brit. India 1: 397. 1874; Haines, Forest Fl. Chota Nagpur: 203. 1910 & Bot. Bihar Orissa: 86. 1921; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 487. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 166. 2000; N.P. Singh & al., Fl. Bihar: 78. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 121. 2002.

**Plate 37B**

Vern. Names: *Changhas, Rajaana, Sonpat* (Hindi).

Herb, to 1 m high. Stems terete, hairy. Leaves simple, alternate, elliptic, ovate or ovate-lanceolate, 1–4.6 × 0.8–2.7 cm, rounded at base, serrate at margins, acute to acuminate at apex, one or two serratures near the base of some or all the leaves produced into very slender tails, hairy mostly on veins, 3–5-veined from base; veins raised and prominent beneath; petioles 0.8–2.5 cm long, pubescent; stipules linear, 4–6 mm long, glabrous. Cymes 2 or 3-flowered; peduncles very short. Flowers 6–8 mm across; pedicels *c.* 1 mm long; bracts and bracteoles linear, 4–7 mm long. Sepals 5, linear-oblong, 4–5 × 0.5–1 mm, apiculate at apex. Petals 5, oblong-spathulate, 3–4 × 1.5–2 mm, obtuse at apex, sparsely hairy at base, yellowish. Stamens 10, free on a short gonophore, united at base, 2.5–3 mm long; anthers *c.* 0.3 mm long, dorsifixed. Carpels 5, 2.5–3 mm long. Ovary cylindric, 1–1.5 mm long, hairy, 5-loculed; style short; stigma 5-lobed, minutely papillate. Capsules subcylindric, 2–7 mm long, 10-ribbed, glabrous, 5-loculed, not horned, septate between seeds. Seeds many, *c.* 2 × 1.5 mm, trigonous, black.

*Fl. & Fr.*: September – December.

*Habitat*: Near damp localities.

*Distribution*: KWLS: Near Phulwarwaria jungle, Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49549.

## 5. GREWIA L.

Subtropical regions, Old World c. 280 species, 42 in India, 12 in Jharkhand (1 cultivated), 2 in KWLS.

### Key to species

1a. Undershrub; drupes unlobed

**1. *G. hirsuta***

1b. Tree; drupes 2-lobed

**2. *G. tilifolia***

**1. *Grewia hirsuta*** Vahl, Symb. Bot. 1: 34. 1790; Masters in Hook.f., Fl. Brit. India 1: 391. 1874; Haines, Forest Fl. Chota Nagpur: 195. 1910 & Bot. Bihar Orissa: 90. 1921; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 501. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 168. 2000; N.P. Singh & al., Fl. Bihar: 80. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 50. 2014.

**Plate 37C**

Vern. Names: *Gurusukri*, *Kukurbicha* (Hindi).

Undershrub, 50–100 cm high. Stems terete, tomentose or stellate-hairy. Leaves simple, alternate, ovate-lanceolate, broadly oblong or ovate elliptic, 2.5–11 × 1.2–4.6 cm, oblique, subobtusate at base, serrate at margins, acute or acuminate at apex, prominently 3-veined at base, pubescent above, densely tomentose with stellate hairs beneath; petioles 3–9 mm long, hairy. Inflorescence a cyme, axillary, polygamous or dioecious; buds ovoid. Flowers 5–6 × 0.8–1 cm; pedicels 2–3 mm long, hairy. Sepals 5, elliptic-lanceolate, 5–6 × 1.5–2 mm, acute at apex, hirsute beneath, reflexed, white or orange or yellow, finally turning brownish. Petals 5, oblong, 1.5–2 × 0.5–1 mm, hairy at base with glands about half the length of petals. Receptacle c. 1 mm long, densely pubescent. Stamens 20–30, free, 2–3 mm long, inserted on receptacle or androphore; anthers globular, c. 0.5 mm. Carpels c. 5 mm long, green turn to orange on maturity; ovary globose, c. 2 mm, densely villous; stigma 5-lobed; lobes fringed. Drupes subglobose, 6–7 × 8–10 mm, wrinkled, densely hirsute or hispid.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Cambodia, China, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49512.

**2. *Grewia tiliifolia*** Vahl, Symb. Bot. 1: 35. 1790; Masters in Hook.f., Fl. Brit. India 1: 386. 1874, '*tiliaefolia*'; Haines, Forest Fl. Chota Nagpur: 198. 1910 & Bot. Bihar Orissa: 91. 1921; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 511, f. 140. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 170. 2000; N.P. Singh & al., Fl. Bihar: 82. 2001. **Plate 37D**

Vern. Names: *Dhamani* (Hindi); *Kukur anda*.

Tree, to 10 m high; bark peeling off. Leaves simple, alternate, ovate, elliptic-ovate, ovate-round or oblong, 3.5–9.7 × 3–8.5 cm, obliquely cordate at base, serrate to crenate at margins, acuminate or rounded at apex, glabrescent above, tomentose with stellate hairs beneath and very distinct subparallel cross veins; petioles 1–2 cm long; stipules semicordate at base. Flowers 3–6 in



axillary cyme; peduncles *c.* 1 cm long; pedicels 1–1.5 cm long. Sepals elliptic or lanceolate, 5–8 × *c.* 3 mm, subacute at apex, tomentose outside. Petals elliptic-oblong or spatulate, 3–4.5 × *c.* 1.5 cm, sparsely ciliate at base, obtuse, notched at apex. Receptacle short, hairy at apex. Stamens many, *c.* 4 mm long. Ovary globose, *c.* 1.2 mm, sparsely hirsute; style slightly longer than stamens; stigma 4-lobed. Drupes 2–5 × 5–10 mm, distinctly 2-globose-lobed, sparsely hirsute, green turns blackish.

*Fl. & Fr.*: May – September.

*Habitat*: On hillslopes of dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; rare. INDIA: Andhra Pradesh, Assam, Bihar, Gujarat, Goa, Himachal Pradesh, Karnataka Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and West Bengal. WORLD: Cambodia, China, Laos, Malaysia, Myanmar, Sri Lanka, Thailand, Vietnam and Tropical East Africa.

*Specimen examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49591.

## 6. HELICTERES L.

Tropical Asia and America, *c.* 60 species, 4 in India and 1 in Jharkhand.

**Helicteres isora** L., Sp. Pl. 2: 963. 1753; Masters in Hook.f., Fl. Brit. India 1: 365. 1874; Haines, Forest Fl. Chota Nagpur: 206. 1910 & Bot. Bihar Orissa: 78. 1921; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 426. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 175. 2000; N.P. Singh & al., Fl. Bihar: 74. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 112. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 46. 2014. **Fig. 36; Plate 37E**

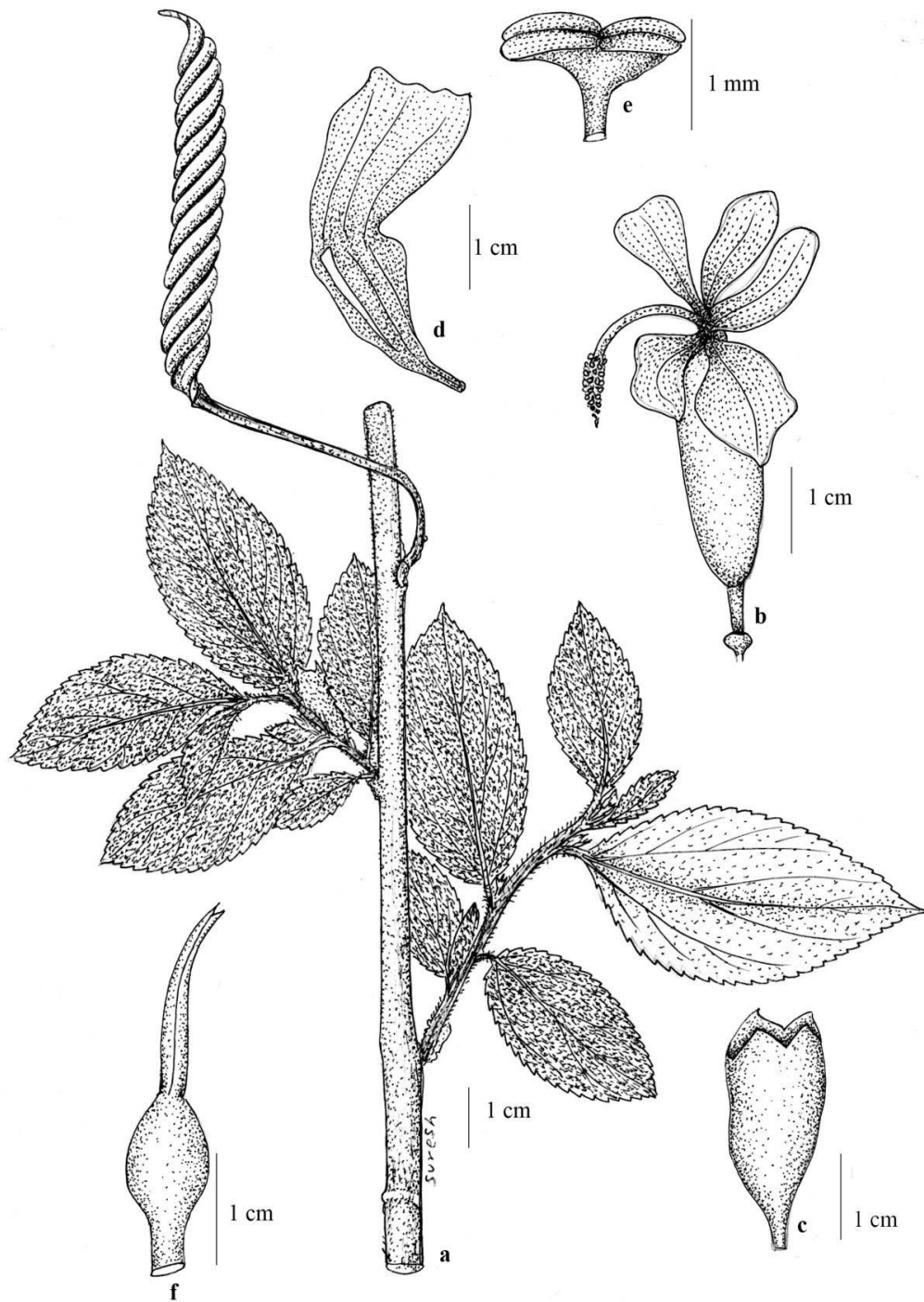
Vern. Names: *Maroprphali* (Hindi); *Aitha*, *aitha*.

Shrub or small tree, to 5 m high. Stems and branchlets terete with scattered stellate hairs. Leaves simple, alternate, elliptic-obovate, ovate-cordate, rounded-cordate or suborbicular, 4.5–15 × 2.5–14 cm, cordate to rounded at base, serrate at margins, shortly acuminate at apex, often 3-lobed, scabrous, stellate hairs mixed with simple hairs on upper surface, stellate-hairy to stellate-tomentose beneath, especially more on veins, 3–7-veined at base; petioles 0.5–1.5 cm long, pubescent; stipules linear to subulate, 0.5–0.8 cm long, deciduous. Inflorescence a cyme, axillary, 2 or 3-flowered, clustered. Flowers 3.5–4 cm long. Calyx tubular, 1.5–2 cm long, 5-toothed, densely stellate-hairy, green. Petals 5, 3.5–5 cm long, somewhat 2-lipped with long claws, often auricled, reflexed, 2 lower shorter and broader than the 3 upper ones, scarlet to orange. Staminal column 3–4 cm long, adnate to gynophore, slightly bent on one side at the tip, exserted; stamens 10, surrounding ovary and alternating in pairs with 5 minute, scaly staminodes attached to the staminal tube. Carpels on a very elongated gynophore; ovary 5-lobed, 5-loculed; styles united, as long as the ovary, deflexed. Follicles 4–8 × 0.5–1 cm, cylindrical, spirally twisted with an apical beak, up to 1 cm long on *c.* 2.5 cm long androgynophore, stellate-tomentose. Seeds many, *c.* 2 mm long, angular, wrinkled, tomentose.

*Fl. & Fr.*: September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; common. INDIA: Throughout. WORLD: Australia, Bangladesh, Bhutan, China, Nepal, Pakistan, Sri Lanka and Southeast Asia.



**Fig. 36.** *Helicteres isora* L.: a. fruiting twig; b. flower; c. calyx; d. petal; e. stamen; f. carpel.

*Specimen examined:* Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49564.

7. **HIBISCUS** L., nom. cons.

Tropical and subtropical regions, c. 675 species, c. 30 in India, 12 in Jharkhand and 3 in KWLS.

**Key to species**

1a. Corolla white

**1. *H. lobatus***

1b. Corolla yellowish, purple at centre

**2. *H. sabdariffa***

**1. *Hibiscus lobatus*** (Murray) Kuntze, Revis. Gen. Pl. 3, 2: 19. 1898; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 336, f. 95. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 194. 2000; N.P. Singh & al., Fl. Bihar: 62. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 99. 2002. *Solandra lobata* Murray, Commentat. Soc. Regiae Sci. Gott. 6: 20, t. 1. 1785. *Hibiscus solandra* L'Hér., Strip. Nov. 1: 103, t. 49. 1788; Masters in Hook.f., Fl. Brit. India 1: 336. 1874; Haines, Bot. Bihar Orissa: 66. 1921.

**Plate 37F**

Herb, 20–100 cm high. Stems terete, erect, pubescent with short white hair. Leaves simple, alternate, lower leaves ovate, upper ones 3-lobed, lobes slightly to deeply lobed, 2–7 × 1.5–6.6 cm, cordate at base, crenate or coarsely serrate at margins, acute to acuminate at apex, with short and long hair; petioles 1.2–8 cm long with short and long hairs; stipules linear to filiform, 4–8 mm long, hairy. Inflorescence axillary, solitary, rarely in terminal racemes; pedicels 0.5–1 cm long. Epicalyx segments 6–8, c. 1 mm in bud, caducous before anthesis. Calyx campanulate, 5-lobed; lobes lanceolate, 6–8 × 1–2 mm, acute at apex, 3-veined, densely hispid outside, glabrous inside. Petals 5, obovate, 1.2–1.5 × 0.6–1 cm, glabrous, white. Staminal column 6–10 mm long, antheriferous throughout, white; stamens 1–1.5 mm long; free anthers c. 0.5 mm long, bilobed, dorsifixed, whitish yellow. Carpels 1–1.2 cm long; ovary dome-shaped, c. 2 × 1–1.5 mm; stigma 5-fid, c. 1 mm long; style slender, c. 1 mm long. Capsules ovoid, 10–15 mm long, stellate-hairy outside, 5-valved, valves smooth inside; locules 3 or 4-seeded. Seeds globose or subglobose, c. 1.5 × 1.3 mm, tubercled or versucose, glabrous, black.

*Fl. & Fr.:* September – December.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Muglamaram forest; common. INDIA: Almost throughout. WORLD: Africa, Bhutan, China, Madagascar, Malaysia, Myanmar, Nepal, Pakistan and Sri Lanka.

*Specimen examined:* Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49509.

**2. *Hibiscus sabdariffa*** L., Sp. Pl. 2: 695. 1753; Masters in Hook.f., Fl. Brit. India 1: 340. 1874; Haines, Forest Fl. Chota Nagpur: 191. 1910 & Bot. Bihar Orissa: 67. 1921; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 391. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 196. 2000; N.P. Singh & al., Fl. Bihar: 63. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 100. 2002.

**Plate 38A**

Herb, 1–2 m high. Stems erect, terete, branched, glabrous, green or pinkish purple. Leaves simple, alternate, deeply palmately 3-lobed, rarely 5-lobed, cuneate at base; mid-lobes broadest and longest, lanceolate, 3.5–8.5 × 0.6–3.7 cm, serrate at margins, acute to acuminate at apex; lateral lobes 1.5–7.5 × 0.2–2 cm, glabrous, 3(–5)-palmate-veined; petioles 2–6.2 cm long,

glabrous, green; stipules linear, *c.* 1.3 cm long. Inflorescence a racemose panicle, or flowers solitary, axillary; pedicels 1–2 cm long, jointed. Epicalyx 10, adnate to base of calyx, lanceolate to oblong-elliptic, 1–1.3 cm long, persistent, green or purple. Calyx campanulate; lobes 5, 1.5–2 × 0.2–0.3 cm in flowers and *c.* 4 × 1 cm in fruits, persistent, dark pinkish. Corolla yellowish, purple at centre; petals 4–5 cm long. Staminal column shorter than petals. Capsules ovoid, *c.* 1.5 cm across, densely strigose. Seeds reniform, 3.5–4 × 5–5.5 mm, furfuraceous, light brownish.

*Fl. & Fr.*: November – January.

*Habitat*: Planted near village.

*Distribution*: KWLS: Near the old church, Koderma NRF; not common. INDIA: Cultivated throughout. WORLD: Cultivated throughout subtropical regions.

*Specimen examined*: Near the old church, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 30th November 2012, *Shyam Biswa* 54113.

## 8. MALVA L.

Cosmopolitan, *c.* 20 species, 5 in India and 1 in Jharkhand.

**Malva parviflora** L. var. **microcarpa** (Pers.) Loscos, *Trat. Pl. Aragon* 2: 203. 1877; Borss.Waalk., *Blumea* 14: 150. 1966; T.K. Paul, *Bull. Bot. Surv. India* 27: 242. 1987. *M. microcarpa* Pers., *Syn. Pl.* 2: 251. 1806; Abedin, *Fl. Pakistan* 130: 41. 1979. **Fig. 37, 38**

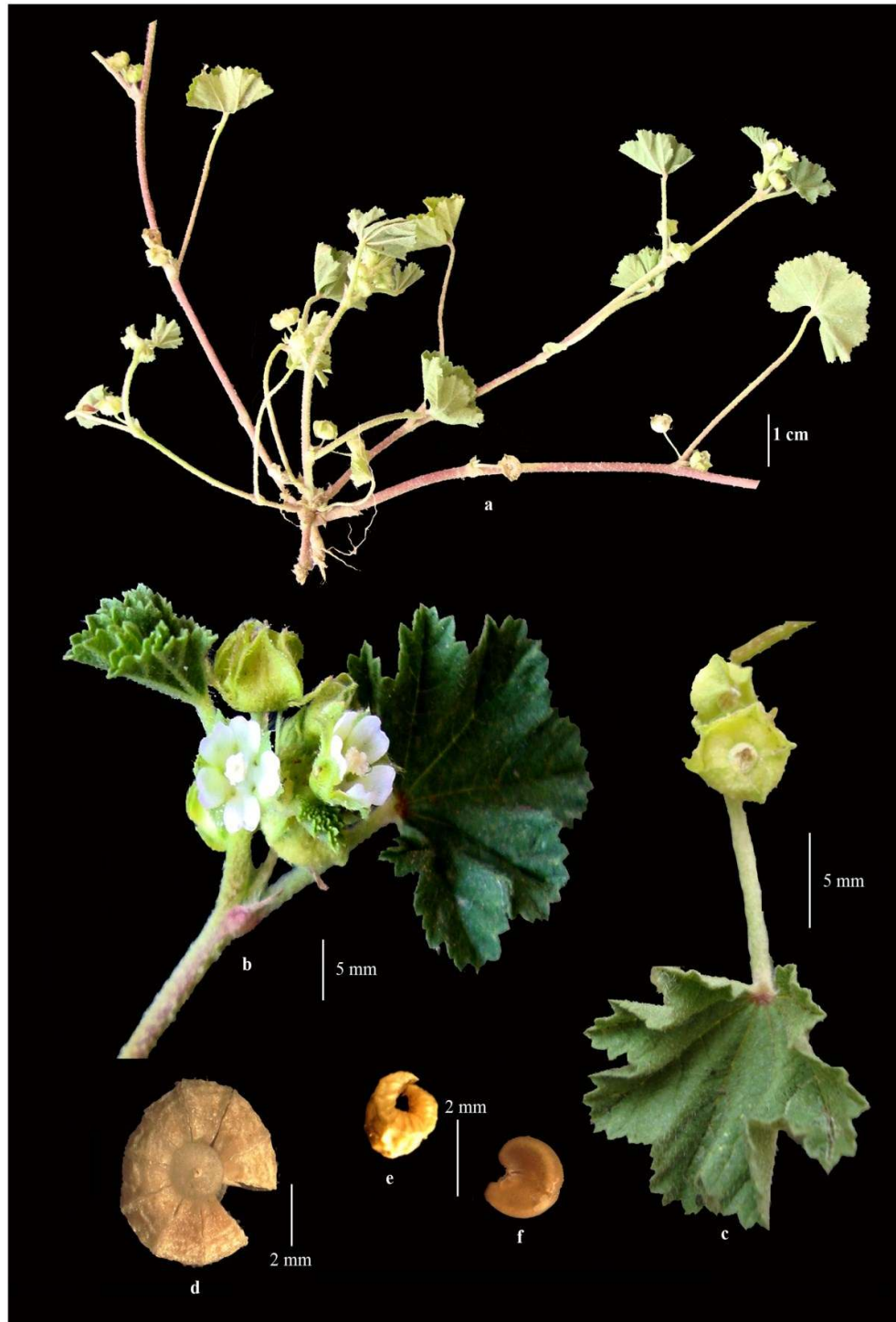
Annual, semi-erect or spreading; roots woody. Stems branched at base, terete, ribbed with scattered simple and stellate hairs. Leaves simple, alternate, suborbicular to ovate, 3–5-lobed (usually 5-lobed), 0.6–1.5 × 1–2.5 cm, cordate at base, dentate at margins, obtuse to rounded at apex, palmately 5–7-veined from base, scattered stellate-hairy, especially more on the lower surface; petioles 1–5 cm long, stellate-hairy; stipules lanceolate to deltoid, 1–3 mm long, acuminate at apex, hairy. Flowers solitary or in pairs, axillary, *c.* 1.2 cm across; pedicels *c.* 1.1 cm long, stellate-hairy. Epicalyx segments 3, linear, 2–3 mm long with simple hairs, caducous, half portion free from calyx, greenish. Calyx persistent, 1–2 cm across, 5-lobed, stellate-hairy outside, glabrous inside. Petals 5, obovate, 3–4 × 2–2.5 mm, emarginate at apex, white-glabrescent. Staminal column 2–2.5 mm long, antheriferous towards the apical portion, glabrous. Carpels *c.* 3 mm long; ovary globose; style *c.* 2 mm long, light brownish. Schizocarps *c.* 6 × 5 mm, margins keeled on the back, rarely slightly winged, dorsally prominently reticulate-veined, glabrous, indehiscent with 10 mericarps; mericarps *c.* 2 mm long, reniform, trigonous with sharp angles. Seeds reniform, *c.* 1.8 × 1.5 mm, smooth, glabrous, brownish.

*Fl. & Fr.*: February – April.

*Habitat*: Damp or water-logged places.

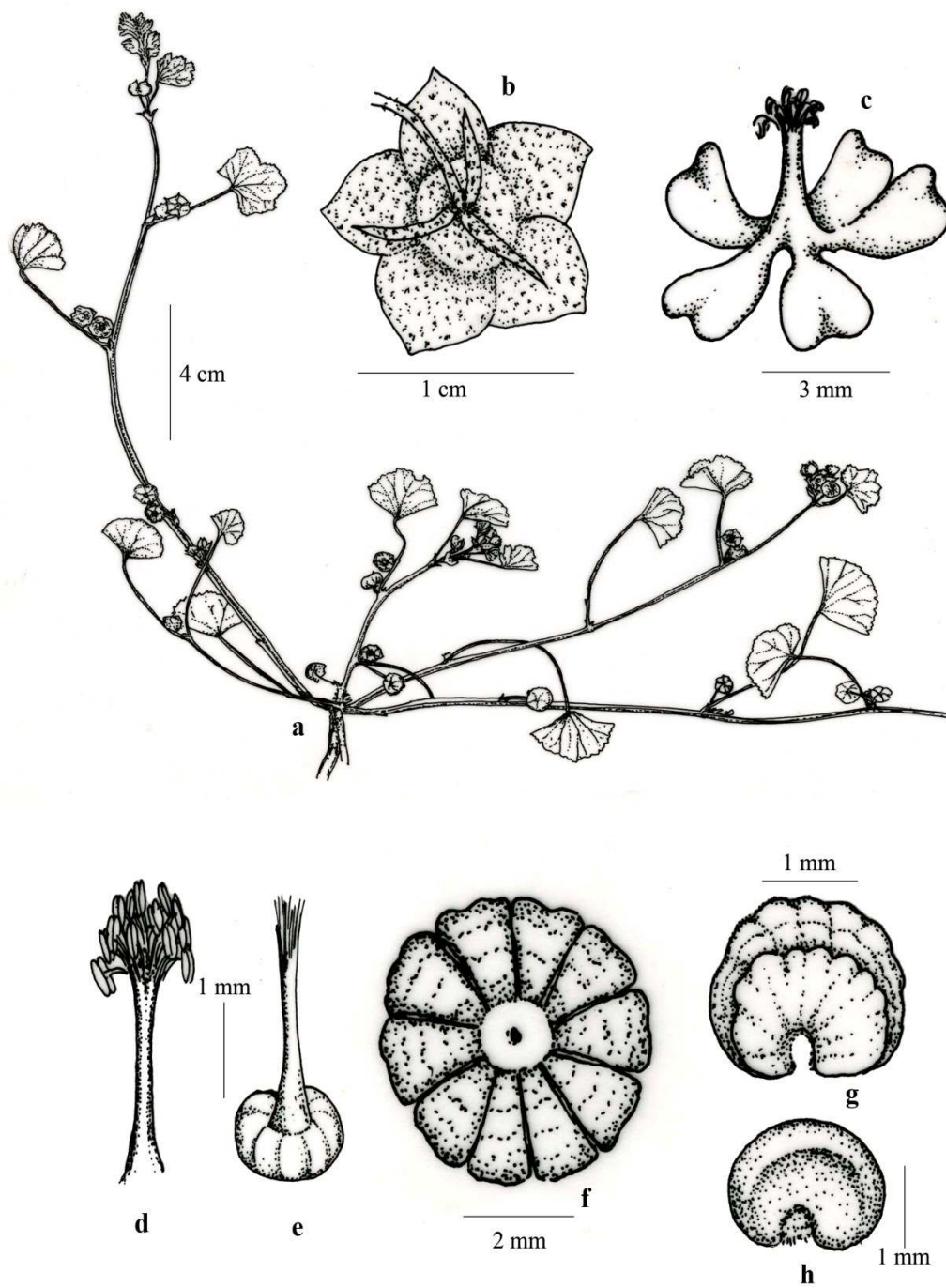
*Distribution*: KWLS, Phoolwarya forest. INDIA: Rajasthan and West Bengal. WORLD: Native of Mediterranean region, Malesia and Pakistan.

*Specimen examined*: INDIA: Jharkhand, Koderma district, Phoolwarya forest, Koderma NRF, 396 m, 24°29'04.4" N, 85°36'00.0" E, 10.3.2011, *Shyam Biswa* 49745 (CAL).



**Fig. 37. *Malva parviflora* var. *microcarpa* (Pers.) Loscos:** a. habit; b. flowering twig; c. fruiting twig; d. fruit; e. single mericarp; f. seed.





**Fig. 38. *Malva parviflora* var. *microcarpa* (Pers.) Loscos:** a. habit; b. epicalyx and calyx (lower surface); c. flower (calyx removed); d. staminal column; e. carpel; f. fruit; g. single mericarp; h. seed.

9. **MELOCHIA** L., nom. cons.

Tropical regions, especially America, c. 60 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Melochia corchorifolia** L., Sp. Pl. 2: 675. 1753; Masters in Hook.f., Fl. Brit. India 1: 374. 1874; Haines, Forest Fl. Chota Nagpur: 209. 1910 & Bot. Bihar Orissa: 82. 1921; Malick in B.D. Sharma & Sanjappa, Fl. India 3: 441. 1993; Paria & Chattopadhyay, Fl. Hazaribagh: 177. 2000; N.P. Singh & al., Fl. Bihar: 177. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 114. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 46. 2014. **Plate 38B**

Vern. Name: *Bilpat* (Hindi).

Herb or undershrub, 40–90 cm high. Stems terete, a few hairs to glabrous, reddish brown. Leaves simple, alternate, ovate, ovate-lanceolate, lanceolate, oblong-ovate or orbicular, 0.6–3.5 × 0.5–2 cm, rounded or cuneate to tapering at base, irregularly serrate at margins, acute at apex, 3–5-veined at base, glabrous, slightly punctate; petioles 0.1–3.5 cm long. Inflorescence clustered or terminal peduncled, small heads surrounded by 4 or 5 bracteoles. Flowers 5–6 mm long. Sepals 5, lanceolate, 1–2 mm long, connate at base, ciliate at margins, hairy outside. Petals 5, obovate to spatulate, 5–6 mm long, white. Stamens 5, connate beneath; filaments 1–2.5 mm long; anthers c. 1 mm long, basifixed, extrorse. Carpels 2–2.5 mm long; ovary sessile, c. 1–1.5 mm long, hairy, 5-loculed; styles short; stigma 5 or 6 fid. Capsules globose or subglobose, 5–6 mm across, pubescent, loculicidally 5-valved. Seeds 1 in each locule, trigonous, c. 1.5 × 2 mm, reddish brown.

*Fl. & Fr.*: September – November.

*Habitat*: Near the lakes or stagnant waters.

*Distribution*: KWLS: Rheio Ghoghar Dam, Chattarbar; Muglamaram forest; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 29th November 2012, *Shyam Biswa* 54105; Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49508.

10. **SIDA** L.

Tropical and subtropical regions, especially America, c. 250 species, 12 in India, 8 in Jharkhand and 2 in KWLS.

**Key to species**

- |                                                              |                             |
|--------------------------------------------------------------|-----------------------------|
| 1a. Stipules of each pair dissimilar; mericarps awned        | <b>1. <i>S. acuta</i></b>   |
| 1b. Stipules of each pair similar; mericarps muticous-beaked | <b>2. <i>S. cordata</i></b> |

**1. *Sida acuta*** Burm.f., Fl. Ind.: 147. 1768; Haines, Forest Fl. Chota Nagpur: 184. 1910 & Bot. Bihar Orissa: 61. 1921; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 281, f. 76. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 201. 2000; N.P. Singh & al., Fl. Bihar: 67. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 103. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 43. 2014. *Sida carpinifolia* sensu Masters in Hook.f., Fl. Brit. India 1: 323. 1874, non L.f., 1782. **Plate 38C**

Vern. Name: *Kureta* (Hindi).

Herb, erect or ascending, 20–80 cm high; branches terete, slender, minutely stellate-pubescent and sparsely with simple hairs when young, glabrescent later. Leaves simple, alternate, oblong-lanceolate to linear-lanceolate,  $2-8.5 \times 0.6-4$  cm, subacute, obtuse or rounded at base, serrate or dentate at margins, acute or subacuminate at apex, sparsely stellate-hairy, becoming glabrescent soon; petioles 3–6 mm long, stellate-pubescent; stipules in pairs,  $5-12 \times 1-1.5$  mm; each pair different with one linear to lanceolate, 3–6-veined and another linear to filiform 1–4-veined stipules. Flowers solitary or 2 or 3 together in clusters, axillary, *c.* 1.5 cm across; pedicels jointed above middle, accrescent, 0.5–1 cm long (longer in fruits), stellate-pubescent. Calyx campanulate, 5–8 mm long, divided almost half-way down, 5-lobed; tube *c.* 4 mm long; lobes triangular, sharply acute, to 3.5 mm long. Petals obliquely obovate, to 1 cm long, ciliate at base, truncate to emarginate at apex, yellow. Staminal column to 3 mm long, antheriferous towards apex. Ovary ovoid, *c.* 1 mm across, 5 or 6-loculed; style *c.* 5 cm long. Schizocarps globose, to 5 mm, wrinkled, glabrous; mericarps 6–10, tetrahedral, to 5 mm long, toothed on dorsal margins, reticulated, 2-awned; awns *c.* 3 mm long, glabrous, dehiscing apically. Seeds trigonous, 1.5–2 mm long, smooth, dark brown.

*Fl. & Fr.*: September – February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; very common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Muglamaram forest, 385 m,  $24^{\circ}29'16.0''$  N,  $85^{\circ}34'39.8''$  E, 3rd September 2010, *Shyam Biswa* 49507.

**2. *Sida cordata*** (Burm.f.) Borss.Waalk., *Blumea* 14: 182. 1966; T.K. Paul in B.D. Sharma & Sanjappa, *Fl. India* 3: 283, f. 77. 1993; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 203. 2000; N.P. Singh & al., *Fl. Bihar*: 67. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 104. 2002; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 43. 2014. *Melochia cordata* Burm.f., *Fl. Ind.*: 143. 1768. *Sida veronicifolia* Lam., *Encycl.* 1: 5. 1783; Haines, *Forest Fl. Chota Nagpur*: 182. 1910 & *Bot. Bihar Orissa*: 59. 1921. *Sida humilis* Cav., *Diss.*: 5, t. 134, f. 2. 1788; Masters in Hook.f., *Fl. Brit. India* 1: 322. 1874.

**Plate 38D**

Vern. Name: *Bonaniyar* (Hindi).

Herb, prostrate or ascending. Stems branched, terete with scattered long patent hairs, simple and minute stellate hairs. Leaves simple, alternate, orbicular to ovate,  $0.7-2.5 \times 1-2.7$  cm, cordate at base, serrate or crenate-dentate at margins, acute, acuminate or rounded at apex, 5–7-veined at base, hairy on both surfaces; petioles 0.5–2.5 cm long, hairy; stipules filiform, 1–5 mm long, hairy. Inflorescence a raceme, axillary, few-flowered, either by development of accessory buds or by reduction of upper leaves. Flowers  $6-8 \times c.$  10 mm; pedicels 1–1.2 cm long, hairy. Epicalyx absent. Calyx campanulate, 5–6 mm long, 5-lobed; lobes triangular, ciliate at margins, acuminate at apex, 1-veined, hairy outside, glabrous inside. Petals obovate,  $4-5 \times c.$  4 mm, yellow. Staminal column 3–4 mm long; filaments 1–1.5 mm long. Carpels 4–5 mm long; ovary ovoid or globular, *c.*  $1 \times 1$  mm; style *c.* 1.5 cm long, slender; stigma 5-fid, 2–2.5 mm long. Schizocarps subglobose, *c.*  $4 \times 3$  mm, enclosed in persistent calyx, brownish black; mericarps 5, *c.*  $4 \times 2$  mm, slightly longitudinally keeled on the back, tetrahedral with rounded angles, awnless. Seeds *c.*  $2 \times 1$  mm, glabrous, dispersed by withering of wall, brownish black.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near Pesara mica mining area, Suggi forest; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near Pesara mica mining area, Suggi forest, 274 m, 24°33'11.4" N, 85°35'29.1" E, 15th August 2011, *Shyam Biswa* 49804.

## 11. TRIUMFETTA L.

Tropical regions, *c.* 150 species, 8 in India, 4 in Jharkhand and 1 in KWLS.

**Triumfetta rhomboidea** Jacq., Enum. Syst. Pl.: 22. 1760; Masters in Hook.f., Fl. Brit. India 1: 395. 1874; Haines, Forest Fl. Chota Nagpur: 203. 1910 & Bot. Bihar Orissa: 85. 1921; P. Daniel & Chandrab. in B.D. Sharma & Sanjappa, Fl. India 3: 520. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 171. 2000; N.P. Singh & al., Fl. Bihar: 83. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 124. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 52. 2014.

**Plate 38F**

Vern. Name: *Chikiti* (Hindi).

Herb or undershrub, 0.5–1 m high. Stems terete, branched, pubescent with long, straight and stellate hairs. Leaves simple, alternate, rhombic-ovate, ovate-lanceolate or orbicular, 1–6.1 × 0.8–6 cm, slightly cordate to cuneate at base, irregularly serrate at margins, acuminate at apex, 3–5-veined at base, pubescent with simple and a few stellate hairs; stipules lanceolate, 3–4 mm long; petioles to 4 mm long, fine hairy. Inflorescence a cyme, terminal or leaf-opposed. Flowers 3–4 mm long; pedicels 1–2 mm long, hairy. Sepals 5, oblong, 2.5–3.5 × *c.* 0.5 mm, apiculate at apex, glabrous, yellow. Petals 5, oblong-obovate, 3–4 × 0.5–0.8 mm, simple and stellate-hairy beneath, bright yellow. Stamens 5, free, 1.5–2 mm long, attached at the torus; anthers 0.3–0.5 mm long, dorsifixed, yellow. Carpels 2 or 3, 2–2.5 mm long; ovary roundish, *c.* 1 mm with spines; style subulate, 1–6.5 mm long; stigma 2 or 3-lobed. Capsules globose or subglobose, 3.5–4 mm across, spinescent; spines 0.5–3 mm long, tip with white hook. Seeds 1 or 2 in each locule, ovoid, *c.* 3 × 2.5 mm.

*Fl. & Fr.*: November – January.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Baghitan forest; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Baghitan forest, 392 m, 24°29'20.3" N, 85°35'50.7" E, 20th November 2012, *Shyam Biswa* 54065.

## 12. URENA L.

Tropical regions, 6–8 species, 2 in India, 2 in Jharkhand and KWLS.

### Key to subspecies

1a. Leaves unlobed to shallowly lobed

**1. U. lobata** subsp. **lobata**

1b. Leaves lobed (usually 5) beyond the middle

**2. U. lobata** subsp. **sinuata**

**1. Urena lobata** L., Sp. Pl. 2: 692. 1753; subsp **lobata**; Masters in Hook.f., Fl. Brit. India 1: 329. 1874; Haines, Forest Fl. Chota Nagpur: 184. 1910 & Bot. Bihar Orissa: 62. 1921; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 380, f. 109. 1993; Paria & Chattopadhyay, Fl. Hazaribagh

1: 210. 2000; N.P. Singh & al., Fl. Bihar: 69. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 108. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 44. 2014. **Plate 38G**

Vern. Name: *Bachita* (Hindi).

Undershrub or shrub, annual or perennial, 0.5–2 m high. Stems terete, branched, hairy. Leaves simple, alternate, ovate to orbicular, unlobed to shallowly 3–5 or more-lobed,  $1.2\text{--}5 \times 1\text{--}6$  cm, shallowly cordate or rounded at base, serrate to crenate at margins, obtuse, acute to acuminate at apex, hairy above, densely hairy with stellate hairs beneath; petioles 0.5–2.7 cm long, hairy; stipules 2–4 mm long, acute, hairy. Flowers solitary or 2 or 3 in clusters, *c.* 2 cm long; pedicels 1–5 mm long, hairy. Epicalyx segments 5, lanceolate,  $5\text{--}6 \times 1\text{--}1.5$  mm, shortly adnate at base, enveloping the calyx, hairy towards upper half. Calyx campanulate, 5-lobed; lobes ovate to lanceolate,  $4\text{--}5 \times 1.5\text{--}2$  mm, minute-hairy outside. Corolla pinkish with a purple centre; petals 5, obovate,  $1\text{--}1.5 \times c.$  0.5 cm, rounded at apex, glabrous. Staminal column 0.8–1.2 cm long, antheriferous towards tip. Carpels 9–12 cm long; ovary globose, 5-loculed; ovule 1 in each locule; styles 9–10 mm long, divided into 10 arms near apex, reflexed; stigmas discoid or capitate. Schizocarps globose, 5–10 mm, glochidiate with 3–5 retrorse short, sharp hooks at the top; mericarps  $5\text{--}7 \times 3\text{--}4$  mm, hairy. Seeds reniform, 3–5 mm long, minutely crystal hairy or glabrous, brownish.

*Fl. & Fr.*: August – February.

*Habitat*: In the open forests and in Scrub forests.

*Distribution*: KWLS: Near Bherwa tan Lokai forest.

*Specimen examined*: Bherwa tan Lokai forest, 382 m,  $24^{\circ}28'57.6''$  N,  $85^{\circ}37'20.5''$  E, 24th February 2012, *Shyam Biswa* 49867.

**2. *Urena lobata* subsp. *sinuata* (L.) Borss.Waalk., Blumea 14: 142. 1966; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 382, f. 110. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 211. 2000; N.P. Singh & al., Fl. Bihar: 69. 2001. *Urena sinuata* L., Sp. Pl. 2: 692. 1753; Masters in Hook.f., Fl. Brit. India 1: 329. 1874 Haines, Forest Fl. Chota Nagpur: 185. 1910 & Bot. Bihar Orissa 63. 1921; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 109. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 44. 2014.**

**Plate 38 H & I**

Vern. Name: *Bhaat Phool*.

Undershrub, to 1.5 m high, annual or perennial. Stems terete, hairy. Leaves simple, alternate, ovate, usually palmately deeply 3–5-lobed,  $1.5\text{--}4.5 \times 1\text{--}10.5$  cm, rounded at base, oblong or lanceolate segments constructed at base and often pinnatifid, acute at apex, hairy above, densely stellate-hairy beneath; petioles 0.5–2.7 cm long, hairy; stipules 2–4 mm long, acute, hairy. Flowers solitary or 2–4 in clusters; pedicels 1–5 mm long, hairy. Epicalyx segments 5, linear to lanceolate,  $5\text{--}6 \times 1\text{--}1.5$  mm, shortly adnate at base, spreading or reflexed in fruits, hairy. Calyx campanulate, 5-lobed; lobes ovate to lanceolate,  $4\text{--}5 \times 1.5\text{--}2$  mm, hairy outside. Corolla pinkish with purple centre; petals 5, obovate,  $1\text{--}1.5 \times 0.5$  cm, rounded at apex, glabrous. Staminal column 0.8–1.2 cm long, antheriferous towards tip. Carpels 9–12 cm long; ovary globose, 5-loculed; locules uniovulate; styles 9–10 mm long, divided into 10 arms near apex, reflexed; stigmas discoid or capitate. Schizocarps globose, 5–10 mm, glochidiate with 3–5 retrorse short, sharp hook at the top; mericarps  $5\text{--}7 \times 3\text{--}4$  mm, hairy. Seeds reniform, 3–5 mm long, minutely crystal hairy or glabrous, brownish.



*Fl. & Fr.*: September – November.

*Habitat*: Open forests.

*Distribution*: KWLS: Inside the enclosure forest, Koderma NRF; Bherwa tan, Lokai forest.

*Specimens examined*: Inside the enclosure forest, Koderma NRF, 390 m, 24°29'18.7" N, 85°35'15.1" E, 8th September 2010, *Shyam Biswa* 49600; Bherwa tan, Lokai forest, 387 m, 24°29'16.2" N, 85°35'45.0" E, 19th November 2012, *Shyam Biswa* 54059.

## 56. BIXACEAE Kunth, nom. cons.

Tropical regions, 4 genera and 21 species; 2 genera and 2 species in India.

### COCHLOSPERMUM Kunth

Tropical regions, 12 species and 1 in India.

***Cochlospermum religiosum* (L.) Alston**, Handb. Fl. Ceylon 6(suppl.): 14. 1931; N.P. Balakr. in B.D. Sharma & N.P. Balakr., Fl. India 2: 383, f. 71. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 218. 2000; N.P. Singh & al., Fl. Bihar: 45. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 76. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 34. 2014. *Bombax religiosum* L., Sp. Pl. 1: 512. 1753, '*religiosa*'. *Cochlospermum gossypium* DC., Prodr. 1: 527. 1824; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 190. 1872; Haines, Forest Fl. Chota Nagpur: 158. 1910 & Bot. Bihar Orissa: 34. 1921. **Plate 39A**

Vern. Names: *Galgol* (Hindi); *Hopo* (Kharwari).

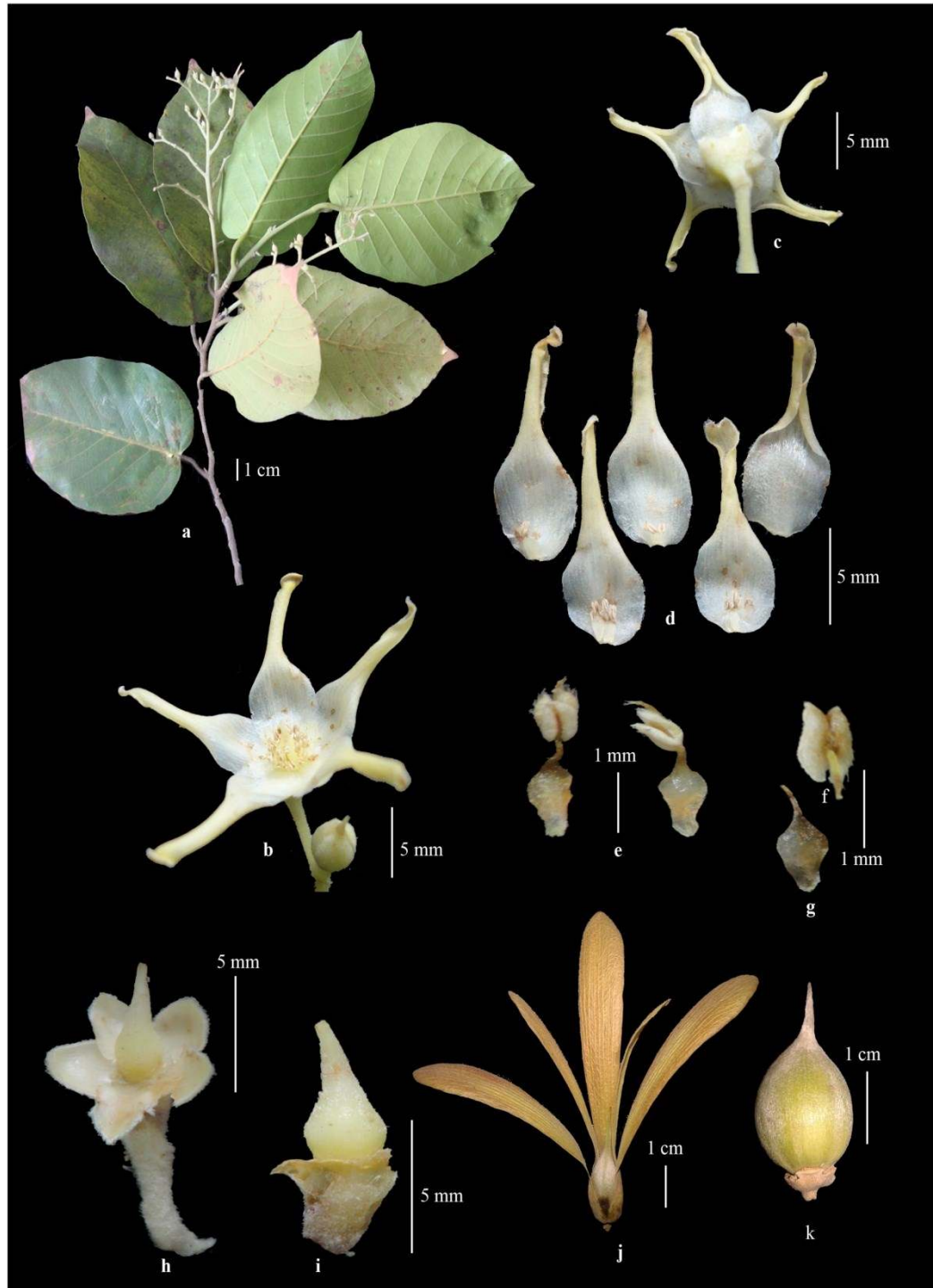
Tree, 6–8 m high; bark fluted, creamish; branchlets whitish smooth. Leaves simple, alternate, 6–20 cm in diam., cordate at base, entire to undulate at margins, palmately 3–5-lobed; lobes acute to subacuminate at apex, tomentose beneath when young, shining above; petioles 5–20 cm long; stipules linear, cauducous. Inflorescence terminal few-flowered panicles, bears large yellow flowers when tree leafless. Flowers 10.5–11 cm in diam.; pedicels 2–3 cm long, tomentose, pinkish; bracts deltoid arcuate, *c.* 3 mm long, cauducous. Sepals 5(2+3), unequal, small sepals 2, lanceolate, 1.4–1.6 × 0.5–0.6 cm, pinkish green; large sepals 3, elliptic-ovate, 2–2.1 × 1.2–1.5 cm, ciliate at margins, light yellowish with pink shade outside. Petals 5, *c.* 5.5 × 2.8–3 cm, emarginated, bright yellow. Stamens many in 8–10 clusters; filaments 1.5–1.8 cm long, orange-coloured; anthers falcate, 5–7 mm long, yellow. Ovary *c.* 4 mm long, 1-loculed with 3–5 parietal placentae; styles 2.5–2.7 cm long, yellowish; stigmas punctiform. Capsules obovoid or pear-shaped, 7–10 × *c.* 6 cm, longitudinally ribbed. Seeds many, reniform, 7–8 × 5–6 mm, brown.

*Fl. & Fr.*: March – June

*Habitat*: On hillslopes of Dry deciduous forest

*Distribution*.: KWLS: Phoolwarya forest; common. INDIA: Bihar, Madhya Pradesh, Maharashtra, Odisha, Uttar Pradesh, and throughout Southern India. WORLD: Cambodia, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Phoolwarya forest, 404 m, 24°29'04.8" N, 85°35'46.2" E, 26th March 2013, *Shyam Biswa* 54164.



**Fig. 39. *Shorea robusta* Roxb. ex C.F. Gaertn.:** a. flowering twig; b flower and flower bud; c. flower (back view); d. petals; e. stamens; f. anther; g. filament; h. calyx and carpel; i. carpel; j fruit; k. seed.

**57. DIPTEROCARPACEAE** Blume, nom. cons.

Tropical regions, especially Malesia, 17 genera and *c.* 535 species; 5 genera and *c.* 30 species in India.

**SHOREA** Roxb. ex C.F. Gaertn.

Sri Lanka to South China, Moluccas and Lesser Sunda Islands, 196 species, 4 in India and 1 in Jharkhand.

**Shorea robusta** Roxb. ex C.F. Gaertn., Suppl. Carp. 3: 48, t. 186. 1805; Dyer in Hook.f., Fl. Brit. India 1: 306. 1874; Haines, Forest Fl. Chota Nagpur: 178. 1910 & Bot. Bihar Orissa: 56. 1921; K.P. Janardh. in B.D. Sharma & Sanjappa, Fl. India 3: 237, f. 62. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 159. 2000; N.P. Singh & al., Fl. Bihar: 57. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 95. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 39. 2014.

**Fig. 39; Plate 39B**

Vern. Names: *Sal* (Hindi); *Sakuwa* (Kharwari).

Tree, 20–50 m high; bark longitudinally fissured, smooth in old trees, reddish brown or grey; branchlets tomentose. Leaves simple, alternate, ovate-oblong, 4–8.7 × 2.5–5.5 cm, rounded or cordate at base, entire at margins, short-acuminate at apex; lateral veins 9–12 pairs, prominent beneath, very short or few stellate hairs on both surfaces more so on veins; stipules falcate, *c.* 8 mm long, covering young buds; petioles 2–2.5 cm long. Panicles branching in axillary or terminal racemes, densely pubescent. Flowers subsessile, 2–2.5 cm across; flower buds densely pubescent. Sepals ovate or triangular, 2.5–3 × 2–3 mm, ciliate at margins, smooth, glossy inside, yellowish pubescent outside. Petals 5, lanceolate, 1–1.5 × *c.* 0.5 cm, acuminate with a twisted acumen at apex, parallel-veined, glabrous inside, silky hairy outside, yellowish white or cream. Stamens 30–32, free; filaments 2–3 mm long, swollen at base but slender below; anthers basifixed, hairy, 2-celled, dehiscing laterally; connective elongated above cells, *c.* 1 mm long. Carpels 4–5 mm long; ovary globose, *c.* 1 mm, pubescent; style subulate, *c.* 1.5 mm long; stigma tridentate, 3-. Fruits indehiscent, 1-seeded; belly ovoid, 1–1.5 cm long, densely pubescent; three larger wings, 6–8 × 1.5–2 cm; smaller wings 2, oblong or spatulate, *c.* 3.5 × 0.5 cm, obtuse, 10–12-veined, pubescent.

*Fl. & Fr.*: March – July.

*Habitat*: Dry deciduous Sal forests.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; near the Forest Rest house, Koderma NRF; common. INDIA: Bihar, Odisha, and Eastern districts of Madhya Pradesh, extending further south to the Eastern Ghats in Andhra Pradesh, up to an elevation of 900 m. WORLD: Bhutan, China and Nepal.

*Specimens examined*: Near Dhanarjay Nadi, Meghatari, 184 m, 24°34'39.3" N, 85°34'48.4" E, 7th March 2011, *Shyam Biswa* 49708; near the Forest Rest House, Koderma NRF, 401 m, 24°28'46.6" N, 85°36'57.3" E, 3rd March 2012, *Shyam Biswa* 54166.

**58. MORINGACEAE** Martinov, nom. cons.

Semi-arid Africa to Asia, 1 genus and 13 species; 2 species in India and Jharkhand and 1 in KWLS.

**MORINGA** Adans.

13 species, semi-arid Africa to Asia; 2 species in Jharkhand (cultivated) and 1 in KWLS.

**Moringa oleifera** Lam., Encycl. 1(2): 398. 1785; N.P. Singh & al., Fl. Bihar: 119. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 163. 2002. *Moringa pterygosperma* Gaertn., Fruct. Sem. Pl. 2: 314. 1791; Hook.f., Fl. Brit. India 2: 45. 1876; Haines, Forest Fl. Chota Nagpur: 174. 1910 & Bot. Bihar Orissa: 225. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 262. 2000. **Plate 39C**

Vern. Name: *Sajjana* (Hindi).

Tree, 5–10 m high. Leaves alternate, tripinnately imparipinnate, 15–30 cm long; leaflets 3–11, obovate or elliptic, 0.6–1.5 × 0.3–1 cm, obtuse or rounded at base, entire at margins, obtuse or rounded at apex, tomentose on both surfaces, terminal leaflet larger than the lateral ones; leaf rachis hairy; stipules and stipulules reduced into stipitate glands, linear, 1–2 mm long, hairy. Panicles axillary, erect, 20–30 cm long. Flowers 2–2.5 mm across, white, fragrant; pedicels 1–3 cm long. Calyx tube 3–4 mm, hairy, 5-lobed; lobes linear-lanceolate, 1–2 × 0.5–0.7 cm, reflexed. Petals 5, unequal, white; anterior petal erect 1.8–2 × 0.7–0.8 cm; lateral petals 1–2 × 0.5–0.7 cm, reflexed. Stamens 5, alternating with staminodes, 7–8 mm long; filaments hairy at base; anthers c. 2.5 mm long, dorsifixed, yellowish. Ovary superior, 1-loculed; ovules 10–20, on 3 parietal placentae; style cylindric, villous; stigma minute. Capsules elongated, 15–30(–45) cm long, rostrate, torulose, pendent, ribbed, 3-valved, green. Seeds ovoid, c. 1 cm long, 3-winged; wings hyaline, to 7 mm wide.

*Fl. & Fr.*: March – June.

*Habitat*: Near the villages.

*Distribution*: KWLS: Meghatari, near the village; common. INDIA: Almost throughout. WORLD: Native to India; cultivated in many tropical countries.

*Specimen examined*: Meghatari, near the village, 212 m, 24°35'23.8" N, 85°34'55.8" E, 2nd March 2012, *Shyam Biswa* 54043.

*Note*: Haines had mentioned stipules, but glands usually present at the base of the leaves and leaflets, but the specimens of KWLS observed interpetiolar stipe between the leaflets and its hairy.

## 59. CAPPARACEAE Juss., nom. cons.

Tropical, subtropical, and few Temperate arid regions, 19 genera and c. 510 species; 7 genera and c. 55 species in India.

### CAPPARIS L.

Tropical and subtropical regions, c. 250 species, 26 in India, 2 in Jharkhand and 1 in KWLS.

**Capparis zeylanica** L., Sp. Pl. 2: 720. 1762; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 98. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 250. 2000; N.P. Singh & al., Fl. Bihar: 42. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 73. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 32. 2014. *Capparis horrida* L.f., Suppl. Pl.: 264. 1782; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 178. 1872; Haines, Forest Fl. Chota Nagpur: 157. 1910 & Bot. Bihar Orissa: 31. 1921. **Fig. 40; Plate 39D**

Vern. Names: *Ardanda* (Hindi); *Bagnahim* (Kharwari); *Bagnahi*.

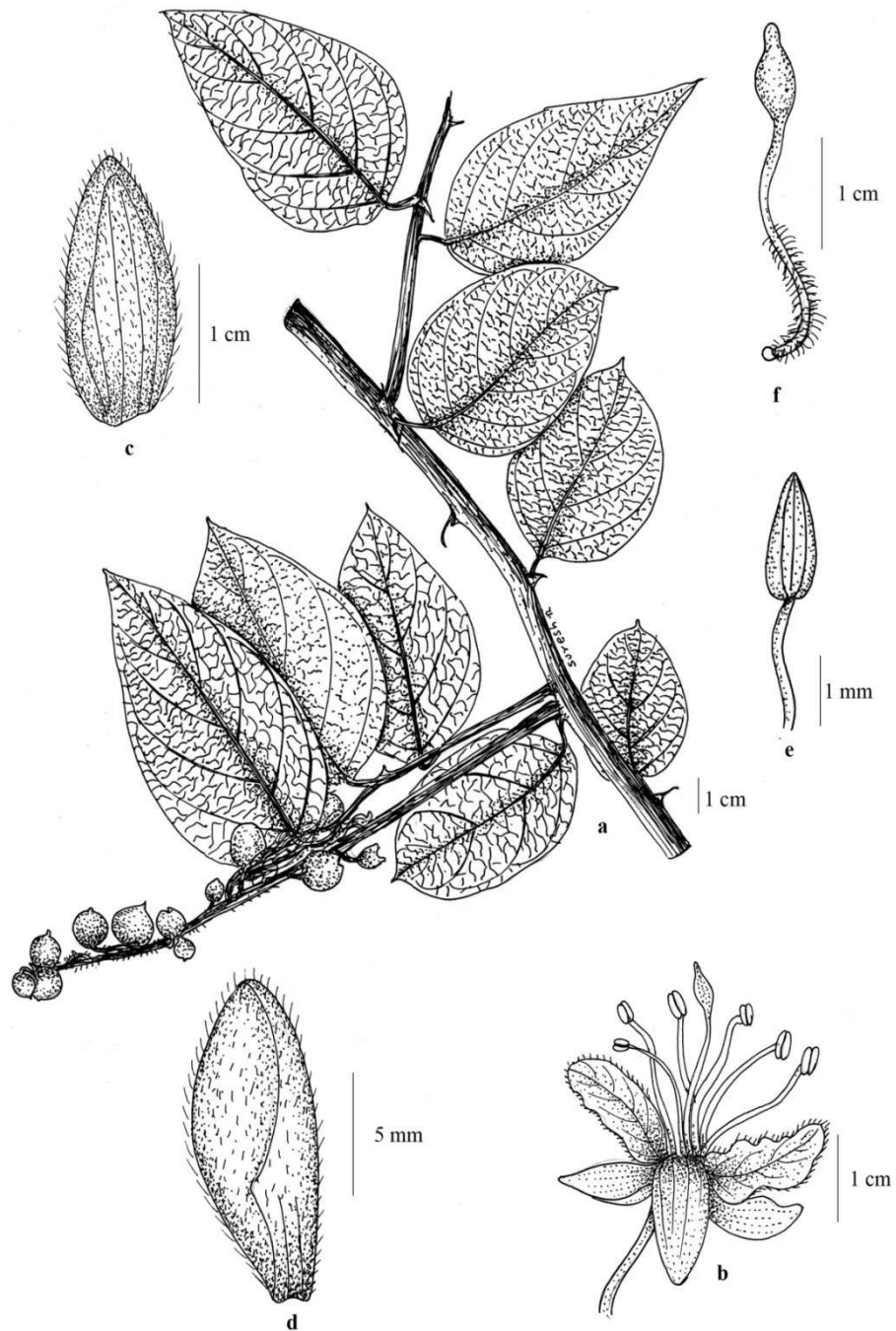


Fig. 40. *Capparis zeylanica* L.: a. fruiting twig; b. flower; c. sepal; d. petal; e. stamen; f. carpel.



Climbing shrub. Stems terete, armed with spines, white-tomentose towards apex. Leaves simple, alternate, ovate,  $1.5\text{--}3.5 \times 0.7\text{--}1.8$  cm, tapering at base, entire at margins, caudate at apex with two adjacent curved downwards spines; petioles 5–6 mm long. Flower solitary, axillary, 4–5 cm across; pedicels *c.* 1.5 cm long, hairy. Sepals 4, lanceolate,  $10\text{--}12 \times 5\text{--}8$  mm, truncate at base, acute at apex, hairy. Petals 4, oblong,  $1.6\text{--}1.8 \times 0.6\text{--}0.8$  cm, white tomentose, off white. Stamens numerous, 3–3.2 cm long, free at base of the gynophore; filaments about twice as long as the petals, smooth, light pinkish; anthers basifixed, *c.*  $2 \times 1$  mm, dark purplish. Carpels 3–3.5 cm long; ovary glabrous, ellipsoid or ovoid,  $1.5\text{--}2.5 \times 1\text{--}1.5$  mm. Berries ovoid or oblong, *c.*  $5 \times 4$  cm, smooth, reddish orange; stipe  $5\text{--}8 \times 0.4\text{--}0.5$  cm. Seeds many,  $5\text{--}7 \times 4\text{--}6$  mm, embedded in scarlet pulp.

*Fl.*: March – April; *Fr.*: May – August.

*Habitat*: Scrub forests.

*Distribution*: KWLS: Khamba R.F.; common. INDIA: Throughout. WORLD: Bangladesh, Indian Ocean Islands, Indonesia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Khamba R.F., 313 m,  $24^{\circ}33'01.5''$  N,  $85^{\circ}34'34.6''$  E, 1st April 2013, *Shyam Biswa* 54139.

## 60. CLEOMACEAE Bercht. & J. Presl

Tropical and subtropical regions, *c.* 10 genera and *c.* 300 species; 1 genus and *c.* 15 species in India.

### CLEOME L.

Tropical and subtropical regions, *c.* 250 species, 15 in India, 4 in Jharkhand and 1 in KWLS.

**Cleome viscosa** L., Sp. Pl. 2: 672. 1753; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 170. 1872; Haines, Forest Fl. Chota Nagpur: 157. 1910 & Bot. Bihar Orissa: 29. 1921; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 317. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 253. 2000; N.P. Singh & al., Fl. Bihar: 42. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 74. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 33. 2014. **Plate 39E**

Herb, erect, 20–90 cm high. Stems roundish, ribbed, pubescent and glandular-hairy all over. Leaves alternate, palmately 3–5-foliolate; leaflets ovate, obovate or rhomboid,  $0.5\text{--}4.5 \times 0.3\text{--}1.7$  cm, tapering or cuneate at base, entire with glandular hair at margins, acute at apex, central leaflets larger than the lateral ones, few glandular hairs above, glandular-hairy only on veins beneath; petioles 0.5–6 cm long, glandular-hairy. Flowers solitary or in axillary raceme. Flowers 5–8 mm long; pedicels 0.5–2.5 cm long, glandular-pubescent. Sepals 4, lanceolate  $5\text{--}7 \times 1\text{--}1.5$  mm, glabrous inside, few glandular hair outside, distinctly veined. Petals 4, spatulate or obovate,  $8\text{--}10 \times 2.5\text{--}3$  mm, glabrous, prominently 3–5-veined, yellow. Stamens 12 or more, free, arising from the base; filaments 6–7 mm long, slender; anthers 1.5–2 mm long, dorsifixed, 2-lobed, extrorse. Carpels 4–5 cm long; ovules many on 2-parietal placentae; style *c.* 1 mm long, persistent in fruit; stigma capitate. Capsules 5–7.5 cm long, ribbed/striate, tapering at ends, glandular-pubescent. Seeds many, reniform, *c.* 1.5 mm long, with transverse ridges, reddish black.

*Fl. & Fr.*: July – February.

*Habitat*: Dry deciduous forests.

*Distribution:* KWLS: Muglamaram forest; common. INDIA: Throughout. WORLD: Africa, America, Asia and Australia.

*Specimen examined:* Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49505.

**61. BRASSICACEAE** Burnett., nom. cons (=CRUCIFERAE Juss., nom. cons.)

Cosmopolitan, 321 genera and c. 3400 species; 64 genera and 207 species in India.

**Key to genera**

1a. Herb prostrate; Pods reniform, joined together, c. 1.5 × 2 mm, minutely notched at apex; seeds bean-shaped **1. *Lepidium***

1b. Herbs erect; siliquae linear-lanceolate or cylindric, 4.5–8 × 0.5–0.8 cm; seeds globular **2. *Raphanus***

**1. LEPIDIUM L.**

Cosmopolitan, c. 220, 10 in India, 2 in Jharkhand and 1 in KWLS.

***Lepidium didymum* L.**, Mant. Pl.: 92. 1767. *Coronopus didymus* (L.) Sm., Fl. Brit. 2: 691. 1800; Paria & Chattopadhyay, Fl. Hazaribagh 1: 258. 2000; N.P. Singh & al., Fl. Bihar: 37. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 70. 2002. *Senebiera pinnatifida* DC. in Mém. Soc. Hist. Nat. Paris: 144, t. 9. 1799; Haines, Bot. Bihar Orissa: 28. 1921. **Plate 40A**

Herb, prostrate or procumbent, annual or biennial. Stems ribbed, branched mostly from base, hairy. Leaves alternate, pinnatisect, 0.5–3.5 × 0.5–1 cm; lobes 3–5 per side, sinuate-toothed; basal and lower leaves petioled; cauline leaves sessile or subsessile. Racemes to 4 cm long, corymbose. Flowers minute, c. 1 mm across; pedicels short, 3–4 mm long in fruit, filiform. Sepals ovate, c. 0.5 mm long, scarious at margins. Petals shorter, spathulate. Stamens only 2 or 4, but only 2 fertile. Pods reniform, joined together, c. 1.5 × 2 mm, minutely notched at apex, broader than length, bilobed, valves globose, reticulately rugose, glabrous; septum very narrow, inconspicuous, c. 0.3 mm wide. Seeds bean-shaped, c. 1 mm long, brownish.

*Fl. & Fr.:* February – March.

*Habitat:* Moist and shady localities.

*Distribution:* KWLS: Lokai forest, near Birhore Tola; occasional. INDIA: Almost throughout. WORLD: Probably, native to South America, but widely introduced almost throughout the world.

*Specimen examined:* Lokai forest, near Birhore Tola, 382 m, 24°28'57.6" N, 85°37'20.5" E, 24th February 2012, *Shyam Biswa* 49868.

**2. RAPHANUS L.**

West and Central Europe to Central Asia, 3 species, 2 in India, 1 in Jharkhand (cultivated).

***Raphanus sativus* L.**, Sp. Pl. 2: 669. 1753; Hook.f. & T. Anderson in Hook.f., Fl. Brit. India 1: 166. 1872; Haines, Bot. Bihar Orissa: 28. 1921; Hajra & al. in Hajra & al., Fl. India 2: 144. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 260. 2000; N.P. Singh & al., Fl. Bihar: 39. 2001.

**Plate 40B**

Herb, annual or biennial, to 120 cm high; roots linear, fusiform, oblong, or globose, fleshy, white, pink or red. Stems erect, simple or branched, glabrous or hairy. Basal leaves oblong, obovate, oblanceolate or spatulate in outline, lyrate or pinnatisect,  $2-20 \times 1-8$  cm, sometimes undivided, dentate at margins, obtuse or acute at apex; lateral lobes 1–7 on each side of midrib, sometimes absent, oblong or ovate, to *c.*  $10 \times 5$  cm; uppermost cauline leaves subsessile, simple, elliptic or oblanceolate, often undivided, dentate. Racemes 10–30-flowered. Flowers 1–2 cm across; pedicels 5–10 mm long, elongated to 20 mm in fruit. Sepals narrowly oblong,  $5-8 \times 1-2$  mm, glabrous or sparsely pubescent. Petals obovate,  $1.2-2 \times c. 0.5$  cm, obtuse or emarginate at apex, white or pinkish. Stamens 6; filaments slender, 5–12 mm long; anthers 1.5–2 mm long, sagittate at base. Style 1–4 cm long; stigma entire. Siliquae linear-lanceolate or cylindric,  $4.5-8 \times 0.5-0.8$  cm (including beak); beak 0.7–2 cm long, conical at apex, smooth or rarely slightly constricted between seeds. Seeds globular, *c.* 2 mm, reddish brown.

*Fl. & Fr.*: January – April.

*Habitat*: Near the waste land.

*Distribution*: KWLS: Near the mica factory, Chattarbar; as an escape from cultivation. INDIA: Cultivated throughout. WORLD: A native of Mediterranean region, cultivated worldwide.

*Specimen examined*: Near the mica factory, Chattarbar, 375 m,  $24^{\circ}28'36.5''$  N,  $85^{\circ}32'20.5''$  E, 28th February 2012, *Shyam Biswa* 54012.

## 62. OLACACEAE Juss. ex R. Br., nom. cons.

Tropical regions, 21 genera and *c.* 120 species; 5 genera and *c.* 15 species in India.

### OLAX L.

Old World tropical regions, *c.* 40 species, 6 in India, 2 in Jharkhand and 1 in KWLS.

***Olax scandens*** Roxb., Pl. Coromandel 2(1): 2, t. 102. 1799 & Fl. Ind. 1: 163. 1820; Masters in Hook.f., Fl. Brit. India 1: 575. 1875; Haines, Bot. Bihar Orissa: 183. 1921; Paria & Chattopadhyay, Fl. Hazaribagh 1: 439. 2000; Uniyal in N.P. Singh & al., Fl. India 5: 9, f. 3. 2000; N.P. Singh & al., Fl. Bihar: 101. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 145. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 58, f. 8. 2014. **Plate 40D**  
Vern. Name: *Dheniani* (Hindi).

Shrub or climber, 1–2 m high; branches pubescent, armed when old; thorns blunt. Leaves simple, alternate, elliptic, elliptic-oblong or ovate-oblong,  $3.3-8.1 \times 2.3-4.2$  cm, rounded or rarely slightly cordate at base, entire at margins, obtuse or emarginate at apex, glabrous; petioles 3–10 mm long, hairy. Flowers solitary or in racemes, axillary, pubescent to densely short-hairy, fragrant; bracts ovate-oblong, *c.* 2 mm long, caducous. Calyx cupular,  $0.5-1 \times 1.5-2$  mm, ciliate. Petals 5, linear to lanceolate, 4–6 mm long, more or less connate, white. Stamens 7–10, only 3-fertile and prominent, usually opposite and adnate to the edges of petals; filaments free, *c.* 2 mm long; anthers oblong, 1–1.2 mm long, 2-celled; staminodes opposite the centre of the petals, 2-cleft at apex. Carpels 5–6 mm long; ovary ovoid, superior, usually 3-loculed beneath and 1-loculed above, glabrous; style linear; stigma 3-lobed. Drupes globose, 1.5–2 mm, enclosed more than half by accrescent calyx, orange or yellowish orange, sweet in taste.

*Fl. & Fr.*: September – October.

*Habitat*: Dry deciduous forests on hillslopes.

*Distribution:* KWLS: Dhawjadhari Pahar; common. INDIA: Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Malay Peninsula, Mauritius, Myanmar, Sri Lanka and Thailand.

*Specimen examined:* Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49592.

### 63. SANTALACEAE R. Br., nom. cons.

Subcosmopolitan, 44 genera and *c.* 875 species; *c.* 10 genera and 18 species in India.

#### VISCUM L.

Old World Tropical to temperate regions, *c.* 100 species, 14 in India, 3 in Jharkhand and 1 in KWLS.

**Viscum articulatum** Burm.f., Fl. Ind.: 311. 1768; Hook.f., Fl. Brit. India 5: 226. 1886; Haines, Bot. Bihar Orissa: 804. 1924; Paria & Chattopadhyay, Fl. Hazaribagh: 445. 2000; N.P. Singh & al., Fl. Bihar: 447. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 539. 2002; Sanjai & N. P. Balakr. in N.P. Balakr., Fl. India 23: 50. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 191. 2014.

#### Plate 40E

Shrub, epiparasitic, monoecious, pendulous. Stems slender; branches leafless, opposite and decussate or dichotomous, sometimes whorled, flattened, yellowish green; internodes longitudinally 3-ridged; basal internodes usually rounded; succeeding internodes decussately flattened, 0.6–5.5 × 0.1–0.7 cm, longitudinally striate. Leaves absent or rudimentary. Inflorescence a cyme, axillary, 3-flowered; central female flower subtended by a pair of small scaly bracts united into a cup, then a pair of lateral male flowers, one on either side below the upper bracteal cup and in the axils of another pair of lower decussately developed bracts, *c.* 0.5 mm long. Male flowers sessile, globose in bud, 0.5–1 mm; perianth lobes 4, free, ovate or triangular, connate with each other inside, *c.* 0.5 × 0.4 mm; stamens 4; anthers sessile, attached to perianth lobe, *c.* 0.3 × 0.4 mm, dehiscing by pores. Female flowers ellipsoid in bud, 1–1.5 mm long; bracts annular; perianth lobes 4, triangular, *c.* 0.5 mm long; ovary inferior; style short; stigma nipple-shaped. Berries globose or subglobose, 2–5 mm across, smooth, green, turning yellowish on maturity. Seeds bright green.

*Fl. & Fr.:* September – March.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Dhodhakhola forest; common. INDIA: Almost throughout. WORLD: Australia, Bhutan, China, Malesia, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam.

*Specimen examined:* Dhodhakhola forest, 367 m, 24°34'33.6" N, 85°39'21.7" E, 6th September 2010, *Shyam Biswa* 49581.

### 64. LORANTHACEAE Juss., nom. cons.

Tropical and Temperate regions, 84 genera and *c.* 950 species; 14 genera and *c.* 70 species in India.

#### DENDROPTHOE Mart.

Tropical Africa, Asia and Australia, 38 species, 4 in India, 1 in Jharkhand.

**Dendrophthoe falcata** Blume in Roem. & Schult., Syst. Veg., ed. 15 bis 7(2): 1730. 1830; Paria & Chattopadhyay, Fl. Hazaribagh 1: 441. 2000; N.P. Singh & al., Fl. Bihar: 446. 2001; T.K.

Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 538. 2002; Rajasek. in N.P. Balakr., Fl. India 23: 3. 2012; Ranjan, Fl. Parasnath Wildlife Sanct.: 190. 2014. *Loranthus falcatus* L.f., Suppl. Pl.: 211. 1782. *Loranthus longiflorus* Desr. in Lam., Encycl. 3: 598. 1792; Hook.f., Fl. Brit. India 5: 214. 1886, incl. var. *falcata* (L.f.) Kurz & var. *amplexifolia* (DC.) Thwaites; Haines, Forest Fl. Chota Nagpur: 375. 1910 & Bot. Bihar Orissa: 801. 1924.

**Plate 40F & G**

Vern. Names: *Banda* (Hindi); *Bandh*, *Bandhawri*.

Shrub, hemiparasitic with haustoria, bearing surface runners; branches usually glabrous, greyish brown. Leaves simple, alternate or subopposite, elliptic-oblong, obovate or ovate-lanceolate, 8–15 × 4.5–8 cm, cordate to rounded at base, entire at margins, obtuse or acute to obtuse at apex, coriaceous; petioles 5–8 mm long. Inflorescence a raceme, axillary, 3–8 cm long, to 50-flowered; pedicels 2–5 mm long; bracts cupular, c.1 mm long, oblique, acute. Flowers 5-merous, 3–4 cm long; mature floral buds bright orange or red or orange-yellow with a dark green band below constriction. Sepals adnate to ovary, c.1 mm long, entire or obscurely toothed. Petals bright orange, red or orange-yellow, united into a tubular; tube c.2.5 cm long, terete, ventricose, 5-lobed; lobes oblong, 1–1.2 mm long, reflexed. Stamens 5, adnate to corolla tube; filaments to 2 cm long, bright red; anthers 3–5 mm long, yellow. Ovary c.3 mm long; style exserted, c.2.5 cm long, slightly enlarged below stigma, reddish brown. Drupes ellipsoid, c.1 × 0.5 cm, crowned by persistent calyx, pink. Seed solitary.

*Fl. & Fr.*: November – March.

*Habitat*: Hemiparasitic on trees in dry deciduous forests.

*Distribution*: KWLS: Bagitan jungle, Koderma NRF; common. INDIA: Throughout. WORLD: Bangladesh, Bhutan, Indo-China, Myanmar, Nepal, Sri Lanka, Thailand, Malesia to tropical Australia and Solomon Islands.

*Specimen examined*: Bagitan jungle, Koderma NRF, 391 m, 24°29'26.8" N, 85°35'39.0" E, 1st March 2011, *Shyam Biswa* 49651.

**65. TAMARICACEAE** Link., nom. cons.

Eurasia and Africa, especially Mediterranean to Central Asia, 5 genera and 79 species; 3 genera and 16 species in India.

**TAMARIX** L.

Eurasia and Africa, 54 species, 9 in India, 2 in Jharkhand and 1 in KWLS.

**Tamarix ericoides** Rottler, Neue Schriften Ges. Naturf. Freunde Berlin 4: 214, t. 4. 1803; Dyer in Hook.f., Fl. Brit. India 1: 249. 1874; Haines, Forest Fl. Chota Nagpur: 162. 1910 & Bot. Bihar Orissa: 51. 1921; B.V. Shetty & R.P. Pandey in B.D. Sharma & al., Fl. India 3: 25. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 221. 2000; N.P. Singh & al., Fl. Bihar: 54. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 91. 2001.

**Plate 40H**

Undershrub or shrub, 0.5–1 m high. Stems and branchlets covered with leaves. Leaves simple, ovate-lanceolate to triangular-ovate or broadly triangular, 3–5 × 4–5 mm, sheathing, amplexicaul; leaves scale-like on oldest stems and on branchlets, 1–1.5 × 0.5–1 mm, truncate at base, entire at margins, acuminate or acute at apex, keeled, persistent and brownish, green. Racemes lateral or terminal, 4–19 × 1–1.5 cm; rachis papillose; bracts broadly triangular to broadly ovate-lanceolate,



2.5–5.2 mm long, semi-amplexicaul or amplexicaul, denticulate to subentire at margins, acuminate at apex. Flowers c. 1 cm across. Sepals 5, almost free, ovate,  $2.5\text{--}3.5 \times 1.5\text{--}2.2$  mm, irregular, denticulate, subequal; outer 2 more acute than the inner three. Petals 5, obovate to oblong-obovate,  $5\text{--}6.5 \times 4\text{--}4.5$  mm, pink or pale pink. Five longer stamens antiseplous, inserted hypodiscally with filaments 3.5–5.5 mm long, alternating with 5 short antipetalous ones inserted peridiscally with filaments 1.2–4 mm long. Disk 1.5–2 mm across, 10-lobed. Capsules 1–1.5 cm long, 2 or 3-valved, opening and disclosing the silky coma of the seeds. Seeds plumose, 1–1.5 mm long; coma 5–8.5 mm long.

*Fl. & Fr.*: October – April.

*Habitat*: On the dried-up sandy river beds.

*Distribution*: KWLS: Dhanarjay Nadi, Meghatari; occasional. INDIA: Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Bangladesh, Pakistan and Sri Lanka.

*Specimen examined*: On the dried-up river beds, Dhanarjay Nadi, Meghatari, 184 m,  $24^{\circ}34'39.3''$  N,  $85^{\circ}34'48.4''$  E, 7th March 2011, *Shyam Biswa* 49711.

## 66. POLYGONACEAE Juss., nom. cons.

Cosmopolitan, 46 genera and c. 1200 species; 12 genera and 121 species in India.

### Key to genera

- |                                                                             |                      |
|-----------------------------------------------------------------------------|----------------------|
| 1a. Plants climbing; inflorescence axis ending in branched tendrils         | <b>1. Antigonon</b>  |
| 1a. Plants erect or prostrate; inflorescence axis not ending into a tendril | 2                    |
| 2a. Plants prostrate; stamens 8; styles 3; fruits not enclosed by perianth  | <b>3. Polygonum</b>  |
| 2b. Plants erect; stamens 6; style 2; fruits enclosed by the perianth       | <b>2. Persicaria</b> |

### 1. ANTIGONON Endl.

Tropical America, 6 species, 2 in India, 1 in Jharkhand.

**Antigonon leptopus** Hook. & Arn., Bot. Beechey Voy.: 308. 1838; Haines, Forest Fl. Chota Nagpur: 383. 1910 & Bot. Bihar Orissa: 783. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 143. 2000; N.P. Singh & al., Fl. Bihar: 434. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 528. 2002; R.C. Srivast. Indian J. Pl. Sci. [Jaipur] 3: 113. 2014.

### Plate 41A

Climber, tendrillar, slender, sometimes woody at base. Stems angular, slightly thickened on nodes, finely pubescent. Leaves simple, alternate, hastate-ovate, triangular or cordate-ovate,  $3\text{--}11 \times 1.5\text{--}5.5$  cm, undulate at margins, acute at apex, pubescent especially on veins beneath; petioles 0.5–2.5 cm long. Inflorescence a raceme, ending in branched tendrils. Flowers 1.5–2 cm across, showy; pedicels 4–6 mm long with sparsely spreading simple hairs. Tepals 5, oblong or ovate-oblong,  $5\text{--}7 \times 4\text{--}5$  mm, distinctly reticulate-veined, bright pink. Stamens 7 or 8, c. 5 mm long; filaments basally connate into a short ring; anthers oblong, c. 1 mm long, dorsifixed. Ovary ovoid, trigonous, 2–3.5 mm long, glabrous; styles 3, c. 1.5 mm long, pinkish orange; stigma capitate, reddish. Nuts rounded at base, 5–6 mm long, acute at apex, shiny.

*Fl. & Fr.*: August – December.

*Habitat*: On waste land or on hedges.

*Distribution:* KWLS: Chattarbar forest, very common. INDIA: Throughout. WORLD: Native to Mexico, grown as an ornamental throughout the world for its showy bright pink flowers.

*Specimen examined:* Chattarbar forest, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, Shyam Biswa 49833.

## 2. **PERSICARIA** (L.) Mill.

Subcosmopolitan, c. 150 species, 80 in India and 1 in KWLS.

**Persicaria hydropiper** (L.) Delarbre, Fl. Auvergne ed. 2: 518. 1800. *Polygonum hydropiper* L., Sp. Pl. 1: 361. 1753; Hook.f., Fl. Brit. India 5: 39. 1886; Haines, Bot. Bihar Orissa: 779. 1924; Mooney, Suppl. Bot. Bihar Orissa: 130. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 149. 2000; N.P. Singh & al., Fl. Bihar: 436. 2001; R.C.Srivast. Indian J. Pl. Sci. [Jaipur] 3: 129. 2014.

### Plate 41B

Herb, erect, 30–60 cm high, glabrous. Stems branched, slender above, glandular-punctate, pinkish. Leaves simple, alternate, subsessile or shortly petiolate, linear-lanceolate, 5–16 × 0.5–2.5 cm, attenuate at base, entire at margins, acuminate at apex, glabrous or scabrous on margins, glandular-punctate; petioles 2–8 mm long. Ocrea 1–3 cm long with few and usually deciduous setae of 1–2 mm long, glabrous, gland-dotted. Inflorescences a pseudo-spike, lax, slender or filiform, erect, flexuous or decurved, 2–5 cm long, often interrupted at base; peduncles 2–5 cm long. Flowers 3–3.5 × 3–4 mm; bracts truncate, 2.5–3 mm long, ciliate on upper margins, glabrous, gland-dotted or not; pedicels c. 1 mm long. Perianth ovate-rounded, 2.5–3 × 1–1.5 mm, glandular, pink or light pink, 5-lobed. Stamens 6, included; filaments c. 1 mm long, light pink; anthers oblong, c. 0.5 mm long, pinkish. Ovary c. 1 mm long, compressed; style 2, c. 1 mm long, united in the upper half, then free; stigma capitate. Nuts 3-angled, biconvex, c. 3 mm long, brown. Seeds c. 3 × 2, beaked at apex, shiny, smooth, brownish.

*Fl. & Fr.:* September – March.

*Habitat:* On river banks.

*Distribution:* KWLS: Phutlaiya Nala, very common. INDIA: Throughout. WORLD: Tropical regions and Western Europe.

*Specimen examined:* Phutlaiya Nala, 343 m, 24°30'33.9" N, 85°39'31.8" E, 5th March 2011, Shyam Biswa 49673.

## 3. **POLYGONUM** L., nom. cons.

North Temperate, c. 230 species, 75 in India, 11 in Jharkhand and 1 in KWLS.

**Polygonum plebeium** R. Br., Prodr. Fl. Nov. Holland. 420. 1810, “*plebejum*”; Hook.f., Fl. Brit. India 5: 27. 1886; Haines, Forest Fl. Chota Nagpur: 383. 1910 & Bot. Bihar Orissa: 775. 1924; Mooney, Suppl. Bot. Bihar Orissa: 129. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 151. 2000; N.P. Singh & al., Fl. Bihar: 437. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 533. 2002; R.C.Srivast. Indian J. Pl. Sci. [Jaipur] 3: 134. 2014. **Plate 41C**

Annual, prostrate, diffusely branched, usually with a woody rootstock and long tap root. Stems and branches terete, grooved, scaberrulous, green or purple. Leaves simple, alternate, sessile or shortly petiolate, linear-lanceolate, 5–10 × 2–3 mm, narrowed at base, entire at margins, acute or obtuse at apex, hairy. Ocrea c. 2 mm long, hyaline, lacerate into hair-like segments or fimbriate,

translucent, whitish. Flowers solitary or 2 or 3 in clusters, axillary; pedicels 2–3 mm long. Perianth white or light pinkish to bright, 5-parted; tepals narrowly elliptic, 1–1.5 × c. 1 mm, prominently veined. Stamens 8; filaments included, slightly dilated at base; anthers c. 3 mm long. Ovary glabrous; styles 3, rarely 2, very short; stigmas capitate. Nuts somewhat spindle-shaped, c. 1.5 mm long, 3-gonous, smooth, shining, brownish black.

*Fl. & Fr.*: November – March.

*Habitat*: Fallow fields near river.

*Distribution*: KWLS: Near the river Dhanarjay Nadi, Meghatari; Fallow field, Kharharia village, Meghatari; common. INDIA: Almost throughout. WORLD: Afghanistan, Bangladesh, Bhutan, Nepal, Pakistan, Tropical East Africa, Madagascar, extending to Australia through Indonesia and Malaysia.

*Specimens examined*: Meghatari, near Dhanarjay Nadi, 182 m, 24°34'32.9" N, 85°34'41.6" E, 7th March 2011, *Shyam Biswa* 49702; Kharharia village, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 1st March 2013, *Shyam Biswa* 54141.

## 67. DROSERACEAE Salisb., nom. cons.

Cosmopolitan, 3 genera and c. 105 species; 2 genera and 4 species in India.

### DROSERA L.

Cosmopolitan, c. 100 species, 3 in India, 3 in Jharkhand and 1 in KWLS.

***Drosera burmanni*** Vahl, *Symb. Bot.* 3: 50. 1794; C.B. Clarke in Hook.f., *Fl. Brit. India* 2: 424. 1878; Haines, *Bot. Bihar Orissa*: 344. 1922; Mooney, *Suppl. Bot. Bihar Orissa*: 64. 1950; Paria & Chattopadhyay, *Fl. Hazaribagh* 1: 214. 2000; N.P. Singh & al., *Fl. Bihar*: 191. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 245. 2002. **Plate 41D & E**

Annual, 12–14 cm high, insectivorous, with few long fibrous roots. Stems unbranched, terete, light reddish brown. Leaves simple, rosette, subsessile or petiolate, persistent, obovate to obovate-spathulate, 5–10 × 5–6 mm, attenuate at base, rounded at apex, densely covered with stalked insect-trapping glands of c. 1 mm; stipules c. 5 mm long, deeply divided; petioles short or absent, green or reddish. Flowers in sub-terminal or terminal racemes on leafless scapes, 10–14 cm long, glabrous, 2–19-flowered; bracts simple, hastate, 1–3 mm long; pedicels erect, 3–4 mm long. Sepals 5, narrowly oblong, c. 3 × 1 mm, united at base, light green, red, with short, glandular hairs on outer surface. Petals 5, obovate, c. 4 × 1–1.5 mm, white to reddish. Stamens 5, 2–3 mm long; anthers dorsifixed. Ovary subglobose, glabrous; styles 5, filiform, 2–3 mm long, incurved; stigma tooth-like. Capsules subglobose, c. 2 × 1 mm, 4 or 5-valved, reddish. Seeds numerous, roundish, veined, dark brown to black.

*Fl. & Fr.*: February – March.

*Habitat*: On dried sandy river bed.

*Distribution*: KWLS: on dried river bed of Phutlaiya Nala. INDIA: Bihar, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Tamil Nadu. WORLD: Australia, China, East and South-East Asia.

*Specimen examined*: Phutlaiya Nala, 343 m, 24°30'33.9" N, 85°39'31.8" E, 27th February 2012, *Shyam Biswa* 54004.

# 68. CARYOPHYLLACEAE Juss., nom. cons.

Cosmopolitan, *c.* 85 genera and *c.* 2630 species; *c.* 25 genera and 122 species in India.

## POLYCARPAEA Lam. nom. cons.

Tropical and subtropical regions, especially Old World, *c.* 50 species, 3 in India and 1 in Jharkhand.

**Polycarpaea corymbosa** (L.) Lam., Tabl. Encycl. 2: 129. 1797; Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1: 245. 1874; Haines, Bot. Bihar Orissa: 46. 1921; Mooney, Suppl. Bot. Bihar Orissa: 24. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 139. 2000; N.P. Singh & al., Fl. Bihar: 51. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 87. 2002. *Achyranthes corymbosa* L., Sp. Pl. 1: 205. 1753 . **Plate 41F**

Herb, annual or perennial, erect or decumbent, 10–30 cm high; rootstocks woody, with very long taproot. Stems terete, branched, tomentose. Leaves simple, opposite, pseudoverticillate, linear-subulate, 3–10 × 0.1–0.5 mm, rounded to obtuse at base, entire at margins, acute to aristate at apex; arista bristle-like, *c.* 1 mm long, 1-veined, glabrous; stipules linear to lanceolate, scarious. Inflorescence terminal, densely cymose panicle, silvery whitish. Flowers 2.5–3.5 mm long, silvery white; pedicels 1–1.5 mm long, puberulent; bracts lanceolate to subulate. Sepals 5, lanceolate, 2–3 × 0.5–1 mm, acuminate at apex, glabrous, pinkish white. Petals 5, ovate to roundish, 0.8–1 mm, entire at margins, obtuse to rounded at apex, persistent, white or pinkish. Stamens 5, *c.* 0.5 mm long, free or cohering and adnate at the base of petals, white; anthers white. Carpels 0.3–0.5 mm long, brownish; ovary ovoid, *c.* 0.3 mm long, 1-loculed; ovules 5–13; style very short. Capsules ovoid, 1.5–2 mm long, entire, glossy and shiny, brownish, 3-valved. Seeds reniform or bean-shaped, *c.* 0.5 mm long, whitish brown.

*Fl. & Fr.*: August – March.

*Habitat*: On the dried up sandy river or sandy gravelly places.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; not common. INDIA: Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. WORLD: Africa, America, Australia, Pakistan and Tropical Asia.

*Specimen examined*: Near Dhanarjay Nadi, Meghatari, 182 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49693.

# 69. AMARANTHACEAE Juss., nom. cons.

Tropical and subtropical regions, few temperate regions, *c.* 175 genera and *c.* 2000 species; 29 genera and 114 species in India.

## Key to genera

- |                                                                                               |                       |
|-----------------------------------------------------------------------------------------------|-----------------------|
| 1a. Flowers usually ebracteate; perianth membranous, herbaceous or coriaceous, never scarious | <b>7. Chenopodium</b> |
| 1b. Flowers always bracteate; perianth scarious and dry                                       | 2                     |
| 2a. Leaves alternate or if opposite then fasciculate and filiform                             | 3                     |
| 2b. Leaves opposite, not fascicled                                                            | 8                     |
| 3a. Ovary 2- or more-ovuled                                                                   | <b>6. Celosia</b>     |
| 3b. Ovary 1-ovuled                                                                            | 4                     |
| 4a. Leaves alternate; staminodes none; ovules erect                                           | 5                     |

- |                                                                                                                                              |                         |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 4b. Leaves alternate or fascicled or opposite and alternate mixed; stamens with interposed staminodes; ovules suspended from a basal funicle | 7                       |
| 5a. Flowers bisexual                                                                                                                         | 6                       |
| 5b. Flowers unisexual                                                                                                                        | <b>5. Amaranthus</b>    |
| 6a. Flowers capitate; fruit a circumscissile utricle                                                                                         | <b>3. Allmania</b>      |
| 6b. Flowers spicate; fruit a crustaceous nut                                                                                                 | <b>8. Digera</b>        |
| 7a. Leaves alternate or opposite and alternate mixed; spikes sessile                                                                         | <b>2. Aerva</b>         |
| 7b. Leaves filiform in opposite fascicles; spikes peduncled                                                                                  | <b>10. Trichuriella</b> |
| 8a. Anthers 1-celled                                                                                                                         | 9                       |
| 8b. Anthers 2-celled                                                                                                                         | <b>1. Achyranthes</b>   |
| 9a. Staminal tube short; stigma capitate, subsessile                                                                                         | <b>4. Alternanthera</b> |
| 9b. Staminal tube long; stigma 2-fid; style long                                                                                             | <b>9. Gomphrena</b>     |

1. **ACHYRANTHES** L., nom. cons.

Old World tropical and subtropical regions, 8–10 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

**Achyranthes aspera** L., Sp. Pl. 1: 204. 1753; Hook.f., Fl. Brit. India 4: 730. 1885; Haines, Forest Fl. Chota Nagpur: 381. 1910 & Bot. Bihar Orissa: 767. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 108. 2000; N.P. Singh & al., Fl. Bihar: 425. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 514. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 184. 2014.

**Plate 42A**

Vern. Name: *Chir Chiri*.

Herb, perennial, erect, 30–90 cm high. Stems terete, simple or branched, pubescent turns glabrous, pinkish; nodes more or less shrunken on drying, dark pink. Leaves sessile, simple, opposite, obovate, elliptic or roundish, 1–11 × 0.8–6 cm, attenuate or narrowed at base, entire at margins, acute, obtuse to roundish at apex, pubescent. Flowers initially dense and congested, elongating into slender spikes, strongly deflexed and distant later, 2–50 cm long, axillary and terminal; peduncles 1–6 cm long; bracts subulate, spinous, 3–3.5 mm long, basal part 1–1.5 mm long, broadened and concave, adnate to spine throughout. Tepals 5, lanceolate, 4–4.5 × c. 1 mm, truncate to rounded at base, acute at apex, whitish, pale green to red or purple. Stamens 5; filaments connate at base into a short cup, 1.5–3 mm long; anthers 2-celled; staminodes fimbriate, prominently appendaged inside. Ovary oblong, c. 0.5 mm long; style filiform, c. 1.5 mm long; stigma capitate. Capsules oblong, c. 2.5 × 1 mm, rounded at base, 1-seeded. Seed oblong, c. 1 mm long, smooth, red.

*Fl. & Fr.*: November – March.

*Habitat*: Scrub forests.

*Distribution*: KWLS: Khararia jungle, Meghatari, near Chirkundi Village and Koderma NRF; very common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Khararia jungle, Meghatari, near Chirkundi Village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49717; Koderma NRF, 401m, 24°28'46.5" N, 85°35'57.3" E, 21st November 2012, *Shyam Biswa* 53901.

*Note*: Fruits are very spiny and thus adhering to clothes and skin.



2. **AERVA** Forssk., nom. cons.

Sub-tropical regions and Tropical Old World 10 species, 4 in India, 2 in Jharkhand and KWLS.

**Key to species**

- 1a. Spikes axillary, usually clustered, sub-globose, leafy inflorescence along the stem and branches **1. A. lanata**  
 1b. Spikes of the stem cylindrical, ascending branches frequently without subtending leaves **2. A. sanguinolenta**

**1. Aerva lanata** (L.) Juss. ex Schult., Syst. Veg. 5: 564. 1819; Hook.f., Fl. Brit. India 4: 728. 1885; Haines, Forest Fl. Chota Nagpur: 381. 1910 & Bot. Bihar Orissa: 766. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 109. 2000; N.P. Singh & al., Fl. Bihar: 426. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 515. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 185. 2014. *Achyranthes lanata* L., Sp. Pl. 1: 204. 1753. **Plate 42B**

Vern. Name: *Chaya* (Hindi).

Herb, 20–50 cm high, erect, sometimes woody. Stems and branches terete, more or less lanate with whitish hairs. Leaves simple, alternate, suborbicular to broadly ovate, 1–4 × 0.7–3.5 cm, cuneate or attenuate at base, entire at margins, subacute to rounded, and apiculate at apex, pubescent above, densely white-pubescent or villous beneath; petioles 0.2–2 cm long. Flowers in axillary, subglobose sessile spikes of 2–6 × 2–4 mm, bisexual, whitish or villous; bracts 0.7–1 mm long. Tepals densely woolly dorsally; outer 2 ovate-oblong, 1–1.5 mm long, hyaline; inner 3 slightly shorter and narrower with green midrib. Stamens 5, alternating with pseudostaminodes; filaments c. 0.5 mm long, connate at base; anthers c. 0.2 mm long, yellow. Ovary globose, c. 0.4 mm; style c. 0.2 mm long; stigma 2-fid. Utricles globose, c. 1.5 mm, compressed, 1-seeded. Seed slightly reniform, c. 1 × 1 mm, shining, reddish brown.

*Fl. & Fr.*: August – March.

*Habitat*: Open forests or in wastelands and scrub forests.

*Distribution*: KWLS: Suggi Pahar, near Suggi mining area.

*Specimen examined*: Suggi Pahar, near Suggi mining area, 269 m, 24°33'28.8" N, 85°35'14.6" E, 15th August 2011, *Shyam Biswa* 49807.

**2. Aerva sanguinolenta** (L.) Blume, Bijdr.: 547. 1826; N.P. Singh & al., Fl. Bihar: 426. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 516. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 185. 2014. *Achyranthes sanguinolenta* L., Sp. Pl. ed. 2, 1: 294. 1762. *Achyranthes scandens* Roxb., Fl. Ind. 2: 503. 1824. *Aerva scandens* (Roxb.) Wall. ex Moq. in DC., Prodr. 13(2): 302. 1849; Hook.f., Fl. Brit. India 4: 727. 1885; Haines. Bot. Bihar Orissa 765. 1924. **Plate 42C**

Herb, 60–90 cm high, woody, prostrate to erect. Stems and branches terete, striate, densely tomentose, pinkish to whitish. Leaves simple, alternate, lanceolate or elliptic, 2–4 × 0.8–1.5 cm, cuneate to attenuate at base, entire at margins, acute at apex, appressed-whitish hairy especially beneath; petioles to 5 mm long. Flowers in short terminal and axillary cylindrical spikes of 0.5–2.5 × 0.5–0.8 cm, silky, white; upper ascending branches frequently without subtending leaves; bracts 1–1.5 mm long, thinly pilose, persistent; bracteoles similar to bract, slightly smaller, persistent. Tepals 5, ovate to lanceolate, 1.5–2 mm long, acute, hyaline with a narrow central green vitta along the midrib, papery, densely lanate dorsally, white. Stamens 5; filaments connate into a basal collar; anthers oblong, 0.3–0.4 mm long. Ovary orbicular, 0.5–1 mm, compressed;

style slender, 0.3–0.5 mm long; stigmas minutely bilobed. Utricles globose, *c.* 1 mm, compressed, 1-seeded. Seed reniform, *c.* 1 × 0.8 mm, glossy, blackish.

*Fl. & Fr.*: October – March.

*Habitat*: Shade localities in dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest. INDIA: WORLD: Bhutan, Cambodia, China, Laos, Malaysia, Myanmar, Nepal, Philippines, Sikkim, Thailand and Vietnam.

*Specimen examined*: Muglamaram forest, 382 m, 24°30'57.7" N, 85°34' 39.6" E, 4th March 2011, *Shyam Biswa* 49667.

### 3. **ALLMANIA** R. Br. ex Wight.

Tropical Asia, 2 species, 2 in India and 1 in Jharkhand.

**Allmania nodiflora** (L.) R. Br. ex Wight, J. Bot. 1: 226, t. 128. 1834; Hook.f., Fl. Brit. India 4: 716. 1885; Haines, Bot. Bihar Orissa: 759. 1924. Mooney, Suppl. Bot. Bihar Orissa: 127. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 111. 2000; N.P. Singh & al., Fl. Bihar: 427. 2001. *Celosia nodiflora* L., Sp. Pl. 1: 205. 1753. *Allmania albida* R. Br. ex Hook.f., Fl. Brit. India 4: 717. 1885.

**Plate 42D**

Annual, 15–50 cm high; taproot slender. Stems terete, ribbed, glabrous. Leaves simple, alternate, linear to linear-lanceolate or spathulate, 2.5–10 × 0.2–1.4, attenuate or tapering at base, entire at margins, acute at apex, glabrous with small cluster dots, sessile or subsessile. Inflorescence a terminal, subglobose head, 1.2–1.5 cm across; bracts papery, long-pointed. Tepals 5, lanceolate, 5–6 × *c.* 1 mm, papery, whitish or orange with green or orange midrib, sparsely hairy on midrib on outside. Stamens 5; filaments connate into a tube at base; anthers 2-celled. Ovary ovoid, compressed; style slender; stigma shortly bilobed. Utricles ovoid, *c.* 3.5 mm long, circumscissile, 1-seeded. Seeds *c.* 2 × 2 mm, glossy, smooth, blackish.

*Fl. & Fr.*: August – November.

*Habitat*: On hillslopes and open areas of dry deciduous forests.

*Distribution*: KWLS: way to Basraon forest, Dhawjadhari Pahar and Dhanarjay Nadi; common. INDIA: Tropical regions. WORLD: Tropical Asia.

*Specimens examined*: Way to Basraon forest, 337 m, 24°34'33.6" N, 85°38'34.0" E, 6th September 2010, *Shyam Biswa* 49574; Dhawjadhari Pahar, 543 m, N 24°28'51.8", E 85°35' 37.6", 14th August 2011, *Shyam Biswa* 49801; on the dry river bed of Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 26th November 2012, *Shyam Biswa* 54088.

### 4. **ALTERNANTHERA** Forssk.

Tropical and subtropical regions, especially America, *c.* 80 species, 11 in India, 5 in Jharkhand and 4 in KWLS.

#### Key to species

- 1a. Bracts and bracteoles glabrous; tepals very dissimilar both in length and form,  
abaxially glabrous **4. A. pungens**
- 1b. Bracts and bracteoles hairy outside; tepals similar both in length and form, abaxially  
hairy 2
- 2a All tepals 1-veined; pseudostaminodes fimbriate at margins; anthers 5, oblong **2. A. ficoidea**

- 2b. Outer tepals prominently 3-veined in the lower half; pseudostaminode laciniate at margins; anthers 3–5, globose 3
- 3a. Plant prostrate; leaves green on both surfaces; pseudostaminodes much shorter than the stamens 3. **A. paronychioides**
- 3b. Plant erect or ascending; leaves pinkish beneath; pseudostaminodes as long as the stamens 1. **A. bettzickiana**

**1. *Alternanthera bettzickiana*** (Regel) G. Nicholson, Ill. Dict. Gard. 1: 59. 1884. *Telanthera bettzickiana* Regel, Index Seminum [St. Petersburg (Petropolitanus)] 28: 1862.

**Fig. 41; Plate 42E**

Herb, 10–30 cm high. Stems erect or creeping, branched, terete, glabrous. Leaves simple, opposite, oblong-lanceolate or oblanceolate, 1–3.5 × 0.2–1.5 cm, attenuate or tapering at base, entire at margins, obtuse to rounded at apex, glabrous, pubescent when young, green or pinkish beneath; petioles 0.5–3 mm long. Heads 1–4 in clusters, terminal or axillary, 0.6–1.5 cm across; bracts and bracteoles ovate-lanceolate, 1.5–3 mm long, acuminate at apex, hairy outside. Tepals ovate-oblong, 2–3 × 0.5–1.2 mm, distinctly 3-veined, dense white-pilose on back, white. Stamens 5; filaments 1–1.5 mm long, united into a basal cup, alternating with pseudostaminodes; anthers linear, c. 0.8 mm long, dorsifixed, 1-celled; pseudostaminodes fasciated, 3–5-parted, as long as stamens. Ovary c. 0.8 mm across, glabrous; style c. 0.5 mm long; stigma capitate. Utricles 1-seeded, indehiscent.

*Fl. & Fr.*: August – April.

*Habitat*: Shade localities in dry deciduous forests.

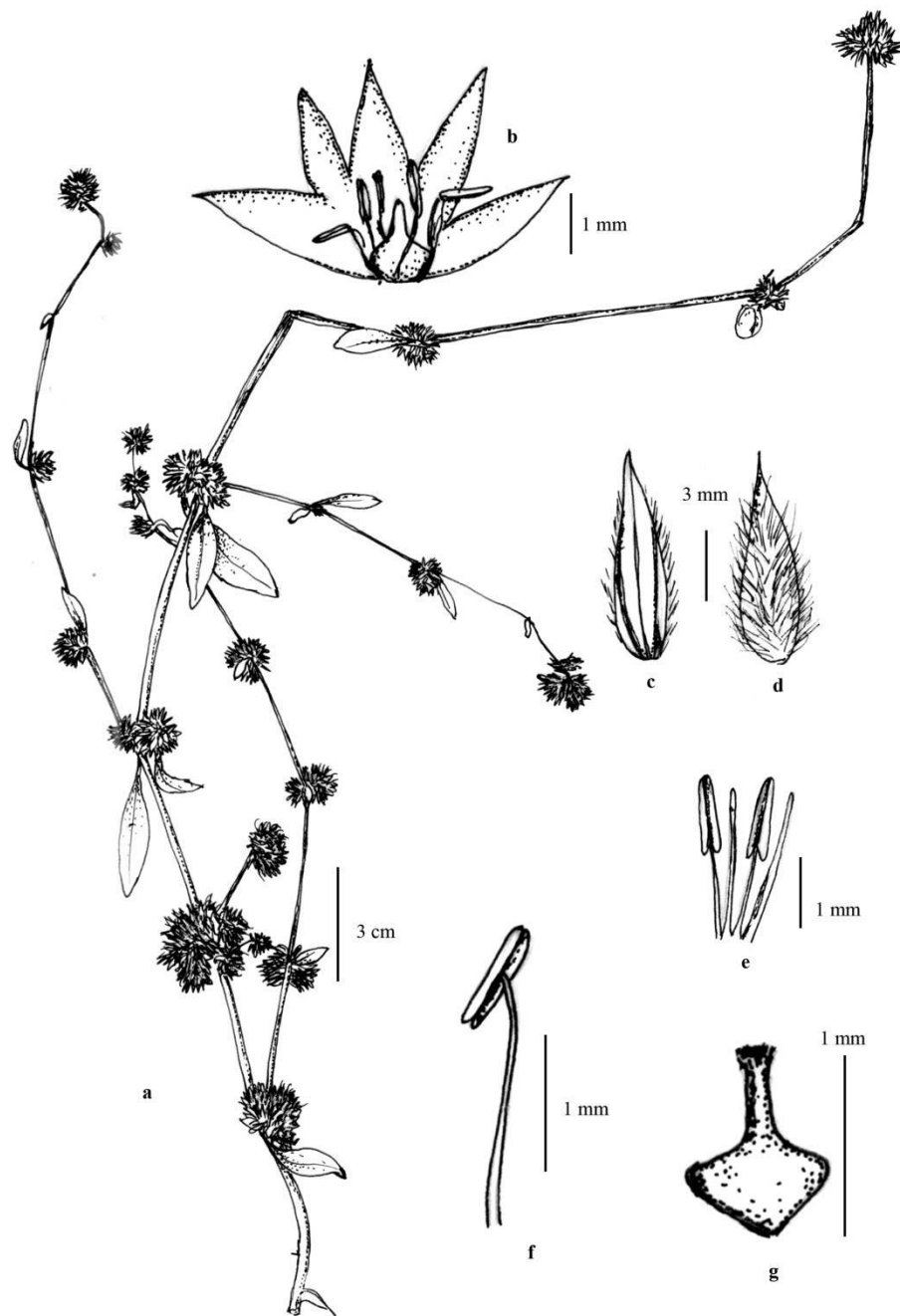
*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; not common. INDIA: Eastern northern, north-eastern, peninsular India and Western Himalaya. WORLD: Native to South America; cultivated throughout Southeast Asia.

*Specimens examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49896.

**2. *Alternanthera ficoidea*** (L.) P. Beauv., Fl. Oware 2: 66, t. 99, f. 1. 1818. *Gomphrena ficoidea* L., Sp. Pl. 1: 225. 1753. *Alternanthera tenella* Colla, Mem. Reale Accad. Sci. Torino 33: 131, t. 9. 1828; Paria & Chattopadhyay, Fl. Hazaribagh 1: 117. 2000; N.P. Singh & al., Fl. Bihar: 428. 2001.

**Plate 42F**

Herb, 5–35 cm high, decumbent-ascending. Stems much-branched from base, rooting at lower nodes, terete in lower part, quadrangular upwards with a longitudinal furrow on two opposite sides. Leaves simple, opposite, linear-lanceolate or obovate-oblong, 1.5–5.5 × 0.4–1.4 cm, narrowly acute or attenuate at base, entire or subentire at margins, obtuse or rounded at apex, nearly glabrous; petioles 1–5 mm long, hairy. Spikes usually in dense clusters of 2–8, terminal and axillary, globose or oblong, 2–6 mm long, whitish; rachis hairy; bracts and bracteoles ovate, 1.8–2 mm long, long-acuminate at apex, hairy on back or glabrous. Tepals 5, unequal, oblong or ovate-lanceolate, 1.5–2 × c. 1 mm; outer 3 tepals close-set; abaxial 2 concave, densely patent-hairy on back in lower halves and glabrous in upper halves. Stamens 5, c. 0.5 mm long (including basal cup); anthers 5, oblong, c. 0.3 mm long, 1 or 2 sometimes shorter than others, 1-celled. Ovary dome-shaped; style subconical, c. 0.5 mm long; stigma capitate. Utricles faintly notched, reniform or heart-shaped, 1.5–2 × 2–2.5 mm, 1-seeded. Seeds orbicular, c. 1 mm, reddish brown.



**Fig. 41. *Alternanthera bettzickiana* (Regel) G. Nicholson:** a. flowering twig; b. flower; c. tepals (inner view & outer view); e. stamens and staminoides; f. stamen; g. carpel.

*Fl. & Fr.*: August – April.

*Habitat*: Shade localities in dry deciduous forests.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Almost throughout. WORLD: Pantropical.

*Specimens examined*: Near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 16th August 2011, *Shyam Biswa* 49811; near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 2nd March 2012, *Shyam Biswa* 54032.

**3. *Alternanthera paronychioides*** A.St.-Hil., Voy. Distr. Diam. 2: 439. 1833; Paria & Chattopadhyay, Fl. Hazaribagh 1: 112. 2000; N.P. Singh & al., Fl. Bihar: 427. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 517. 2002. *Alternanthera polygonoides* R. Br. ex Sweet, Hort. Suburb. Lond.: 48. 1818. **Plate 42G**

Herb, prostrate, perennial, rooting at nodes; rootstocks woody. Stems and branches terete, glabrescent. Leaves simple, opposite, elliptic or spatulate, 0.7–3 × 0.2–1 cm, attenuate at base, entire at margins, obtuse to rounded at apex, glabrescent above, hairy beneath. Spikes sessile, axillary, solitary or 2 or 3 together, globose or ovoid, 5–10 mm in across; bracts ovate-acuminate, c. 3 mm long, mucronate with the ex-current midrib, membranous, white, bracteoles similar but smaller and slightly narrower, c. 2.5 mm long. Tepals 5, subequal, ovate-oblong, 4–5 × 1–1.5 mm, acute at apex, scarious, hairy on veins, white; outer 3 tepals 3-veined in proximal half; inner 2 somewhat laterally compressed, acute to mucronate at apex, 1-veined. Stamens 5, all fertile; anthers ellipsoid or globose, yellow, 1-celled; pseudostaminodes much shorter than filaments, margins entire or dentate. Ovary compressed, narrowed below; style very short, broader than long; stigma capitate. Utricles compressed, orbicular-obcordate, c. 2 × 1.5–2 mm, 1-seeded. Seed discoid, c. 1 mm, shining, brownish.

*Fl. & Fr.*: February – March.

*Habitat*: Open grasslands.

*Distribution*: KWLS: Baghitan forest; near Rheio Ghoghar Dam, Chattarbar; near Dhanarjay Nadi, Meghatari; common. A native of tropical America and now widespread as a weed in tropical regions.

*Specimen examined*: Baghitan forest, 402 m, 24°29'06.6" N, 85°36'12.8" E, 3rd March 2011, *Shyam Biswa* 49656.

**4. *Alternanthera pungens*** Kunth, Nov. Gen. Sp. 2: 206. 1818; Paria & Chattopadhyay, Fl. Hazaribagh 1: 115. 2000; N.P. Singh & al., Fl. Bihar: 427. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 518. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 185. 2014. *Alternanthera echinata* sensu Mooney, Suppl. Bot. Bihar Orissa: 128. 1950, non Sm. 1818.

**Plate 43A**

Herb, prostrate, perennial; rootstocks vertical, stout. Stems and branches terete, striate, with stellate and long-white hairs. Leaves simple, opposite, broadly ovate, obovate to orbicular, 0.4–3 × 0.5–2.5 cm, attenuate to tapering at base, entire at margins, rounded and mucronate at apex, minute-hairy or glabrous, glossy above; petioles to 1 cm long. Spikes sessile, axillary, globose or subglobose, 0.5–1.5 cm across. Flowers solitary or 2 or 3 together; bracts and bracteoles similar, 5–7 × 1–1.5 mm, spinescent. Tepals 5, dissimilar, linear-lanceolate, 5–7 × 1–2 mm, with tuft of whitish bristles, light greenish white or stramineous. Stamens 5, all perfect; filaments 0.5–0.7 mm long; anthers oblong, c. 0.3 mm long, 1-celled; pseudostaminodes membranous, dentate at



margins. Ovary depressed-globose; style *c.* 0.1 mm long; stigma capitate. Utricles lenticular, *c.* 1.4 × 1.3 mm, much-compressed, brown, 1-seeded. Seed discoid, *c.* 1 mm, shining, brown.

*Fl. & Fr.*: November – April.

*Habitat*: Open wastelands.

*Distribution*: KWLS: Near NH-31, Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near NH-31, Koderma NRF, 401 m, 24°28'46.5" N, 85° 35'57.3" E, 21st November 2012, *Shyam Biswa* 54076.

## 5. AMARANTHUS L.

Tropical and temperate regions, *c.*

70 species, 14 in India, 5 in Jharkhand and 1 in KWLS.

**Amaranthus spinosus** L., Sp. Pl. 2: 991. 1753; Hook.f., Fl. Brit. India 4: 718. 1885; Haines, Forest Fl. Chota Nagpur: 379. 1910 & Bot. Bihar Orissa: 761. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 120. 2000; N.P. Singh & al., Fl. Bihar: 428. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 520. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 186. 2014.

**Plate 43B**

Vern. Name: *Kata-notee sag.*

Annual, erect, 20–40 cm high, branched. Stems ribbed, green, purple-red or brownish green. Leaves simple, alternate, ovate, oblong to rhomboid-ovate, 1.5–5.5 × 0.6–3 cm, cuneate or attenuate at base, entire at margins, slightly emarginate and mucronate at apex, glabrous; petioles to 5 cm long, sometimes longer than lamina; each leaf axil bearing a pair of *c.* 2 cm long spines. Flowers in axillary clusters or in terminal spikes of 2.5–15 × *c.* 1 cm, green; lower clusters and lower part of spike bearing only female flowers; upper part of spike with male flowers; bracts and bracteoles deltoid-ovate, sharp-spiny; bracteoles shorter than bracts 1.5–2 mm long, greenish. Tepals 5, elliptic to lanceolate, *c.* 2 × 0.5–0.8 cm, whitish, with green midrib and scarious margins, of male acuminate, of female obtuse, apiculate. Stamens 5; filaments *c.* 0.2 mm long; anthers oblong, sagittate at base, 0.8–1 mm long, 2-loculed. Ovary *c.* 0.7 mm long; styles 2, *c.* 1 mm long. Utricles included in perianth, oblongoid, 1.5–1.8 mm long, circumscissile, 1-seeded. Seeds subglobose, *c.* 1 mm, glossy, reddish brown.

*Fl. & Fr.*: August – March.

*Habitat*: On the sandy dried up river beds and on roadsides.

*Distribution*: KWLS: Chattarbar forest and Dhanarjay Nadi, common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Chattarbar forest, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49840; near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 2nd March 2012, *Shyam Biswa* 54029.

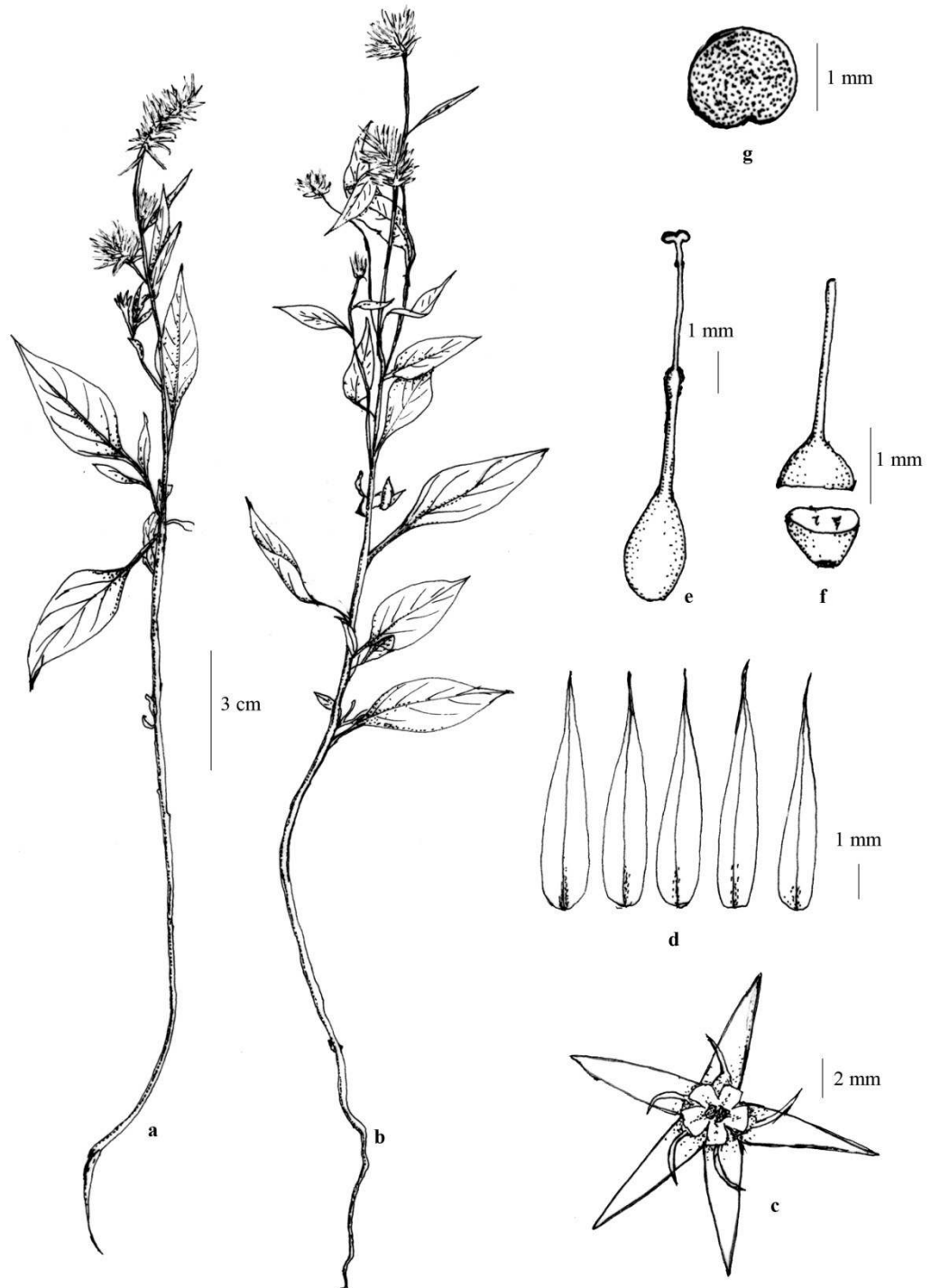


Fig. 42. *Celosia argentea* L.: a., b. habit; c. flower; d. tepal; e. carpel; f. fruit; g. seed.

6. **CELOSIA** L.

Subtropical regions, America and Africa, c. 65 species, 3 in India, 1 in Jharkhand.

**Celosia argentea** L., Sp. Pl. 1: 205. 1753; Hook.f., Fl. Brit. India 4: 714. 1885; Haines, Bot. Bihar Orissa: 759. 1924; Mooney, Suppl. Bot. Bihar Orissa: 127. 1950; Paria & Chattopadhyay, Fl. Hazaribagh 1: 123. 2000; N.P. Singh & al., Fl. Bihar: 429. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 521. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 186. 2014. *Celosia cristata* L., Sp. Pl. 1: 205. 1753; Hook.f., Fl. Brit. India 4: 715. 1885; Haines, Bot. Bihar Orissa: 759. 1924.

**Fig. 42; Plate 43C & D**

Vern. Names: *Safaid Murgha* (Hindi); *Surwar*.

Herb, 10–50 cm high. Stems and branches ribbed, glabrous. Leaves simple, alternate, lanceolate or subulate or narrowly elliptic, 1–7 × 0.3–2.7 cm, attenuate or tapering at base, entire at margins, acute to acuminate at apex, glabrous; petioles 0.5–2.5 cm long. Inflorescence a spike, terminal, conical at first but later cylindrical, 0.5–5 cm long, dense, many-flowered, white or pink-tinged. Flowers in clusters, sessile; peduncles 15–20 cm long; bracts lanceolate, c. 6 mm long, scarious, midrib excurrent, acute, aristate at apex; bracteoles oblanceolate, curved, c. 5 mm long, midvein excurrent, aristate at apex, persistent. Tepals 5, ovate-lanceolate or narrowly elliptic-oblong, c. 7 × 1.5 mm, acute or acuminate at apex, scaly, scarious. Stamens 5; filaments slender, connate into a tube at base; pseudostaminodes minute; anthers 2-celled. Ovary ovoid, c. 1 mm across, 2- or more-ovuled; style c. 6 mm long; stigma minutely forked. Utricles ellipsoid, 3–4 mm long, circumscissile, burst from the middle leaving a cup shape, releasing mostly 2 fertile seeds. Seeds compressed-reniform, c. 1.5 × 1.8 mm, glossy, raised in middle, smooth, black.

*Fl. & Fr.*: August – November.

*Habitat*: On the rocky hillslopes or stony places.

*Distribution*: KWLS: Dhawjadhari Pahar and Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Base of Dhawjadhari Pahar, 343 m, 24°30'33.9" N, 85°39'39.3" E, 7th September 2010, *Shyam Biswa* 49585; Dhawjadhari Pahar, 563 m, 24°28'53.1" N, 85°35' 39.4" E, 14th August 2011, *Shyam Biswa* 49798; mid of Dhawjadhari Pahar, Koderma NRF, 435 m, 24°28'58.3" N, 85°35'48.5" E, 19th November 2012, *Shyam Biswa* 54054.

7. **CHENOPODIUM** L.

Temperate, c. 100 species, 7 in India, 2 in Jharkhand and 1 in KWLS.

**Chenopodium album** L., Sp. Pl. 1: 219. 1753; Hook.f., Fl. Brit. India 5: 3. 1886, p.p.; Haines, Bot. Bihar Orissa: 769. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 104. 2000; N.P. Singh & al., Fl. Bihar: 433. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 526. 2002; T.K. Paul, *Pleione* 6: 282. 2012.

**Plate 43E**

Herb, 10–100 cm high, with slender long tap root, whitish. Stems terete, glabrous, basal portion pinkish. Leaves simple, opposite, oblong-lanceolate or ovate-deltoid, 1–7 × 0.3–4 cm, cuneate at base, entire or shallowly dentate at margins, subacute at apex, sometimes weakly 3-lobed, mealy beneath; petioles 0.5–4 cm long. Inflorescence a variable spiciform or cymosely branched panicle, mostly terminal. Flowers in clusters, dense, sessile, forming slender panicles, bisexual or

lower ones female, *c.* 0.7 mm in across. Perianth segments 5, broadly ovate to elliptic, abaxially longitudinally keeled, farinose, membranous at margins, acute or slightly emarginate at apex. Stamens 5; anthers exserted. Stigmas 2. Utricles pericarp membranous or slightly fleshy, adnate to seed, indehiscent. Seeds globose, *c.* 1.5 mm, blackish.

*Fl. & Fr.*: October – March.

*Habitat*: Near cultivated fields.

*Distribution*: KWLS: Khararia jungle, Meghatari, near Chirkundi village; common. INDIA: Throughout. WORLD: Native of Europe, now probably throughout temperate and tropical regions of the world.

*Specimen examined*: Khararia jungle, Meghatari, near Chirkundi village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49719.

## 8. **DIGERA** Forssk.

Old World tropical regions, monotypic.

**Digera muricata** (L.) Mart., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 13: 285. 1826; Paria & Chattopadhyay, Fl. Hazaribagh 1: 125. 2000; N.P. Singh & al., Fl. Bihar: 430. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 522. 2002. *Achyranthes muricata* L., Sp. Pl. ed. 2, 1: 295. 1762. *Achyranthes alternifolia* L., Mant. Pl.: 50. 1767. *Digera arvensis* Forssk., Fl. Aegypt.-Arab.: 65. 1775; Hook.f., Fl. Brit. India 4: 717. 1885; Haines, Forest Fl. Chota Nagpur: 380. 1910. *Digera alternifolia* Aschers. in Schweinf., Beitr. Fl. Aethiop.: 180. 1867; Haines, Bot. Bihar Orissa: 760. 1924. **Plate 43F**

Vern. Name: *Mahruwa*.

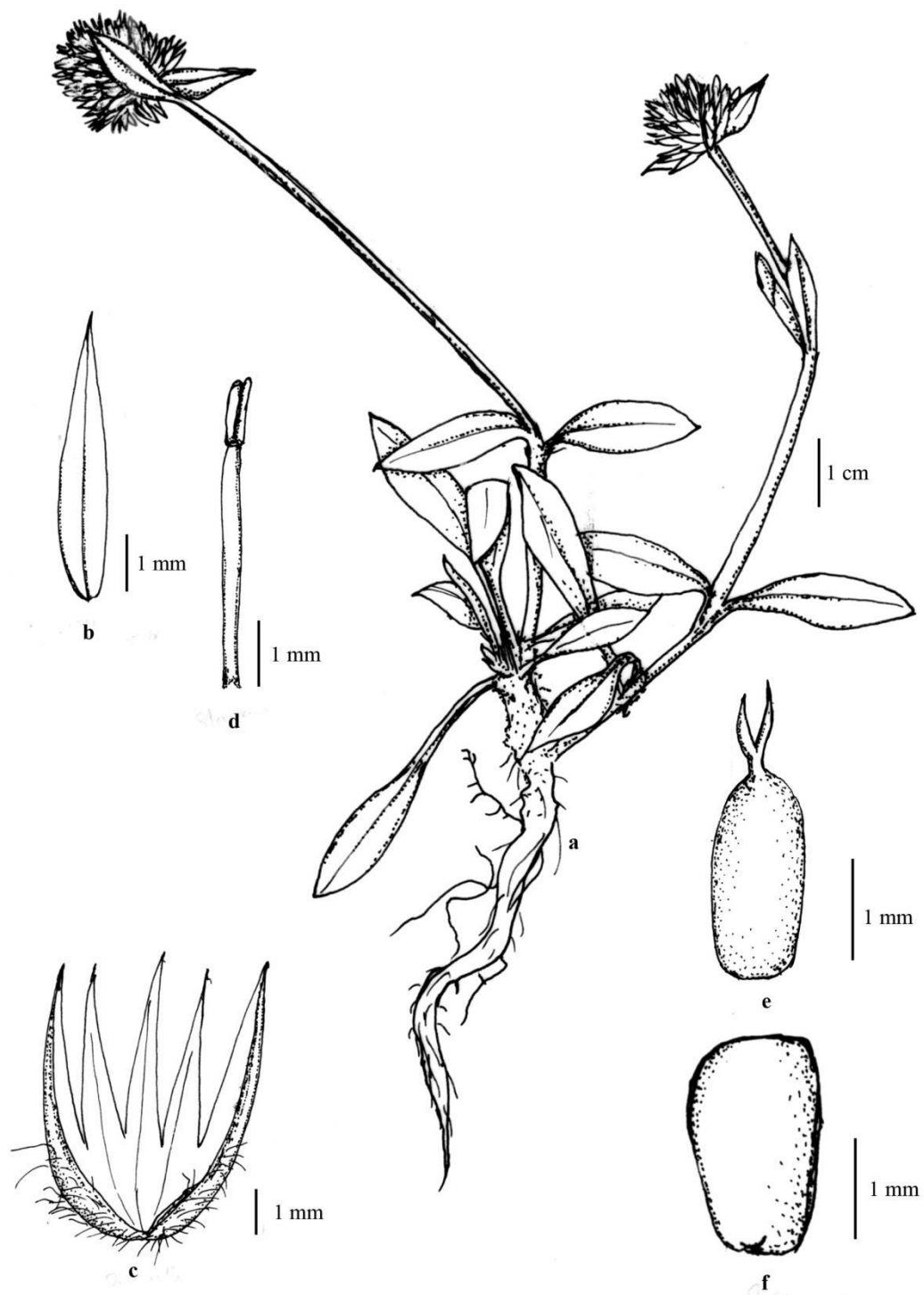
Herb, 10–40 cm high. Stems erect, terete; branches glabrous, pinkish. Leaves simple, alternate, ovate narrowly linear to broadly ovate, 1–5 × 0.7–3 cm, rounded at base, entire at margins, acute or acuminate at apex, reduced in size towards apex, glabrous or sparsely hairy on the principal veins beneath; petioles 0.5–2.5 cm long. Inflorescence slender or shorter and dense, axillary or terminal spikes or racemes, consisting of a central fertile flower and two highly modified, sterile, 1-bracteolate lateral flowers. Flowers *c.* 3.5 mm long, glabrous; peduncles slender, to 10 cm long; bracts persistent, linear, 1–1.5 mm long, acuminate, glabrous, membranous with a green or brownish midrib; central fertile flower: perianth segments 4 or 5, the outer pair opposite and sheathing, ovate or ovate-oblong 2–3 mm long, acute at apex, the inner segments much more delicate and hyaline, bright pink or pinkish white. Stamens 4 or 5, free; filaments filiform, *c.* 3 mm long, pink; anthers oblong, *c.* 0.4 mm long pink. Ovary 1-ovuled; style 1.5–4 mm long; stigmas 2, finally recurved; lateral flowers appressed; bracteole 1, similar to bract, these flowers much-reduced and increasingly so in the upper part of the spike, sometimes absent. Fruits subglobose, 1.5–2 mm, slightly compressed, bluntly keeled along each side.

*Fl. & Fr.*: August – September.

*Habitat*: Near the village.

*Distribution*: KWLS: Khararia jungle, near village. INDIA: Throughout. WORLD: South Asia, tropical Arabia and the Yemen to Afghanistan, South, Central and East tropical Africa and Madagascar.

*Specimen examined*: Khararia jungle, near village, 178 m, 24°35'15.2" N, 85°34'36.2" E, 16th August 2011, *Shyam Biswa* 49812.



**Fig. 43. *Gomphrena celosioides* Mart.:** a. habit; b. bracteole; c. perianths; d. stamen; e. carpel; f. seed.



## 9. GOMPHRENA L.

Tropical and subtropical regions, c. 125 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

**Gomphrena celosioides** Mart., Beitr. Amarantac.: 93. 1825; Mooney, Suppl. Bot. Bihar Orissa: 129. 1950; N.P. Singh & al., Fl. Bihar: 431. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 187. 2014. *Gomphrena serrata* L., Sp. Pl. 1: 224. 1753; Paria & Chattopadhyay, Fl. Hazaribagh 1: 127. 2000; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 523. 2002.

### Fig. 43; Plate 43G

Herb, 10–20 cm high, prostrate or decumbent, perennial; roots woody. Stems hairy, whitish, base pinkish. Leaves simple, opposite, obovate-lanceolate, elliptic-oblongate or spatulate, 1–3.5 × 0.4–1 cm, attenuate at base, entire at margins, acute to obtuse at apex, pilose with long-appressed hairs, especially beneath; petioles 2–10 mm long. Flower heads subglobose or oblongoid, terminal, 0.5–1.2 × 0.6–1.5 cm, silvery-whitish with yellowish tip, closely subtended by uppermost leaves; bracts ovate, c. 3 × 2 mm; bracteoles 5–6 × c.2 mm. Perianth segments 5–6 mm long; outer 3 almost flat, lanate outside; inner 2 with green midrib, lanate outside to apex. Stamens 5; anthers c.1 mm long, 1-celled; filaments united into a tube of c.4 mm long. Ovary ovoid; style short; stigmas 2-fid or divergent, c.0.5 mm long. Capsules ovoid, compressed, c.2 mm long. Seeds oblong or roundish, c.1.8 × 1 mm, glossy, reddish brown.

*Fl. & Fr.*: August – September.

*Habitat*: Open grasslands or wastelands.

*Distribution*: KWLS: Dengra Pahar, near RIT Institute, Chattarbar; common. INDIA: Cultivated and run wild, almost throughout. WORLD: Pantropical.

*Specimen examined*: Dengra Pahar, near RIT Institute, Chattarbar, 390 m, 24°28'09.3" N 85°34'14.9" E, 13th August 2011, *Shyam Biswa* 49791.

## 10. TRICHURIELLA Bennet

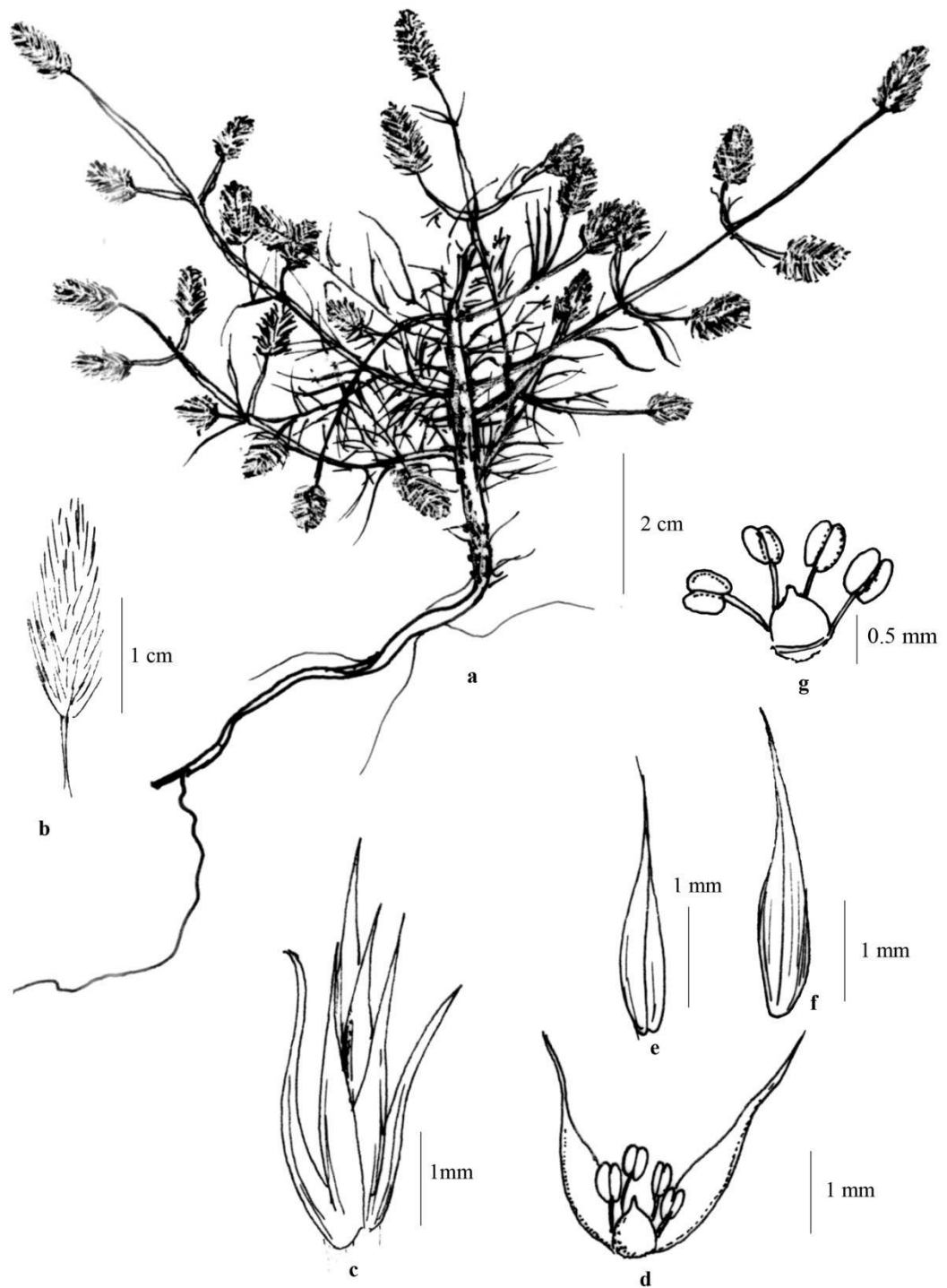
South and Southeast Asia, monotypic.

**Trichuriella monsoniae** (L.f.) Bennet, Indian J. Forest. 8: 86. 1985; N.P. Singh & al., Fl. Bihar: 432. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 525. 2002. *Illecebrum monsoniae* L.f., Suppl. Pl.: 161. 1781. *Celosia monsonia* Retz., Observ. Bot. 2: 13. 1781. *Aerva monsonia* (Retz.) Mart., Beitr. Amarantac.: 83. 1825; Hook.f., Fl. Brit. India 4: 728. 1885; Haines, Forest Fl. Chota Nagpur: 382. 1910 & Bot. Bihar Orissa: 766. 1924. *Trichurus monsoniae* (L.f.) C.C. Towns., Kew Bull. 29: 466. 1974; Paria & Chattopadhyay, Fl. Hazaribagh 1: 128. 2000.

### Fig. 44; Plate 43H

Herb, 5–15 cm high; taproot long, woody. Stems erect, woolly. Leaves sessile, simple, opposite or fascicled, filiform or acicular, 2–25 × 0.5–1 mm, attenuate at base, entire at margins, acute at apex, glabrous. Flowers axillary or clustered and terminating all the branches into a cylindric spike of 0.5–2.5 × 0.3–0.6 cm, main stem also terminating into a spike; bracts and bracteoles small, acuminate at apex, membranous. Tepals 4, persistent, lanceolate, subulate, c. 2.8 mm long, white or pinkish. Stamens 4 or 5, united at base; pseudostaminodes alternating stamens; anthers 2-celled. Style short; stigma capitellate or 2-fid. Utricles oblong, enclosed in a large staminal cup with small circumscissile top, dehiscent by lid. Seeds ovoid, 1–1.5 mm long, smooth, shining, brown.

*Fl. & Fr.*: November – March.



**Fig. 44. *Trichuriella monsoniae* (L.f.) Bennet:** a. habit; b. spike; c. flowers with bracts; d. flower split open; e. bract; f. tepal; g. stamens and carpel.

*Habitat*: Open sandy places near river, or sandy gravelly places, sometimes in shade localities.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari and Phoolwariya forest road. INDIA: Central, Eastern and Peninsular regions. WORLD: Southeast Asia.

*Specimens examined*: Near Dhanarjay Nadi, Meghatari, 182 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49691; Phoolwariya forest road, 398 m, 24°29'20.3" N, 85°35'46.9" E, 20th November 2012, *Shyam Biswa* 54063.

## 70. NYCTAGINACEAE Juss., nom. cons.

Tropical and subtropical regions, especially America, and a few in temperate regions, 7 genera and *c.* 350 species; 4 genera and 15 species in India.

### Key to genera

- 1a. Flowers in small dense subumbellate cymes; bracts minute or absent, free, not forming involucre; anthocarps oblongoid or clavate, glandular-pubescent **1. Boerhavia**
- 1b. Flowers in corymbose cymes or panicles; bracts large, connate, forming calyx-like involucre; anthocarps subglobose or ovoid, eglandular **2. Mirabilis**

### 1. BOERHAVIA L.

Subtropical regions, *c.* 50 species, 8 in India and 1 in Jharkhand.

**Boerhavia diffusa** L., Sp. Pl. 1: 3. 1753; Haines, Bot. Bihar Orissa: 757. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 97. 2000; N.P. Singh & al., Fl. Bihar: 424. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 510. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 183. 2014. *Boerhavia repens* L. var. *diffusa* (L.) Hook.f., Fl. Brit. India 4: 709. 1885.

**Plate 44A**

Herb, prostrate or decumbent, with stout woody rootstock. Stems terete, branched, pubescent, pinkish. Leaves simple, opposite, ovate or suborbicular, 1–3.5 × 1–3 cm, rounded or cuneate at base, entire and undulate at margins, obtuse or acute at apex, glabrous or minutely puberulent; petioles 0.2–1.5 cm long. Inflorescences terminal, capitate-cymose panicle; peduncles slender, 1–2.5 cm long, sparsely pubescent. Flowers 3–4 mm wide; pedicels short to almost absent; bracts lanceolate, small, pubescent. Perianth pink or bright purple, 4 or 5-lobed; lobes 1–2 mm long. Stamens 4(–5), slightly exserted or included; filaments *c.* 1 mm long, pink; anthers *c.* 0.2 mm long, light yellowish. Ovary ovoid, *c.* 0.5 mm long; style *c.* 1 mm long; stigma capitate. Anthocarps oblongoid or clavate, 1.5–2 × 0.5–1 mm, rounded at apex, 5-ribbed, with viscid glands.

*Fl. & Fr.*: Almost throughout.

*Habitat*: Rocky hillslopes.

*Distribution*: KWLS: Near the base of the Rishi Dhurwasa Pahar; common. INDIA: Almost throughout. WORLD: Africa, America, Australia, Cambodia, China, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Pacific Islands, Philippines, Thailand and Vietnam.

*Specimen examined*: Near the base of the Rishi Dhurwasa Pahar, 286 m, 24°35'25.2" N, 85°34'50.4" E, 11th September 2010, *Shyam Biswa* 49609.

## 2. **MIRABILIS** L.

Subtropical regions, *c.* 60 species, 2 in Jharkhand and 1 in KWLS.

**Mirabilis jalapa** L., Sp. Pl. 1: 177. 1753; Haines, Bot. Bihar Orissa: 756. 1924; Paria & Chattopadhyay, Fl. Hazaribagh 1: 99. 2000; N.P. Singh & al., Fl. Bihar: 425. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 512. 2002. **Plate 44B**

Herb or undershrub, 60–100 cm high. Stems erect, branched, terete, inflated at nodes, sparsely pubescent. Leaves simple, opposite, ovate or triangular-ovate, 4–8 × 2–4.5 cm, truncate at base, entire at margins, acuminate at apex, puberulous; petioles 0.5–2 cm long. Flowers usually several, clustered at apex of branches, fragrant; pedicels 1–2 mm long. Involucre campanulate, 0.7–1.2 cm long, 5-lobed; lobes triangular-ovate, acute or acuminate at apex, glabrous, persistent. Perianth trumpet-shaped or narrowly funnel-shaped, bright pink or white, or variegated; tube 2–4 cm long, 5-lobed; lobes 2–3 cm across. Stamens 5 or 6, exserted; filaments slender, 3–4 cm long, white; anthers globose, *c.* 1 mm. Styles 4–4.5 cm long, exserted beyond stamens; stigmas capitate. Anthocarps subglobose or ovoid, 5–8 × *c.* 5 mm. Seeds subglobose, *c.* 5 mm across, ribbed, black.

*Fl. & Fr.*: March.

*Habitat*: Near settlement areas.

*Distribution*: KWLS: Koderma Village, Koderma NRF; common. INDIA: Almost throughout. WORLD: Native to tropical America; now pantropical.

*Specimen examined*: Koderma Village, Koderma NRF, 390 m, 24°29'06.6" N, 85°35'49.8" E, 1st March 2012, *Shyam Biswa* 54027.

## 71. **MOLLUGINACEAE** Bartl., nom. cons.

Tropical and subtropical regions, 9 genera and *c.* 80 species; 2 genera and species in India.

### **MOLLUGO** L.

Tropical and subtropical regions, *c.* 25 species, 4 in India, 2 in Jharkhand and 1 in KWLS.

**Mollugo pentaphylla** L., Sp. Pl. 1: 89. 1753; Paria & Chattopadhyay, Fl. Hazaribagh 1: 137. 2000; N.P. Singh & al., Fl. Bihar: 233. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 288. 2002. *Mollugo stricta* L., Sp. Pl. ed. 2, 1: 131. 1762; C.B. Clarke in Hook.f., Fl. Brit. India 2: 663. 1879; Haines, Bot. Bihar Orissa: 48. 1921. **Plate 44C**

Herb, 10–30 cm high, diffuse. Stems 4-angular, dichotomously branched, spreading, slender, glabrous. Leaves simple in pseudowhorls of 3–5 or opposite; lower ones rosulate, oblong-obovate or spatulate, distinctly petioled; upper ones sessile or shortly petioled, oblong-lanceolate or linear-lanceolate, 1–3 × 0.1–0.8 cm, narrowed at base, entire at margins, acute at apex, glabrous, pale beneath; midrib prominent beneath; stipules minute, scarious. Panicles corymbosely branched, lax, terminal and axillary. Flowers 2–3 mm across; pedicels 2–4 mm long; bracts *c.* 1 mm long, persistent. Tepals 5, elliptic-oblong or obovate-oblong, 1.5–1.8 mm long, connate at base or free, imbricate, obtuse at apex, white inside, green outside; widely patent during anthesis, afterwards conniving together to form a globular form. Stamens 3–5; filaments filiform, short, connate at base; anthers versatile, small, linear-oblong. Ovary ovoid, 3-loculed; styles 3,

radiating, white. Capsules subglobose, *c.* 3 mm across, faintly 3-lobed; seeds many, globose or reniform,  $0.5-0.8 \times c. 0.5$  mm, tuberculate, reddish brown, without filiform appendages.

*Fl. & Fr.*: August – November.

*Habitat*: On moist and shady places.

*Distribution*: KWLS: Dengra Pahar, near RIT institute, Chattarbar common. INDIA: Throughout. WORLD: Old World tropics and subtropics.

*Specimen examined*: Dengra Pahar, near RIT Institute, Chattarbar, 423 m, 24°28'09.3" N, 85°34'14.9" E, 13th August 2011, *Shyam Biswa* 49794.

## 72. BASELLACEAE Raf., nom. cons.

Tropical and subtropical regions, 4 genera and 19 species; 1 genus and 1 species in India.

### BASELLA L.

Tropical Africa, 5 species, 1 in India.

**Basella alba** L., Sp. Pl. 1: 272. 1753; Paria & Chattopadhyay, Fl. Hazaribagh 1: 133. 2000; N.P. Singh & al., Fl. Bihar: 433. 2001. *Basella rubra* L., Sp. Pl. 1: 272. 1753; Hook.f., Fl. Brit. India 5: 20. 1886; Haines, Forest Fl. Chota Nagpur: 382. 1910 & Bot. Bihar Orissa: 772. 1924.

#### Plate 44D

Herb, perennial. Stems twining, terete, fleshy, slender towards apex, with few small protuberances, glabrous, green or pinkish. Leaves simple, alternate, broadly ovate, sometimes elliptic above,  $5.5-9.5 \times 4.5-8$  cm, cordate or rounded at base, entire at margins, acute to obtuse at apex; petioles 1–3 cm long. Spikes axillary or terminal, 4–14 cm long, bearing flowers in upper half. Flowers subsessile, remaining closed at anthesis; bracteoles oblong, *c.* 3 mm long. Perianth segments 5, ovate-oblong, 3–4 mm long, blunt at apex, white or pinkish. Stamens 5, borne on perianth segments; filaments short, white; anthers yellowish. Ovary 1-loculed; ovule 1; styles 3, linear. Utricles subglobose,  $4-8 \times 3-5$  mm, enclosed within the persistent fleshy perianth, black or dark purple, indehiscent. Seeds globose, *c.* 5 mm.

*Fl. & Fr.*: March – December.

*Habitat*: Waste lands, as an escape.

*Distribution*: KWLS: Near Meghatari village; common. INDIA: Almost throughout. WORLD: Pantropical .

*Specimen examined*: Near Meghatari village, 185 m, 24°34'39.8" N, 85°34'37.2" E, 16th August 2011, *Shyam Biswa* 49819.

## 73. PORTULACACEAE Juss., nom. cons.

Cosmopolitan, *c.* 20 genera and *c.* 325 species; 2 genera and 8 species in India.

### PORTULACA L.

Tropical and subtropical regions, 107 species, 7 in India, 4 in Jharkhand and 1 in KWLS.

**Portulaca pilosa** L., Sp. Pl. 1: 445. 1753; M.K.V. Rao in B.D. Sharma & Sanjappa, Fl. India 3: 6. 1993; Paria & Chattopadhyay, Fl. Hazaribagh 1: 131. 2000; N.P. Singh & al., Fl. Bihar: 53. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 90. 2002. **Plate 44E**

Herb, 7–15 cm high, rooting at nodes. Stems terete, fleshy whitish pilose. Leaves simple, opposite, or spiral crowded at apices of branches linear or linear-elliptic,  $0.5-2 \times 0.1-0.3$  cm,



attenuate at base, entire at margins, acute to acuminate at apex, glabrous, thick, fleshy; petioles 1–2 mm long; axillary hairs 3–4 mm long. Flowers terminal, solitary or 3–5 in clusters, 0.6–1 cm across. Sepals 2–5, ovate, 2–8 × 1–4 mm, weakly keeled at apex, scarious at margins, whitish. Petals 4–6, obovate, 2.5–8 × 1.8–11 mm, with a mucro at apex, bright pink. Stamens 5–10 or numerous, adnate to petals, 1.5 mm long, free, pinkish; anthers yellowish. Ovary semi-inferior, 1-loculed; style 2–8 mm long; stigma 5–6 fid, pinkish. Capsules circumscissile, globose, 2–5 mm. Seeds many, reniform, 0.4–0.7 mm, whitish brown or black.

*Fl. & Fr.*: August – September.

*Habitat*: Grasslands.

*Distribution*: KWLS: Suggi Pahar, near Suggi mining area; rare. INDIA: Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal. WORLD: Native of tropical America, now pantropical.

*Specimen examined*: Suggi Pahar, near Suggi mining area, 290 m, 24°32'58.9" N, 85°35'16.1" E, 15th August 2011, *Shyam Biswa* 49805.

#### 74. BALSAMINACEAE A. Rich.

Tropical Old World with few temperate regions, 2 genera and *c.* 1000 species; 1 genus and *c.* 200 species in India.

##### IMPATIENS L.

Tropical and North Temperate regions, especially India, *c.* 1000 species, *c.* 200 in India and 1 in Jharkhand.

***Impatiens balsamina*** L., Sp. Pl. 2: 938. 1753; Hook.f., Fl. Brit. India 1: 453. 1874; Haines, Bot. Bihar Orissa: 158. 1921; Vivek. & al. in Hajra & al., Fl. India 4: 123. 1997; N.P. Singh & al., Fl. Bihar: 89. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 132. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 550. 2005.

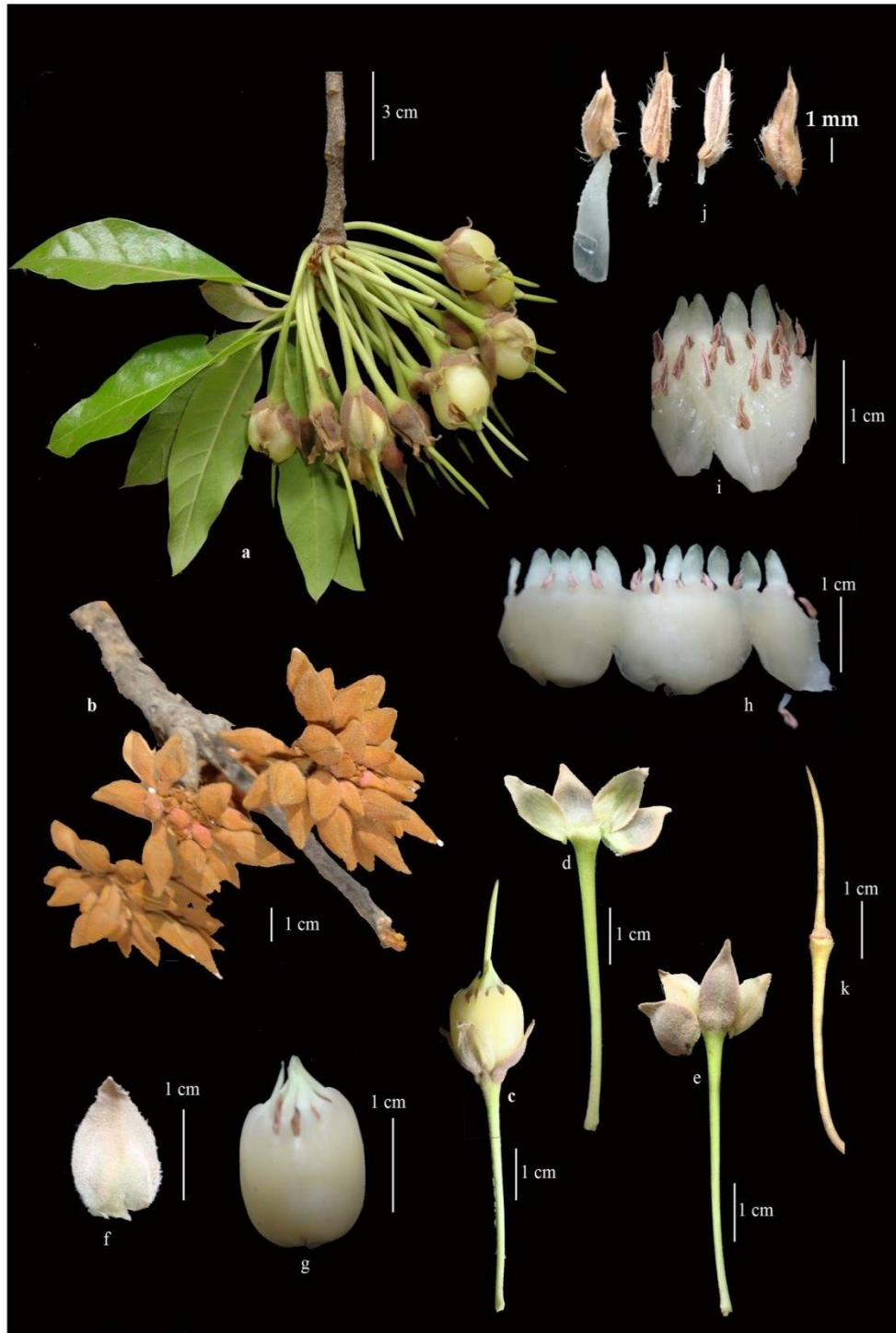
**Plate 45A & B**

Vern. Name: *Gul-Mendhi* (Hindi).

Annual, erect, to 110 cm high. Stems terete, fleshy, glabrous or pubescent when young. Leaves simple, alternate or whorled at apex, narrow-lanceolate or lanceolate-elliptic, 6–14 × 1.5–3 cm, attenuate at base, deeply serrate at margins, acuminate at apex, glabrous; petioles 1–2 cm long, glabrous. Flowers solitary or in fascicles of 2 or 3 in leaf axils, ebractate, zygomorphic; pedicels 1–2 cm long, glabrous, dark pinkish. Sepals 3; lateral sepals ovate-lanceolate, 2–3 mm long. Lip cymbiform, 1.2–1.8 cm long, petaloid with small yellowish blotch; spur filiform, incurved, 1.5–3 cm long; standard *c.* 1.2 cm long, with a crest terminating into a mucro; wings obovate, 2–2.5 cm long, deeply notched; auricles ovate-rounded. Stamens 5; filaments linear, very short; anthers connate, hooded over the sigma. Ovary fusiform, 5-loculed; ovules many, 1-seriate in each locule. Capsules ellipsoid, 5–2 × 0.7–1 cm, tapering at ends, succulent, tomentose, green, opening upwards by 5-valves. Seeds globose, *c.* 2 mm, brownish.

*Fl. & Fr.*: July – October.

*Habitat*: An escape near settlement areas.



**Fig. 45. *Madhuca longifolia* var. *latifolia* (Roxb.) A. Chev.:** a. flowering twig; b. twig with flower-buds; c. flower; d., e. calyx with pedicel (inner & outer views); f. sepal; g. corolla; h. corolla split open; i. stamens adnate to corolla; j. stamens; k. carpel.

*Distribution:* KWLS: Near RFO office, Koderma NRF; common. INDIA: Cultivated throughout. WORLD: Central, South and Southeast Asia, Europe, New Guinea; introduced into many countries.

*Specimen examined:* Near RFO office, Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 20th August 2011, *Shyam Biswa* 49843.

## 75. SAPOTACEAE Juss., nom. cons.

Tropical, a few in Temperate regions, 53 genera, *c.* 975 species; 14 genera and *c.* 50 species in India.

### MADHUCA Buch.-Ham. ex J.F. Gmel.

Indomalesia to Australia, *c.* 100 species, 4 in India and 1 in Jharkhand.

**Madhuca longifolia** (L.) J.F. Macbr., Contr. Gray Herbs. 53: 17. 1918; Paria & Chattopadhyay, Fl. Hazaribagh 1: 264. 2000; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 367. 2002, var. **latifolia** (Roxb.) A. Chev., Rep. Bot. Appl. 23: 149. 1943; N.P. Singh & al., Fl. Bihar: 290. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 134. 2014. *Bassia latifolia* Roxb., Pl. Coromandel 1: 20, t. 19. 1795; C.B. Clarke in Hook.f., Fl. Brit. India 3: 544. 1882; Haines, Forest Fl. Chota Nagpur: 407. 1910 & Bot. Bihar Orissa: 511. 1922. *Bassia longifolia* L., Mant. Pl. 2(App.): 563. 1771; C.B. Clarke in Hook.f., Fl. Brit. India 3: 544. 1882. **Fig. 45; Plate 45C**  
Vern. Name: *Mahua* (Hindi).

Tree, 8–25 m high, deciduous. Branchlets usually thickened in nodes, tomentose. Leaves simple, alternate or confined at apex of branchlets, sometimes in whorls, oblong or oblanceolate or elliptic, 7–19 × 3–8 cm, cuneate or rounded at base, entire at margins, acute or obtusely acuminate at apex, tomentose when young, glabrous on age; lateral veins 8–15 pairs, ascending; petioles 1.5–4 cm long, thickened at base. Flowers 3 to many in each fascicle, erect when young, pendulous later; pedicels angular, 1–6 cm long, tomentose. Calyx 4-lobed; lobes ovate-lanceolate or elliptic, 1.2–1.5 × 0.6–0.8 cm, woolly pubescent. Corolla 1–2 cm long, fleshy, glabrous, yellowish white, to 11-lobed; lobes ovate or ovate-elliptic, obtuse at apex, 5–6 × 2–3 mm. Stamens 20–30 in 2 or 3 whorls; filaments subulate, *c.* 1 mm long; anthers ovate-lanceolate or oblong, 4–5 mm long, hairy, yellowish brown. Ovary 8–11-loculed; style linear, 3–4 cm long, persistent, yellowish green. Berries obovoid-ellipsoid or subglobose, 2–4 × 1–3 cm, with a remnant of style at apex, fleshy, tomentose. Seeds 1–4, ellipsoid, 2.5–3 × 1–1.5 cm, brown.

*Fl. & Fr.:* March – July.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Koderma NRF, near the Koderma Rest House; common. INDIA: Bihar, Madhya Pradesh, Odisha, Uttar Pradesh and Peninsular India. WORLD: Myanmar, Pakistan and Sri Lanka.

*Specimen examined:* Koderma NRF, near the Koderma Rest House, 401 m, 24°28'49.6" N, 85°35'49.6" E, 10th March 2011, *Shyam Biswa* 49748.

## 76. EBENACEAE Gürke, nom. cons.

Tropical and subtropical regions and a few in temperate regions, 3 genera and *c.* 575 species and 1 genus and 66 species in India.

## DIOSPYROS L.

Tropical regions, *c.* 550 species, 66 in India, 10 in Jharkhand (1 cultivated) and 1 in KWLS.

**Diospyros melanoxylon** Roxb., Pl. Coromandel 1: 36, t. 46. 1795; C.B. Clarke in Hook.f., Fl. Brit. India 3: 564. 1882; Haines, Forest Fl. Chota Nagpur: 412. 1910 & Bot. Bihar Orissa: 519. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 267. 2000; N.P. Singh & al., Fl. Bihar: 292. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 372. 2002, var. **melanoxylon** V. Singh, Monogr. Ind. Diospyros: 149, f. 36. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:135. 2014.

**Plate 45D**

Vern. Names: *Kendu* (Hindi); Kend.

Tree, 4–12 m high; bark very thick, corky, deeply fissured vertically, blackish; young parts rusty-tomentose. Leaves simple, subopposite to alternate, 11–20 × 5.5–11 cm, rounded at base, entire at margins, obtuse or rounded at apex, thick, minutely light brown-woolly on both surfaces when young, glabrous on age, with conspicuously reticulate venation; petioles 0.5–2 cm long. Male flowers 3–7 in a dichasial cyme; peduncles 0.3–1 cm long, densely woolly; pedicels 1–1.5 cm long; bracts and bracteoles gradually decreasing in size upwards, woolly. Calyx campanulate, 5–8 mm long, yellowish green, 5-lobed; lobes acute, 2–3 mm long. Corolla 1–1.5 cm long, densely sericeous, yellowish white, 5-lobed; lobes rounded, 2–2.5 mm. Stamens 8–16; filaments *c.* 4 mm long; anthers lanceolate, *c.* 2 mm long, awnless. Pistillode absent. Female flowers solitary, axillary; pedicels stout, 1–2 mm long. Calyx 7–8 mm long, woolly, green to brown, deeply 5-lobed; lobes with reflexed undulate margins. Corolla 2.5–3 mm long, yellow. Staminodes 5. Ovary 4–8-loculed; ovule solitary in each locule; styles 2, each bifid at apex; stigma 4, fimbriate, fleshy. Berries globose, 3–5 cm, densely hairy when young, yellow and glabrous when matured; fruiting calyx to 2.5 cm in diam., closely enveloping the base of the fruits. Seeds ovate-oblongoid, 1.7–2 × *c.* 1 cm, roundish at base, truncate at apex, glossy, brownish.

*Fl. & Fr.*: February – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Dhodhakola forest; common. INDIA: Andhra Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal. WORLD: Sri Lanka.

*Specimen examined*: Dhodhakola forest, 389 m, 24°32'48.8" N, 85°40'04.4" E, 2nd April 2013, *Shyam Biswa* 54168.

## 77. PRIMULACEAE Batsch ex Borkh., nom cons.

Subcosmopolitan, *c.* 60 genera and *c.* 2575 species; *c.* 10 genera and 183 species in India.

### LYSIMACHIA Tourn. ex L.

Temperate and Subtropical to tropical mountains, 282 species, 23 in India, ? in Jharkhand and 1 in KWLS.

**Lysimachia arvensis** (L.) U.Manns & Anderb., Willdenowia 39(1): 51. 2009. *Anagallis arvensis* L., Sp. Pl. 1: 148. 1753; Hook.f., Fl. Brit. India 3: 506. 1882; Haines, Bot. Bihar Orissa: 506. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 1: 271. 2000; N.P. Singh & al., Fl. Bihar: 287. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 366. 2002.

**Plate 45E**

Herb, procumbent. Stems quadrangular, somewhat slightly winged, glabrous. Leaves simple, opposite, occasionally in whorls of 3, ovate or ovate-oblong,  $0.8-2 \times 0.3-1$  cm, rounded or slightly cordate at base, entire at margins, acute at apex, glabrous, brownish gland-dotted beneath. Flowers solitary, axillary, *c.* 1 cm across; pedicels 1–2 cm long, erect at first later decurved. Calyx short-campanulate, 5-lobed; lobes lanceolate, 3–5 mm long. Corolla rotate, 5-lobed; lobes obovate,  $4-6 \times 3-4$  mm, erose at margins, minutely glandular-ciliate, blue with centrally reddish. Stamens 5, adnate to corolla tube; filaments 2–3 mm, reddish; anthers *c.* 0.5 mm long, yellowish. Carpels connate in a globose ovary; ovules many; style filiform. Capsules circumscissile, dome-shaped, 4–6 mm across. Seeds suborbicular, *c.* 1 mm, compressed, peltate, brownish.

*Fl. & Fr.*: November – March.

*Habitat*: Moist and shade localities near river and on hillslopes.

*Distribution*: KWLS: Bishnutikar Jungle, way to Rajdah, Meghatari; not common. INDIA: Almost throughout. WORLD: Australia, Bhutan, China, Europe, Japan, Nepal, North-West Africa, North America, Pakistan, Russia, South America and West Asia.

*Specimen examined*: Bishnutikar Jungle, way to Rajdah, Meghatari, 210 m,  $24^{\circ}34'47.8''$  N,  $85^{\circ}35'56.0''$  E, 8th March 2011, *Shyam Biswa* 49722.

#### 78. RUBIACEAE Juss., nom. cons.

Cosmopolitan, especially tropical and subtropical regions, *c.* 590 genera, *c.* 13620 species; 113 genera and 616 species in India.

##### Key to genera

- |                                                                                             |                          |
|---------------------------------------------------------------------------------------------|--------------------------|
| 1a. Trees or shrubs                                                                         | 2                        |
| 1b. Herbs                                                                                   | 11                       |
| 2a. Flowers collected into dense heads on a globose or somewhat oblong receptacle           | 3                        |
| 2b. Flowers not collected into heads on a globose receptacle (but cymes sometimes capitate) | 6                        |
| 3a. Ovules numerous in each locule                                                          | 4                        |
| 3b. Ovules 1 in each locule                                                                 | <b>11. Morinda</b>       |
| 4a. Hypanthia confluent or connate                                                          | <b>12. Neolamarckia</b>  |
| 4b. Hypanthia not connate                                                                   | 5                        |
| 5a. Sepals distinct                                                                         | <b>1. Adina</b>          |
| 5b. Sepals not distinct or 0                                                                | <b>10. Mitragyna</b>     |
| 6a. Ovules more than 1 in each locule                                                       | 7                        |
| 6b. Ovules solitary in each locule                                                          | 10                       |
| 7a. Corolla lobes valvate; seeds winged                                                     | <b>6. Hymenodictyon</b>  |
| 7b. Corolla lobes twisted in bud; seeds not winged                                          | 8                        |
| 8a. Fruit dehiscent                                                                         | <b>16. Wendlandia</b>    |
| 8b. Fruit indehiscent                                                                       | 9                        |
| 9a. Plants armed; ovary 2-loculed                                                           | <b>2. Catanagum</b>      |
| 9b. Plants unarmed; ovary 1-loculed                                                         | <b>5. Gardenia</b>       |
| 10a. Shrubs not foetid when bruised; fruit baccate or drupaceous                            | <b>7. Ixora</b>          |
| 10b. Shrubs foetid when bruised; fruit capsular                                             | <b>15. Spermadiction</b> |
| 11a. Ovules many in each locule                                                             | 12                       |
| 11b. Ovules solitary in each locule                                                         | 14                       |
| 12a. Prostrate herbs; petals toothed; fruits indehiscent                                    | <b>4. Dentella</b>       |



- |                                                                                        |                        |
|----------------------------------------------------------------------------------------|------------------------|
| 12b. Erect herbs; petals not toothed; fruit usually dehiscent or of cocci              | 13                     |
| 13a. Leaves opposite, linear; seeds polyhedral, or triangular, smooth                  | <b>13. Oldenlandia</b> |
| 13b. Leaves whorled or basal, ovate or ovate-elliptic; seeds subglobose, pitted        | <b>3. Debia</b>        |
| 14a. Flowers axillary clustered                                                        | 15                     |
| 14b. Flowers subspicate on the branches of terminal cymes                              | <b>8. Knoxia</b>       |
| 15a. Fruit loculicidal then septicidal; seeds with longitudinal groove on ventral face | <b>14. Spermacoce</b>  |
| 15b. Fruit circumscissile; seeds with X-shaped furrow on ventral face                  | <b>9. Mitracarpus</b>  |

### 1. ADINA Salisb.

India to Bangladesh, 3 species, 3 in India and 1 in Jharkhand.

**Adina cordifolia** (Roxb.) Hook.f. & Benth. in Brandis, Forest Fl. N.W. India [Brandis] 263. 1874; Hook.f., Fl. Brit. India 3: 24. 1880; Haines, Forest Fl. Chota Nagpur: 497. 1910 & Bot. Bihar Orissa: 421. 192; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 299. 2002. *Nauclea cordifolia* Roxb., Pl. Coromandel 1: 49, t. 53 1796. *Haldina cordifolia* (Roxb.) Ridsdale, Blumea 24: 361. 1978; N.P. Singh & al., Fl. Bihar: 231. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 821. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 108. 2014.

**Plate 46A**

Vern. Name: *Karam*.

Tree, 10–25 m high; branches sympodial; branchlets with conspicuous petiolar scars; bole buttressed and fluted; bark reddish-brown. Leaves simple, opposite whorled at branches apex, broadly ovate, 9–16 × 9.5–15 cm, deeply cordate at base, entire at margins, abruptly acuminate at apex, subcoriaceous, sparsely hirsute above, densely pubescent beneath; lateral veins 5–9 pairs; petioles 2–8 cm long, pubescent; stipules ovate-oblong, 1–1.8 × 0.8–1.2 cm, strongly keeled, pubescent. Flowers 5-merous, subsessile, in axillary, globose heads, heads 7–10 cm across; peduncles 2–4 cm long; bracts ovate-suborbicular, c. 2 mm long; bracteoles linear-subulate, chaffy. Calyx cupular; tube 1.5–2 mm long, obscurely 5-angled, 5-lobed; lobes ovate-oblong, 1.5–1.8 mm long, attenuate at base into filiform shaft. Corolla funnel-shaped, 7–10 mm long, cream; tube 5–6 mm long, finely hairy outside; lobes oblong, 1–3 mm long, hairy outside, papillose inside. Stamens 5, partly exserted; filaments c. 0.5 mm; anthers oblong, hastate at base, c. 1 mm, obtuse. Ovary 2-loculed; ovules 3–5 on apical placentae; style filiform, 9–11 mm long, exserted; stigma capitate. Capsules c. 4 mm, clustered, breaking into 2-follicular cocci. Seeds obovoid, apically with 2 claw-like short projections.

*Fl. & Fr.*: August – May.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Top of Rishi Dhurwasha Pahar (Debor Ghati), Meghatari; common. INDIA: Throughout. WORLD: India to China (Yunnan) and Peninsula Malaysia.

*Specimen examined*: Top of Rishi Dhurwasha Pahar (Debor Ghati), Meghatari, 250 m, 24°35'24.54" N, 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 53903.

### 2. CATUNAREGAM Wolf

Tropical Africa to Asia, 8 species, 3 in India, 3 in Jharkhand and 1 in KWLS.

**Catunaregam spinosa** (Thunb.) Tirveng., Bull. Mus. Natl. Hist. Nat., Sér. 3, Bot. 35: 13 1978.

Taxon 27: 515. 1978; N.P. Singh & al., Fl. Bihar: 234. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 300. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 812. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 107. 2014. *Gardenia spinosa* Thunb., *Gardenia*: 16. 1780; *Randia dumetorum* (Retz.) Poir. in Lam., Encycl. Suppl. 2: 829. 1812; Hook.f., Fl. Brit. India 3: 110. 1880; Haines, Forest Fl. Chota Nagpur: 501. 1910 & Bot. Bihar Orissa: 432. 1922.

#### Plate 46B

Tree or shrub, 2.5–5 m high, armed; spines axillary, stout, straight, nearly opposite and decussate, 2.5–3.5 cm long. Leaves obovate-spathulate or oblanceolate, 1–9.5 × 0.8–5 cm, cuneate or attenuate at base, entire at margins, rounded or obtuse or shortly acuminate at apex, clustered, wrinkled, pubescent; petioles 1–7 mm long; stipules ovate, acuminate at apex, 2–2.5 mm long. Inflorescences axillary. Flowers 5-merous, solitary or in fascicles at ends of short leaf-bearing branchlets, fragrant. Calyx cupular, 8–9 mm long, strigose; tube broadly campanulate; lobes broadly ovate or obovate oblanceolate, 6–7 mm long, foliaceous. Corolla 2.3–2.5 cm long, yellow or creamish white; tube 1.3–1.5 cm long, hairy inside at base; lobes suborbicular, globose or ovoid, *c.* 10 × 6–7 mm, crowned by semi-persistent calyx-teeth, glabrous, yellow. Stamens 4, epipetalous at the mid of the corolla tube; filaments *c.* 1 mm long; anthers oblong, *c.* 8 × 1 mm dorsifixed slightly below the middle. Ovary 2–3.5 mm; style 6–8 mm long; stigma fusiform, *c.* 5 mm long. Berries globose, *c.* 4 cm, slightly ribbed. Seeds many, flat, smooth, 4–5 mm, embedded in pulp.

*Fl. & Fr.*: March – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Dhodhakhola forest; Baghi tan road, Koderma NRF; common. INDIA: Throughout. WORLD: Pakistan to South China and West Malesia.

*Specimens examined*: Dhodhakhola forest, 367 m, 24°33'33.4" N, 85°39'21.7" E, 6th September 2010, *Shyam Biswa* 49579; Baghi tan road, Koderma NRF, 390 m, 24°29'06.6" N, 85°36'49.8" E, 4th April 2013, *Shyam Biswa* 54158.

### 3. **DEBIA** Neupane & N. Wikstr.

Tropical Asia, 4 species, 2 in India and 1 in Jharkhand.

**Debia ovatifolia** (Cav.) Neupane & N. Wikstr. Taxon 64: 315. 2015. *Hedyotis ovatifolia* Cav., Icon. 6: 52. 1802; R.S. Rao & Hemadri, Indian Forester 99: 377. 1973; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 304. 2002; R. Dutta & Deb, Taxon. Revis. Ind. Subcont. *Hedyotis*: 112, pl. 38. 2004. *Oldenlandia nudicaulis* Roth, Nov. Pl. Sp.: 95. 1821; Hook.f., Fl. Brit. India 3: 70. 1880; Haines, Bot. Bihar Orissa: 449. 1922; Mooney, Suppl. Bot. Bihar Orissa: 72. 1950. *Oldenlandia ovatifolia* (Cav.) DC., Prodr. 4: 427. 1830. *Thecagonum ovatifolium* (Cav.) Babu, Bull. Bot. Surv. India 11: 214. 1971; N.P. Singh & al., Fl. Bihar: 249. 2001.

#### Plate 46C

Herb, 5–10 cm high. Stems quadrangular, pubescent. Leaves simple, opposite, two lower pairs are smaller and two pairs above which are sometimes separated by a short internodes as to appear whorled, ovate, elliptic or elliptic-ovate, 2–5.5 × 0.8–3.2 cm, attenuate at base, entire at margins, acute or obtuse at apex, pubescent; lateral veins 3 or 4 pairs; petioles 1–6 mm long, pubescent; stipules truncate, *c.* 2 mm. Inflorescence terminal cymose or panicle, di- or tri-chotomously branched; peduncles 4–7 cm long, very slender, terete, pubescent. Flowers 3–3.5 × 1–1.5 mm, in a long-stalked dichotomous cymes, bearing a pair of bract at the first fork; pedicels 0.5–1.2 mm

long. Hypanthium globose or ovoid, 0.5–0.8 mm long; calyx 4-toothed, triangular,  $1-1.5 \times 0.2-0.3$  mm, acute, widely separated and minute in fruit. Corolla white, 4-lobed; lobes oblong,  $2.5-3 \times 0.5-0.7$  mm, pubescent at the middle of the inner surface. Stamens 4, inserted at base of sinus of corolla lobes; filaments 1.5–2 mm long, white; anthers oblong, *c.* 0.5 mm long, dorsifixed. Ovary *c.* 0.6 mm long, 2-loculed; ovules many on globose placenta; style stout, *c.* 2.5 mm, white; stigma capitate. Capsules ovoid,  $2.5-3 \times 3-4$  mm, hemispheric above, globose at base, obtusely angular, dehiscing loculicidally, prominently veined, glabrous. Seeds numerous, subglobose or angular, *c.* 0.5 mm long, deeply reticulate or pitted, brownish.

*Fl. & Fr.*: September – December.

*Habitat*: Near damp places.

*Distribution*: KWLS: Muglamaram forest; not common. INDIA: Andhra Pradesh, Assam, Bihar, Meghalaya, Odisha, tropical Himalayas from Kumaon to Sikkim and Western India. WORLD: Indian subcontinent to south central China and Philippines.

*Specimen examined*: Muglamaram forest, 385 m,  $24^{\circ}29'16.0''$  N,  $85^{\circ}34'39.8''$  E, 3rd September 2010, *Shyam Biswa* 49515.

#### 4. DENTELLA J.R. Forst. & G. Forst.

Indomalesia, Australia and New Caledonia, 2 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Dentella repens** (L.) J.R. Forst. & G. Forst., Char. Gen. Pl., ed. 2. 26, t. 13. 1776; Hook.f., Fl. Brit. India 3: 42. 1880, p.p.; Haines, Bot. Bihar Orissa: 443. 1922; Mooney, Suppl. Bot. Bihar Orissa: 71. 1950; N.P. Singh & al., Fl. Bihar: 235. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 301. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 817. 2005. *Oldenlandia repens* L., Mant. Pl. 1: 40. 1767. **Plate 46D**

Herb, prostrate, rooting at nodes, strigose. Stems terete, branched, nodes bearing long tendril-like to attach to the substratum. Leaves simple, opposite, narrow-elliptic or oblanceolate or spatulate,  $1.5-6 \times 1-2$  mm, cuneate or attenuate at base, entire at margins, acute to rostrate at apex; midribs not visible, hairy; petioles *c.* 1 mm long; stipules connate, 0.6–0.8 mm long. Flowers solitary, axillary in one of the two axils of a pair of opposite leaves, in some cases, in forks of branches, 5-merous, 3–5 mm long; pedicels 0.5–1 mm long hairy. Calyx campanulate, 2–3 mm long; lobes 5, equal, valvate, linear, *c.* 2 mm long, acute-acuminate, hairy outer surface. Corolla funnel-shaped, 3.5–4 mm long, white, 5-lobed; lobes ovate, 0.5–1 mm long, acute. Stamens 5, inserted at about lower portion of the corolla; filaments *c.* 0.4 mm long; anthers oblong, *c.* 0.5 mm long, dorsifixed. Ovary globular, *c.* 1.5 mm long, hairy outside, 2-locular; ovules many; style bifurcated; stigma subulate, sessile. Capsules asymmetrically subglobose or oval, tapering at ends,  $4-5 \times c.$  2.5 mm, indehiscent, densely covered with pellucid trichomes, crowned by persistent calyx. Seeds angular or subglobose, *c.* 0.5 mm long, blackish.

*Fl. & Fr.*: April – July.

*Habitat*: Near the sandy river banks attached to the stone.

*Distribution*: KWLS: Phutlaiya Nala; not common. INDIA: Throughout. WORLD: Tropical and subtropical Asia to Southwest Pacific.

*Specimen examined*: Phutlaiya Nala, 343 m,  $24^{\circ}30'33.9''$  N,  $85^{\circ}39'31.8''$  E, 2nd April 2013, *Shyam Biswa* 54149.

5. **GARDENIA** J. Ellis, nom. cons.

Old World tropical and subtropical regions, *c.* 200 species, 7 in India, 5 in Jharkhand and 1 in KWLS.

**Gardenia latifolia** Aiton, Hort. Kew. 1: 294. 1789; Hook.f., Fl. Brit. India 3: 116. 1880; Haines, Forest Fl. Chota Nagpur: 504. 1910 & Bot. Bihar Orissa: 431. 1922; N.P. Singh & al., Fl. Bihar: 236. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 301. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 820. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 108. 2014. **Plate 46E**

Vern. Names: *Papra* (Hindi); *Papar* (Kharwari).

Tree, 8–12 m high with divergent branches; bark pale-grey, smooth, flaking off in small round pieces. Leaves simple, opposite, broadly elliptic or suborbicular or oblong, 13.5–18.5 × 9.5–12.5 cm, attenuate at base, entire at margins, shortly acuminate at apex, glabrous above, minutely pubescent beneath, greenish above, paler beneath; midrib and lateral veins raised beneath; lateral veins 12–17 pairs, parallel with small gland in veins; stipules tubular, connate, acuminate at apex; petioles 0.7–2 cm long. Flowers solitary or 2-nate, 7–10 cm across, subsessile. Calyx tubular-campanulate, 1.5–2.5 cm long, densely pubescent; lobes 7–9, lanceolate or subulate, unequal, recurved with ciliate margins, acuminate at apex. Corolla white, turning yellow or orange when fading; tube 2–3 cm long, hirsute; lobes 5–9, obliquely oblong-obovate, 2–3 × 1–1.5 cm, thin-fleshy. Stamens subexserted, 1.5–2 cm long. Ovary oblong, *c.* 1 × 0.5 cm; stigma 2-lamellate. Berries subglobose or oval, 4.5–5 × 3.5–4 cm, pubescent when young, rough, grey or speckled greenish yellow when ripe. Seeds numerous, 5–6 × 4–5 mm, brownish.

*Fl. & Fr.*: March – December.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Almost throughout. WORLD: India to Bangladesh.

*Specimen examined*: Muglamaram forest, 380 m, 24°30'56.7" N, 85°34'33.4" E, 4th March 2011, *Shyam Biswa* 49665.

6. **HYMENODICTYON** Wall., nom. cons.

Old World East to Sulawesi, *c.* 30 species, 3 in India and 1 in Jharkhand.

**Hymenodictyon orixense** (Roxb.) Mabb., Taxon 31: 66. 1982; Deb, J. Econ. Taxon. Bot. 13: 679, f. 3. 1984; N.P. Singh & al., Fl. Bihar: 239. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 824. 2005; Razafim. & B. Bremer, Bot. J. Linn. Soc. 152: 375. 2006; Ranjan, Fl. Parasnath Wildlife Sanct.: 109, f. 14. 2014. *Cinchona orixensis* Roxb., Bot. Descr. Swietenia: 21. 1793. *Hymenodictyon excelsum* (Roxb.) Wall. in Roxb., Fl. Ind. 2: 149. 1824; Hook.f., Fl. Brit. India 3: 35. 1880; Haines, Forest Fl. Chota Nagpur: 498. 1910 & Bot. Bihar Orissa: 425. 1922; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 307. 2002. **Plate 46F**

Vern. Names: *Bhaulan* (Hindi); *Bhoorkund*.

Tree, to 25 m high; bark smooth. Leaves simple, opposite-decussate, elliptic-ovate to oblanceolate, 11–21.5 × 6.5–12 cm, acute-attenuate at base, entire at margins, attenuate at base, entire at margins, shortly acute to acuminate at apex, finely pubescent on both surfaces; lateral

veins 6–10 pairs; midrib raised beneath; petioles 5–10 cm long, pubescent; stipules broadly oblong, recurved. Inflorescence a panicle raceme, 6–15 cm long, terminal and axillary; bracts 2, ovate to elliptic, 8–10 × 3–6 cm, leafy, persistent; bracteoles linear, 3–4 mm long, strongly veined. Flowers 5-merous, subsessile. Calyx subtruncate-globose, *c.* 2 mm long, 5-lobed; lobes valvate, triangular, acute, *c.* 0.7 mm thick, puperulous outside, deciduous. Corolla salver-form, greenish; tube 2–3 mm long; lobes 5, oblong, 2.5–3 mm long, valvate, concave, thick, puberulous outside. Stamens 5, between the lobes; anthers subsessile, oblong, *c.* 7 mm long, mucronate. Ovary *c.* 1 mm, 2-loculed; ovules many on elongated, broad placentae, adnate to the septum; style *c.* 1.5 mm; stigma fusiform, acute. Fruiting pedicels 0.7–1.8 cm long, reflexed, pendulous. Capsules loculicidal, ellipsoid or ovoid, 1.8–2.2 × 0.8–1 cm, dotted, brownish. Seeds circular, 1.1–1.2 × 0.6–0.7 cm, winged; wings membranous, light brownish.

*Fl. & Fr.:* September – March.

*Habitat:* Dry deciduous forests.

*Distribution:* KWLS: Near the base of Rishi Dhurwasa Pahar; common. INDIA: Western Himalayas from Garhwal eastward throughout Deccan, Central and South India. WORLD: Indian subcontinent to Indo-China, Philippines.

*Specimens examined:* Near the base of the Rishi Dhurwasa Pahar, 286 m, 24°35'25.2" N, 85°34'50.4" E, 11th September 2010, *Shyam Biswa* 49610; Baghitan forest, 398 m, 24°29'06.7" N, E85°36'12.8" E, 3rd March 2011, *Shyam Biswa* 49658.

## 7. IXORA L.

Tropical regions, *c.* 560 species, 46 in India, 4 in Jharkhand (2 cultivated) and 1 in KWLS.

***Ixora pavetta*** Andrews, Bot. Repos.: t. 2: 78. 1799; N.P. Singh & al., Fl. Bihar: 239. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 827. 2005; *Ixora arborea* Roxb. ex Sm. in Rees, Cycl. 19: 5. 1811. *Ixora parviflora* Vahl, Symb. Bot. 3: 11, t. 52. 1794, non Lam., 1791; Hook.f., Fl. Brit. India 3: 142. 1880; Haines, Forest Fl. Chota Nagpur: 505. 1910 & Bot. Bihar Orissa: 435. 1922; T. Hussain & S. R. Paul, J. Econ. Taxon. Bot. Addit. Ser. 6: 155, f. 28. 1989. **Plate 46G**

Vern. Name: *Khota*.

Small to 2 m high. Leaves simple, subsessile, opposite, oblong or elliptic, 3–12 × 1.8–5.3 cm, rounded or cordate at base, entire at margins, rounded or acuminate at apex, glossy above, glabrous. Inflorescence a panicle, compact. Flowers subsessile, 7–8 × *c.* 8 mm; bracteoles linear, 0.5–1 mm long. Calyx 4-toothed; teeth 1.5–2 mm long. Corolla white or pinkish; tube 5–5.5 mm long; lobes 4, *c.* 3 × 1 mm, obtuse, spreading and reflexed. Stamens 4, adnate to corolla mouth by a very short filaments; anthers basifixed, exserted, linear, 2.5–3 mm long. Ovary 2-loculed; carpels 7–8 mm long; style filiform, exserted but never twice as long as corolla tube; stigma slender at first, fusiform afterwards, usually divided into 2 branches. Ovules 1 in each locule, peltately attached to septum. Fruits depressed-globose, shining black. Seeds peltate; cotyledons flat, thin.

*Fl. & Fr.:* March – June.

*Habitat:* On rocks, near river in dry deciduous mixed forests.

*Distribution:* KWLS: Dipluswa Nala, Meghatari; common. INDIA: Bihar, Nicobar Islands, Peninsular India and West Bengal. WORLD: Bangladesh, Myanmar and Sri Lanka.



*Specimen examined:* Dipluswa Nala, Meghatari, 186 m, 24°34'25.1" N, 85°35'19.4" E, 31st March 2013, *Shyam Biswa* 54128.

## 8. KNOXIA L.

Indomalesia, 7 species, 7 in India, 2 in Jharkhand and 1 in KWLS.

**Knoxia sumatrensis** (Retz.) DC., Prodr. 4: 569. 1830; R. Bhattacharjee & Deb, J. Econ. Taxon. Bot. 6: 89. 1985; N.P. Singh & al., Fl. Bihar: 240. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 307. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 828. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 110. 2014. *Spermacoce sumatrensis* Retz., Observ. Bot. 4: 23. 1786. *Knoxia corymbosa* Willd., Sp. Pl. 1: 582. 1798; Hook.f., Fl. Brit. India 3: 128. 1880; Haines, Forest Fl. Chota Nagpur: 510. 1910 & Bot. Bihar Orissa: 452. 1922. **Plate 47A**

Herb, 30–60 cm high. Stems quadrangular, unbranched or sparsely branched, densely pubescent. Leaves simple, opposite, elliptic or lanceolate to linear-lanceolate, 2–9 × 1–2.2 cm, attenuate at base, entire at margins, acute at apex, puberulous on both surfaces, more so beneath; lateral veins 8–12 pairs; petioles 2–10 mm long, puberulous; stipules ovate-rounded, 2–3 mm long with 3 or 4 filiform hairy bristles. Flowers 4-merous, small, numerous, on sides of slender, pubescent branches of large, lax corymbose cymes; pedicels *c.* 1 mm long. Calyx 4-lobed; lobes triangular, *c.* 1 mm, subequal. Corolla tube dilated above, *c.* 2 mm long, whitish; lobes 4, ovate, 0.5–1 mm long, whitish violet. Long-styled flowers with subsessile anthers included in the dilated part of corolla tube; stamens 4; filaments 0.5–0.8 mm long; anthers 0.8–1 mm long; style exserted, *c.* 2.5 mm long; stigma bifid, violet. Short-styled flowers with anthers exserted and stigma included. Fruits with persistent calyx teeth, ellipsoid-ovoid, *c.* 2 × 1 mm, 4-angled, indehiscent or splitting into 2 mericarps suspended from a columnar carpophore; carpophore often bifurcate at apex. Seeds 2, oblong to ellipsoid in stony endocarp, black.

*Fl. & Fr.:* September – December.

*Habitat:* Dry deciduous mixed forests.

*Distribution:* KWLS: Lokai forest near the road pond; common. INDIA: Throughout. WORLD: Tropical and subtropical Asia to Queensland.

*Specimen examined:* Lokai forest near road pond, 399 m, 24°29'01.4" N, 85°36'52.9" E, 28th September 2013, *Shyam Biswa* 54178.

## 9. MITRACARPUS Zucc.

Tropical America and Old World, 30 species and 1 in India.

**Mitracarpus hirtus** (L.) DC., Prodr. 4: 572. 1830. *Spermacoce hirta* L., Sp. Pl. ed. 2. 1: 148. 1762. *Spermacoce villosa* Sw., Prodr.: 29. 1788. *Mitracarpus villosus* (Sw.) Cham. & Schltdl. ex DC., Prodr. 4: 572. 1830; Paria & Chattopadhyay, Fl. Hazaribagh 2: 830. 2005. **Plate 47B**

Herb, 30–70 cm high. Stems quadrangular, unbranched or few-branched with long-pubescent. Leaves simple, opposite, elliptic or lanceolate, 1–4.5 × 0.5–1.7 cm, cuneate or attenuate at base, entire at margins, acute at apex, puberulous on both surfaces more so beneath; petioles *c.* 1 mm long, pubescent; stipules connate with petioles into a broad truncate tube with unequal bristles,

1.5–4 mm long. Inflorescences 0.5–1.8 cm in diam., mostly present in the axils. Flowers sessile; bracteoles filamentous, 2–3 mm long. Calyx tube 1–1.5 mm long; lobes 4, 2 oblong-lanceolate, 1.3–2.5 mm long, green with hyaline margins, rather thick; other 2 hyaline, triangular-lanceolate, 0.5–1.5 mm long, all with ciliate margins. Corolla glabrous or slightly hairy outside, white; tube 1.5–2 mm long; lobes 4, ovate, 0.5–1 mm long. Stamens 4, varying in their degree of exsertion; anthers *c.* 0.3 mm long, dorsifixed. Ovary 2-loculed; style *c.* 2.5 mm long; stigma bifid, *c.* 1 mm across, hairy. Capsules ellipsoid-rectangular, *c.* 2 mm long, thin, circumscissile, straw-coloured. Seeds oval, *c.* 1 × 1 mm, minutely pitted and with cruciform or X-shaped attachment scar, brownish.

*Fl. & Fr.*: August – November.

*Habitat*: On dried-up sandy river bed.

*Distribution*: KWLS: Suggi Pahar near Suggi mining area; common. INDIA: Andhra Pradesh, Kerala and Tamil Nadu. WORLD: Mexico to tropical America.

*Specimens examined*: Suggi Pahar near Suggi mining area, 269 m, 24°33'28.8" N, 85°35'14.6" E, 15th August 2011, *Shyam Biswa* 49808; Phoolwarya forest road, 403 m, 24°29'12.2" N, 85°35'48.5" E, 20th November 2012, *Shyam Biswa* 54061.

#### 10. MITRAGYNA Korth., nom. cons.

Old World tropical regions, 9 species, 3 in India and 1 in Jharkhand.

**Mitragyna parvifolia** (Roxb.) Korth., *Observ. Naocl. Ind.*: 19. 1839; Haines, *Forest Fl. Chota Nagpur*: 497. 1910 & *Bot. Bihar Orissa*: 422. 1922; N.P. Singh & al., *Fl. Bihar*: 241. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 309. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 832. 2005; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 112. 2014. *Nauclea parvifolia* Roxb., *Pl. Coromandel* 1: 40, t. 52. 1796. *Stephegyne parvifolia* (Roxb.) Korth., *Verh. Nat. Gesch. Ned. Bezitt., Bot.* 161. 1842; Hook.f., *Fl. Brit. India* 3: 25. 1880.

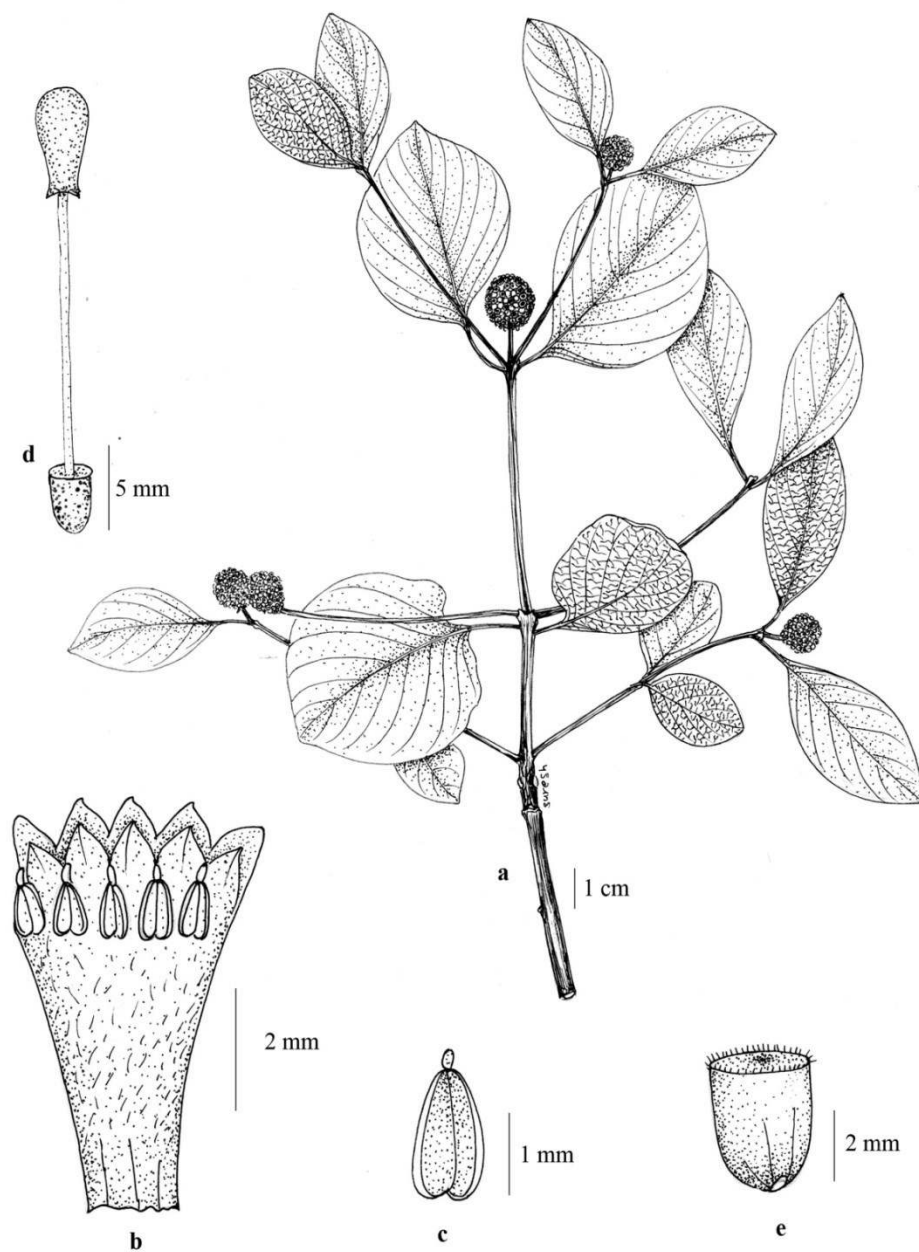
**Fig. 46; Plate 47C**

Vern. Names: *Kaim* (Hindi); *Goori Karam*.

Tree, 15–25 m high; bark rough, flakes peeling off. Leaves simple, opposite, obovate or oblanceolate or oblong-suborbicular, 3–16.5 × 2–10 cm, rounded, cuneate at base, entire at margins, acute to bluntly acuminate or rounded at apex, subcoriaceous, glabrous on both surfaces except minutely hairy vein-axils on lower surface; lateral veins 5–9 pairs; petioles 1–3 cm long; stipules oblong-spathulate, 1–1.5 cm long, foliaceous. Heads globular, 1–1.5 cm; peduncle solitary, *c.* 1 cm long, each carrying one head; bracts caducous; bracteoles many, linear, 3–3.5 mm long, clavate. Calyx truncate, *c.* 2 mm long. Corolla funnel-shaped, white; tube 4–5 mm long; lobes 5, equal, triangular, 2–2.5 mm long, recurved. Stamens 5, exserted; filaments basifixed, 2.5–3 mm long; anthers oblong, 1–1.5 mm long, apiculate. Ovary 2-loculed; ovules many; stigma mitriform. Fruits a head of capsules, 1.2–1.5 cm across; capsules oblong, 4–4.5 × *c.* 1.5 mm, verrucose with blunt rounded tips, splitting into 2 cocci. Seeds many, *c.* 1 cm long, winged all rounded.

*Fl. & Fr.*: August – March.

*Habitat:* Dry deciduous forests.



**Fig. 46.** *Mitragyna parvifolia* (Roxb.) Korth.: a. flowering twig; b. corolla split open; c. stamen; d. carpel; e. capsule.

*Distribution:* KWLS: Near the base of Rishi Dhurwasa Pahar; common. INDIA: Throughout. WORLD: Bangladesh, Myanmar and Sri Lanka.

*Specimen examined:* Near the base of the Rishi Dhurwasa Pahar, 214 m, 24°35'23.8" N, 85°34'55.8" E, 11th September 2010, *Shyam Biswa* 49608.

### 11. **MORINDA** L.

Old World tropical regions, c. 90 species, 8 in India, 2 in Jharkhand (1 cultivated) and 1 in KWLS.

***Morinda pubescens*** Sm. in Rees, Cycl.: 24, n. 3. 1813. *Morinda tinctoria* Roxb., Hort. Bengal.: 15. 1814, nom. nud.; Fl. Ind. 1: 543. 1832; Hook.f., Fl. Brit. India 3: 156. 1880; Haines, Forest Fl. Chota Nagpur: 509. 1910 & Bot. Bihar Orissa: 423. 1922; N.P. Singh & al., Fl. Bihar: 242. 2001.

#### **Plate 47D**

Vern. Name: *Chelia*.

Tree, 8–15 m high; bark fissured, corky, dark brownish. Leaves simple, opposite or whorled at branches apex, ovate or ovate-oblong or elliptic, 7.5–16 × 3.5–11 cm, attenuate at base, entire at margins, obtuse or acute or shortly acuminate at apex, glabrous above glabrous or tomentose beneath; petioles 0.5–2.5 cm long; stipules narrowly triangular or ovate, acute, sometimes slightly bifid. Inflorescences globose heads; peduncles 1–2 cm long, solitary or 2-nate, leaf-opposed or terminal. Calyx tube connate, uniformly and broadly tubular, truncate, 3–4 mm long. Corolla white; tube 1.5–2 cm long, hairy outside; lobes oblong, 1–1.2 cm long, Stamens 5, included, subsessile or with c. 3 mm long filaments; anthers linear. Ovary 2-loculed, free or connate at apex; style slender with 2 short or long linear branches, glabrous; stigma bifid. Few fruit-set in each head. Drupes mostly free, turbinate, c. 8 × 9 mm, black when dry. Pyrenes pyriform, c. 8 × 5 mm.

*Fl. & Fr.:* June – August.

*Habitat:* Dry deciduous mixed forests.

*Distribution:* KWLS: Khalaktambi forest; rare. INDIA: Almost throughout in dry forests, and also cultivated. WORLD: Bangladesh, Malaya Archipelago and Sri Lanka.

*Specimen examined:* Khalaktambi forest, 310 m, 24°31'38.6" N, 85°33'54.9" E, 12th August 2011, *Shyam Biswa* 49785.

### 12. **NEOLAMARCKIA** Bosser

Indomalesia to Australia, 2 species and 1 in India.

***Neolamarckia cadamba*** (Roxb.) Bosser, Bull. Mus. Natl. Hist. Nat., B, Adansonia Sér. 4, 6(3): 247. 1985; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 309. 2002. *Nauclea cadamba* Roxb., Fl. Ind. 2. 121. 1824. *Anthocephalus chinensis* auct. non. (Lam.) A. Rich. ex Walp. 1843; N.P. Singh & al., Fl. Bihar: 232. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 810. 2005. *Cephalanthus chinensis* Lam., Encycl. 1: 678. 1785. *Anthocephalus cadamba* (Roxb.) Miq., Fl. Ned. Ind. 2: 135. 1856; Hook.f., Fl. Brit. India 3: 23. 1880; Haines, Forest Fl. Chota Nagpur: 496. 1910 & Bot. Bihar Orissa: 421. 1922.

#### **Plate 47E**

Vern. Names: *Kadamba*, *Kadam* (Hindi).

Tree, 10–20 m high; branches horizontal, widely spreading, sub-whorled; younger parts pubescent. Leaves simple, opposite, ovate-oblong or elliptic-oblong, 9.5–18 × 5–10 cm attenuate to cuneate at base, entire at margins, acute to shortly acuminate at apex, coriaceous, glabrous; lateral veins 9–11 pairs; petioles 2.5–4 cm long, glabrous; stipules linear, 1–1.5 cm long. Heads globular, 4–4.5 cm, on 2.5–3.5 cm long peduncles. Flowers ebracteolate. Calyx truncate, 5–6 mm long; lobes 5, narrowly oblanceolate. Corolla 4–10 mm long, glabrous, orange; tube slender, infundibuliform, 4–8 mm long; lobes 5 (4–10), oblong, acute at apex, *c.* 2 mm long, slightly pubescent outside. Stamens 5, inserted in throat; anthers *c.* 2 mm long, mucronate. Ovary 4-loculed above, 2-loculed below; style filiform *c.* 1.5 mm long, white; exserted; stigma fusiform, whitish. Fruits of the size of a small orange, packed into a fleshy globose mass of many few-seeded coriaceous pyrenes, 5–7 cm in diam., yellow when ripe. Seeds muriculate, not winged.

*Fl. & Fr.*: September – November.

*Habitat*: Dry deciduous forest and also near village.

*Distribution*: KWLS: Meghatari NRF, near Chirkundi village; common. INDIA: Throughout. WORLD: South China to tropical Asia.

*Specimen examined*: Meghatari NRF, near Chirkundi village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 27th November 2012, *Shyam Biswa* 54091.

### 13. *OLDENLANDIA* L.

Tropical and subtropical regions, especially Africa, *c.* 300 species, *c.* 10 in India, 5 in Jharkhand and 3 in KWLS.

#### Key to species

- 1a. Leaves thin-papery; inflorescences axillary or mostly terminal paniced cymes; peduncles and pedicels very long; corolla tube long, far longer than the sepals **1. *O. affinis***
- 1b. Leaves not thin-papery; inflorescences axillary, 1–4-flowered corymbs; peduncles short or absent, pedicels short; corolla tube short or only slightly exceeding the sepals **2. *O. corymbosa***

**1. *Oldenlandia affinis*** (Roem. & Schult.) DC., Prodr. 4: 428. 1830; N.P. Singh & al., Fl. Bihar: 244. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 835. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 112. 2014. *Hedyotis affinis* Roem. & Schult., Syst. Veg., ed. 15 bis. 3: 194. 1819. *Oldenlandia dichotoma* (K.D. Koenig ex Roth) Hook.f., Fl. Brit. India 3: 67. 1880 nom. illeg.; Haines, Bot. Bihar Orissa: 448. 1922.

Herb, 15–30 cm high. Stems ribbed, glabrous, whitish; branches terete, copious, paniculately branched, ultimately filiform, glabrous. Leaves simple, opposite, linear or linear-lanceolate or narrowly lanceolate, 1.5–4 × 0.2–0.7 cm, narrowed at base, entire at margins, acute to acuminate at apex, subsessile, thin-papery, 1-veined, glabrous above, sparsely hairy and whitish green beneath; stipules scarious and bristly. Inflorescences axillary or terminal paniced cymes. Flowers *c.* 4 × 3–4 mm, whitish; bracts *c.* 3 mm long, fimbriate at margins; pedicels 0.5–1 mm long, hispid; peduncles and pedicels filiform. Hypanthium *c.* 1 mm across; calyx 4-toothed; teeth *c.* 1 mm long, hairy outside. Corolla funnel-shaped, 2.5–3 mm long, white; tube short, pubescent, 4-lobed. Stamens 4, adnate to corolla sinus; filaments very short; anthers oblong, *c.* 0.5 mm long, dorsifixed. Ovary 2-loculed; style filiform, *c.* 2 mm long, glabrous; stigma 2-lobed. Capsules loculicidal, ovoid, 1.5–2 × 1.5–2, often splitting with hypanthium to the base. Seeds many, polyhedral, or triangular, *c.* 0.5 mm, light brownish.



*Fl. & Fr.*: August – March.

*Habitat*: On hillslopes of dry deciduous forests.

*Distribution*: KWLS: On hillslopes of Dhawjadhari Pahar. INDIA: Karnataka and Kerala. WORLD: India to Peninsula Malaysia.

*Specimen examined*: On hillslopes of Dhawjadhari Pahar, 435 m, 24°28'58.3" N, 85°35'48.5" E, 7th September 2010, *Shyam Biswa* 53904.

**2. *Oldenlandia corymbosa* L.**, Sp. Pl. 1: 119. 1753; Hook.f., Fl. Brit. India 3: 64. 1880; Haines, Bot. Bihar Orissa: 446. 1922; N.P. Singh & al., Fl. Bihar: 244. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 838. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 113. 2014. *Hedyotis corymbosa* (L.) Lam., Encycl. 1: 272. 1791; R. Dutta & Deb, Taxon. Rev. Ind. Subcont. *Hedyotis*: 147, t. 48(A–F). 2004.

Herb, prostrate, diffusely branched. Stems acutely angular, ridges prominent, glabrous or scabrid. Leaves sessile, simple, opposite, linear to linear-lanceolate, 1–2.5 × 0.05–0.2 cm, narrowed at base, entire at margins, acute or apiculate at apex, flat or recurved, glabrous or sparsely to densely scabrid, particularly on the midrib; stipules 2–3 mm long with few unequal fine filiform appendages. Inflorescences 1–4-flowered corymbs; peduncles axillary, c. 2 mm long; pedicels 3–6 mm long. Flowers 2–3 mm long. Hypanthium ovoid or ellipsoid, 0.8–1 mm long; calyx limb short; 4-toothed; teeth triangular or triangular-lanceolate, 1–2 mm long, hairy, green. Corolla tubular, infundibular-cylindrical, c. 2 mm long, glabrous or with a ring of pubescent hairs inside below sinus or middle of the lobes, white, 4-lobed; lobes oblong, 0.7–1 × c. 0.5 mm. Stamens 4, inserted; filaments 0.1–0.4 mm long, adnate to base of corolla tube; anthers subglobose, 0.3–0.4 mm long, basifixed. Ovary 0.5–1 mm long, 2-loculed; ovules many; style c. 2 mm long; stigma subglobose, 0.3–0.5 mm long, 2-lobed, fleshy, papillose. Capsules globose or ellipsoid, 1–2 × 1–2 with crown little raised, crown not projecting above the hypanthium. Seeds triangular, c. 0.5 mm, smooth, dark brownish.

*Fl. & Fr.*: August – April.

*Habitat*: Near the shades of damp places.

*Distribution*: KWLS: Dhodhakola forest; common. INDIA: Throughout. WORLD: Tropical and subtropical Old World.

*Specimen examined*: Dhodhakola forest, 380 m, 24°33'15.1" N, 85°39'37.9" E, 17th August 2011, *Shyam Biswa* 49823.

#### 14. **SPERMACOCE** L.

Subtropical regions, c. 250 species, 9 in India, 2 in Jharkhand and 1 in KWLS.

***Spermacoce articularis* L.f.**, Suppl. Pl. 119. 1782 (1781); Sivar. & al., Proc. Indian Acad. Sci. Pl. Sci. 97: 350, ff. 5–10. 1987; N.P. Singh & al., Fl. Bihar: 248. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 314. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 846. 2005. *Borreria articularis* (L.f.) F.N. Williams, Bull. Herb. Boissier Ser. 2, 5: 956. 1905. *Spermacoce hispida* auct. non L. 1753; Hook.f., Fl. Brit. India 3: 200. 1881; Haines, Bot. Bihar Orissa: 451. 1922.

**Plate 47F**

Herb, 20–30 cm high. Stems terete to 4-angled, pubescent or hispid-hairy with long internodes. Leaves simple, opposite, elliptic-oblong or lanceolate or oblong-lanceolate, 1.5–4 × 0.5–1.7 cm,

truncate or attenuate at base, entire at margins, apiculate at apex, scarbrid on both surfaces, more so beneath; lateral veins 4 pairs; petioles *c.* 3 mm long; stipules membranous with few bristles. Flowers 4–6 in whorl within the stipular cup, *c.* 3 mm long; bracts lanceolate-subulate, hyaline. Calyx oblong-globose, hispid, 2–4 mm long; lobes 4, (sub) equal, lanceolate, reflexed, hairy, *c.* 2 mm long. Corolla funnel-shaped, violet or whitish, with a ring of hairs just above the base of tube; lobes 4, oblong, acute-apiculate, 2–2.5 mm long. Stamens exserted; filaments 1–1.5 mm; anthers *c.* 1 mm. Style 5–6 mm long, shortly pubescent; stigmas 2, capitate. Capsules subglobose or obovoid, *c.* 3 × 2 mm, hispidly hairy at apex; splitting longitudinally in 2 halves; septum detaching from valves. Seeds narrowly oblong, *c.* 2 × 1 mm, smooth, shining with linear attachment scar.

*Fl. & Fr.*: September – October.

*Habitat*: In open places under the shades.

*Distribution*: KWLS: Muglamaram forest; common. INDIA: Throughout. WORLD: China, Malaya, Nepal and Sri Lanka.

*Specimen examined*: KWLS: Muglamaram forest, 385 m, 24°29'16.0" N, 85°34'39.8" E, 3rd September 2010, *Shyam Biswa* 49502.

### 15. SPERMADICTYON Roxb.

India 1 species.

**Spermadictyon suaveolens** Roxb., Pl. Coromandel 3: 32, t. 236. 1815; N.P. Singh & al., Fl. Bihar: 249. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 849. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 115. 2014. *Hamiltonia suaveolens* Roxb., Fl. Ind. 2: 223. 1824; Hook.f., Fl. Brit. India 3: 197. 1880; Haines, Bot. Bihar Orissa: 442. 1922. **Plate 47G**

Vern. Name: *Chelli*.

Shrub, 1–1.5 m high. Stems terete, hairy, reddish brown or blackish brown, peeling off as a whole from stem. Leaves elliptic or ovate-lanceolate, 4.5–21 × 1.5–8.5 cm, cuneate or attenuate at base, entire at margins, acute at apex, those in inflorescence smaller, glabrous above, subglabrous to pubescent beneath; lateral veins 10–15 pairs, raised beneath; petioles 1–2 cm long; stipules 3–5 mm long, acute at apex, tinged crimson near apex. Inflorescence terminal, lax, paniculate or corymbose, pubescent cyme. Flowers slaverform, 1.8–2 × 0.5–0.8 cm; bracts narrowly triangular 0.5–5.5 × 0.2–2.2 cm. Calyx 4–4.5 mm long, densely hirsute, crimson-purple greenish with crimson tinge; lobes 2.5–3 mm long, glandular-hairy. Corolla slaverform, pubescent outside, glabrous or pubescent inside tube, purplish or blue; tube 1.5–1.8 cm long; lobes spreading, ovate, 3–4 mm long. Stamens 5; filaments *c.* 2 mm long, inserted top of tube; anthers 2.5–3 mm long, included or exserted, white or whitish blue. Ovary 5-loculed; ovule solitary in each locule; style filiform, *c.* 15 mm long; stigma 5-fid, 1.2–1.5 mm long, exserted or included. Capsules oblong-ellipsoid, 7–10 mm long; pyrenes triquetrous, reticulate.

*Fl. & Fr.*: November – January.

*Habitat*: On the hillslopes of dry deciduous forests.

*Distribution*: KWLS: Near base of Dhawjadhari Pahar, Koderma NRF. INDIA: Central & Western India, Bihar, Bengal. WORLD: Indian subcontinent.

*Specimen examined*: Near base of Dhawjadhari Pahar, Koderma NRF, 435 m, 24°28'58.3" N,

85°35'48.5" E, 19th November 2012, *Shyam Biswa* 54052.

16. **WENDLANDIA** Bartl. ex DC., nom. cons.

Tropical regions Asia Indomalesia, c. 70 species, c. 20 in India, 2 in Jharkhand and 1 in KWLS.

**Wendlandia tinctoria** (Roxb.) DC., Prodr. 4: 411. 1830; Hook.f., Fl. Brit. India 3: 38. 1880; Haines, Forest Fl. Chota Nagpur: 499. 1910 & Bot. Bihar Orissa: 426. 1922; N.P. Singh & al., Fl. Bihar: 250. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 317. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 852. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 116. 2014. *Rondeletia tinctoria* Roxb., Fl. Ind. 2: 134. 1824, non Blume, 1826. **Plate 47H**

Vern. Names: *Tula-lodh*, *Telai* (Hindi).

Shrub, 5–7 m high, densely branched. Stems terete, glabrous with reddish brown bark. Leaves elliptic or oblong or obovate, 4.5–14 × 1.6–6 cm, narrowed or tapering at base, entire at margins, acute or subacuminate at apex, shining, glabrous above, minute pubescent beneath, more on veins beneath; lateral veins 10–15, flattened above, obscure beneath; petioles 3–12 mm long; stipules ovate or ovate-orbicular, 3–6 mm long, erect, stiff, terminating in a subulate point with a long laterally compressed cusp. Flowers sessile, 5–6 × 2–2.5 mm, fascicled, in terminal dense paniced cymes; panicles pyramidal, 9–20 cm long pubescent; bracteoles 2, linear, c. 0.5 mm long; bracts subulate, 4–8 mm at the node of inflorescence rachis. Hypanthium globose, small. Calyx 1.5–2 mm long, 5-lobed; lobes persistent, hairy. Corolla 5-lobed, white; lobes very short, reflexed outside; tube 3–4 mm long, hairy on upper portion. Stamens 4 or 5, adnate to corolla mouth by a very short filament; anthers 0.6–0.8 mm long, versitile and dorsifixed, exserted. Ovary 2-loculed, rarely 3-loculed; style filiform, c. 4 mm long; stigma 2-lobed, c. 1 mm across. Capsules globose, 1.5–1.8 mm, splitting longitudinal through the top, 2-valved, pubescent, crowned by minute sepals, reddish.

*Fl. & Fr.*: March – April.

*Habitat*: Near the river dry deciduous mixed forests.

*Distribution*: KWLS: Near the river Phutlaiya Nala; common. INDIA: Andhra Pradesh, Bihar, Himalaya, Karnataka, Kerala, Manipur and Odisha. WORLD: Indian subcontinent to South China.

*Specimen examined*: Near the river Phutlaiya Nala, 380 m, 24°33'08.8" N, 85°38'31.0" E, 5th March 2011, *Shyam Biswa* 49683.

79. **GENTIANACEAE** Juss., nom. cons.

Cosmopolitan, c. 85 genera and c. 1600 species; 24 genera and c. 190 species in India.

**Key to genera**

- 1a. Flowers irregular; stamens 4 didynamous, 2 long 2 short; capsules linear-ovoid to oblongoid **1. Canscora**
- 1b. Flowers regular, stamens 4 or 5 all equal; capsules narrowly oblong **2. Centaurium**

**1. CANSCORA** Lam.

Old World tropical regions, 9 species, 7 in India, 4 in Jharkhand and 2 in KWLS.

## Key to species

1a. Stems flat, stems and calyx prominently winged; leaves always sessile; flowers white

**1. *C. alata***

1b. Stems angular, stems and calyx not winged; lower leaves at least petiolate; flowers pink

**2. *C. diffusa***

**1. *Canscora alata*** (Roth) Wall., Numer. List: n. 4363. 1831. *Exacum alatum* Roth in Roem. & Schult., Syst. Veg. ed. 15, 3: 159. 1818. *Pladera decussata* Roxb., Fl. Ind.: 418. 1820 & Fl. Ind. 1: 402. 1832. *Canscora decussata* (Roxb.) Roem. & Schult., Syst. Veg. 1: 229. 1822; C.B. Clarke in Hook.f., Fl. Brit. India 4: 104. 1883; Haines, Forest Fl. Chota Nagpur: 422. 1910 & Bot. Bihar Orissa: 569. 1922; Mooney, Suppl. Bot. Bihar Orissa: 89. 1950; N.P. Singh & al., Fl. Bihar: 317. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 402. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 565. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 146. 2014.

**Plate 48A**

Vern. Name: *Sankhaphuli* (Hindi).

Herb, 10–30 cm high. Stems thinly 4-winged, glabrous. Leaves simple, opposite, ovate or oblong-lanceolate, 1.5–2 × 0.5–1.5 cm, subcordate or rounded at base, entire at margins, acute at apex, almost glabrous except at the basal parts with minutely ciliolate, 3-veined at base, gradually smaller upwards and bractiform on inflorescence; petioles 1–2 mm long. Inflorescence a cyme, terminal, dichotomously branched; peduncles *c.* 1.2 cm long. Flowers *c.* 1.5 × 1 cm; pedicels *c.* 5 mm long, prominently 4-winged. Calyx tube 0.8–1 cm long, 4-lobed; prominently winged. Corolla salverform, white; tube as long as calyx, 4-lobed (2+2); lobes of upper lip larger, obovate-orbicular, *c.* 8 × 4 mm, each with 2 green spots towards base; lobes of lower lip smaller, ovate-oblong, 6–7 × *c.* 2 mm. Stamens 4(2+2), two long two short, inserted at the base of the corolla lobes; anthers *c.* 0.5 mm long. Ovary oblong, *c.* 5 × 2 mm, 1-loculed; ovules many; style filiform, *c.* 5 mm long; stigma 2-fid, hirtellous. Capsules oblongoid, obtuse with persistent style at apex, 6–8 × 1.5–2 mm, septicidally 2-valved. Seeds many, suborbicular, angular, *c.* 0.4 mm long.

*Fl. & Fr.*: November – March.

*Habitat*: Shade rocky localities in dry deciduous mixed forests.

*Distribution*: KWLS: Meghatari NRF, border of Dhodhakola; occasional. INDIA: Almost throughout. WORLD: Madagascar and Tropical Africa.

*Specimen examined*: Meghatari NRF, border of Dhodhakola, 236 m, 24°34'31.7" N, 85°35'31.4" E, 25th November 2012, *Shyam Biswa* 54085.

**2. *Canscora diffusa*** (Vahl) R. Br. ex Roem. & Schult., Syst. Veg. ed. 15, 3: 301. 1818; C.B. Clarke in Hook.f., Fl. Brit. India 4: 103. 1883; Haines, Bot. Bihar Orissa: 565. 1922; N.P. Singh & al., Fl. Bihar: 317. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 403. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 562. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 146. 2014. *Gentiana diffusa* Vahl, Symb. Bot. 3: 47. 1794. *Canscora tenella* Wight, Icon. Pl. Ind. Orient. 4: 7, t. 1327. 1850. *Canscora diffusa* (Vahl) R. Br. var. *tenella* (Wight) C.B. Clarke in Hook.f., Fl. Brit. India 4: 103. 1883; Haines, Bot. Bihar Orissa: 569. 1922.

**Plate 48B**

Annual, 12–60 cm high, diffusely branched from above base. Stems angular, narrowly margined. Leaves simple, opposite; lower ones obovate, ovate or oblong-lanceolate,  $0.5\text{--}5 \times 0.3\text{--}2.2$  cm, attenuate or narrowed at base into a short petiole, entire at margins, acute or shortly acuminate at apex; upper most ones smaller and passing into bracts, 3–5-veined at base. Cymes diffusely branched; pedicels quadrangular, 0.5–2 cm long, narrowly winged. Calyx tube 3–6 mm long, not winged, ribbed, 4-lobed; lobes linear-lanceolate, long-acuminate at apex, 1–2 mm long. Corolla salverform, pink; tube as long as calyx, 4-lobed; lobes of upper lip oblong. Stamens 4; uppermost stamen *c.* 2.5 mm long; lower 3, *c.* 1.5 mm long. Ovary *c.* 4 mm long; style 2.5–3 mm long; stigma oblong-orbicular, minutely pubescent at margins, 2-lamellate; lobes obtuse. Capsules linear-ovoid to oblongoid,  $3\text{--}7 \times 1\text{--}1.5$  mm, with recurved valves. Seeds many, *c.* 2 mm long, angular.

*Fl. & Fr.*: Almost throughout the year.

*Habitat*: Near the river banks.

*Distribution*: KWLS: Near the river Dhanarjay nadi, Meghatari; common. INDIA: Throughout. WORLD: Bangladesh, Bhutan, China, Indonesia, Laos, Malaysia, Nepal, Philippines, Sri Lanka, Thailand, tropical Africa, tropical Australia and Vietnam.

*Specimen examined*: Near the river Dhanarjay nadi, Meghatari, 180 m,  $24^{\circ}34'44.3''$  N,  $85^{\circ}34'43.2''$  E, 7th March 2011, *Shyam Biswa* 49686.

## 2. CENTAURIUM Hill.

Eurasia, *c.* 20 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

***Centaurium centaurioides*** (Roxb.) S.R. Rao & Hemadri, J. Bombay Nat. Hist. Soc. 67: 357. 1970; Paria & Chattopadhyay, Fl. Hazaribagh 2: 567. 2005. *Chironia centaureoides* Roxb., [Hort. Bengal.: 16. 1814, nom. nud.] Fl. Ind. 2: 283. 1824 & 1: 584. 1832. **Plate 48C**

Herb, erect, 3–10 cm high. Stems roundish or quadrangular, glabrous. Leaves simple, basal also cauline, ovate or elliptic,  $0.5\text{--}1.8 \times 0.8\text{--}0.9$  cm, rounded at base, entire at margins, acute to rounded at apex; cauline ones smaller, linear-ovate to lanceolate, *c.*  $3 \times 1$  mm. Inflorescence a dichasial cyme. Flowers regular, *c.* 8 mm long; bracts *c.* 2 mm long; pedicels *c.* 5 mm long, glabrous. Sepals 4 or 5, linear or subulate, 4–5 mm long. Corolla salver-shaped constricted near mouth, white or light pinkish; tube 4–5 mm long, 4- or 5-lobed; lobes elliptic, 3–4 mm long, spreading. Stamens 4 or 5, equal, inserted in middle of corolla tube; filaments *c.* 1.5 mm long; anthers *c.* 1 mm long, basifixed. Carpels 5–6 mm long, *c.*  $1 \times 1$  mm, 1-loculed; stigmas 2-lobed. Capsules narrowly oblong, 2-valved. Seeds numerous, minute, globose.

*Fl. & Fr.*: April – May.

*Habitat*: Fallow fields.

*Distribution*: KWLS: Bherwa tan on the fallow crop field, Koderma NRF; not common. INDIA: Almost throughout. WORLD: Central Asia, Egypt, Europe, Iran, Mediterranean, Pakistan and Turkey.

*Specimen examined*: Bherwa tan, Koderma NRF, 397 m,  $24^{\circ}28'43.6''$  N,  $85^{\circ}36'26.7''$  E, 5th April 2013, *Shyam Biswa* 54160.



**80. LOGANIACEAE** R. Br. ex Mart., nom. cons.

Tropical to a few temperate regions, 14 genera and c. 400 species; 11 genera and 44 species in India.

**MITRASACME** Labill.

Indomalesia, East Asia, Australia, New Caledonia, and New Zealand, 54 species, 3 in India, 1 in Jharkhand and KWLS.

**Mitrasacme prolifera** R.Br., Prodr. Fl. Nov. Holland. 453. 1810. *Mitrasacme indica* Wight, Icon. Pl. Ind. Orient.: t. 1601. 1850; N.P. Singh & al., Fl. Bihar: 315. 2001. *Mitrasacme alsinoides* auct. non R. Br., 1810: C.B. Clarke in Hook.f., Fl. Brit. India 4: 80. 1883; Haines, Bot. Bihar Orissa: 566. 1922.

**Plate 48D**

Herb, 5–10 cm high. Stems branched, slender, distinctly 4-ribbed to narrowly 4-winged, glabrous. Leaves simple, opposite, lanceolate or ovate, 2–8 × 1.5–5 mm, rounded at base, entire at margins, acute at apex, glabrous; midrib abaxially prominent; lateral veins inconspicuous on both surfaces; stipules forming a minute sheath. Flower solitary or in clusters, c. 3 mm long, axillary; bracts 2, linear; pedicels 2–2.5 cm long. Calyx 4-lobed; lobes to 2.5 mm long, acute at apex, glabrous, basally connate. Corolla c. 3 mm long, white or light greenish white, 4-lobed. Stamens 4, unequal in size and different in shape. Pistil c. 1.5 mm long; ovary ovoid, c. 0.5 mm wide; style c. 1 mm long, base strongly parted, connate along apical half; stigma broadly truncate to 2-cleft. Capsules subglobose, c. 2 mm wide, splitting by middle, many-seeded. Seeds globose, brownish.

*Fl. & Fr.*: October – February.

*Habitat*: Near water sources.

*Distribution*: KWLS: Near Rheio Ghoghar Dam, Chattarbar; rare; INDIA: Throughout. WORLD: Indomalesia to Australia and East Asia.

*Specimen examined*: Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 54002.

*Note*: The flowers in the present collection exhibit variation in size and shape of the stamens. Among the four stamens, one is larger in size, one is slightly smaller, and the remaining two are like rudimentary.

**81. APOCYNACEAE** Juss., nom. cons.

Mostly Tropical and few temperate regions, c. 380 genera and c. 4700 species; 47 genera and 119 species in India.

**Key to genera**

- |                                                                                                                           |                       |
|---------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1a. Tree, shrubs or climbers; stamens not in a column, pollen granular or pollinia absent                                 | 7                     |
| 1b. Climbers rarely trees or shrubs; stamens united into a column or if free pollen forming one or two masses/pollina     | 2                     |
| 2a. Filaments usually free; anthers acuminate or with a terminal appendage; pollen masses granular, in pairs in each cell | 3                     |
| 2b. Filaments connate; pollen masses waxy                                                                                 | 4                     |
| 3a. Corolla reddish; lobes ovate, 3–4 mm long, lobes valvate                                                              | <b>9. Hemidesmus</b>  |
| 3b. Corolla yellowish green or florescent green, lobes-lanceolate, 7–8 mm long, lobes overlapping or imbricate            | <b>7. Cryptolepis</b> |

- 4a. Anthers with a membranous inflexed tip; pollinia often pedicelled 5  
 4b. Anthers incumbent on the stigma without a membranous tip; pollinia sessile or subsessile **6. Ceropegia**  
 5a. Pollinia erect on the corpuscle **14. Stephanotis**  
 5b. Pollinia pendulous from the corpuscle 6  
 6a. Shrubs; stems erect; corona of 5 free, fleshy, often elaborate lobes **2. Calotropis**  
 6b. Climbers; stems twining; corona membranous and cupular to cylindric, or if deeply 5-lobed, lobes always joined laterally at base **8. Cynanchum**  
 7a. Anthers not adhering to the stigma, anther cell not spurred 9  
 7b. Anthers adhering to the stigma by a point, anther cells subulate, empty, spur 13  
 8a. Plants armed; fruit indehiscent and pulpy; seeds without wings or coma **3. Carissa**  
 8b. Plants unarmed; fruit indehiscent but not pulpy within; seeds with wings or coma 9  
 9a. Leaves alternate; corollas showy, lobes overlapping to the left **4. Cascabela**  
 9b. Leaves whorled or opposite; corolla salver shaped 10  
 10a. Calyx not glandular within 11  
 10b. Calyx glandular within **10. Hollarhena**  
 11a. Fruit indehiscent drupaceous seeds without wings or coma **13. Rauwolfia**  
 11b. Fruit dehiscent of two slender free several seeded follicles 12  
 12a. Herbs; leaves opposite; ovules in each carpel 6 or more in two rows; seeds subcylindric, truncate at both ends **5. Catharanthus**  
 12b. Trees; leaves whorled; ovules many in several rows in each carpel; seeds ciliate at both ends **1. Alstonia**  
 13a. Trees or shrubs; mouth of corolla with scales 14  
 13b. Climbers; mouth of corolla without scales **11. Ichnocarpus**  
 14a. Tree; leaves opposite; anthers exerted, follicles connate **15. Wrightia**  
 14b. Shrub or small tree; leaves whorled; anthers included, fruits not connate **12. Nerium**

# 1. ALSTONIA R. Br.

China, Indomalesia, West Pacific, Africa, Central America, c. 45 species, 7 in India, 3 in Jharkhand and 1 in KWLS.

**Alstonia scholaris** (L.) R. Br. in Mem. Wemer. So 1:76.1811; Hook.f., Fl. Brit. India 3: 642. 1882; Haines, Forest Fl. Chota Nagpur: 425. 1910 & Bot. Bihar Orissa: 539. 1922; N.P. Singh & al., Fl. Bihar: 300. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 379. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 572. 2005. *Echites scholaris* L., Mant. Pl. 53. 1767. **Plate 48E**

Vern. Names: *Chatawan* (Hindi); *Chattani*.

Tree, 20–40 m high; trunk tall, base often buttressed, bark grey-brown; branches whorled. Leaves in whorls of 4–7, very coriaceous, oblanceolate to elliptic-oblong, 7–25 × 3–7.5 cm, cuneate to attenuate at base, entire at margins, obtuse to rounded or acute at apex, green above, white beneath, sparsely hairy, particularly along midrib; petioles, 0.5–1.5 cm long. Flowers green-white, numerous, in shortly branched cymes or almost sessile clusters at ends of umbellate, stout inflorescence branches. Calyx lobes ovate-lanceolate, 1.5–3 mm long, densely puberulent. Corolla tube 6–10 mm long, slightly inflated at apex, puberulent; lobes 2–4 × 2–4mm, rounded,

both sides puberulent, margin undulate. Disk absent. Fruit slender, pendulous in clusters, 30–60 × 0.2–0.5 cm. Seeds *c.* 8 mm long, linear, with coma-like long brown cilia at both ends.

*Fl. & Fr.*: December – April.

*Habitat*: Planted near the road..

*Distribution*: KWLS: Inderwa, Chittarpur; common. INDIA: Andaman Islands, drier parts of India. WORLD:

*Specimen examined*: Inderwa, Chittarpur, 333 m, 24°32'02.2" N, 85°34'47.0" E, 2nd April 2013, *Shyam Biswa* 54145.

## 2. **CALOTROPIS** R. Br.

Tropical and subtropical Africa and India, 3 species, 3 in India, 2 in Jharkhand and 2 in KWLS.

### Key to species

1a. Flower white or purple; corolla usually reflexed; corona shorter than gynostegium

**1. *C. gigantea***

1b. Flower pinkish-violet; corolla not reflexed; corona as long as gynostegium **2. *C. procera***

**1. *Calotropis gigantea* (L.) W.T.Aiton**, *Hortus Kew.* ed. 2. 2: 78. 1811; Hook.f., *Fl. Brit. India* 4: 17. 1883; Haines, *Forest Fl. Chota Nagpur*: 433. 1910 & *Bot. Bihar Orissa*: 550. 1922; A.P. Jagtap & N.P. Singh, *Fas Fl. India* 24: 9, pl. 1, f. 3. 1999; N.P. Singh & al., *Fl. Bihar*: 307. 2001; T.K. Sharma & A.K. Sarkar in N.+P. Singh & P.S.N. Rao, *Fl. Palamau*: 394. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 592. 2005. *Asclepias gigantea* L., *Sp. Pl.* 1: 214. 1753.

### Plate 48F

Vern. Names: *Akon*, *Aakwan* (Kharwari).

Shrub upto 1.5 m high with milky white latex. Stem thick with white cottony pubescence. Leaves simple, opposite, obovate, oblanceolate or oblong 5.5–24 × 2.6–14 cm, deeply cordate at base, entire at margins, slightly acute or obtuse to rounded at apex, thick; petioles 5–10 mm. Flowers in umbelliform or sub-racemose cymes; flowers *c.* 3.5 cm across, white or purplish-white; pedicels 0.7– 3.5 cm long, with white hair covered all over. Involuncre bract lanceolate *c.* 10 × 2 mm. Calyx 5-lobed, sepals 5–6 × 1.5–3 mm, hairy outside. Corolla broadly campanulate with broad valvate 5-lobed, petals *c.* 1.5 × 0.5 cm, lobes white or purple or bluish white. Corona shorter than gynostegium; corolline coronal horns *c.* 11 mm long, just shorter than anther collar, pale purple, with two small auricles on either side just below apex. Pollen sac 0.8–1 mm long. Stigmatic surface *c.* 4–5 mm broad. Follicles recurved, short and thick, 7–10 × 2–3 cm, usually one pair per inflorescence. Seeds broadly ovate, 6–8 × *c.* 5 mm; coma 2.5–4 cm.

*Fl.*: September - July, *Fr.*: February – June.

*Habitat*: in open waste land or near the roads.

*Distribution*: KWLS: Koderma NRF near forest rest house; Koderma NH- 31; Bholaghat Forest road.

*Specimens examined*: Koderma NRF, near forest rest house, 395 m, 24°28'49.6" N, 85°35'59.0" E, 4th September 2010, *Shyam Biswa* 49559; Koderma NH-31, 375 m, 24°28'36.5" N,

85°32'20.5" E, 15th September 2010, *Shyam Biswa* 49627; Bholaghat Forest road 402 m, 24°29'05.0" N, 85°36'06.1" E, 28th February 2011, *Shyam Biswa* 49637.

**2. *Calotropis procera*** W.T. Aiton, Hort. Kew. ed. 2, 2: 78. 1811; Hook.f., Fl. Brit. India 4: 18. 1883; Haines, Forest Fl. Chota Nagpur: 433. 1910 & Bot. Bihar Orissa: 551. 1922; A.P. Jagtap & N.P. Singh, Fas Fl. India 24: 11, pl. 2, f. 1. 1999; N.P. Singh & al., Fl. Bihar: 307. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 394. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 593. 2005. *Asclepias procera* Aiton, Hortus Kew. ed. 1. 1: 3-5. 1789.

**Plate 48G**

Vern. Names: *Akon*, *Aakwan* (Kharwari).

Undershrub 0.5–1 m high. Stem thick with dusty white hair. Leaves simple, opposite, oblong cordate 6.5–11 × 3.8–7.2 cm, thick, broad, subsessile or short petioled, lower surface dusty white hair above glabrous. Flowers in umbelliform or sub-racemose cymes, pedicellate, pedicel 2–2.5 cm long with white hair covered all over. Flowers 2.5–3 cm in diameter. Involuncre bract lanceolate 5–7 mm long. Calyx white, sepals hairy outside 5-lobed, sepals 6–7 × 3–4 mm. Corolla broadly campanulate with broad valvate lobes, 5-lobed, 1.5–1.6 cm long, lobes 6–8 mm, cleft or cut, white with pinkish-violet blotch on the upper half. Corona as long as gynostegium. Staminal corona of 5 fleshy laterally compressed sculptured process radiating from the staminal column, pinkish, anthers tip membranous inflexed, pollinia 1 in each cell, waxy flattened, pendulous, pollen sac 0.8–1 mm long. Carpel 7–8 mm long, stigma depressed 5-angled or lobed. Follicles subglobose to ovoid, 6–9.5 × 3–5.1 cm, recurved, inflated. Seeds 6–8 mm long, flat, broadly ovate, minutely tomentose, coma 3–5 cm long.

*Fl.*: March – April, *Fr.*: April – May.

*Habitat*: in open waste land.

*Distribution*: KWLS: Lokai forest; few patches. INDIA: Throughout tropical India. WORLD: Afghanistan, Africa, China, Myanmar, Nepal, Pakistan, South-Weat Asia, Thailand, Vietnam; introduced to Australia and Central and South America.

*Specimen examined*: Lokai forest, 397 m, 24°29'02.9" N, 85°37'04.4" E, 29th March 2013, *Shyam Biswa* 54121.

### 3. **CARISSA** L.

Sub-tropical regions Old World East to Australia and New Caledonia, 7 species, 10 in India, 6 in Jharkhand (2 cultivated) and 1 in KWLS.

***Carissa carandas*** L., Mant. Pl. 52. 1767; Hook.f., Fl. Brit. India 3: 630. 1882; Haines, Forest Fl. Chota Nagpur: 424. 1910 & Bot. Bihar Orissa: 535. 1922; N.P. Singh & al., Fl. Bihar: 300. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 382. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 574. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:139. 2014.

**Plate 49A**

Vern. Names: *Konada*, *Kanod*.

Small tree or shrub 2–9 m high, spiny, with strong dichotomous branches and pairs of divaricate very strong often forked spines 2–2.5 cm long, straight. Leaves simple, opposite, ovate or elliptic 1.5–5.2 × 0.8–3 cm, rounded or tapering at base, entire at margin, acuminate or emarginated at

apex, gloss or shiny above, glabrous; petiole 2–4 mm long. Flowers in peduncled cymes; flowers *c.* 2 mm across, white; pedicels 3–4 mm long. Calyx 5-partite, sepals lobes linear *c.* 5 mm long; corolla tubular or salver-shaped throat naked lobes overlapping to right, stamens at top of tube included, ovary 2-loculed, ovules 1–4 in each locule; style filiform; stigma large minutely 2-fid. Berries, oval or ellipsoid, 0.5–1 cm long, smooth green turns reddish then blackish sweet in taste, green ones sour.

*Fl. & Fr.*: September – March.

*Habitat*: Scrub forests and Dry deciduous sal forests.

*Distribution*: KWLS: Koderma NRF near the Phulwarwaria jungle; common. INDIA: Throughout.

*Specimens examined*: Koderma NRF near the Phulwarwaria jungle, 394m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49553 & Phoolwariya forest, 404 m, 24°29'04.8" N, 85°35'46.2" E, 23rd February 2012, *Shyam Biswa* 49856.

#### 4. **CASCABELA** Raf. (=THEVETIA Juss. ex Endl.).

Tropical America 8 species, 1 in Jharkhand (cultivated).

**Cascabela thevetia** (L.) Lippold, Feddes Repert. 91: 52 (1980). *Thevetia peruviana* (Pers.) K. Schum. in Engler & Prantl, Nat. Pflanzenfam. 4(2): 159. 1895; N.P. Singh & al., Fl. Bihar: 305. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 391. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 586. 2005. *Cerbera peruviana* Pers., Syn. Pl. 1: 267. 1805. *Thevetia neriifolia* Juss. ex Steud., Nomencl. Bot. ed. 2. 2: 680. 1841; Haines, Forest Fl. Chota Nagpur: 425. 1910 & Bot. Bihar Orissa: 535. 1922.

**Plate 49B**

Vern. Names: *Pila Kaner* (Hindi); *Kanel*, *Kaner*.

Small tree, to 6–9 m high, bark grey, darkening with age. Leaves simple, whorled at a tips, coriaceous, linear to linear-lanceolate, 7.5–12 × 0.4–0.8 cm, attenuate at base, entire at margins, acuminate at apex, dark green and glossy above, glabrous at both surfaces; petiole *c.* 1.5 mm, leaves almost sessile. Flowers salver-shaped, yellow, fragrant, solitary in upper leaf axils. Calyx 5-lobed, lobes oblanceolate, 6–9 mm long. Corolla tube 1–1.5 cm long below stamens, widening for *c.* 10 mm; lobes-5, obovate, 3–3.5 mm long. Disk absent. Stamens subsessile; anthers free from stigma, pubescent at the junction of the anther. Stigma umbrella shaped; style filiform; ovary dome shaped, superior. Fruit transversely ellipsoid with transverse distal ridge, 18–27 × 25–33 mm, red, ripening black, hard. Seeds globose, 4 per fruit, *c.* 13 × 13 mm, glabrous, unwinged.

*Fl. & Fr.*: Throughout the year.

*Habitat*: Planted near the houses / monuments or near the roads.

*Distribution*: KWLS: Koderma NRF near forest rest house; common. INDIA: Cultivated.

*Specimen examined*: Koderma NRF near forest rest house, 395m, 24°28'49.6" N, 85°35'59.0" E, 5th April 2013, *Shyam Biswa* 53922.

#### 5. **CATHARANTHUS** G. Don

Madagaskar, India & Sri Lanka, 8 species, 2 in India, 2 in Jharkhand (1 cultivated) and 1 in KWLS.



**Catharanthus pusillus** (Murr.) G. Don, Gen. Hist. 4: 95. 1837-1838; N.P. Singh & al., Fl. Bihar: 301. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 383. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 576. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:140. 2014. *Vinca pusilla* Murr. in Comment. Soc. Regiae Sci. Gotting. 3: 66. 1773; Hook.f., Fl. Brit. India 3: 640. 1882; Haines, Bot. Bihar Orissa 537. 1922; Mooney, Suppl. Bot. Bihar Orissa: 85. 1950. *Lochnera pusilla* K. Schum. in Engler & Prantl, Nat. Pflanzenfam. 4(2): 145. 1895.

**Plate 49D**

Herb, 20–30 cm high; stem erect, terete, yellow-green. Leaves simple, opposite, lanceolate or oblong-lanceolate 1–3.5 × 0.4–1.3 cm, obtuse to rounded at base, entire at margins, acute to acuminate at apex; petiole 2–3 mm long. Cymes 1–2 flowered; flowers white; pedicels 1–2 mm. Sepals linear, thin 4–5 mm long, green. Corolla tube c. 5 mm long, inflated near mouth, lobes obovate 2–3 mm long. Stamens 5, inserted in widened part of corolla, anthers oblong. Disk modified into 2 long linear glands alternating with the carpel. Carpels 2, free, ovules numerous, style filiform, stigma capitate, Follicle 2, linear, cylindric, 2–4.5 × 0.1–0.2 cm, acute at apex, striate, green, upto 12 seeded. Seeds oblong, 2.5–3 × 1–1.2 mm, truncate at both ends, rugose, blackish.

*Fl. & Fr.*: August – September.

*Habitat*: Waste or cultivated land.

*Distribution*: KWLS: Khararia jungle near the village; common. INDIA: Throughout.

*Specimen examined*: Khararia jungle near the village, 178m, 24°35'15.2" N, 85°34'36.2" E, 16th August 2011, *Shyam Biswa* 49814.

**6. CEROPEGIA L.**

Arabia subtropical Africa to Australia, c. 160 species, 48 in India, 2 in Jharkhand and 1 in KWLS.

**Ceropegia hirsuta** Wight & Arn., Wight, Contrib. Bot. India 30. 1834; Hook.f., Fl. Brit. India 4:71.1883; Haines, Forest Fl. Chota Nagpur: 438. 1910 & Bot. Bihar Orissa: 562. 1922; Mooney, Suppl. Bot. Bihar Orissa: 88. 1950. A.P. Jagtap & N.P. Singh, Fas Fl. India 24: 223. 1999; N.P. Singh & al., Fl. Bihar: 308. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.:142, f. 17. 2014.

**Plate 49C**

Vern. Name: *Bosia kand*.

Climber; stem slender, terete, twining, hirsute or pubescent. Leaves simple, opposite, linear-lanceolate or ovate, 2–11 × 0.3–2.6 cm, rounded at base, entire at margins, acute at apex, pubescent on both sides; petioles c. 1 cm long, pubescent. Cymes axillary, few-flowered. Flowers large, c. 3.5 cm long; peduncle 1–1.5 cm long, pubescent, dark purplish; pedicels 0.5–1.2 cm long, pubescent, pinkish. Sepals 5, free, linear, c. 1 × 0.1 cm, with gland at base, glabrous inside, pubescent outside, pinkish. Corolla urceolate, 3–3.5 cm long, corolla tube 1.5–2 cm long, curved, inflated at base, funnel-shaped above, sparsely hairy inside, puberulent outside, white with dark purplish spots; corolla lobes, broadly ovate, 1–2 × 0.4–0.5 cm, hairy inside, margin hairy, folded back, forming plate-like hairy keels inside; apex fused, forming an almost globose dome, light yellowish-green. Corona in 2 rows; outer corona 5, bifid, deltoid, hairy, inner corona 5, linear, erect, tip hooked, sparsely hairy. Pollinaria 5, pollinium ascending 0.4 mm long, yellow with

deltoid pellucid tip, corpusculum spatulate, reddish-brown. Ovaries 2, *c.* 2 mm long, ovules numerous, style very short.

*Fl. & Fr.*: August – October.

*Habitat*: Rare, Dry deciduous sal forests.

*Distribution*: KWLS: near the Enclosure wall Koderma NRF; very rare. INDIA: Throughout.

*Specimen examined*: Near the Enclosure wall Koderma NRF, 399 m, 24°29'01.2" N, 85°36'06.8" E, 14th September 2010, *Shyam Biswa* 49620.

## 7. **CRYPTOLEPIS** R. Br.

Old World tropical regions, *c.* 15 species, 3 in India, 1 in Jharkhand.

***Cryptolepis buchmanii*** Roem. & Schult., Syst. Veg., ed. 15, 4: 409. 1819; Hook.f., Fl. Brit. India 4: 5. 1883; Haines, Forest Fl. Chota Nagpur: 431. 1910 & Bot. Bihar Orissa: 549. 1922; A.P. Jagtap & N.P. Singh, Fas Fl. India 24: 290, pl. 48, f. 2. 1999; N.P. Singh & al., Fl. Bihar: 308. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 399. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 594. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 142. 2014. *Cryptolepis dubia* (Burm.f.) M.R. Almeida, Fl. Maharashtra 3A: 221. 2001.

### **Fig. 47; Plate 49E**

Vern. Names: *Karanta* (Hindi); *Dudhla lar* (Kharwari); *Dudhiya*.

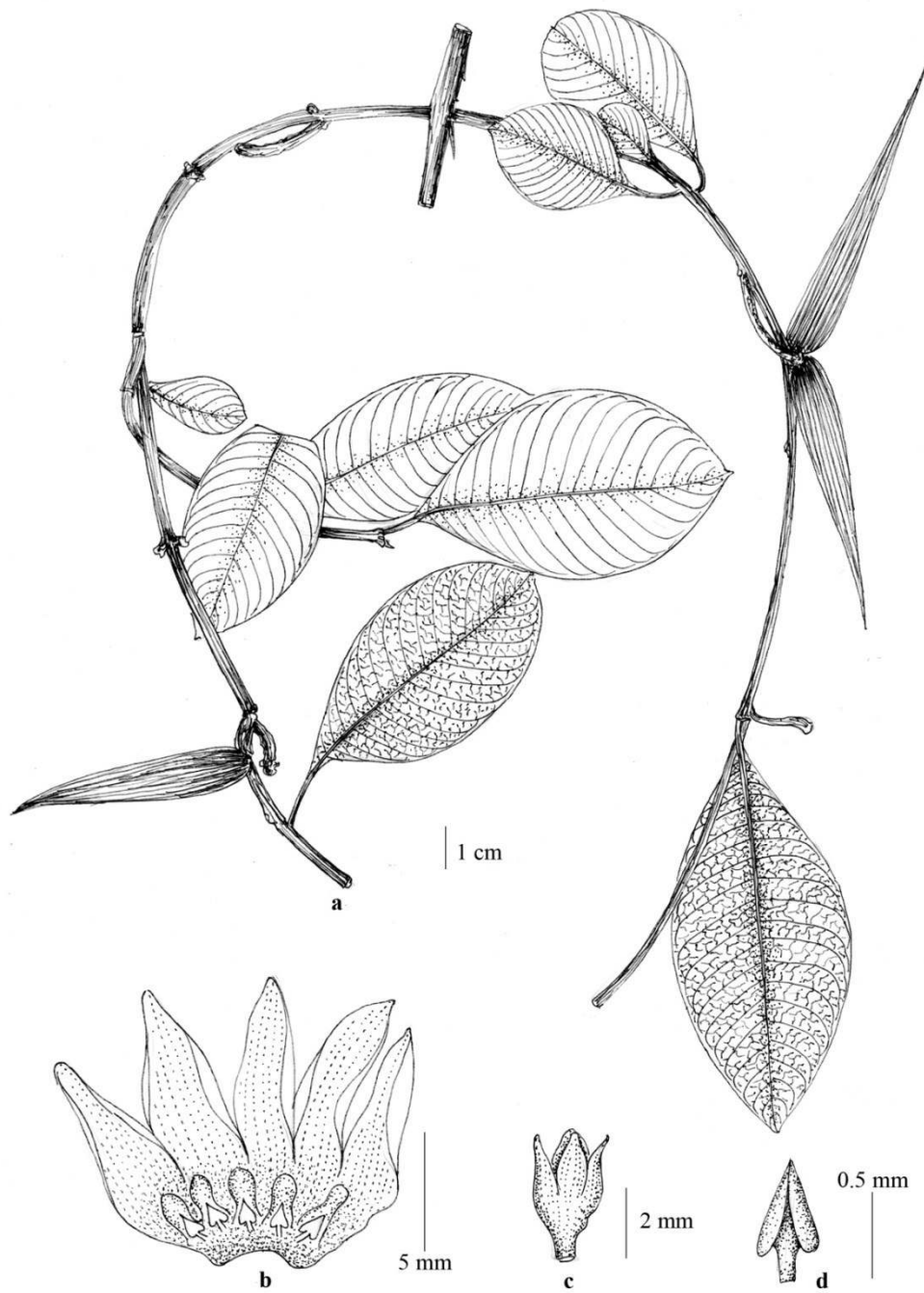
Climber, with milky white latex. Stem terete, glabrous. Leaves simple, opposite, broadly elliptic, elliptic-oblong or ovate-elliptic, 4.5–10 × 1.5–5.5 cm rounded or subcuneate at base, entire at margins, obtuse and apiculate at apex, subcoriaceous, glabrous, green, shining above, pale glaucous beneath; lateral veins 10–15 pairs; petioles 0.5–1 cm long. Inflorescences a dichotomously branched cymes, 2.5–5 cm long; peduncles to 1.5 cm long. Flowers *c.* 1 × 1.5 cm; bracts ovate, scarious at margins; pedicels 2.5–3 mm long. Calyx 5-lobes, ovate-lanceolate, 2–3 mm long, imbricate. Corolla petals 5 deeply lobed, pale light greenish-yellow or florescent-green; tube 2.5–3 mm long; lobes-lanceolate, 7–8 × 2–3 mm, imbricate. Stamens 5; filaments free, *c.* 0.3 mm long; anthers sagittate, *c.* 0.5 mm long; translators oblong, *c.* 0.7 mm long. Ovaries *c.* 1.5 mm long. Follicles paired, opposite, 4–8 × 1–1.5 cm, basally inflated, gradually tapering towards apex. Seeds ovate-oblong or obovate, 7–8 × 4–4.5 mm, compressed, dotted, rough; coma 2–2.5 mm long, silky-white.

*Fl. & Fr.*: August – September.

*Habitat*: Dry deciduous forest s.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; Baghi tan road, Koderma NRF; common. INDIA: Throughout. WORLD: Nepal and Pakistan.

*Specimens examined*: Near the Phulwarwaria jungle Koderma NRF, 390m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49552; Baghi tan road, Koderma NRF, 394 m, 24°28'59.7" N, 85°36'14.3" E, 8th August 2011, *Shyam Biswa* 49755.



**Fig. 47.** *Cryptolepis buchanani* Roem. & Schult.: a. fruiting twig; b. corolla split open; c. calyx; d. stamen.

## 8. CYNANCHUM L.

Tropical and subtropical regions, c. 300, 15 in India, 2 in Jharkhand.

### Key to the species

- |                                                |                         |
|------------------------------------------------|-------------------------|
| 1a. Stems leafless, jointed trailing           | <b>2. C. viminalis</b>  |
| 1b. Stems leafy, erect or climbing not jointed | <b>1. C. annularium</b> |

**1. Cynanchum annularium** (Roxb.) Liede & Khanum, Taxon 65(3): 477. 2016. *Holostemma ada-kodien* Schult., Roem. & Schult., Syst. Veg. 6: 95. 1820; N.P. Singh & al., Fl. Bihar: 310. 2001. *Sarcostemma annulare* Roth, Nov. Pl. Sp. 178. 1821. *Holostemma rheedei* Wall., Pl. Asiat. Rar. 2: 51. 1831; Hook.f., Fl. Brit. India 4: 21. 1883; Haines, Forest Fl. Chota Nagpur: 435. 1910 & Bot. Bihar Orissa: 554. 1922. *Holostemma annulare* (Roth) K. Schum. in Engler & Prantl, Nat. Pflanzenfam. 4(2): 250. 1895; A.P. Jagtap & N.P. Singh, Fas. Fl. India 24: 29, pl. 5, f. 3. 1999. **Plate 50C**

Climber, stems twining to the right, with abundant white latex. Leaves simple, opposite, ovate to ovate-lanceolate, 4–7.5 × 3.8–7.2 cm, deeply and widely cordate at base with blunt sinus, entire at margins, acuminate at apex, minutely puberulous, 5–7 palmately veined at base; petiole 1.5–4 cm long hairy. Inflorescence in axillary cluster; flowers c. 1.5 × 2 cm; peduncles 1–3 cm long; pedicels 5–18 (–25) mm. Calyx 5-lobed, lobes narrowly ovate, 3–3.5 × 1.5–2 mm. Corolla tube c. 3 mm long; lobes ovate, obtuse, c. 1 × 5 mm pinkish white; corolline coronal ring 1–2 mm high. Stamens 8–10 mm long, overtopping stigmatic head with membranous apical appendages. Stigmatic head 2.5–3 mm broad. Follicles 7–12 × c. 3 cm. Seeds ovate, c. 7 × 3 cm; coma c. 2 cm.

*Fl. & Fr.*: August – January.

*Habitat*: On the rocky hill dry deciduous forests.

*Distribution*: KWLS: Dengra Pahar, Chattarbar; not common. INDIA: Throughout. WORLD: China, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand.

*Specimen examined*: Dengra Pahar, Chattarbar, 418 m, 24°27'58.8" N, 85°34'23.2" E, 13th August 2011, *Shyam Biswa* 49787.

**2. Cynanchum viminalis** (L.) L., Mant. Pl. 2: 392. 1771. *Euphorbia viminalis* L., Sp. Pl. 1: 452. 1753. *Asclepias acida* Roxb., Fl. ind. (Ed. Carey) 2: 31. 1832. *Sarcostemma brevistigma* Wight & Arn. in Wight, Contr. bot. India 59. 1834; Hook.f., Fl. Brit. India 4: 26. 1883; Haines, Bot. Bihar Orissa 555. 1922. *Sarcostemma acidum* (Roxb.) Voigt, Hort. suburb. Calcutt. (Ed. Griff.) 542. 1845; ssp. *viminalis*. *Sarcostemma viminalis* (L.) R. Br., Prodr. Fl. Nov. Holland. 464. 1810; N.P. Singh & al., Fl. Bihar: 313. 2001. *Cynanchum viminalis* subsp. *viminalis* Ulrich Meve & Sigrid Liede-Schumann Kew Bulletin vol. 67: 753. 2012.

Vern. Name: *Haath-jod*.

Twining herb. Stem cylindrical, 3–5 mm in diam., green, glabrous, internodes 7–18 cm long. Leafless. Flowers in sessile umbellate clusters, umbels c. 2 cm across, terminal or solitary at nodes, fragrant; pedicels 6–12 mm long, pubescent; bracts minute, linear-lanceolate. Sepals 5, 1–1.5 mm long, subacute, margin membranous, glandular inside near the base. Corolla campanulate, pale greenish white, divided almost to the base, lobes ovate-oblong, 4–6 mm long, subacute at apex, revolute at margins. Outer corona 5-lobed, inner corona 5-lobed, lobes of the inner corona thick, fleshy obtuse, longer than the staminal column and concealing the anther.

Staminal column very short. Pollen-masses compressed, clavate. Style apex short-conical, entire not exerted. Follicles 2 linear-oblong, 1–1.2 cm × c. 1 cm, lanceolate, tapering at both ends, slightly diverging when 2 together. Seeds 3–6 mm long, flattened ovate; coma 1.8 cm long, silky.

*Fl. & Fr.*: August – May

*Habitat*: Dry deciduous forest.

*Distribution*: KWLS: Lokai forest near Birhore Tola; INDIA; Central, Eastern, Northern & Peninsular India. WORLD: Egypt, Nepal, Pakistan and West Africa

*Specimen examined*: Lokai forest near Birhore Tola, 382 m, 24°28'57.6" N, 85°37'20.5" E, 24th February 2012, *Shyam Biswa* 53933.

## 9. **HEMIDESMUS** R. Br.

Southeast Asia, India, A monotypic genus

**Hemidesmus indicus** (L.) W.T. Aiton, Hortus Kew. ed. 2, 2: 75. 1811; Hook.f., Fl. Brit. India 4: 5. 1883; Haines, Forest Fl. Chota Nagpur: 432. 1910 & Bot. Bihar Orissa: 548. 1922; A.P. Jagtap & N.P. Singh, Fas Fl. India 24: 301. 1999; N.P. Singh & al., Fl. Bihar: 309. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 400. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 596. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:144. 2014. *Periploca indica* L., Sp. Pl. 1: 211. 1753.

**Plate 50A**

Vern. Names: *Kapuri* (Hindi); Kapri, Kapurni.

Climbers, perennial; rootstock woody, aromatic. Stems slender, terete, glabrous. Leaves simple, opposite, obovate or oblanceolate to lanceolate-oblong, 3–7 × 1.5–4 cm, subcuneate at base, entire at margins, slightly emarginated truncate to rounded and apiculate at apex, coriaceous, glabrous, often variegated with white along veins above, pale and sometimes silvery-white beneath; petioles 5–10 mm long. Flowers 5–6 × 8–10 mm; pedicels c. 2 mm long; bracts ovate, acute at apex. Calyx lobes 5, broadly ovate or lanceolate, c. 2 × 1 mm, rounded to truncate at base, thin at margins, acute at apex. Petals deeply 5-lobed reddish; lobes ovate, 3–4 × 1.5–2 mm, acute at apex. Stamens 5; filaments free, c. 1 mm long; anthers connivent by their tips over style apex; pollinia c. 0.5 mm long. Ovaries c. 2 mm long. Follicles paired, slightly falcate, not inflated at base, tapering to a point, 5–12 × 0.4–0.6 cm, slender, glabrous. Seeds oblong-linear, 4–7 × 1–2 mm, flat; coma 3–4 cm long, brownish white.

*Fl.*: August – September & *Fr.*: October – December.

*Habitat*: On the shades of dry deciduous forests.

*Distribution*: KWLS: Koderma NRF near the Phulwarwaria jungle; very common. INDIA: Almost throughout. WORLD: Malaysia, Pakistan and Sri Lanka.

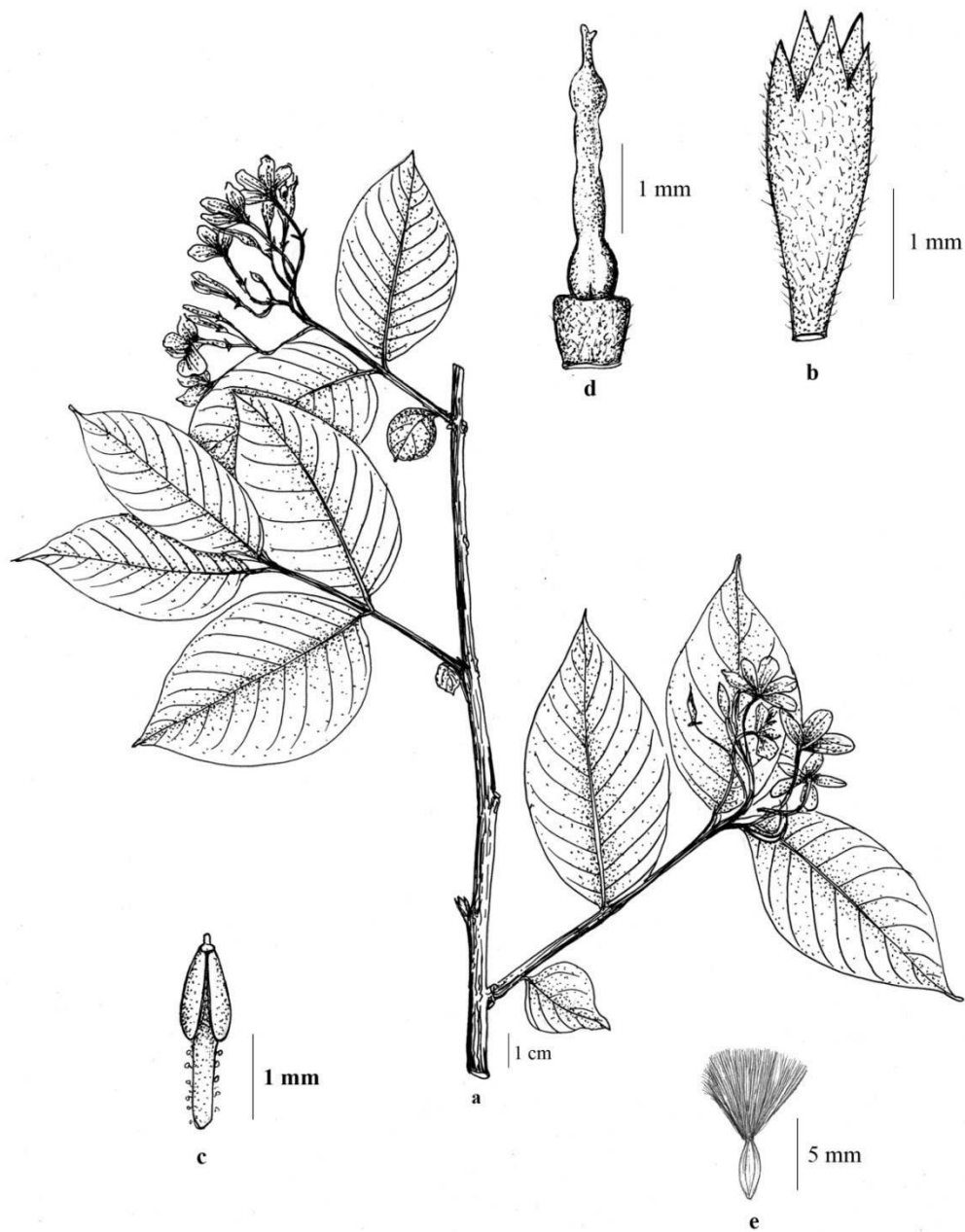
*Specimen examined*: Koderma NRF near the Phulwarwaria jungle, 393m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49548.

## 10. **HOLARRHENA** R. Br.

Tropical Africa, Indomalesia, 4 species, 1 in India.

**Holarrhena pubescens** Wall. ex G. Don, Gen. Syst. Hist. 4: 78. 1838; N.P. Singh & al., Fl. Bihar: 302. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 285. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 579. 2005; Ranjan, Fl. Parasnath Wildlife





**Fig. 48. *Holarrhena pubescens* Wall. ex G. Don:** a. flowering twig; b. calyx; c. stamen; d. carpel; e. seed.

Sanct.:140. 2014. *Holarrhena antidysenterica* Wall. ex A.DC., Prodr. 8: 413. 1844; Hook.f., Fl. Brit. India 3: 644. 1882; Haines, Forest Fl. Chota Nagpur: 426. 1910 & Bot. Bihar Orissa: 538. 192. *Echites pubescens* Buch.-Ham., Trans. Linn. So London 13: 524. 1822, nom. Illeg.

**Fig. 48; Plate 50B**

Vern. Name: *Koraiya* (Kharwari).

Shrub or small tree, 1.5–5 m high, branches with lenticels. Leaves simple, opposite, elliptic-oblong to ovate-oblong, 8–19 × 6–9 cm, rounded to obtuse or shortly acute at base, entire at margins, acute to acuminate at apex, pubescent or glabrous above pubescent beneath; lateral veins 10–15 pairs, looping near margins; petioles 2–5 mm long. Cymes paniculate or corymbose, terminal and axillary; pedicels to 1.5 cm long. Calyx cupular, unequally 5-lobed; lobes lanceolate, acute at apex, c. 4.5 mm long, glandular inside, hirsute outside. Corolla salver-form 2.5–3 cm across, white; tube slender, 0.8–1.2 cm long, slightly inflated near base, 5-lobed; lobes overlapping to left in bud, obtuse at apex, 1.2–1.4 cm long, puberulous outside. Stamens 5, inserted near the base of corolla tube, included; corona absent; filaments c. 0.7 mm long, hirsute; anthers oblong, rounded-sagittate at base, mucronate at apex, c. 1.5 mm long, free from stigma. Carpels 2, free, subglobose; ovules many, marginal; style c. 1 mm long, puberulous; stigma fusiform, 2-lobed. Disk absent. Follicles paired, cylindrical, 16–23 × 0.5–0.8 cm, terete, blunt-tipped, slender, with few lenticels, curved. Seeds oblong, 1–1.2 × 0.2–0.25 cm, reddish-brown; coma apical, 3.5–4 cm long, golden silky.

*Fl.*: May – July & *Fr.*: September – February.

*Habitat*: On dry deciduous Sal forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: Throughout, including Himalayas. WORLD: Africa, Bangladesh, Cambodia, China, Laos, Malay Peninsula Myanmar, Nepal, Thailand and Vietnam.

*Specimen examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49531.

## 11. ICHNOCARPUS R. Br.

Indomalesia to South China & Tropical Australia, 12 species, 3 in India, 3 in Jharkhand and 1 in KWLS.

***Ichnocarpus frutescens*** (L.) W.T.Aiton in W.T. Aiton, Hort. Kew. ed. 2, 2: 69. 1811; Hook.f., Fl. Brit. India 3: 669. 1882; Haines, Forest Fl. Chota Nagpur: 429. 1910 & Bot. Bihar Orissa: 546. 1922; N.P. Singh & al., Fl. Bihar: 302. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 386. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 581. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:141. 2014. *Apocynum frutescens* L., Sp. Pl. 1: 213. 1753.

**Plate 50D**

Vern. Names: *Saon-lar* (Kharwari); *Dudhia*.

Climber or straggling shrub, with glabrous branches. Leaves simple, opposite, elliptic-oblong or lanceolate, 1.5–9 × 0.4–3.8 cm, rounded to subcuneate at base, entire at margins, acute to shortly acuminate at apex, subcoriaceous, glabrous above, glabrous to sparsely pubescent beneath; lateral veins 4–6 pairs; petioles 1–10 mm long. Flowers paniculate cymes, terminal and axillary; peduncles c. 13 cm long; pedicels 2–3 mm long. Calyx 5-lobed, cupular, 1–1.5 mm long, lobes

subequal, ovate, acute at apex, alternating with 5 glandular scales, hirsute outside. Corolla salverform, *c.* 6 × 6–7 mm, cream-coloured; tube *c.* 2 mm long, pubescent at mouth, 5-lobed; lobes falcate, 2–3 mm, acuminate at apex, undulate. Stamens 5, adnate below the middle of corolla tube, included; anthers oblong, sagittate at base, *c.* 1 mm long, shortly spurred, connivent around stigma; filaments *c.* 0.5 mm long. Carpels 2, partly connate, *c.* 0.5 mm long; ovules many, marginal; style obconic, *c.* 0.5 mm long; stigma columnar. Disk of 5, linear glands. follicles paired, cylindric, 2–14.5 × 0.1–0.4 cm. Seeds linear, *c.* 1.7 × 0.2 cm, basally furrowed; coma apical to 1 cm long.

*Fl.*: September – December & *Fr.*: January – April.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Dhodhakola forest; Taraghati forest, way to Muglamaram forest road; Phulwarya Forest road; Bagitan jungle; common. INDIA: Throughout hotter regions of India

*Specimens examined*: Dhodhakola forest, 374 m, 24°30'33.9" N, 85°39'31.8" E, 5th March 2011, *Shyam Biswa* 49679; Taraghati forest, way to Muglamaram forest road, 321 m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49850; Phulwarya Forest road, 403 m, 24°29'12.2" N, 85°35'48.5" E, 20th November 2012, *Shyam Biswa* 54060; Bagitan jungle, 403 m, 24°29'13.9" N, 85°36'25.0" E, 29th March 2013, *Shyam Biswa* 54118.

## 12. **NERIUM** L.

Mediterranean to Cape Verde Island and Japan, 1 species, 1 in India.

**Nerium oleander** L., Sp. Pl. 1: 209. 1753; Nicolson et al. in Regnum Veg. 119 (Interpr. Rheedee's Hort. Malab.): 56.1988. *Nerium indicum* Mill., Gard. Dict. ed. 8. no. 2. 1768; Santapau in Re Bot. Surv. India 16(1): 170. 1953. ; N.P. Singh & al., Fl. Bihar: 303. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 387. 2002; *Nerium odorum* Soland. in Aiton, Hortus Kew. ed. 1. 1: 297. 1789; Hook.f., Fl. Brit. India 3: 655. 1882; Haines, Forest Fl. Chota Nagpur: 427. 1910 & Bot. Bihar Orissa: 541. *Nerium oleander* L. Sp. Pl. 1: 209. 1753; Paria & Chattopadhyay, Fl. Hazaribagh 2: 582. 2005. **Plate 50E**

Vern. Name: *Kaner*.

Small tree to 6 m high. Leaves simple, sub-alternate or whorled at apex, linear-lanceolate or linear-oblong or linear-oblongate, 5–19 × 1–2.3 cm, cuneate to attenuate at base, entire at margins, sharply acute to acuminate at apex, glossy above, glabrous, mid vein raised beneath; petioles 5–10 mm. Flowers funnel-shaped, very fragrant, in terminal many-flowered cymose; flowers white, rose-red or pink, 2–2.5 × 2–3 cm; bracts lanceolate 5–6 × 1.5–2 mm. Calyx lobes rounded-oblong to linear 5–6 × 1–2 mm. Corolla overlapping tube *c.* 1.5 cm, glabrous except for a ring of hairs inside where the stamens are inserted; 5-lobed, lobes broadly obovate 1–1.5 × *c.* 2 cm; coronal scales with appendages to 8 mm long. Fruit 7.5–17.7 × *c.* 1 cm. Seeds 4–7 × 1.5–2 mm, coma 9–12 mm long.

*Fl. & Fr.*: April – February.

*Habitat*: Cultivated/ planted along the roads.

*Distribution*: KWLS: near NH-31 Koderma NRF; common. INDIA: Throughout India including Andaman & Nicobar Islands.

*Specimen examined*: near NH -31, Koderma NRF, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49841.

### 13. RAUVOLFIA L.

Tropical regions, c. 80 species, 5 in India, 1 in Jharkhand.

**Rauvolfia tetraphylla** L., Sp. Pl. 1: 208. 1753; Haines, Bot. Bihar Orissa 539. 1922. N.P. Singh & al., Fl. Bihar: 304. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 390. 2002; *Rauvolfia canescens* L., Sp. Pl. ed. 2. 1: 303. 1762, nom. superfl. **Plate 50F**

Herb to 0.5 m high; stems terete, pubescent or tomentose when young, glabrescent with age. Leaves simple, in whorls of 4, unequal, ovate or narrowly ovate or oblong, 1–15 × 0.8–4 cm, membranous, broadly cuneate to rounded at base, entire at margins, acute or obtuse at apex; lateral veins 5–12 pairs; petiole 2–5 mm; peduncles 1–4 cm. Cymose, sometimes paniculate, alternate with leaves, becoming lateral. Flowers salver-shaped. Sepals fused at base. Corolla white, tube urceolate, 2–3 mm long, hairy inside distal half; lobes ovate or suborbicular. Stamens inserted at corolla throat. Ovaries connate. Drupes subglobose, 5–10 mm across, glossy green turns reddish and to blackish, glabrous, connate. Seeds 2, ovoid, glabrous, without wings.

*Fl. & Fr.*: April – September.

*Habitat*: On the waste land edges of Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF; common. INDIA: Cultivated & naturalised

*Specimen examined*: Koderma NRF, 390 m, 24°29'06.6" N, 85°36'49.8" E, 8th August 2011  
*Shyam Biswa* 49757.

### 14. STEPHANOTIS Thouars

Tropical and South Africa, Madagascar, Arabian Peninsula, South China to tropical Asia., c. 15 species, 1 in India.

**Stephanotis volubilis** (L.f.) S.Reuss, Liede & Meve Taxon 71(4): 864. 2022. *Asclepias volubilis* L.f., Suppl. Pl. 170. 1782. *Hoya viridiflora* R.Br. in Mem. Werner. So 1: 27. 1811. *Dregea volubilis* (L.f.) Benth. ex Hook.f., Fl. Brit. India 4: 46. 1883. *incl. var. lacuna*, Haines, Forest Fl. Chota Nagpur: 437. 1910 & Bot. Bihar Orissa: 559. 1922; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 395. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.:144. 2014. *Marsdenia volubilis* (L.f.) Cooke, Fl. Bombay 2: 166. 1904. *Wattakaka volubilis* (L.f.) Stapf in Curtis, Bot. Mag. 148. sub t. 8976, 1923; A.P. Jagtap & N.P. Singh, Fas Fl. India 24: 175, pl. 35, f. 2. 1999; N.P. Singh & al., Fl. Bihar: 315. 2001. **Plate 49F**

Vern. Names: *Nak-chhikni* (Hindi); *Diya Batti*.

Climber woody, stems terete hairy / puberulent. Leaves simple, opposite, ovate or oblong-ovate, 6–14 × 4–11.5 cm, deeply cordate to truncate at base, entire at margins, acuminate at apex, puberulous or small hair on both surface; petioles slender, 2–6.5 cm long hairy. Flowers yellow-green, in many-flowered umbellate axillary. Flowers c. 12 mm across; peduncle 2–6 cm; pedicels 1.5–3 cm. Calyx lobes 3–4 × 1.5–2 mm. Corolla tube 3.5–4 mm; lobes c 6 × 6 mm. Staminal coronal lobes obovate-elliptic c. 2 × 1.5 mm. Follicles in pair opposite to each other, bottle-shaped 8–10 × 2.5–3 cm, base broad tapering towards apex blunt and rounded at apex, tomentose, light-green. Seeds truncate-ovate, 10–12 × 5–7 mm; coma 1.5–7 cm.

*Fl.*: March – June, *Fr.*: September – December.

*Habitat*: On the hill slopes of dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; common. INDIA: Throughout tropical India. WORLD: Bangladesh, Cambodia, China, Indonesia, Kashmir, Laos, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49589.

### 15. **WRIGHTIA** R. Br.

Tropical regions Old World, 23 species, 5 in India, 2 in Jharkhand and 1 in KWLS.

**Wrightia arborea** (Dennst.) Mabb., *Taxon* 26: 533. 1977; N.P. Singh & al., *Fl. Bihar*: 306. 2001; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 588. 2005. *Periploca arborea* Dennst., *Schluessel Hortus Malab.*: 13, 23, 25. 1818. *Wrightia tomentosa* Roem. & Schult., *Syst. Veg.* 4: 414. 1819; Hook.f., *Fl. Brit. India* 3: 653. 1882; Haines, *Forest Fl. Chota Nagpur*: 427. 1910 & *Bot. Bihar Orissa*: 541. 1922.

### Plate 50G

Tree, 2–10 m high, branchlets glabrous or puberulous. Leaves simple, opposite, obovate or elliptic oblong 4–11.5 × 2–5 cm, cuneate or rounded at base, entire at margins, acuminate or rarely emarginated at apex, villous; petiole 2–5 mm long. Flowers in lax terminal cyme; flowers 2.5 cm across, white, fragrant; pedicel 2–1.2 cm long; bracts *c.* 2.5 mm long, ovate. Calyx lobes oblong *c.* 2.5 mm long, deeply divided, hairy or glabrous, glandular inside, margin scarious. Corolla tube cylindric, *c.* 5 mm long, lobes narrow, oblong, obtuse; corona of many linear scales, inserted on the filaments and corolla lobes; anthers cream or yellowish, forming a cone. Ovary of 2 free or united carpels, ovules numerous. Follicles slender, cylindrical 12–32 × 0.3–0.7 cm, pendulous, cohering at the apex only glabrous, striate. Seeds 1.25–2 cm long, pale brown; coma twice as long as seed.

*Fl. & Fr.*: July – September.

*Habitat*: On the rocky hill or hill slopes of Dry deciduous forests.

*Distribution*: KWLS: Koderma NRF near the Dumaria village; common. INDIA: Native of Central India. WORLD: Burma and Timor; cultivated in Pakistan.

*Specimen examined*: Koderma NRF near the Dumaria village, 394 m, 24°29'36.6" N, 85°35'49.8" E, 9th August 2011, *Shyam Biswa* 49765.

## 82. **BORAGINACEAE** Juss., nom. cons.

Subcosmopolitan, 142 genera and *c.* 2450 species; 43 genera and *c.* 210 species in India.

### **EHRETIA** P. Browne

Tropical and subtropical regions, *c.* 50 species, 8 in India, 2 in Jharkhand and 1 in KWLS.

**Ehretia aspera** Willd., *Phytographia* 4. 1794. *Ehretia laevis* Roxb., *Pl. Coromandel* 1: 42, t. 56. 1796; C.B. Clarke in Hook.f., *Fl. Brit. India* 4: 141. 1883; Haines, *Forest Fl. Chota Nagpur*: 475. 1910 & *Bot. Bihar Orissa*: 576. 1922; N.P. Singh & al., *Fl. Bihar*: 325. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 412. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 656. 2005. *Ehretia floribunda* Royle, *Ill. Bot. Himal. Mts.* 1: 306. 1839. *Ehretia*



*laevis* Roxb. var. *floribunda* (Benth.) Brandis, Forest Fl. N.W. India: 340. 1874; C.B. Clarke in Hook.f., Fl. Brit. India 4: 143. 1883.

**Plate 50H & I**

Vern. Names: *Dantranga* (Hindi); *Bhairo*, *Hardi* (Kharwari); *Makar-kend*.

Tree, 3–8 m high; bark smooth, grey. Leaves simple, alternate, oblong-lanceolate or elliptic or broadly obovate to oblong, 2–13 × 1.3–7 cm, unequally cuneate at base, entire and undulate at margins, abruptly acuminate or acute to obtuse at apex, shiny above, glabrous; lateral veins 4–6 pairs; petioles 3–10 mm long. Inflorescence sparsely dichotomously branched cymes, terminal and axillary, appearing just before leaf renewal; branches somewhat scorpioid. Flowers *c.* 6 × 5–7 mm; pedicels 1–1.5 mm long. Calyx 2–3 mm long, pubescent, 5-lobed. Corolla subrotate, 4–5 mm long, white, 5-lobed; lobes recurved. Stamens 5, inserted; filaments filiform, 3–4 mm long, white; anthers oblong, 1–1.5 mm long, dorsifixed, greyish. Ovary ovoid or subglobose, *c.* 2 mm long, 2-loculed; style 1–3 mm long, white, 2-fid; lobes to 1 mm long; stigma capitate. Drupes depressed-globose, 4–6 × 2–4 mm, green, turning black when dry; pyrenes 4, each 1-seeded.

*Fl.*: February – March; *Fr.*: April – May.

*Habitat*: Dry deciduous forests, near river banks.

*Distribution*: KWLS: Lokai forest; Taraghati forest and near Dhanarjay nadi, Meghatari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Lokai forest, 382 m, 24°28'57.6" N, 85°37'20.5" E, 28th February 2011, *Shyam Biswa* 49633; near the river Dhanarjay nadi, Meghatari, 192 m, 24°34'33.0" N, 85°34'41.7" E, 7th March 2011, *Shyam Biswa* 49697 and 3rd April 2013, *Shyam Biswa* 54127; Taraghati forest, way to Muglamaram forest road, 321m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49847.

### 83. CONVULVULACEAE Juss., nom. cons.

Cosmopolitan, 52 genera and *c.* 1650 species; 29 genera and *c.* 200 species in India.

#### Key to genera

- |                                                                                                                                                                                    |                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 1a. Plants parasitic, leafless, yellowish                                                                                                                                          | <b>1. Cuscuta</b>    |
| 1b. Plant not parasitic; leaves present, greenish                                                                                                                                  | 2                    |
| 2a. Plants spreading or prostrate; corolla rotate                                                                                                                                  | <b>2. Evolvulus</b>  |
| 2b. Plants erect, straggling or climbing; corolla other than rotate                                                                                                                | 3                    |
| 3a. Fruits dehiscent                                                                                                                                                               | 5                    |
| 3b. Fruits indehiscent                                                                                                                                                             | 4                    |
| 4a. Leaves with a gland at laminar base; flower solitary; corolla hypocrateriform; stigmatic lobes linear-oblong                                                                   | <b>5. Rivea</b>      |
| 4b. Leaves without a gland at laminar base; flowers in corymbose cymes or panicles; corolla funnel-shaped, rarely campanulate-rotate, white; stigmatic lobes globose or subglobose | <b>4. Poranopsis</b> |
| 5a. Petals usually yellow or yellowish with a red or purple eye, or white; seeds usually glabrous                                                                                  | <b>6. Xenostegia</b> |
| 5b. Petals often purple or variously coloured; seeds usually velvety or woolly                                                                                                     | <b>3. Ipomoea</b>    |

## 1. CUSCUTA L.

Cosmopolitan, c. 145 species, 12 in India, 3 in Jharkhand and 1 in KWLS.

**Cuscuta reflexa** Roxb., Pl. Coromandel 2: 3, t. 104. 1798; C.B. Clarke in Hook.f., Fl. Brit. India 4: 225. 1883; Haines, Forest Fl. Chota Nagpur: 471. 1910 & Bot. Bihar Orissa: 605. 1922; N.P. Singh & al., Fl. Bihar: 341. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 432. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 646. 2005. **Plate 51A**

Vern. Names: *Akasbel* (Hindi); *Amar lata*.

Climber, parasitic. Stems branched, smooth, fleshy, greenish yellow. Inflorescence a short lax raceme, to 12-flowered. Flowers 6–8 × c. 5 mm; pedicels 3–5 mm long; bracts leaf-like. Calyx 5-lobed; lobes ovate-obtuse, 0.7–3 × 1.5–2.5 mm, much shorter than corolla tube, scarious at margins, white. Corolla tubular, creamy white, sweetly scented; tube 5–7 mm long, 5-lobed; lobes obtuse, erect, finally reflexed, 1–1.5 × 0.5–0.7 mm; scales reaching middle of corolla tube, fringed. Stamens 5, at the tip of corolla lobes; filaments linear, c. 1 mm long; anthers 1.5–2 mm long, basifixed, slightly exserted from corolla. Stigmas 2, unequal, thick. Capsules globose-conical, 1–3 × 2–3 mm, dehiscing irregularly.

*Fl. & Fr.*: November – December.

*Habitat*: On hedges in scrub forests.

*Distribution*: KWLS: Lokai forest; very common. INDIA: Throughout. WORLD: Afghanistan, China, Malesia, Myanmar, Sri Lanka and Thailand. .

*Specimen examined*: Lokai forest, 382 m, 24°28'57.6" N, 85°37'20.5" E, 24th February 2012, *Shyam Biswa* 49869; Lokai forest, 400 m, 24°29'17.5" N, 85°36'37.4" E, 22nd November 2012, *Shyam Biswa* 54081.

*Use*: The entire plant is boiled in water, and the water is used for relieving body pain.

## 2. EVOLVULUS L.

Subtropical regions and Tropical America, 2 extended to Old World, 98 species, 2 in India, Jharkhand and KWLS.

### Key to species

- 1a. Leaves oblong-elliptic or spatulate; peduncles present; sepals lanceolate, apex acute or acuminate; corolla blue **1. E. alsinoides**
- 1b. Leaves nearly oblong-suborbicular to suborbicular; peduncles absent; sepals ovate-oblong to oblong, apex obtuse or acute; corolla white **2. E. nummularia**

**1. Evolvulus alsinoides** (L.) L., Sp. Pl. ed. 2. 1: 392. 1762; C.B. Clarke in Hook.f., Fl. Brit. India 4: 220. 1883; Haines, Forest Fl. Chota Nagpur: 462. 1910 & Bot. Bihar Orissa: 585. 1922; N.P. Singh & al., Fl. Bihar: 332. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 416. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 625. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:150. 2014. *Convolvulus alsinoides* L., Sp. Pl. 1: 157. 1753. **Plate 51B**

Vern. Name: *Sankhapushpi* (Hindi).

Herb, spreading or prostrate, mostly covered with silky indumentum; root woody. Stems slender, densely pubescent. Leaves simple, alternate, elliptic, oblong to lanceolate, 3–7 × 1–4 mm, obtuse

or rounded at base, entire at margins, acute or acuminate at apex, more or less densely appressed silky hairy; lateral veins 5 or 6 pairs; petioles more or less stout, *c.* 1 mm or less, silky whitish pubescent on both surfaces. Inflorescence a cyme, axillary, 1 or 2-flowered; peduncles 3–5 mm long, densely silky hairy; pedicels slender, 1–5 mm long, sometimes more longer, densely hairy; bracts 2, subulate to linear-lanceolate, sharply acute at apex, *c.* 1 mm long, hairy, persistent. Calyx lobes 5, acute to gradually acuminate at apex, *c.* 4 × 1 mm. Corolla rotate, *c.* 1 cm across, blue with a central white portion, 5-lobed. Stamens 5, equal, exserted, *c.* 3 mm long; filaments filiform, adnate to base of corolla tube; anthers oblong, *c.* 1.5 mm long, sagittate at base. Ovary *c.* 0.8 mm long, glabrous; ovules 4; styles 2; each cleft into 2 subclavate stigmas. Capsules ovoid to globose, 3–5 mm across, glabrous, 2-loculed. Seeds mostly 3 or 4, triangular-obovoid, 1.5–2 mm long, glabrous, pale brown to black.

*Note:* The collection no. 49522: the plant is prostrate very slender very long, thin, loosely arranged. Stem terete not congested like field no. 49690. Stem not congested like previous plant. Stem terete sparsely hairy (hair long) Leaves linear or linear oblong, 1–1.6 × 0.2–0.6 cuneate to acute at base entire, acute to apiculate at apex; peduncle 0.8–2.5 cm long; pedicel 1.5–4 mm. Flowers 5–6 mm long.

*Fl. & Fr.:* September - March

*Habitat:* Shady places in the dry deciduous forests.

*Distribution:* KWLS: Chattarbar forest; Near the river Dhanarjay nadi, Meghatari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined:* Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49522; near the river Dhanarjay nadi, Meghatari, 179 m, 24°34'33.0" N, 85°34'41.7" E, 7th March 2011, *Shyam Biswa* 49690. .

**2. *Evolvulus nummularius* (L.) L., Sp. Pl. ed. 2. 1: 391. 1762; Mooney, Suppl. Bot. Bihar Orissa: 91. 1950; N.P. Singh & al., Fl. Bihar: 332. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 417. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 626. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 150. 2014. *Convolvulus nummularius* L., Sp. Pl. 1: 157. 1753. *Volvulopsis nummularium* (L.) Roberty, Candollea 14: 28. 1952. **Plate 51C****

Herb, perennial, branched, spreading or prostrate, rooting at nodes. Stems slender, terete, pilose, green or purplish. Leaves simple, alternate, oblong-suborbicular to suborbicular, 0.6–2.4 × 0.5–2 cm, cordate to rounded at base, entire at margins, rounded or slightly emarginate at apex, glabrous; lateral veins 3–5 pairs; petioles slender, 1–13 mm long, pubescent. Inflorescences a cyme, axillary, 1 or 2-flowered; peduncles absent. Flowers 5–7 mm across; pedicels slender, 2–3 mm long, pubescent, reflexed in fruits; bracts linear-elliptic, acute at apex, *c.* 1 mm long, sparsely hairy, persistent. Calyx lobes 5, elliptic-ovate to elliptic-oblong, 3–4 mm long; inner lobes slightly shorter than outer, ciliate at margins, acute at apex, pubescent. Corolla shortly tubular-campanulate or rotate, 5–9 mm wide, white. Stamens 5, sub-exserted; filaments *c.* 1.5 mm long; anthers *c.* 0.7 mm long. Ovary subglobose, *c.* 0.5 mm long; styles 2, free from base; each cleft into 2 linear stigmas. Capsules globose, 3–4 mm, 1-loculed, greenish or purplish. Seeds usually 4, often less in number, ovoid-trigonous to ellipsoid-trigonous, 1–2 × 1–1.5 mm, glabrous, brown.

*Fl. & Fr.:* August – September.

*Habitat:* Open forest areas or shady places in forest.

*Distribution:* KWLS: Koderma NRF, near the Phulwarwaria jungle and enclosure Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined:* Koderma NRF, near the Phulwarwaria jungle, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49539; inside the enclosure Koderma NRF, 397 m, 24°29'02.0" N, 85°35'59.6" E, 11th August 2011, *Shyam Biswa* 49780.

### 3. *IPOMOEA* L., nom. cons.

Tropical, subtropical and temperate regions, *c.* 650 species, *c.* 60 in India, 17 in Jharkhand and 5 in KWLS.

#### Key to Species

- 1a. Shrubs; stems erect, non-climbing, cylindrical and hollow **1. *I. carnea***
- 1b. Herbs or climbers; stems trailing on ground or twining, not cylindrical and hollow 2
- 2a. Leaves pinnatisect with 9–17 opposite or alternate to sub-opposite pairs of narrow lobes; sepals glabrous; corolla salver-shaped, scarlet red **5. *I. quamoclit***
- 2b. Leaves palmately lobed or 3–7-lobed or even lobed at apex or entire, ovate-cordate; sepals hairy; corolla funnel-form, white, pink or purple with darker throat, not scarlet red 3
- 3a. Leaves palmately divided nearly to base; corolla funnel-form, white **4. *I. pes-tigridis***
- 3b. Leaves entire or lobed not divided to base; corolla salverform, pink or purple 4
- 4a. Leaves 3-lobed; capsules globose, 5–7 mm long; seeds *c.* 4 mm long, densely pubescent **2. *I. hederifolia***
- 4b. Leaves broadly ovate; capsules dome-shaped, 1.5–2 cm long; seeds 1.2–1.5 cm long, glabrous **3. *I. muricata***

**1. *Ipomoea carnea*** Jacq., Enum. Syst. Pl.: 13. 1760; Haines, Bot. Bihar Orissa: 600. 1922; N.P. Singh & al., Fl. Bihar: 333. 2001. *Ipomoea fistulosa* Mart. ex Choisy in DC., Prodr. 9: 349. 1845. *Ipomoea carnea* Jacq. subsp. *fistulosa* (Mart. ex Choisy) Austin in Taxon 26: 237. 1977; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 421. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 630. 2005.

**Plate 51D**

Vern. Names: *Nakta*, *Sabgad*, *Besharam* (Hindi).

Shrub, 2–3 m high; exudate milky white juice. Stems erect or ascending, woody at base, cylindrical and hollow; the mature parts lenticellate; the younger parts densely pubescent. Leaves simple, alternate, ovate to ovate-lanceolate, 8.5–20 × 5–11.5 cm, deeply cordate at base, entire or slightly wavy at margins, acuminate at apex; lateral veins 9–11 pairs; petioles 4.5–10.5 cm long. Inflorescence of cymose-paniculate clusters of 3 to several-flowered, axillary and terminal; peduncles stout, terete, 5–15 cm long, pubescent. Flowers 5.5–7.3 cm long; pedicels 1–2 cm long, pubescent; bracts ovate-oblong, *c.* 4 mm long, obtuse at apex, caducous. Calyx 5-lobed; lobes suborbicular, subequal, or the outer ones slightly shorter, 6–7 × 5–6 mm, sub-coriaceous; inner sepals with scarious margins; nectaries 5, between the sepal bases. Corolla funnel-shaped, 5.5–6.5 cm long, pink; tube and mid-petaline bands minutely pubescent outside; limb 8–12 cm across. Stamens 5, included; filaments very unequal, dilated and hairy at base; anthers *c.* 7 mm long. Ovary 2–4-loculed; ovules 4 or 6; style 1, filiform, included; stigma capitate, or 2- or 3-globulose. Capsules ovoid, ellipsoid, or somewhat pyriform, mucronate at apex, 1.5–2 cm long, finely pubescent in the basal portion, pale brown, 4-valved, 2-loculed or incompletely 4-loculed. Seeds

4 or less, ovoid, slightly trigonal, or ellipsoid-angular, 8–9 mm long, densely villous, blackish brown.

*Fl. & Fr.*: September – October.

*Habitat*: Degraded or disturbed areas near the drains.

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Lokai forest, 400 m, 24°29'17.5" N, 85°36'37.4" E, 15th September 2010, Shyam Biswa 49626.

**2. *Ipomoea hederifolia* L.**, Syst. Nat. ed. 10: 925. 1759. *Ipomoea coccinea* auct. non L., 1753: C.B. Clarke in Hook.f., Fl. Brit. India 4: 199. 1883; Haines, Forest Fl. Chota Nagpur: 471. 1910. *Quamoclit coccinea* auct. non Moench, 1794: Haines, Bot. Bihar Orissa 4: 591. 1922. N.P. Singh & al., Fl. Bihar: 334. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 422. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 632. 2005. **Plate 51E**

Annual twiner. Stems terete, glabrous or sparsely pilose. Leaves simple, alternate, ovate to suborbicular, 2.5–5.5 × 3–6 cm, deeply 3-lobed, cordate at base, dentate at margins, acuminate at apex, glabrous; petioles slender, 1.5–5 cm long. Cymes terminal and axillary, long-pedunculate; peduncles 2.5–13 cm long; first branch dichasial, others monochasial. Flowers salverform, 3.5–4 × 2–2.5 cm; pedicels erect, 6–7 cm long. Sepals 5, oblong, 6–7 mm long, erect at anthesis but patent in fruit and finally reflexed, each with a large, narrowly linear, herbaceous awn of 2–3 mm long, inserted just below tip. Corolla narrowly infundibular, glabrous, bright red or scarlet; tube 2.8–3 cm long, very slender, 5-lobed; limb *c.* 1 cm long, with spreading lobes. Stamens 5, adnate to base of corolla; filaments *c.* 3 cm long, orange; anthers 2–2.5 cm long, white. Ovary dome-shaped; style 3.5–4 cm long, exserted; stigma globular, white. Capsules globose, 5–8 mm, with a mucro, yellowish brown. Seeds 4, *c.* 4 × 2 mm, densely pubescent, black.

*Fl. & Fr.*: September – October.

*Habitat*: Scrub forests.

*Distribution*: KWLS: Tilaya forest, near the railway track. INDIA: Almost throughout. WORLD: Native of Tropical America; cultivated or naturalized in many countries of the Old World tropical regions.

*Specimen examined*: Tilaya forest, near the railway track, 333 m, 24°25'02.2" N, 85°25'47.0" E, 28th September 2013, Shyam Biswa 54188.

**3. *Ipomoea muricata* (L.) Jacq.**, Pl. Hort. Schoenbr. 3: 40, t. 323. 1798, non Cav., 1799; C.B. Clarke in Hook.f., Fl. Brit. India 4: 197. 1883; Haines, Forest Fl. Chota Nagpur: 471. 1910; N.P. Singh & al., Fl. Bihar: 336. 2001. *Ipomoea turbinata* Lag., Gen. Sp. Pl.: 10. 1816. *Convolvulus muricatus* L., Mant. Pl. 44. 1767. *Calonyction muricatum* (L.) G. Don, Gen. Hist. 4: 264. 1837–1838; Haines, Bot. Bihar Orissa: 591. 1922; Mooney, Suppl. Bot. Bihar Orissa: 92. 1950.

**Plate 51H**

Annual twiner. Stems twining, terete, ribbed, with minute thorns/spines, glabrous with milky juice. Leaves simple, alternate, broadly ovate, 3.5–6 × 3–6 cm, cordate at base, entire at margins, acuminate at apex, glabrous; petioles 1.5–3 cm long. Inflorescence of solitary to a few-flowered cyme; peduncles 2–5 cm long, muricate. Flowers to 8 cm long; pedicels 2–3.5 cm long, jointed, *c.* 1 cm long. Sepals ovate to oblong, *c.* 1 × 0.4 cm, persistent, larger in fruits, with a fleshy-caudate awn, 4–6 mm long; inner sepals 7–8 mm long, the awn shorter. Corolla 5–7.5 cm long, lavender to purplish; tube 3–6 cm long; limb funnel-shaped to salverform. Stamens slightly exserted or



not; filaments inserted in apical part of corolla tube, base sparsely short pubescent; anthers large, cordate at base. Pistil slightly exserted or not; ovary glabrous; stigma 2-lobed. Capsules dome-shaped,  $1.5-2 \times 1.5-2.5$  cm. Seeds ellipsoid or ovoid,  $1.2-1.5 \times 0.8-1$  cm, white, turn black on maturity, glabrous.

*Fl. & Fr.*: October – November.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; common. INDIA: Almost throughout. WORLD: Africa, China, Indonesia, Japan, Myanmar, Nepal, North America, Pakistan, Philippines, South America, Sri Lanka and Vietnam.

*Specimen examined*: Taraghati forest, 333 m,  $24^{\circ}32'02.2''$  N,  $85^{\circ}34'47.0''$  E, 21st November 2012, *Shyam Biswa* 54073.

4. ***Ipomoea pes-tigridis*** L., Sp. Pl. 1: 162. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 204. 1883; Haines, Forest Fl. Chota Nagpur: 470. 1910 & Bot. Bihar Orissa: 595. 1922; N.P. Singh & al., Fl. Bihar: 335. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 424. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 635. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:151. 2014. *Ipomoea hepaticifolia* L., Sp. Pl. 1: 161. 1753. *Ipomoea pes-tigridis* L. var. *hepaticifolia* (L.) C.B. Clarke in Hook.f., Fl. Brit. India 4: 204. 1883. **Plate 51F**

Climber. Stems slender, trailing, covered with long spreading yellow to whitish bristly hairs. Leaves simple, alternate, orbicular,  $2.5-8 \times 3-12.5$  cm, palmately divided somewhat to the base into 5–9 lobes, rarely entire, or 3 or 4-lobed and angular not up to the base; lobes elliptic, elliptic-lanceolate to obovate,  $2-8 \times 1-5.5$  cm, entire at margins, mucronate at apex, each having a prominent midrib radiating from lamina base; lateral veins 5 or 6 pairs to the smaller lobes and 7–9 pairs to the larger lobes; densely appressed pubescent to strigose on both surfaces; petioles slender, 1.5–15 cm long, hairy. Inflorescence of a few-flowered involucrate cymose head, axillary; peduncles terete, 2–18 cm long, hairy; outer bracts oblong to linear-oblong,  $1.5-2.5 \times 0.7-1.2$  cm; inner bracts linear or linear-oblong,  $c. 1 \times 0.3$  cm; all foliaceous, pubescent, persistent. Calyx 5-lobed; lobes lanceolate to narrowly lanceolate, subequal, 7–12 mm long, long-hairy, slightly enlarged in fruit, silky pubescent, green with white base. Corolla funnel-shaped, 3–3.5 cm long, white or light pinkish or white with pinkish rim. Stamens 5,  $c. 1$  cm long; filaments glabrous; anthers  $c. 2$  mm long. Ovary conical,  $c. 1$  mm long; style 1–1.5 cm long, included; stigma rounded. Capsules ovoid to globular, 5–6 mm across, 4-thin-valved, brown, 2-loculed. Seeds 4, obovoid-rounded, 3.5–4 mm long, unevenly grey-tomentose, black.

*Fl. & Fr.*: September – October.

*Habitat*: Near crop fields.

*Distribution*: KWLS: Tilaya, near crop fields; common. INDIA: Throughout. WORLD: Africa, China, Malaya, Polynesia and Sri Lanka.

*Specimen examined*: Tilaya, near crop fields, 333 m,  $24^{\circ}25'02.2''$  N,  $85^{\circ}25'47.0''$  E, 28th September 2013, *Shyam Biswa* 54173.

5. ***Ipomoea quamoclit*** L., Sp. Pl. 1: 159. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 199. 1883; Haines, Forest Fl. Chota Nagpur: 471. 1910; N.P. Singh & al., Fl. Bihar: 336. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 425. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 636. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 151. 2014.

*Quamoclit vulgaris* Choisy, Mem. Soc. Phys. Geneve 6: 434. 1834; Haines, Bot. Bihar Orissa: 591. 1922.

**Plate 51G**

Vern. Names: *Kamalata* (Hindi); *Taru Lata*.

Twiner or climber. Stems terete or slightly angular, slender, herbaceous, glabrous. Leaves simple, alternate, pinnatisect with 9–17 opposite or alternate to subopposite pairs of patent lobes, ovate or oblong in outline, 1–5 × 1–4 cm; lobes linear, 2–3 cm long, glabrous with single lateral veins; lowest pair often bifid or trifid; petioles slender, 0.8–2 cm long, glabrous, often with pinnate pseudostipules at base. Inflorescence of 1- or 2–6-flowered cyme, axillary; peduncles slender, 1.5–6 cm long. Flowers 3–3.6 cm long; pedicels 0.5–1.2 cm long, glabrous, thickened and clavate in fruits; bracts deltoid or roundish, 1–1.5 mm long, acute at apex, caducous. Calyx lobes oblong to broadly oblong, 5–6 × c. 2 mm, obtuse, mucronate somewhat below apex, verruculose outside, glabrous; outer ones slightly shorter. Corolla salver-shaped, bright red; tube 2.5–3 cm long, narrowed towards base; limb expanded to 2 cm across; lobes 5, mucronate. Stamens 5, to 3 cm long, exserted; filaments hairy at base; anthers c. 2.5 mm long. Ovary conical, c. 1 mm long, glabrous, 4-loculed; style 1.5–1.7 cm long, exserted, curved; stigma subglobose. Capsules ovoid-oblong, 6–9 mm long, often with thickened style base, glabrous, 4-valved, 4-loculed, longitudinally splitting. Seeds 4, ovoid-oblong or ovoid-angular, 5–6 mm long, dark brown to black with somewhat irregularly scattered dark brown patches of short hairs.

*Fl. & Fr.*: September – October.

*Habitat*: Scrub forests or on hedges.

*Distribution*: KWLS: Khararia jungle, near Kharounia mines, Meghatari; common. INDIA: Throughout. WORLD: Native to tropical America, probably Mexico, now grown as an ornamental and also naturalized in most of the tropical countries.

*Specimen examined*: Khararia jungle, near Kharounia mines, Meghatari, 184 m, 24°35'15.08" N, 85°34'55.06" E, 11th September 2010, *Shyam Biswa* 49604.

#### 4. PORANOPSIS Roberty

South and Southeast Asia, 3 species and 1 in KWLS.

**Poranopsis paniculata** (Roxb.) Roberty in Candollea 14: 26. 1953. *Porana paniculata* Roxb., Pl. Coromandel 3: 31, t. 235. 1819; C.B. Clarke in Hook.f., Fl. Brit. India 4: 222. 1883; Haines, Forest Fl. Chota Nagpur: 461. 1910 & Bot. Bihar Orissa: 590. 1922; Mooney, Suppl. Bot. Bihar Orissa: 92. 1950; N.P. Singh & al., Fl. Bihar: 340. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 429. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 644. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 151, f. 19. 2014.

**Plate 52B**

Vern. Name: *Safed bel* (Hindi).

Climber or twiner. Stems herbaceous towards apex, woody and hard with age, densely tomentose, white; young branches villous. Leaves simple, alternate, narrowly or broadly ovate, 2.5–10 × 1.5–6.6 cm, cordate at base, entire or sometimes undulate at margins, acuminate at apex; lateral veins 5 or 6 originating at base, whitish pubescent on both surfaces but more dense beneath, velvety when young; petioles slender, 1–2 cm long, pubescent. Inflorescence a paniculate cyme, both axillary and terminal. Flowers 6–7 × 5–6 mm, white; peduncles long, slender; pedicels 3–5 mm long, densely whitish tomentose, longer in fruiting; bracts linear, c. 1 mm long. Calyx 5-

lobed; lobes linear, 1–2 mm long, densely whitish tomentose, 3 of them much enlarged in fruit. Corolla funnel-form, 6–7 mm long, sparsely whitish hairy, white; limb shallowly lobed. Stamens 5, *c.* 1 mm long, included; filaments adnate to corolla near base; anthers oblong, *c.* 0.5 mm long, basifixed. Ovary dome-shaped or ovoid, *c.* 0.5 mm long, 2-locular; ovules 2 per locule; style filiform, *c.* 0.5 mm long; stigma 2-lobed, indistinctly bilobed. Capsules ovoid-globular, 5–6 mm long, dry, densely greyish tomentose, indehiscent, 1-seeded; 3 sepals wing-like, enlarging in fruit to 10 × 5 mm, obtuse, pubescent on both surfaces, other 2 linear, *c.* 5 mm long. Seeds ovoid, 3–4 mm long, glabrous, blackish brown.

*Fl. & Fr.*: November – December.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest; occasional. INDIA: Almost throughout. WORLD: Tropical and subtropical regions.

*Specimen examined*: Taraghati forest, 333 m, 24°32'02.2" N, 85°34'47.0" E, 21st November 2012, *Shyam Biswa* 54071.

### 5. RIVEA Choisy

Tropical Asia, 2 species, 2 in India and 1 in Jharkhand.

**Rivea hypocrateriformis** (Desr.) Choisy in Mém. Soc. Phys. Genève 6: 408 (Conv. Or. 26). 1833; C.B. Clarke in Hook.f., Fl. Brit. India 4: 184. 1883; Haines, Forest Fl. Chota Nagpur: 462. 1910 & Bot. Bihar Orissa: 586. 1922; Mooney, Suppl. Bot. Bihar Orissa: 91. 1950. *Convolvulus hypocrateriformis* Desr. in Lam., Encycl. 3: 561. 1792. **Plate 52C**

Vern. Name: *Phang* (Hindi).

Climber. Stems terete, woody, pubescent. Leaves simple, alternate, more or less orbicular, 2.5–9 × 3–14 cm, deeply cordate at base, entire at margins, obtuse or rounded with minutely apiculate apex, glabrous above, more or less pubescent beneath, silky villous when young; lateral veins 6 or 7 pairs; petioles 1–8.5 cm long, silky-pubescent. Inflorescence a cyme, axillary, 1 or rarely 3-flowered; peduncles slender, 2–6 cm long, silky pubescent; pedicels slender, 0.5–1.5 cm long, stout in fruit, jointed in about middle, pubescent; bracts spatulate, 1–1.3 cm long, pubescent, caducous. Sepals 5, ovate-elliptic, unequal, 1–1.2 cm long, enlarged in fruits; outer 2 sepals shorter and narrower, obtuse or subacute at apex, silky hairy outside; inner sepals obtuse to rounded and mucronate at apex, glabrous except on median longitudinal part, scarious at margins. Corolla hypocrateriform or salverform, white; tube 5–6 cm long, glabrescent outside, 5-lobed; lobes 2–3 cm long. Stamens 5, equal; filaments short, woolly at base; anthers oblong, *c.* 7 mm long. Disk annular. Ovary 4-loculed, 4-ovuled; style filiform, *c.* 3 cm long; stigma linear-oblong, papillose, 2-lobed. Capsules conical, mucronate at apex with the stylar base, 1.6–1.8 × 1.3–1.6 cm, woody, glabrous, polished chestnut-brown, subtended by persistent deflexed woody calyx, indehiscent; seeds 3 or 4, ellipsoid-ovoid, 6.5–7 × 0.8–1 cm, glabrous, chest-nut brown.

*Fl. & Fr.*: August – November.

*Habitat*: Dry deciduous mixed forests.

*Distribution*: KWLS: Koderma NRF; common. INDIA: Assam, Bihar, Odisha and West Bengal. WORLD: Pakistan.

*Specimens examined*: Koderma NRF, 390 m, 24°29'06.6" N, 85°36'49.8" E, 9th August 2011, *Shyam Biswa* 49759; Bagitan jungle, 398 m, 24°29'33.1" N, 85°35'48.6" E, 20th November 2012, *Shyam Biswa* 54066.

## 6. XENOSTEGIA D.F.Austin & Staples

Tropical and Subtropical Old World regions, c. 6 species, 1 in India.

**Xenostegia tridentata** (L.) D.F.Austin & Staples *Brittonia* 32(4): 533. 1981. *Convolvulus tridentatus* L., *Sp. Pl.* 1: 157. 1753. *Ipomoea tridentata* (L.) Roth, *Arch. Bot. (Leipzig)* 1(3): 38. 1798; C.B. Clarke in Hook.f, *Fl. Brit. India* 4: 205. 1883; Haines, *Forest Fl. Chota Nagpur*: 468. 1910 & *Bot. Bihar Orissa*: 595. 1922. *Merremia tridentata* (L.) Hallier f. in *Bot. Jahrb. Syst.* 16: 552. 1893; N.P. Singh & al., *Fl. Bihar*: 338. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 428. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 641. 2005.

### Plate 52A

Twiner. Stems and branches terete or angled, unarmed, glabrous. Leaves simple, alternate, subsessile, oblong-obovate to obovate, 1–2.5 × 0.3–0.9 cm, deeply cordate or amplexicaul and 3-lobed or toothed at base, undulate and entire at margins towards apex, rounded or truncate and mucronate at apex, glabrous. Inflorescence of solitary or 1–3-flowered, axillary. Flower bell-shaped, 8–10 mm across; peduncles 1–3 cm long; bracteoles small, spreading with peduncle; pedicels 2–6 mm long; bracts at the base of pedicels 2, linear, c. 2 mm long, glabrous. Calyx subequally 5-lobed; outer lobes oblong, c. 5 mm long; inner lobes lanceolate-elliptic, c. 5.5 mm long, undulate at margins, acute at apex. Corolla campanulate, 8–10 mm across, undulate at margins, white with central portion pinkish, 5-lobed. Stamens 5, adnate to corolla base; filaments slender, c. 5.5 mm long, white hairy at base; anthers oblong, c. 1 mm long. Ovary globose-ovoid, c. 1 mm across, 4-loculed; ovules 4; style slender, c. 5 mm long, glabrous; stigma 2, globose, c. 0.5 mm. Capsules globose or dome-shaped, 7–10 mm across. Seeds 4, subglobose, triangular, 3–4 × c. 2 mm, white turns blackish when old.

*Fl. & Fr.*: August – September.

*Habitat*: Open forests.

*Distribution*: KWLS; Koderma NRF; common. INDIA: Almost throughout. WORLD: Africa, Australia, Bangladesh, Cambodia, Indonesia, Laos, Malaysia, Myanmar, New Guinea, Philippines, Singapore, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Koderma NRF, 390 m, 24°29'06.6"N, 85°36'49.8"E, 9th August 2011, *Shyam Biswa* 49762; Near Rishi Dhurwasha Pahar, Meghatari, 226 m, 24°35'24.54" N, E 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 49818.

## 84. SOLANACEAE Juss., nom. cons

Subcosmopolitan, predominantly Tropical America, 91 genera and c. 2450 species; 17 genera and c. 75 species in India.

### Key to genera

- 1a. Flowers solitary or 4–6 in clusters; anthers dehiscing longitudinally 2
- 1b. Flowers in cymose, umbelliform or racemiform; anthers dehiscing poricidally **3. Solanum**

- 2a. Corolla funnelform; fruit a capsule, spiny or tuberculate, not enclosed by an accrescent and inflated calyx **1. Datura**
- 2b. Corolla campanulate; fruit a berry, smooth, completely enclosed by an accrescent and inflated calyx **2. Physalis**

### 1. DATURA L.

South and North America, 11 species, 10 in India, 4 in Jharkhand, 2 in KWLS.

#### Key to species

- 1a. Plants glandular-pubescent; stems and branches green; corolla white, capsules densely grey-white pubescent with slender prickles **1. D. innoxia**
- 1b. Plants glabrescent; stems and branches usually dark purplish; corolla purplish outside, capsules with blunt prickles **2. D. metel**

**1. Datura innoxia** Mill., Gard. Dict. ed. 8. n. 5. 1768. *Datura. metel* auct. non L. 1753: C.B. Clarke in Hook.f., Fl. Brit. India 4: 243. 1883; N.P. Singh & al., Fl. Bihar: 343. 2001.

#### Plate 52D & E

Vern. Name: *Dhatura* (Hindi).

Herb or undershrub, 1–1.5 m high. Stems erect, woody at base, branched, densely pubescent and glandular, green. Leaves simple, alternate, broadly ovate or ovate-oblong, 5–16 × 3–8.5 cm, asymmetric and rounded or obtuse at base, subentire, sinuate, or irregularly dentate at margins, acute at apex, minutely tomentose; lateral veins 5–7 pairs; petioles 1–8 cm long. Flowers erect, to 18 cm long; pedicels 1–2.5 cm long. Calyx cylindric, 7–9.5 × 1.5–3 cm, 5-lobed; lobes narrowly deltate, 1–2 cm long, sometimes unequal. Corolla 14–18 cm long, white; limb 7–10 cm in diam.; lobes mucronate at apex. Stamens 5; filaments *c.* 5.5 cm long, white; anthers 1–1.5 cm, cream-coloured. Capsules globose or ovoid, 3–4 cm in diam., deflexed, densely armed with slender, subequal prickles, pubescent with white hairs, irregularly dehiscent at apex, subtended by remnants of persistent calyx. Seeds numerous, discoid-reniform, 3–5 mm across, yellowish brown.

*Fl. & Fr.*: September – November.

*Habitat*: Near rivers and villages.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; base of Dhawjadhari Pahar, near temple. INDIA: Almost throughout. WORLD: Central and S. America, West Indies, Southwestern USA; naturalised in the Mediterranean region, Afghanistan, Pakistan and Malaysia.

*Specimens examined*: Near Dhanarjay Nadi, Meghatari, 186 m, 24°35'00.7" N, 85°34'56.3" E, 13th September 2010, *Shyam Biswa* 49617; base of Dhawjadhari Pahar, near temple, 412 m, 24°28'47.7" N, 85°35'49.6" E, 19th November 2012, *Shyam Biswa* 54049.

**2. Datura metel** L., Sp. Pl. 1: 179. 1753. *Datura fastuosa* L., Syst. Nat. ed. 10: 932. 1759; C.B. Clarke in Hook.f., Fl. Brit. India 4: 242. 1883; Haines, Bot. Bihar Orissa: 615. 1922; N.P. Singh & al., Fl. Bihar: 343. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 434. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 605. 2005. **Plate 52F & G**

Vern. Name: *Dhatura* (Hindi).



Herb or undershrub or shrub, 1–2 m high. Stems erect, branched, green, dark purple, minutely pubescent to almost glabrous. Leaves simple, alternate, elliptic to broadly ovate, 4–21 × 3–21 mm, asymmetric obtuse at base, distantly serrate or angulate at margins, acute or shortly acuminate at apex, glabrous; lateral veins 3–5 pairs; petioles 1–10.5 cm long. Flowers solitary, erect, 8–13 cm long; pedicels 1–2 cm long, pubescent. Calyx tubular, 5.5–6.5 cm long, green; tube 4.5–5.5 cm long, minutely pubescent; teeth unequal, 0.5–1 cm long, triangular-acuminate at apex. Corolla funnelform, sometimes in 2 or 3 whorls, purple outside, greenish white inside; tube 8–13 cm long, pubescent outside; limb 4–7 cm across, 5-cuspidate. Stamens 5; filaments *c.* 5 cm long, white; anthers 1–1.2 cm long, whitish. Stigma capitate. Capsules pendulous, subglobose, 2–2.5 × 2–3 cm, dehiscing irregularly; pericarp with blunt spines, subtended by remnants of persistent calyx. Seeds many, reniform-discoid, *c.* 5 mm, cochleate, yellowish brown.

*Fl. & Fr.*: November – March.

*Habitat*: Open localities.

*Distribution*: KWLS: Bagitan jungle, Koderma NRF; base of Dhawjadhari Pahar, near the temple. INDIA: Almost throughout. WORLD: Native of the Americas, long introduced and naturalized in Asia.

*Specimens examined*: Bagitan jungle, Koderma NRF, 387 m, 24°29'05.7" N, 85°36'04.3" E, 1st March 2011, *Shyam Biswa* 49645; base of Dhawjadhari Pahar, near the temple, 412 m, 24°28'47.7" N, 85°35'49.6" E, 19th November 2012, *Shyam Biswa* 54048.

## 2. **PHYSALIS** L.

Cosmopolitan, *c.* 75 species, 8 in India, 2 in Jharkhand and 1 in KWLS.

***Physalis angulata*** L., Sp. Pl. 1: 183. 1753; Rydberg, Mem. Torrey Bot. Club 4: 333. 1896; C.S. Reddy & al., J. Econ. Taxon. Bot. 23: 710. 1999; V.S. Raju & al., Acta Phytotax. Sin. 45: 241, ff. 1A – *c.* 2007.

**Plate 53A**

Vern. Name: *Tulatipati* (Hindi).

Herb, 8–40 cm high. Stems terete towards base, angular-ribbed above, patent-hairy, green, usually purple-tinged. Leaves simple, alternate, ovate-elliptic or ovate, 1.5–9.5 × 1–5.5 cm, obliquely rounded or subcordate at base, coarsely toothed or lobed at margins, acute to subacuminate at apex, pubescent; petioles 0.5–5 cm long, slender, more or less pubescent. Flower solitary, axillary; pedicels 0.4–1 cm long in flower, 0.8–1.5 cm long in fruit, patent-hairy. Calyx divided about halfway, 2–4 mm long, 5-lobed; lobes deltoid to broadly lanceolate, ciliate, with green or purplish veins. Corolla 4–6 mm across, pale yellow with brown spots at base inside, 5-lobed; lobes oblanceolate, acute at apex, 4–5 mm long. Stamens 5; filaments 2–4 mm long; anthers oblong, *c.* 1 mm long, yellowish, dehiscing longitudinally. Ovary ovoid, *c.* 1 mm across, 2-locular; ovules numerous; style *c.* 4 mm long, glabrous; stigma minutely 2-lobed. Fruiting calyx bladder-like, subglobose or ovoid, 1.5–2.7 × 1–2 cm, 10-angled, purple reticulate-veined. Berries globose, 5–12 mm, smooth, green, yellow when ripe, entirely enveloped in enlarged calyx. Seeds many, rugose.

*Fl. & Fr.*: September – March.

*Habitat*: Moist and shade localities near river and in dry deciduous forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; near the river Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined:* Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49571; near Dhanarjay Nadi, Meghatari, 188 m, 24°34'32.9" N, 85°34'41.6" E, 7th March 2011, *Shyam Biswa* 49709.

### 3. SOLANUM L.

Subcosmopolitan, c.1250 species, 48 in India, 11 in Jharkhand and 3 in KWLS.

#### Key to species

- |                                                                           |                                 |
|---------------------------------------------------------------------------|---------------------------------|
| 1a. Plants armed with prickles; berries 1.2–2 cm across, yellow when ripe | <b>2. <i>S. virginianum</i></b> |
| 1b. Plants unarmed; berries 4–6 mm across, shiny black when ripe          | <b>1. <i>S. americanum</i></b>  |

**1. *Solanum americanum*** Mill., Gard. Dict., ed. 8, no. 5. 1768. *Solanum nigrum* L., Sp. Pl. 1: 186. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 229. 1883; Haines, Forest Fl. Chota Nagpur: 440. 1910 & Bot. Bihar Orissa: 610. 1922; Mooney, Suppl. Bot. Bihar Orissa: 94. 1950; N.P. Singh & al., Fl. Bihar: 347. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 438. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 614. 2005. **Plate 53B**

Vern. Names: *Makoi* (Hindi); *Ban Phutka*.

Herb or undershrub, 20–100 cm high, unarmed. Stems angular to subterete, glabrous or sparsely hairy. Leaves simple, alternate, ovate or ovate-elliptic, 1.5–6.5 × 0.7–3 cm, cuneate or attenuate at base, subentire or irregularly dentate at margins, acute at apex. Inflorescence umbelliform or racemiform, extra-axillary, 2–8-flowered; peduncles 0.8–2 cm long; pedicels 3–6.5 mm long. Calyx cupular, 1–1.5 × c. 2 mm, 5-lobed; lobes triangular, c.1 mm long, entire and ciliate at margins, acute at apex, pubescent outside, dark green, faintly reflexed in fruit. Corolla stellate, c. 5 mm across, white, 5-lobed; lobes ovate or oblong-ovate, 2–3 × 1–1.5 mm, acute to obtuse at apex. Stamens 5, equal; filaments c. 0.5 mm long; anthers oblong, c. 1 mm long, bright yellow. Ovary ovoid or globose, c. 1 mm long; style c. 2 mm long, hairy in the lower part; stigma simple. Berries globose, 4–6 mm, glossy green. Seeds many, discoid, 1–1.5 mm, pale yellow.

*Fl. & Fr.:* June – March.

*Habitat:* Shade localities.

*Distribution:* KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Widespread in all tropical and temperate regions.

*Specimen examined:* Near Dhanarjay nadi, Meghatari, 182 m, 24°34'32.9" N, 85°34'41.6" E, 7th March 2011, *Shyam Biswa* 49703.

**2. *Solanum virginianum*** L., Sp. Pl. 1: 187. 1753; Hepper & Jaeger, Kew Bull. 41(2): 434. 1986; N.P. Singh & al., Fl. Bihar: 348. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 619. 2005. *Solanum surattense* Burm.f., Fl. Ind.: 57. 1768; Deb, J. Econ. Taxon. Bot. 1: 51. 1980; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 439. 2001. *Solanum xanthocarpum* Schrad. & Wendl. in Schrad., Sert. Hannov. 1: 8, t. 2. 1795; C.B. Clarke in Hook.f., Fl. Brit. India 4: 236. 1883; Haines, Forest Fl. Chota Nagpur: 440. 1910 & Bot. Bihar Orissa: 613. 1922. **Plate 53C**

Vern. Name: *Keteli* (Hindi).

Herb or undershrub, erect or prostrate, horizontally branched, woody at base. Stems zigzag, terete, with stellate hairs; prickles many, straight, to 2 cm long. Leaves simple, alternate, ovate-

elliptic to oblong, pinnately parted, 5–9-lobed; lobes unequal, 4–10 × 2–5.5 cm, subcordate or unequal at base, sinuate at margins, acute at apex, prickly along veins throughout, stellate-pubescent; petioles 1–4 cm long, stellate-pubescent, prickly. Inflorescence cyme, extra-axillary, to 5 cm long, lax, 2–7-flowered; peduncles 1.5–3 cm long, stellate-pubescent, prickled. Flowers 2–2.5 cm across; pedicels 0.5–1 cm long, prickly. Calyx campanulate, *c.* 1 cm in diam., divided half-way down, prickled, stellate-pubescent, green, 5-lobed; lobes oblong-ovate, 0.5–1 cm long, acute at apex. Corolla rotate, 1.5–2 cm across, purple, 5-lobed; lobes deltoid, 1–1.2 cm, stellate-pubescent. Stamens 5; filaments *c.* 1 mm long; anthers oblong, *c.* 1 cm long, bright yellow. Ovary stellate-pubescent and glandular at top; style *c.* 1.2 cm long, glabrous; stigma incurved. Berries globose, 1.2–2 cm, smooth, glabrous, green with light green or white streaks, yellow when ripe. Seeds 2–2.5 mm across, smooth.

*Fl. & Fr.*: March – June.

*Habitat*: Open localities.

*Distribution*: KWLS: Neru Pahari; common. INDIA: Throughout. WORLD: Afghanistan, Africa, India, Japan, Malaysia, Nepal, Pacific Islands, SW Asia, Sri Lanka, Thailand and Vietnam.

*Specimen examined*: Neru Pahari, 415 m, 24°29'20.8" N, 85°39'36.5" E, 5th March 2011, *Shyam Biswa* 49669.

## 85. OLEACEAE Hoffmanns. & Link, nom. cons.

Subcosmopolitan, 24 genera and *c.* 800 species; *c.* 10 genera and *c.* 100 in India.

### Key to genera

- |                                                                                                                    |                      |
|--------------------------------------------------------------------------------------------------------------------|----------------------|
| 1a. Scandent or climbing shrubs, rarely erect; corolla 10-lobed; fruit a berry                                     | <b>1. Jasminum</b>   |
| 1b. Erect shrubs or small trees; corolla less than 10-lobed; fruit a capsule                                       | <b>2</b>             |
| 2a. Leaves simple leaves; capsules nearly orbicular, slightly emarginate with a mucro at apex; seed 1, not winged  | <b>2. Nyctanthes</b> |
| 2b. Leaves compound; capsule obovoid or pear-shaped, woody, loculicidally 2-valved; seeds 4 in each locule, winged | <b>3. Schrebera</b>  |

### 1. JASMINUM L.

Malesia to temperate Old World region, *c.* 450 species, *c.* 40 in India, *c.* 10 in Jharkhand and 1 in KWLS.

**Jasminum arborescens** Roxb., Fl. Ind. 1: 94. 1820; C.B. Clarke in Hook.f., Fl. Brit. India 3: 594. 1882; Haines, Forest Fl. Chota Nagpur: 415. 1910 & Bot. Bihar Orissa: 525. 1922; N.P. Singh & al., Fl. Bihar: 295. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 711. 2005.

### Plate 53D

Shrub, scandent or climbing. Stems terete, glabrous or sparsely hairy; branches pubescent when young. Leaves simple, opposite, broadly ovate, 2–5.5 × 1.3–4.6 cm, rounded or subcordate at base, entire at margins, acute or acuminate at apex, pubescent when young, glabrous with age; petioles 0.6–1.5 cm long, hairy. Cymes lax, trichotomously branched, 7 to many-flowered; bracts linear, 5–7 mm long. Flowers 3–4 cm across; pedicels 5–8 mm long, hairy. Calyx funnel-shaped, 6–7 mm long, hairy, 4–9-lobed; lobes linear, subclavate. Corolla salver-shaped; tube narrow, 1–1.2 cm long, greenish white, usually 4–10-lobed; lobes linear or narrowly oblong, 1.3–1.5 × 0.3–0.5 cm, acuminate at apex, imbricate, white. Stamens 2, on the base of the corolla tube; filaments *c.* 1 mm long; anthers oblong, 4–5 × *c.* 1 mm, basifixed. Ovary dome-shaped, *c.* 2 × 1–1.5 mm, 2-

loculed; ovules 2 per locule; style filiform, c. 1.2 cm long; stigma 2-fid. Berries ellipsoid, 1–1.2 × 0.6–0.7 cm, asymmetric, black. Seed 1, rarely 2 in each carpel.

*Fl. & Fr.*: March – October.

*Habitat*: On hillslopes in dry deciduous forests or near the river.

*Distribution*: KWLS: Bhagitan Jungle; occasional. INDIA: Throughout. World: Sri Lanka.

*Specimen examined*: Bhagitan Jungle, 403 m, 24°29'13.9" N, 85°36'25.0" E, 29th March 2013, *Shyam Biswa* 54117.

## 2. NYCTANTHES L.

India to Java, 2 species, 1 in India.

**Nyctanthes arbor-tristis** L., Sp. Pl. 1: 6. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 3: 603. 1882; Haines, Forest Fl. Chota Nagpur: 416. 1910 & Bot. Bihar Orissa: 526. 1922; N.P. Singh & al., Fl. Bihar: 298. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 377. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 716. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 138. 2014.

**Plate 53E**

Vern. Name: *Harsinghar* (Hindi).

Tree, 2–4 m high; young branches sharply quadrangular, hairy. Leaves simple, opposite, ovate, 3–11 × 1.5–6 cm, rounded or subcuneate at base, entire at margins, acute to subacuminate at apex, coriaceous, covered with stiff whitish hairs; lateral veins 3–5 pairs; petioles 2–7 mm long. Flowers c. 2.5 cm across, fragrant; bracts sessile, broadly ovate or suborbicular, 2–3 mm long, apiculate at apex, hairy. Calyx narrowly campanulate, 3–5 mm long, glabrous inside, hairy outside, 5-toothed, persistent. Corolla tube 6–9 mm long, glabrous, bright orange, 6-lobed; lobes obcordate, 5–7 mm long, irregularly lobed at tip, white. Stamens 2, included. Ovary globose, 2 or 1-loculed; ovule 1 per locule, basal. Capsules nearly orbicular, slightly emarginate with a mucro at apex, 2–2.5 mm across, compressed, glabrous, reticulately veined, green, brownish when mature, 1-seeded; seed orbicular, 1–1.5 cm.

*Fl. & Fr.*: September – January.

*Habitat*: On hillslopes of dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar; common. INDIA: Andhra Pradesh, Bihar, Madhya Pradesh, Odisha and Uttar Pradesh. WORLD: Pantropical.

*Specimen examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49593.

## 3. SCHREBERA Roxb.

Tropical regions, 8 species, 1 in India.

**Schrebera swietenoides** Roxb., Pl. Coromandel. 2: 1. t. 101. 1799; C.B. Clarke in Hook.f. Fl. Brit. India 3: 604. 1882; Haines, Bot. Bihar Orissa 527. 1922; N.P. Singh & al., Fl. Bihar: 298. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.: 138. 2014.

**Plate 53F**

Vern. Name: *Ek-sira* (Birhore).

Tree, to 10 m high, deaciduous. Leaves compound, opposite, to 10 cm long, imparipinnate, estipulate; leaflets 7–9, opposite; petiolule 0.3–3 cm, tomentose; leaflets elliptic-lanceolate,

ovate or elliptic-obovate, 6.5–14 × 3.5–6.5 cm, attenuate or oblique at base, entire at margins, acute to acuminate at apex, glabrous above, villous beneath, coriaceous; lateral veins 5–7 pairs. Flowers fragrant, *c.* 1 cm across, in terminal, trichotomous cymes; pedicels to 5 mm long. Calyx obscurely 4–7 toothed, *c.* 1 mm long, puberulent. Corolla slaver shaped, *c.* 4 mm across, lobes 4–7, rounded, glandular, whitish yellow or whitish brown. Stamens 2, attached near the top of corolla tube; filaments short; ovary 2-loculed, superior, ovules 3–4 in each locule; style cylindric, *c.* 6 mm long; stigma shortly bifid. Capsules obovoid or pear-shaped, 4–5 × 2.5–3 cm, woody, loculicidally 2-valved, orange or reddish brown with lenticels. Seeds oval, 4 in each locule, pendulous, winged.

*Fl. & Fr.*: May – March.

*Habitat*: Dry deciduous forest.

Distribution: KWLS: Dhodhakola near Birhore Tola, Safinalwa; not common. INDIA: Karnataka, Kerala, Maharashtra, Tamil Nadu. WORLD: Indo-China and Myanmar.

*Specimen examined*: Dhodhakola near Birhore Tola, Safi nalwa, 380 m, 24°33'15.1" N, 85°39'37.9" E, 27th February 2012, *Shyam Biswa* 53929.

## 86. PLANTAGINACEAE Juss., nom. cons.

Cosmopolitan, 101 genera and *c.* 1900 species; *c.* 90 genera and 12 species in India.

### Key to genera

- |                                                                                                                      |                      |
|----------------------------------------------------------------------------------------------------------------------|----------------------|
| 1a. Plants erect                                                                                                     | 3                    |
| 1b. Plants prostrate or decumbent                                                                                    | 2                    |
| 2a. Leaves sessile with veins indistinct; calyx 5-lobed; corolla violet or whitish violet with darker lines, 5-lobed | <b>1. Bacopa</b>     |
| 2b. Leaves petiolate with veins distinct; calyx 4-lobed; corolla bright yellow, 4-lobed                              | <b>2. Mecardonia</b> |
| 3a. Calyx subequally 4-lobed; corolla bearded at throat, 4-lobed; Stamens 4                                          | <b>3. Scoparia</b>   |
| 3b. Calyx equally 5-lobed; corolla not bearded, 4 or 5-lobed; stamens 2                                              | <b>4. Veronica</b>   |

### 1. BACOPA Aubl., nom. cons.

Subtropical regions, 56 species, 3 in India, 3 in Jharkhand and 1 in KWLS.

**Bacopa monnieri** (L.) Wettst. in Engl. & Prantl, Nat. Pflanzenfam. IV, 3b: 77. 1891; N.P. Singh & al., Fl. Bihar: 350. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 440. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 721. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 155. 2014. *Lysimachia monnieri* L., Cent. Pl. 2: 9. 1756. *Herpestis monnieri* (L.) Kunth, Nov. Gen. Sp. 2: 366. 1818, nom. illeg.; Hook.f., Fl. Brit. India 4: 272. 1884; Haines, Bot. Bihar Orissa: 622. 1922, '*monniera*'.

### Plate 54A

Herb, procumbent or ascending. Stems terete, rooting at nodes, succulent, glabrous. Leaves simple, opposite, sessile, spatulate to oblong-ob lanceolate, 0.5–2 × 0.1–1 cm, cuneate or obtuse at base, entire at margins, rounded at apex, gland-dotted beneath; veins indistinct. Flowers solitary, axillary, *c.* 1 cm across; pedicels 0.6–3 cm long; bracteoles 2, beneath calyx, linear-lanceolate, 2–3 mm long. Calyx 5-lobed; lobes 4–6 mm long, posterior one ovate, others narrower. Corolla 5-lobed, 8–10 mm long, violet or whitish violet with darker lines. Stamens 4, didynamous; longer filaments *c.* 4 mm long; shorter ones *c.* 2.5 mm long, white; anthers *c.* 1 mm



long, dark purplish. Ovary subglobose, *c.* 1 mm across, green; style *c.* 2 mm long, green; stigma capitate, green. Capsules ovoid, 5–7 mm long, acute at apex.

*Fl. & Fr.*: August – February.

*Habitat*: Moist grasslands.

*Distribution*: KWLS: Lokai forest; near Phutlaiya Nala; near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Throughout. WORLD: Tropical and subtropical regions.

*Specimens examined*: Lokai forest, 382 m, 24°28'57.6" N, 85°37'04.4" E, 28th February 2011, *Shyam Biswa* 49641; near Phutlaiya Nala, 342 m, 24°30'33.0" N, 85°39'31.5" E, 17th August 2011, *Shyam Biswa* 49822; near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49891.

## 2. MECARDONIA Ruiz & Pav.

Subtropical regions, 10 species, 1 in India.

**Mecardonia procumbens** Small, Fl. S.E. U.S.: 1065, 1338. 1903; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 451. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 741. 2005. *Erinus procumbens* Mill., Gard. Dict. ed. 8: n. 6. 1768. *Bacopa procumbens* (Mill.) Greenm., Publ. Field Columb. Mus., Bot. Ser. 2: 261. 1907; N.P. Singh & al., Fl. Bihar: 350. 2001.

### Plate 54B

Herb, 5–15 cm high, prostrate or decumbent with tips ascending or suberect. Stems quadrangular, glabrous. Leaves simple, opposite, ovate-lanceolate or ovate, 0.7–2 × 0.3–1 cm, attenuate and subequal or unequal at base, serrate at margins, acute at apex, glabrous. Flowers 1 or 2, axillary, *c.* 5 mm across; bracteoles 2, linear or linear-lanceolate, *c.* 7 mm long; pedicels 1–1.7 cm long. Calyx 4-lobed; lobes free, unequal, foliaceous; outer 3 oblong-cordate, 6–8 × *c.* 2.5 mm, obtuse or acute at apex, imbricate. Corolla *c.* 5 mm long, bright yellow; tube *c.* 4 mm long, 4-lobed, pubescent; upper lip obovate, 1.2–2 × 2–4.5 mm, emarginate; lower lip with obovate or suborbicular middle lobe. Stamens 4, didynamous; longer filaments *c.* 2.2 mm long; shorter ones *c.* 1 mm long; anthers disjunct, parallel, unequal in shorter pair, oblong, *c.* 0.6 mm long. Ovary ovoid or ellipsoid, *c.* 1.5 mm long, obscurely 2-loculed; style *c.* 0.5 mm long; stigma 2-lamellate. Capsules ellipsoid, *c.* 7 × 3–4 mm, 2-valved, septicidal. Seeds ellipsoid, 0.3–0.5 mm long.

*Fl. & Fr.*: March – April.

*Habitat*: Moist localities near river and on river banks.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near Dhanarjay Nadi, Meghatari, 182 m, 24°34'44.3" N, 85°34'41.6" E, 7th March 2011, *Shyam Biswa* 49696.

## 3. SCOPARIA L.

Tropical regions, *c.* 20 species and 1 in India.

**Scoparia dulcis** L., Sp. Pl. 1: 116. 1753; Hook.f., Fl. Brit. India 4: 289. 1884; Haines, Bot. Bihar Orissa: 637. 1922; N.P. Singh & al., Fl. Bihar: 361. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 451. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 744. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 159. 2014.

### Plate 54C

Herb, 10–40 cm high, often with a woody base. Stems divaricately branched, terete, glabrous. Leaves simple, opposite, obovate-oblong to oblanceolate or elliptic,  $0.8\text{--}3.2 \times 0.2\text{--}1.1$  cm, attenuate or cuneate at base, coarsely crenate-serrate at margins, acute at apex; petioles 1–5 mm long, glabrous, penni-veined. Flowers 1–3 together, often forming leafy racemes, 4–6 mm across; pedicels 3–7 mm long, glabrous. Calyx 2–2.5 mm long, almost divided to base, 4-lobed; lobes subequal, ovate-oblong, ciliate at margins, 2-veined, pubescent outside. Corolla bearded at throat, white, 4-lobed; lobes oblong,  $3\text{--}5 \times 2\text{--}3$  mm, obtuse at apex. Stamens 4, equal, exserted; filaments filiform, *c.* 2 mm long, whitish light violet; anthers oblong, *c.* 1 mm long, dorsifixed, yellowish, 2-celled. Ovary globose, 1.2–1.5 mm, glabrous; style *c.* 2 mm long; stigma truncate. Capsules globose, 2–3 mm, septicidal, tipped by withered style, pale brown. Seeds truncate, 0.4–0.5 mm long, dull brown.

*Fl. & Fr.*: March – December.

*Habitat*: Shady or open localities.

*Distribution*: KWLS: Neru Pahari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Neru Pahari, 415 m,  $24^{\circ}29'20.8''$  N,  $85^{\circ}39'36.5''$  E, 5th March 2011, *Shyam Biswa* 49671.

#### 4. VERONICA L.

North temperate and few tropical regions, *c.* 450 species, 32 in India and 1 in Jharkhand.

**Veronica anagallis-aquatica** L., Sp. Pl. 1: 12. 1753; Hook.f, Fl. Brit. India 4: 293. 1884; N.P. Singh & al., Fl. Bihar: 364. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 455. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 748. 2005. **Plate 54D**

Herb, 20–50 cm high. Stems erect, unbranched (except inflorescence), almost glabrous with creeping rootstock, usually turns black when dry. Leaves sessile, simple, opposite, oblong to oblong-lanceolate,  $1\text{--}6.5 \times 3\text{--}2$  mm, amplexicaul at base, crenate-serrate or shallowly serrate at margins, acute at apex, glabrous. Inflorescence of several pairs of opposite racemes in axils of leaves in upper half of stem; racemes 3–14 cm long; bracts linear-lanceolate, 2–5 mm long; pedicels 2–5 mm long. Calyx 5-lobed; lobes ovate-lanceolate,  $3\text{--}4 \times c. 1$  mm, acute at apex. Corolla rotate,  $2\text{--}3 \times c. 1.5$  mm, 4- or 5-lobed, white. Stamens 2, alternating corolla lobes; filaments *c.* 2 mm long, white; anthers *c.* 0.5 mm long, light yellowish. Ovary globose, *c.* 2 mm, externally 2-lobed; style *c.* 2 mm long; stigma capitate. Capsules subglobose, *c.* 3 mm long, with shallow apical notch of *c.* 0.5 mm, glabrous. Seeds oblong or ovate, *c.* 0.4 mm long, often with an elevation on ventral surface, light brownish.

*Fl. & Fr.*: October – March.

*Habitat*: Near river banks.

*Distribution*: KWLS: Khararia jungle, Meghatari; Bon Kali, Pipra Tan; not common. INDIA: Assam, Northwest India, West Bengal and Western Peninsula. WORLD: China, Europe, Kazakhstan, Korea, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan, Turkmenistan and Uzbekistan; naturalised in North America

*Specimens examined*: Khararia jungle, Meghatari, 190 m,  $24^{\circ}34'57.8''$  N,  $85^{\circ}35'16.5''$  E, 9th March 2011, *Shyam Biswa* 49734; Bon Kali, Pipra Tan, 366 m,  $24^{\circ}28'36.5''$  N,  $85^{\circ}32'20.5''$  E, 25th February 2012, *Shyam Biswa* 49874.

# 87. SCROPHULARIACEAE Juss., nom. cons.

Tropical and subtropical regions, few temperate regions, 54 genera and c. 1800 species; 62 genera and 368 species in India.

## VERBASCUM L.

Eurasia and East Africa, c. 360 species, 6 in India and 1 in Jharkhand.

**Verbascum coromandelianum** (Vahl) Hub.-Mor., Bauhinia 5(1): 11. 1973. *Celsia coromandeliana* Vahl, Sym. Bot. 3: 79. 1794; Hook.f., Fl. Brit. India 4: 251. 1883; Haines, Bot. Bihar Orissa: 619. 1922; Mooney, Suppl. Bot. Bihar Orissa: 94. 1950. *Verbascum chinense* (L.) Santapau, Fl. Purandhar: 90. 1958 & Rec. Bot. Surv. India 16: 177. 1967; N.P. Singh & al., Fl. Bihar: 364. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 454. 2002; Paria & Chattopahyay, Fl. Hazaribagh 2: 747. 2005. **Plate 54E**

Vern. Name: *Gadartambaku* (Hindi).

Herb, 20–40 cm high; roots woody. Stems unbranched or branched above, glandular-pubescent. Leaves simple, whorled at base, alternate above, elliptic-sinuate or oblanceolate-sinuate or pinnatifid, 3.2–11 × 1–3 cm, attenuate or cuneate at base, double serrate or crenate-serrate at margins, acute or rounded at apex, pubescent; cauline leaves sessile, ovate, elliptic, or ovate-triangular, 0.6–2.6 × 0.3–1.5 cm, semi-amplexicaul at base, crenate at margins, acute at apex, pubescent; petioles 0.5–3.5 cm long; upper ones sessile. Inflorescence a raceme, terminal, to 15 cm long, simple or branched, lax; rachis glandular-pubescent. Flowers 1.2–1.5 cm across; bracts sessile, ovate, c. 6 × 2.5 mm, foliaceous, gradually becoming small upwards; pedicels 3–6 mm long. Calyx 5-lobed; lobes ovate, unequal, 3–4 × 2–2.5 mm, shortly united, herbaceous, hispid outside. Corolla rotate, c. 1.2 cm across, bright yellow, 5-lobed; lobes unequal, shortly united; outer larger, obtuse, c. 6 × 5 mm, glabrous. Stamens 4, didynamous, exserted; filament pairs 3–5 mm long, bearded, yellow; anthers reniform, c. 1 mm long, yellowish brown. Ovary globose, c. 2 mm, externally 2-lobed; style c. 5 mm long, green; stigma capitate or lamellate, green. Capsules subglobose, septicidal, 2-valved; seeds many. Seeds oblong, c. 0.4 mm long.

*Fl. & Fr.*: August – May.

*Habitat*: Moist localities near river banks.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; not common. INDIA: Throughout. WORLD: Afghanistan, Cambodia, China, Laos, Pakistan, Sri Lanka and Thailand.

*Specimen examined*: Near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 16th August 2011, *Shyam Biswa* 49810.

# 88. LINDERNIACEAE Borsch & al.

Tropical and subtropical regions, especially America, 21 genera and c.300 species; 6 genera and c. 50 species in India.

## Key to genera

- |                                                                                              |                   |
|----------------------------------------------------------------------------------------------|-------------------|
| 1a. Leaves sessile, sharply dentate with aristate tips                                       | <b>1. Bonneya</b> |
| 1b. Leaves petiolate, serrate or entire at margins                                           | 2                 |
| 2a. Herb more than 10 cm high; leaves serrate at margins; stamens 4, didynamous, all fertile | <b>3. Torenia</b> |

- 2b. Herb less than 10 cm high; leaves entire at margins; stamens 4, fertile 2, staminodes 2

## 2. *Lindernia*

### 1. *BONNAYA* Link & Otto

East Tropical Africa, Madagascar, Tropical & Subtropical Asia to North Australia, 17 species, c. 10 in India and 3 in Jharkhand

***Bonnaya ciliata*** (Colsm.) Spreng., Syst. Veg., ed. 16, 1: 41. 1824. *Bonnaya brachiata* Link & Otto, Icon. Pl. Select. 2: 25, t. 11. 1820; Hook.f., Fl. Brit. India 4: 284. 1884. *Gratiola ciliata* Colsm., Prodr. Descr. Gratiol. 14: 1793. 1820. *Vandellia brachiata* (Link & Otto) Haines, Bot. Bihar Orissa: 632. 1922. *Lindernia ciliata* (Colsm.) Pennell, Brittonia 2: 182. 1936; Mooney, Suppl. Bot. Bihar Orissa: 99. 1950; N.P. Singh & al., Fl. Bihar: 356. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 445. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 735. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 157. 2014. **Plate 54F**

Herb, 2–14 cm high. Stems unbranched or with few branches, glabrous except short-hairy angles near nodes. Leaves simple, opposite, sessile, ovate to elliptic or oblong, 0.5–3 × 0.3–1 cm, rounded to cuneate at base, sharply dentate with aristate-tipped teeth at margins, obtuse or acute at apex, glabrous above, finely hirsute beneath, pinnately veined. Racemes terminal, lax, each subtended by a linear, ciliate bract of 4–6 mm long; pedicels slender, 3–15 mm long. Calyx 4–8 mm long, lobed to middle; lobes linear, scarious-margined, ciliate towards apex. Corolla 5–8 mm long, white or pink; upper lip slightly emarginated; lower lip with 3 rounded lobes. Stamens 2, fertile; staminodes 2, short. Ovary c. 1 mm long, narrow, 2-loculed; style c. 6 mm long, slender; stigma 2-lamellate. Capsules linear-cylindrical, 0.7–1.5 cm long. Seeds ellipsoid, c. 0.5 mm across, truncate at ends, yellow.

*Fl. & Fr.*: September – November.

*Habitat*: Shade localities near river in dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; near Dhanarjay Nadi; common. INDIA: Throughout. WORLD: China, Indonesia (Java), Philippines and Sri Lanka.

*Specimens examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49526; near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 27th November 2012, *Shyam Biswa* 54094.

### 2. *LINDERNIA* All.

Subtropical regions, especially Old World, c. 160 species, 15 in India, 13 in Jharkhand and 3 in KWLS.

***Lindernia parviflora*** (Roxb.) Haines, Bot. Bihar Orissa: 635. 1922; N.P. Singh & al., Fl. Bihar: 358. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 448. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 738. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 159. 2014. *Gratiola parviflora* Roxb., Pl. Coromandel 3: 3, t. 203. 1811. *Ilysanthes parviflora* (Roxb.) Benth. in DC., Prodr. 10: 419. 1846; Hook.f., Fl. Brit. India 4: 283. 1884.

Herb, 5–10 cm high, creeping or ascending. Stems branched. Leaves opposite, sessile, oblong or lanceolate, 2–5 × 1–2 mm, acute to rounded at base, entire at margins, acute to obtuse at apex, glabrous. Flower solitary; peduncle 0.7–1.5 cm long; bracts 2. Sepals 5, lanceolate, c. 3 mm long,

pubescent, pinkish. Corolla tubular, c. 5 mm long, white-purplish; upper lip bifid, lower tripartite. Stamens 4; fertile 2, 3–4 mm long; staminodes 2, reduced to front and slightly raised above the rim, yellow or blue-violet. Pistil c. 5 mm long. Capsules oblong, 3–4 × 1.5–2 mm, glabrous, scrobiculate, yellowish, many seeded. Seeds oblong or subglobose, c. 0.4 mm, straw-coloured.

*Fl. & Fr.*: August – March.

*Habitat*: Moist localities near river.

*Distribution*: KWLS: Near the river Dhanarjay Nadi, Meghatari; not common. INDIA: Punjab to Assam, West Bengal, and Deccan peninsula. WORLD: Tropical and subtropical Africa and Asia.

*Specimen examined*: Near the river Dhanarjay Nadi, Meghatari, 183 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49694.

### 3. TORENIA L.

Tropical & Subtropical regions, 69 species, c. 10 in India 1 in Jharkhand.

**Torenia crustacea** (L.) Cham. & Schltdl., *Linnaea* 2(4): 570. 1827. *Lindernia crustacea* (L.) F. Muell., *Syst. Census Austral. Pl.*: 97. 1882; N.P. Singh & al., *Fl. Bihar*: 357. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 446. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 736. 2005; Ranjan, *Fl. Parasnath Wildlife Sanct.*: 157. 2014. *Capraria crustacea* L., *Mant. Pl.*: 87. 1767. *Vandellia crustacea* (L.) Benth., *Scroph. Ind.*: 35. 1835; Hook.f., *Fl. Brit. India* 4: 279. 1884; Haines, *Bot. Bihar Orissa*: 631. 1922.

Annual, 15–20 cm high. Stems diffusely branched, erect or prostrate, sparingly pubescent on angles and nodes or entirely glabrous. Leaves simple, opposite, broadly ovate or ovate, 1–2.5 × 0.5–1.5 cm, rounded at base, serrate at margins, acute at apex, glabrous; petioles 2–10 mm long, glabrous. Flower solitary, axillary, 8–10 mm long; pedicels 0.5– 2.5 cm long, glabrous. Calyx tubular, 5–6 mm long, shortly 5-lobed; lobes finely pubescent on veins or subglabrous. Corolla 7–8 mm long, glabrous, blue, purple or lilac; posterior lip ovate, subtruncate to emarginate; lower with 3 subtruncate lobes. Stamens 4, didynamous, all fertile; filaments glabrous. Capsules oblong-ovoid to subglobose, c. 5 mm, obtuse, glabrous, pale brown. Seeds c. 0.5 mm, scrobiculate, pale orange.

*Fl. & Fr.*: September – December.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Inside the enclosure forest, Koderma NRF; common. INDIA: Almost throughout. WORLD: Tropical and subtropical regions.

*Specimen examined*: Inside the enclosure forest, Koderma NRF, 390 m, 24°29'18.7" N, 85°35'50.1" E, 16th September 2010, *Shyam Biswa* 49632.

### 89. MARTYNIACEAE Horan., nom. cons.

Tropical regions and subtropical America, 5 genera and 16 species; 1 genus and 1 species in India.

#### MARTYNIA L.

Mexico, monotypic.



**Martynia annua** L., Sp. Pl. 2: 618. 1753; N.P. Singh & al., Fl. Bihar: 376. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 462. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 783. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 163. 2014. *Martynia diandra* Gloxin, Observ. Bot.: 14, t. 1. 1785; C.B. Clarke in Hook.f., Fl. Brit. India 4: 386. 1884; Haines, Forest Fl. Chota Nagpur: 445. 1910 & Bot. Bihar Orissa: 662. 1922. **Plate 55A & B**

Vern. Name: *Bagh Nokh* (Hindi).

Herb or undershrub, 0.5–2 m high, well-branched, glandular-pubescent. Stems subterete, fistular. Leaves simple, opposite, broadly ovate, 5.5–18.5 × 5–18 cm, cordate at base, sinuate-dentate at margins, acute to obtuse at apex, pale green, sticky; petioles 2.5–12 cm long, fistular. Inflorescence a raceme, terminal, 4–15 cm long, 8–20-flowered. Flowers 3–4.5 cm long; bracts ovate, 1.5–3 cm long, clawed, prominently veined, pale pink; pedicels to 2.5 cm long; bracteoles 1.5–2.5 cm long, apiculate, pale green. Calyx 1–1.5 cm long, yellowish white or light greenish white. Corolla 3.5–4 cm long, pale pink with stalked glands and yellow or purple dots on anterior side inside; lobes pink with dark purple or pinkish blotch. Stamens 2, perfect; anthers cohering with widely divergent cells; filaments 1.5–1.7 cm long, white; staminodes 3; lateral staminodes 4–6 mm long; posterior one 1–2 mm long. Ovary globose, c. 2 mm, 1-loculed, falsely 4-loculed; ovules 1 per locule on 2 intruding T-shaped parietal placentae; style c. 2 cm long. Disk larger than ovary. Drupes ovoid, 2–3 cm long with hook-like apical beak. Seeds with thick and rugose testa.

*Fl. & Fr.*: September – October.

*Habitat*: Dry deciduous and scrub forests.

*Distribution*: Jharkhand, Koderma, Koderma Wildlife Sanctuary: Lokai forest; common. INDIA: Throughout. WORLD: Australia, Central America, Malaysia, Mexico, Myanmar and Pakistan.

*Specimen examined*: Lokai forest, 398 m, 24°29'.158" N, 85°37'.038" E, 29th September 2013, *Shyam Biswa* 54192.

## 90. PEDALIACEAE R. Br., nom. cons.

Old World tropical and subtropical regions, 13 genera and c. 72 species; 2 genera and 4 species in India.

### SESAMUM L.

Old World tropical regions, c. 19 species, 4 in India and 1 in Jharkhand.

**Sesamum indicum** L., Sp. Pl. 2: 634. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 387. 1884; Haines, Forest Fl. Chota Nagpur: 445. 1910 & Bot. Bihar Orissa: 661. 1922; N.P. Singh & al., Fl. Bihar: 376. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 461. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 784. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 163. 2014. **Plate 55C**

Vern. Name: *Til* (Hindi).

Herb, 30–100 cm high, glandular-pubescent. Stems terete towards base, obtusely quadrangular with furrowed sides above. Leaves simple, opposite below, alternate above, ovate-elliptic, or elliptic to lanceolate, 2.2–7 × 1–4.5 cm, equal or unequal to cuneate or attenuate at base, lobed or serrate at margins, acute at apex; petioles 0.7–4 cm long. Flowers solitary or few in fascicles,

axillary; pedicels 1–4 mm long with 2 globose, yellowish glands on either side at base. Calyx deeply 5-lobed; lobes lanceolate to linear,  $3-5 \times c. 1$  mm, glandular-pubescent, persistent. Corolla bilabiate, tubular-ventricose,  $1-2.5 \times 0.6-1$  cm, narrowing abruptly at base, glandular-pubescent outside, white or violet, purple-spotted inside and with dark violet blotch on the lower lobe. Stamens 4, didynamous; filament pairs to 0.7 and 1 cm long; anthers  $c. 3$  mm long; connectives ending in white glands. Disk annular, yellow. Ovary bilateral, 1–3 mm long; style 5–7 mm long; stigmas  $1.5-2 \times c. 0.5$  mm. Capsules oblong, 1.5–2.5 cm long, 4-angled, deeply 4-grooved. Seeds many, pyriform or obovate,  $2.5-3 \times 1.5-2$  mm, finely reticulate or almost smooth, pale yellow, brown or black.

*Fl. & Fr.*: June – August.

*Habitat*: Open wastelands, as an escape.

*Distribution*: KWLS: Khararia jungle, near village; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Khararia jungle, near village, 178 m,  $24^{\circ}35'15.2''$  N,  $85^{\circ}34'36.2''$  E, 16th August 2011, *Shyam Biswa* 49813.

### 91. ACANTHACEAE Juss., nom. cons.

Largely tropical, including open country and deserts, extending to Mediterranean, US, Australia, 212 genera 3175 species; 49 genera and 472 species in India.

#### Key to genera

- |                                                                                                               |                          |
|---------------------------------------------------------------------------------------------------------------|--------------------------|
| 1a. Calyx 4-lobed; plants often spiny (except <i>Nelsonia</i> )                                               | 2                        |
| 1b. Calyx 5-lobed; plants rarely spiny (except <i>Lepidagathis</i> )                                          | 4                        |
| 2a. Calyx with 2 large and 2 small lobes                                                                      | 2. <b>Barleria</b>       |
| 2b. Calyx with 3 similar lobes and 1 larger                                                                   | 3                        |
| 3a. Plant with axillary spines (except <i>H. polysperma</i> ) corolla 2-lipped stamen                         | 5. <b>Hygrophila</b>     |
| 3b. Plant unarmed                                                                                             | 8. <b>Nelsonia</b>       |
| 4a. Inflorescence a spike                                                                                     | 5                        |
| 4b. Inflorescence not a spike                                                                                 | 9                        |
| 5a. Spikes condensed head like                                                                                | 6                        |
| 5b. Spike elongate                                                                                            | 7                        |
| 6a. Spike crowded at base of stem                                                                             | 7. <b>Lepidagathis</b>   |
| 6b. Spike in leaf axils                                                                                       | 12. <b>Strobilanthes</b> |
| 7a Bracts 4-farious, broadly scarious                                                                         | 11. <b>Rungia</b>        |
| 7b. Bracts not 4-farious, not or narrowly scarious                                                            | 8                        |
| 8a. Shrub, flowers white; anther-cells not spurred at the base, but apiculate calyx lobes                     | 6. <b>Justicia</b>       |
| 8b. Herb, flowers pink; anther-cells at least the lower with a white basal spur-like appendage, calyx lobes 4 | 9. <b>Rostellularia</b>  |
| 9a. Corolla two lipped 8                                                                                      | 10                       |
| 9b. Corolla 5 subequal lobed 10                                                                               | 11                       |
| 10a. Corolla white                                                                                            | 1. <b>Andrographis</b>   |
| 10b. Corolla pink                                                                                             | 3. <b>Dicliptera</b>     |

- 11a. Herb or undershrub more than 30 cm high; roots not tuberous  
11b. Herb to less than 30 cm high; roots tuberous

4. **Eranthemum**  
10. **Ruellia**

1. **ANDROGRAPHIS** Wall. ex Nees

Tropical Asia, 32 species, 26 in India, 3 in Jharkhand and 2 in KWLS.

**Key to species**

- 1a. Leaves lanceolate or oblong-lanceolate, 2–6 × 0.5–2.3 cm; inflorescences usually shorter than the leaves, *c.* 3 cm long **1. A. echioides**  
1b. Leaves linear-oblong or elliptic-oblong, 1–4 × 0.4–1.1 cm; inflorescences longer than the leaves, racemes usually exceeding leaves, *c.* 5 cm long **2. A. longipedunculata**

**Andrographis echioides** (L.) Nees in Wall., Pl. Asiat. Rar. 3: 117. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 505. 1884; Haines, Forest Fl. Chota Nagpur: 458. 1910 & Bot. Bihar Orissa: 700. 1922; Mooney, Suppl. Bot. Bihar Orissa: 119. 1950; L.H. Cramer, Kew Bull. 51: 555. 1996; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 465. 2002. *Justicia echioides* L., Sp. Pl. 1: 16. 1753. *Neesiella echioides* (L.) Sreem. in Phytologia 15: 271. 1967. *Indoneesiella echioides* (L.) Sreemadh. In Phytologia 16: 466. 1968; N.P. Singh & al., Fl. Bihar: 387. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 764. 2005; Ranjan, Fl. Parasnatsh Wildlife Sanct.: 168. 2014. *Erianthera echioides* (L.) M. R. Almeida, Fl. Maharashtra 4A: 40. 2003.

**Plate 55D**

Herb 20–50 cm high. Stems 4-angular with whitish pubescent. Leaves simple, opposite, sessile, lanceolate or oblong-lanceolate, 2–6 × 0.5–2.3 cm, acute to rounded at base, entire at margins, acute to obtuse at apex, sparsely pubescent or hairy both surfaces. Flowers sessile erect on divaricate simple or branched racemes from all the axils, the whole forming sometimes a large pyramidal but leafy panicle, but in early stages only lower leaves bearing racemes. Flowers 1.5–2 cm long; bracts minute. Calyx 5-lobed cut till base linear 5–10 × 0.5–1 mm, glandular hairy. Corolla bi-lobed; tube *c.* 1 cm long, white; upper 3-lobed, white, with dark pink or maroon ting on the upper half of the inner surface, hairy on outer surface; lower 2-lobed, curled back, white. Stamens 2; filaments thinly hairy, anthers dark-purple, densely white-bearded. Style slender ciliate at the apex, white; stigma capitate, dark pinkish or maroon. Capsules ellipsoid-oblong, compressed, 0.5–1 cm long, slightly hairy. Seeds somewhat oblong, rugose.

*Fl. & Fr.*: August – January.

*Habitat*: Dry deciduous hill forests.

*Distribution*: KWLS: Dhawjadhari Pahar; common. INDIA: Throughout tropical India.

*Specimen examined*: Dhawjadhari Pahar, 419 m, 24°28'46.1" N, 85°35'43.4" E, 14th August 2011, Shyam Biswa 49797.

**2. Andrographis longipedunculata** (Sreem.) L.H. Cramer, Kew Bull. 51: 554. 1996 Phytologia 15: 271. 1967. *Neesiella longipedunculata* Sreem, Phytologia 15: 271. 1967. *Indoneesiella longipedunculata* (Sreem.) Sreem. Phytologia 16: 466. 1968. *Erianthera longipedunculata* (Sreem.) M.R. Almeida, Fl. Maharashtra 4A: 41. 2003. **Plate 56 C, D & E**

Herb 15–30 cm high. Stems and branchlets 4-angular hispid. Leaves simple, opposite, subsessile, linear-oblong or elliptic-oblong, 1–4 × 0.4–1.1 cm, obtuse or shortly auriculate at base entire at

margins subacute to acute at apex, broadest in the middle, pubescent at both surfaces. Inflorescences axillary panicle racemes, unilateral; racemes usually exceeding leaves, *c.* 5 cm long; bracts elliptic-lanceolate; bracteoles linear 1–2 mm long, glandular hairy;. Flowers *c.* 1 cm apart. Calyx-lobes 5, linear or linear-lanceolate 5–10 × 0.5–1 mm, acute, glandular hairy. Corolla white with a pink tinge, tube, *c.* 8 mm, slightly ventricose above, 2-lipped; lobes 5, unequal, 2+3, imbricate; upper lip erect *c.* 5 mm, shortly 2-fid; lower lip deflexed, 3-lobed, obtuse, *c.* 3 mm. Stamens 2; filaments *c.* 7 mm; anthers *c.* 2 mm. Ovary obovoid, *c.* 2 mm, pubescent; ovules 4; styles *c.* 1.5 cm long, hairy, stigmas unequally 2-fid or linear, curved. Capsules ovoid, pointed above and narrow below, 8–10 × 3–4 mm, glandular ciliate, yellowish brown. Seeds 4, oval, 2.5–3.5 mm, brownish, granulated.

*Fl. & Fr.*: September – November.

*Habitat*: On the rocky hills of dry deciduous forests and in the open scrub forests.

*Distribution*: Near base of Dhawjadhari Pahar Koderma NRF; occasional. Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Gujarat and Rajasthan.

*Specimen examined*: Near base of Dhawjadhari Pahar Koderma NRF, 384 m, 24°29'16.2" N, 85°35'44.9" E, 19th November 2012 *Shyam Biswa* 53905.

*Note*: Endemic to Peninsular India (Karthikeyan et al., 2009).

## 2. **BARLERIA** L.

Tropical regions, *c.* 300 species, 26 in India, 5 in Jharkhand (1 cultivated) and 1 in KWLS.

**Barleria cristata** L., Sp. Pl. 2: 636. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 488. 1884; Haines, Forest Fl. Chota Nagpur: 453. 1910 & Bot. Bihar Orissa: 683. 1922; N.P. Singh & al., Fl. Bihar: 378. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 467. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 752. 2005; Shendage & S.R. Yadav, Rheedia 20: 85, fig. 2, 20f – g. 2010; Ranjan, Fl. Parasnath Wildlife Sanct.: 165. 2014. **Plate 55E**

Herb or undershrub, *c.* 1 m high, roots woody. Stems terete, hairy, densely hairy at nodes. Leaves simple, opposite, ovate-oblong ovate-lanceolate or oblong-lanceolate, 2.5–9 × 0.7–3.2 cm, cuneate to attenuate at base, entire at margins, acute at apex, pubescent on both surface more on veins beneath; lateral veins 4–7 pairs; petioles 1–5 mm long, hairy. Flowers subsessile, 1–3 together in leaf-axils or forming dense capitate spike on branchlets; bracteoles linear 1–3 × 0.1–0.3 cm, with spinule-tipped apices. Calyx 2 large and 2 small lobes; outer calyx-lobes ovate-oblong, 1–2 × 0.2–1 cm, toothed, softly hairy, subspinescent, 8–10 veins radiating from base; inner ones linear-lanceolate, 0.8–1.5 cm long, ciliate at margins, acuminate at apex. Corolla 5-lobed; tube 3 cm long, narrowly cylindrical in the lower half and then gradually widened whitish-pink; lobes imbricate 4-lobes *c.* 1 cm broad and a large lobe *c.* 1.5 cm broad light pinkish or purplish-pink. Stamens 2, *c.* 2.5 cm, hairy; anthers 3 mm, dark-purplish; filaments 2–2.6 cm long, pubescent; staminodes 5 mm, with sterile anther cell, central one linear. Ovary oblong-ellipsoid, 4 mm, 4-ovuled; style 3 cm long; stigma minutely 2-lamellate. Capsules ellipsoid, 1.5–2 cm long, glabrous, without a solid beak. Seeds 4, suborbicular, compressed, 4–5 mm across, silky hairy, brown.

*Fl.*: September – November, *Fr.*: October to January.

*Habitat*: Under the shades, Dry deciduous forests.

*Distribution:* KWLS: Phulwarwaria jungle, Koderma NRF; Near the Enclosure fencing, Koderma NRF; common. INDIA: Throughout. WORLD: Bangladesh, China, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka and Vietnam.

*Specimen examined:* Phulwarwaria jungle, Koderma NRF, 394 m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49555; Near the Enclosure fencing, Koderma NRF, 399 m, N 24°29'01.2", E 85°36'06.8" 14th September 2010, *Shyam Biswa* 49622.

### 3. **DICLIPTERA** Juss., nom. cons.

Tropical and sub-tropical regions, *c.* 150 species, 24 in India, 3 in Jharkhand and 1 in KWLS.

**Dicliptera paniculata** (Forssk.) I.Darbysh. apud I. Darbysh. & Vollesen, Kew Bull. 62: 122. 2007. *Dianthera paniculata* Forssk., Fl. Aegypt.-Arab.: 7. 1775. *Dianthera bicalyculata* Retz., Kongl. Vetensk. Acad. Handl. 1775: 297. 1776. *Peristrophe bicalyculata* (Retz.) Nees in Wall., Pl. Asiat. Rar.3: 113. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 554. 1885; Haines, Forest Fl. Chota Nagpur: 457. 1910 & Bot. Bihar Orissa: 696. 1922; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 478. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 777. 2005. *Peristrophe paniculata* (Forssk.) Brummitt, Kew Bull. 38: 451. 1983; N.P. Singh & al., Fl. Bihar: 392. 2001.

**Plate 55F**

Vern. Name: *Atrilal* (Hindi).

Herb 0.4–1 m high. Stems angular, with swollen nodes and long internodes, hairy. Leaves simple, opposite, ovate-lanceolate, 4–8 × 2–2.5 cm, rounded to subcuneate at base, subentire or crenulate at margins, acute or subacuminate at apex, pilose beneath or on both surfaces; upper one smaller, subtending inflorescences; petioles 0.6–1 mm long. Flowers in 1-few-flowered small cymules, combined to form a lax divaricate panicles; bracts 2, linear or linear-spathulate, 3–4 × 0.5–0.8 mm, subequal, glandular-pubescent; bracteoles linear-lanceolate in 2 rows, scarious-margined; pedicels 8–15 mm long, hairy. Epicalyx (1+4–5), one is slightly longer, lanceolate or ovate-lanceolate, 5–10 × 0.5–1 mm, acute to acuminate at apex, whitish margin, central portion dark greenish, sparsely hairy on outer surface. Calyx 5, linear, 3–4 × 0.2–0.4 mm, lobes shortly connate at base, ciliate, whitish-yellow. Corolla bi-lobed, whitish-pink or rosy-pink, *c.* 1 cm long, pubescent outside; tube cylindric, 3–5 mm long; lips, 4–7 × 2–2.5 mm, upper lip shortly 2-fid; lower lip deflexed. Stamens 2, attached at juncture of 2 lips; filament *c.* 4 mm long, sparsely hairy, anthers 2-celled, cells linear, *c.* 1 mm, one higher than the other, muticous. Ovary oblong-conic, 1–1.5 mm long; ovules 2 per locule; style filiform, 5–6 mm long; stigma shortly bifid or clavate-shaped. Capsules oblong, 1.5–2 cm, compressed, beaked, stipitate, hairy. Seeds orbicular, 2.5–3 mm.

*Fl. & Fr.:* August – March.

*Habitat:* Weeds on hedges and scrub forests.

*Distribution:* KWLS: Khararia jungle, Meghatari, near Chirkundi Village; common. INDIA: Subtropical and tropical India. WORLD: Malesia, Nepal, Pakistan, Tropical Africa and Vietnam.

*Specimen examined:* Khararia jungle, Meghatari, near Chirkundi Village 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49715.

*Note:* Observed, epicalyx (1+4–5), one is slightly longer, lanceolate or ovate-lanceolate, 5–10 × 0.5–1 mm, acute to acuminate at apex, whitish margin, central portion dark greenish, sparsely hairy on outer surface





**Fig. 49. *Eranthemum pulchellum* Andrews: a. flowering shoot.**

#### 4. ERANTHEMUM L.

Tropical Asia, c. 30 species, 17 in India, 4 in Jharkhand and 1 in KWLS.

**Eranthemum pulchellum** Andrews, Bot. Repos.: 2, t. 88. 1800; Ranjan, Fl. Parasnath Wildlife Sanct.:167, fig. 22. 2014. *Justicia nervosa* Vahl, Enum. Pl. 1: 164. 1804. *Eranthemum nervosum* (Vahl) R. Br., Prodr.: 477. 1810; Mooney, Suppl. Bot. Bihar Orissa: 115. 1950; N.P. Singh & al., Fl. Bihar: 384. 2001. *Daedalacanthus nervosus* (Vahl) T. Anderson, J. Linn. Soc., Bot. 9: 487. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 4: 418. 1884; Haines, Forest Fl. Chota Nagpur: 448. 1910 & Bot. Bihar Orissa: 679. 1922.

**Fig. 49; Plate 55G**

Herb or undershrub, 30–90 cm high. Stems terete, short hairy. Leaves simple, opposite, ovate or ovate-oblong or ovate-elliptic, 3–17 × 1.5–8.6 cm attenuate or cordate at base, entire or crenulated at margins, acuminate at apex, puberulous on both surfaces, lateral veins 3–7 pairs; petioles 0.2–4.5 cm long. Flowers in terminal, closed, panicle composed of short, uninterrupted, spikes, 3–7.5 cm long; bract foliaceous, ovate or elliptic, 1.5–3 × 0.5–1.2 cm, ciliate at margins, acuminate at apex, glabrous, lineolate white with dark green veins; bracteoles lanceolate, 5–6 mm long, ciliate. Calyx 5-lobed, lobes lanceolate, 8–9 × 1.5–2 mm, densely pubescent whitish. Corolla 5-lobed, tube 2.5–3 cm long; lobes obovate, 1–2 × 0.3–0.5 cm, twisted to left in bud, spreading in flower. Stamens 2, perfect, anthers oblong, c. 3 × 1.5; staminodes 2. Ovules oblong, 2 per locule; styles filiform, 4–4.5 cm long, slender, sparsely hairy; stigma clavate shaped, c. 2 mm, hairy. Capsules, oblong, 1–1.5 cm long, glabrous. Seeds 4, discoid, 3–4 × 2–2.5 mm, hairy.

*Fl. & Fr.*: January – May.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Taraghati forest, way to Muglamaram forest road: common. INDIA: Throughout. WORLD: A native of Indo-Pakistan subcontinent; introduced in gardens elsewhere.

*Specimens examined*: Taraghati forest, way to Muglamaram forest road, 321 m, 24°32'13.5" N, 85°35'12.3" E, 23rd February 2012, *Shyam Biswa* 49852; Taraghati forest, 335 m, 24°32'02.2" N, 85°34'47.0" E, 21st November 2012, *Shyam Biswa* 54074.

#### 5. HYGROPHILA R. Br.

Wet tropical regions, c. 25 species, 18 in India, 5 in Jharkhand and 2 in KWLS.

##### Key to species

- 1a. Plant with axillary spines; flowers in dense clusters at leaf axils, usually 8 in each whorl; fertile stamens 4 **1. H. auriculata**
- 1b. Plant unarmed; flowers in terminal, bracteate spikes; fertile stamens 2 **2.H. polysperma**

**1. Hygrophila polysperma** (Roxb.) T. Anderson, J. Linn. Soc., Bot. 9: 456. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 4: 406. 1884; Haines, Bot. Bihar Orissa 670. 1922; Mooney, Suppl. Bot. Bihar Orissa: 108. 1950; N.P. Singh & al., Fl. Bihar: 387. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 762. 2005. *Justicia polysperma* Roxb., Fl. Ind. (Ed. Carey) 1: 119. 1832. *Hemiadelphus polyspermus* (Roxb.) Nees in Wall., Pl. Asiat. Rar. 3: 80. 1832. **Plate 55H**

Herb 10–20 cm high. Stems terete, ascending, pubescent. Leaves simple, opposite, sessile, lanceolate  $0.5\text{--}2 \times 0.2\text{--}0.7$  cm, acute to attenuate at base, entire at margins, acute to obtuse at apex, slightly hairy. Flowers in terminal, bracteate spikes; bracts narrowly elliptic,  $3\text{--}5 \times 1\text{--}2$  mm. Calyx 4-lobed, lobes linear,  $4\text{--}5 \times c. 1$  mm. Corolla tubular, 5–7 mm long, 2-lipped, upper lip shallowly notched, lower lip 3-lobed, glabrous. Stamens 2, anthers 2-celled. Style 2–3 mm long; stigma capitate. Capsules narrowly-oblong  $c. 8 \times 1.5\text{--}2$  mm, glabrous except near apex, many-seeded. Seeds orbicular  $0.5\text{--}0.7 \times c. 0.5$  mm, brownish, distinctly hooked retinacula.

*Fl. & Fr.*: October – February.

*Habitat*: In the pond or stagnant water.

*Distribution*: KWLS: Bon Kali, Pipra Tan; common. INDIA: Throughout.

*Specimen examined*: Bon Kali, Pipra Tan, 366 m,  $24^{\circ}28'36.5''$  N,  $85^{\circ}32'20.5''$  E, 25th February 2012, Shyam Biswa 49879.

**2. *Hygrophila auriculata*** (Schumach.) Heine, Kew Bull. 16: 172. 1962; N.P. Singh & al., Fl. Bihar: 385. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 760. 2005. *Barleria longifolia* L., Cent. Pl. 2: 22. 1756. *Bahel suchulli* Buch.-Ham., Trans. Linn. Soc. London 14: 289. 1824. *Barleria auriculata* Schumach., Beskr. Guin. Pl.: 285. 1827. *Astercautha longifolia* (L.) Nees in Wall., Pl. Asiat. Rar. 3: 90. 1832; Haines, Bot. Bihar Orissa: 671. 1922. *Hygrophila spinosa* T. Anderson in Thwaites, Enum. Pl. Zeyl.: 225. 1860; C.B. Clarke in Hook.f., Fl. Brit. India 4: 408. 1884; Haines, Forest Fl. Chota Nagpur: 452. 1910. *Hygrophila longifolia* (L.) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39: 78. 1870, non Nees, 1847. *Hygrophila schulli* (Buch.-Ham.) M.R. Almeida & S.M. Almeida, J. Bombay Nat. Hist. Soc. 83 (Suppl.): 221. 1987; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 473. 2002. **Plate 56B**

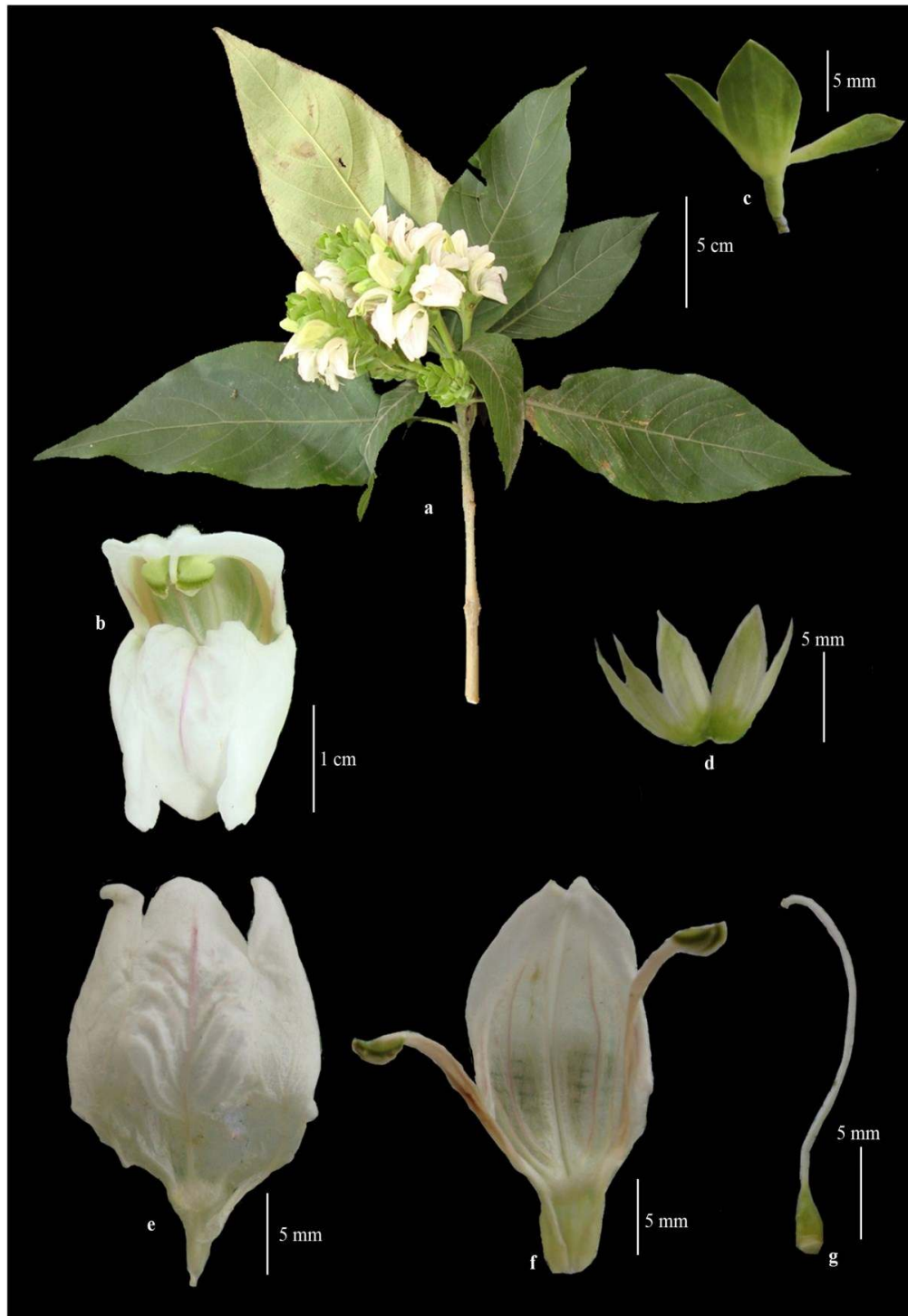
Herb 60–90 cm high; with axillary spines, 1–2.5 cm long, straight, reddish brown or yellowish. Stems subquadrangular, simple or branched, thickened at nodes, hairy. Leaves simple, opposite or in whorls of 6, sessile, oblong-lanceolate,  $2\text{--}3.5 \times 0.5\text{--}1$  cm, narrowed at base, entire at margins, subacute or obtuse at apex, sparsely hispid-hairy. Flowers in dense clusters at leaf axils, usually 8 in each whorl, showy; bracts 2-seriate, linear-lanceolate,  $1\text{--}1.8 \times 0.3\text{--}0.5$  cm, ciliate; bracteoles linear-lanceolate narrow, small. Calyx 4-partite; unequal, linear-lanceolate,  $8\text{--}12 \times 1.5\text{--}2.5$  mm, hispid, outer longest. Corolla bi-lobed, blue; tube 8–10 mm long; upper lip 2-lobed  $c. 1.5 \times 10$ , lower lip deeply 3-lobed,  $1.3\text{--}1.5 \times 8\text{--}10$ , palate yellowish-white with 2 orange ridges. Stamens 4 (2+2), united in pairs, didynamous, 0.5–1 cm long; anther-lobes  $c. 2 \times 1$  mm. Ovary oblong,  $2\text{--}3 \times c. 1.5$  mm, apically ciliate; ovules 4 per locule; style 1.5–1.8 cm long, pubescent; stigma simple linear. Capsules linear-oblong  $8\text{--}10 \times c. 3$  mm; seeds 4–8, orbicular, 2–4 mm across; retinacula long, curved.

*Fl. & Fr.*: October – March.

*Habitat*: On the moist or water logged areas.

*Distribution*: KWLS: Dhodhakola near Birhore Tola, Safinalwa; common. INDIA: Throughout. WORLD: Sri Lanka.

*Specimen examined*: Dhodhakola near Birhore Tola, Safinalwa, 380 m,  $24^{\circ}33'15.1''$  N,  $85^{\circ}39'37.9''$  E, 27th February 2012, Shyam Biswa 54005.



**Fig. 50. *Justicia adhatoda* L.:** a. flowering twig; b. flower; c. bracteole; d. calyx; e. lower petal; f. upper petal and stamens; g. carpel.

## 6. JUSTICIA L.

Tropical and sub-tropical regions, temperate North America, c. 600 species, c. 50 in India, c. 10 in Jharkhand and 2 in KWLS.

**1. *Justicia adhatoda*** L., Sp. Pl. 1: 15. 1753; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 473: 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 767. 2005. *Adhatoda zeylanica* Medik. in Hist. Commentat. Acad. Theod.-Palat. 6: 393. 1790; N.P. Singh & al., Fl. Bihar: 377. 2001. *Adhatoda vasica* Nees in Wall., Pl. Asiat. Rar.3: 103. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 540. 1885; Haines, Forest Fl. Chota Nagpur: 455 1910 & Bot. Bihar Orissa: 694. 1922.

**Fig. 50; Plate 56F**

Vern. Name: *Arusha* (Hindi).

Shrub 1–2 m high; Stems thickened, subquadrangular to subterete; young stem pubescent. Leaves simple, opposite, elliptic-lanceolate or lanceolate 4.5–20 × 1.6–8 cm, acute at base, entire at margins, acuminate at apex, copiously pellucid above, pubescent on veins beneath; lateral veins 7–12 pairs; petioles 0.8–3 cm long. Spikes terminal and axillary, simple 2.5–8 cm long; peduncles 4–6 cm long; bracts ovate-oblong, c. 2.5 × 1.3 cm, 3-veined from base, pubescent; bracteoles linear-lanceolate, 1–1.2 × c.0.4 cm, ciliolate. Flowers large, subsessile, white. Calyx 5 lobes oblong-lanceolate to linear-lanceolate, 5–8 × 2–3 mm, whitish-green. Corolla two lipped, tube 0.5–1 cm long, white; upper lip erect, ovate-oblong, 1.6–2 × 1–1.5 cm, emarginated, white with pink veins; upper lip subentire lower

lip 3 lobed, 2–3 × 1.5–1.8 cm, white with pinkish streaks. Stamens epipetalous 2, near the corolla tube ( upper lip), 1.4 – 2 cm long, exserted; filaments c. 1.5 cm, declinate, glabrous; filament 0.8–1.5 cm, pinkish; anthers 2-celled; cells acute, minutely apiculate, without any spur-like appendage, greenish. Disk annular. Ovary oblong, c. 0.4 cm long; style 1.5–2 cm long, white. stigma entire 2 –2.5cm long. Capsules obovoid, stipitate, 2.5–3.5 cm long, long solid base pubescent. Seeds 4, orbicular, glabrous, born on retinacula.

*Fl. & Fr.:* March & August – September.

*Habitat:* Cultivated or naturalized.

*Distribution:* KWLS: Baghitan forest ; common. INDIA: Throughout. WORLD: South East Asia and Sri Lanka.

*Specimen examined:* Baghitan forest, 402 m, 24°29'16.0" N, 85°35'54.0" E, 3rd March 2011, Shyam Biswa 49661.

## 7. LEPIDAGATHIS

Tropical and sub-tropical regions, c. 100 species, c. 25 in India, 6 in Jharkhand and 1 in KWLS.

***Lepidagathis hamiltoniana*** Wall. ex Nees in Wall., Pl. Asiat. Rar.3: 96. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 516. 1885; Haines, Forest Fl. Chota Nagpur: 455. 1910 & Bot. Bihar Orissa: 687. 1922; N.P. Singh & al., Fl. Bihar: 391. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 475. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 775. 2005.

**Plate 57A**



Herb, 25–60 cm high. Stem terete woody. Leaves sessile, simple, opposite; linear or linear-lanceolate  $2.5\text{--}9 \times 0.1\text{--}0.9$  cm, rounded or truncate at base entire at margins, acute to acuminate at apex, hairy at both surfaces. Inflorescences dense spikes or cymes condensed into globose heads, at the base of the stem or at the mid of the stem one upon the other; head 2–6 cm across, brownish with age; bracts and bracteoles spinescent. Calyx 5-lobed; lobes heteromorphic; posterior lobe usually largest; lateral 2 lobes smallest; anterior 2 lobes usually connate to a greater degree than other lobes. Corolla small; tube usually expanded into a distinct throat near middle; limb 2-lipped; lower lip 3-lobed, patent, usually spotted, lobes subequal or middle one slightly larger; upper lip erect or slightly patent, entire to 2-lobed; lobes quincuncial in bud. Stamens 4, didynamous inserted at the base or throat of corolla tube, included or exerted, all fertile, anthers oblong, minutely ciliate; filaments short. Ovary globose with 2 ovules per locule; stigma subcapitate, slightly 2-fid. Capsule subellipsoid to oblong to linear-conical, to 4-seeded; retinacula present. Seeds discoid, pubescent with hygroscopic trichomes.

*Fl. & Fr.*: December – February.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar, mid of the pahar; rare. INDIA: East, North & South India.

*Specimen examined*: Dhawjadhari Pahar, mid of the pahar, 411 m,  $24^{\circ}28'47.7''$  N,  $85^{\circ}35'49.6''$  E, 29th February 2012, *Shyam Biswa* 54020.

#### 8. NELSONIA R. Br.

Old World tropical regions, 1 species, 1 in India.

**Nelsonia canescens** (Lam.) Spreng., Syst. Veg. 1: 42. 1825; E. Hossain in Willdenowia 14: 402. 1984; N.P. Singh & al., Fl. Bihar: 391. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 477. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 776. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 171. 2014. *Justicia canescens* Lam., Tabl. Encycl. 1: 41. 1791. *Nelsonia campestris* R. Br., Prodr.: 481. 1810; C.B. Clarke in Hook.f., Fl. Brit. India 4: 394. 1884; Haines, Bot. Bihar Orissa: 667. 1922.

**Plate 57B**

Herb, radiating from central tap root. Stems terete, 12–16 cm long; flowering stems trailing, 30–65 cm long. Leaves simple, opposite, dimorphic; leaves on main stem oblong to oblong-lanceolate,  $9.5\text{--}20 \times 4.6\text{--}8.5$  cm, acute or rounded or attenuate at base, entire at margins, obtuse at apex, sparsely pilose and distinctly petioled, petioles 3–6.5 cm long; those on flowering twig,  $1\text{--}4 \times 0.8\text{--}2.5$  cm, sessile, densely pilose. Flowers in ovate or cylindric spikes, terminally on lateral branches, 1.5–5 cm long, glandular-villous; peduncles *c.* 7 cm long, hairy; bracts broadly ovate-lanceolate or ovate-elliptic,  $1\text{--}2.5 \times 0.6\text{--}1.5$  cm, rounded at base, obtuse at apex, silky pubescent, 5–7-veined. Calyx 4-partite, subequal; lobes lanceolate,  $3\text{--}5 \times 1$  mm, hairy, acute at apex, 4–5 parallel veined. Corolla bilabiate, white; tube *c.* 1.5 cm long, with a constriction, posterior longer 2-lobed, *c.* 2 mm long, anterior shorter 3-lobed, *c.* 2 mm long, glabrous. Stamens 2, inserted at point of constriction, included; anther cells subglobose, *c.* 0.5 mm across; filaments glabrous, *c.* 5 mm long. Ovary *c.* 1.5 mm long, glabrous; style *c.* 1 mm long; stigmas shortly 2-lobed, lobes unequal. Capsules ovoid-oblong, 4–6 cm long. Seeds many, small, yellow with brown granulations.

*Fl. & Fr.*: November – March.

*Habitat:* Wear the dried up drain / Nala of forests.

*Distribution:* KWLS: Khalaktambiforest ; Have not seen in many places. INDIA: Throughout including Andaman & Nicobar Islands. WORLD: Africa, Bhutan, Cambodia, China, Indonesia, Laos, Malaysia, Madagascar Myanmar, Nepal, Philippines, Thailand and Vietnam.

*Specimen examined:* Khalaktambi forest, 310m, 24°31'38.6" N, 85°33'54.9" E, 28th February 2012, *Shyam Biswa* 54016.

#### 9. **ROSTELLULARIA** Rchb.

North east tropical Africa, Madagascar, South Arabian Peninsula, Tropical & subtropical Asia to Australia, , c. 25 species, *c.*? in India, *c.* 1 in Jharkhand.

**Rostellularia diffusa** (Willd.) Nees in Wall., Pl. Asiat. Rar. 3:100.1832. *Justicia diffusa* Willd., Sp. Pl. 4: 87. 1805; C.B. Clarke in Hook .f., Fl. Brit. India 4: 538. 1885; Haines, Bot. Bihar Orissa 693. 1922; Fl. Bihar: 388. 2001.

**Plate 56G**

Herb 10–30 cm high, stem 4-angular, hairy. Leaves simple, opposite, lanceolate or ovate or oblong-lanceolate, 1–7.5 × 0.4–2.3 cm, attenuate to acute at base, entire at margins, acute at apex, pubescent at both surface; petioles 1–10 mm long. Inflorescence terminal or axillary, erect 1–3.5 cm long, narrow spike. Flowers small, 5–7 × 5 mm pinkish; bracts linear, *c.* 2 × 0.5 mm, hairy; bracteoles shorter than calyx lobes. Calyx 5-lobed, linear-lanceolate 3–4 × 0.5–1 mm, hairy. Corolla bi-lobed, 5–6 mm long, slightly hairy outside, tube 2–3 mm long, pinkish-white; upper lip *c.* 3 mm long, emarginate, lower lobe broad, *c.* 5 mm long, 3-lobed. Stamens 2, filaments *c.* 2 mm long; anthers *c.* 1 mm long, with a small tail or spur, brownish white. Ovary oblong, *c.* 1 mm long, brownish, glabrous, stylefiliform, *c.* 3 mm long, stigma capitate or clavate-shaped *c.* 0.5 mm. Capsules oblong, *c.* 4–5 mm long, glabrous. Seeds ovate, minutely papillate.

*Fl. & Fr.:* August – December.

*Habitat:* On the hill slopes of dry deciduous forests.

*Distribution:* KWLS: Dhawjadhari Pahar; common. INDIA: Throughout. WORLD: Myanmar, Nepal, Pakistan, Sri Lanka, Thailand.

*Specimens examined:* Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49590; Rajdha, Meghatari, near the river, 188 m, 24°34'47.8", 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49725.

#### 10. **RUELLIA** L.

Tropical region, temperate North America, *c.* 150 species, *c.* 10 in India, 2 in Jharkhand and 2 in KWLS.

#### Key to species

- 1a. Inflorescence few-flowered, contracted; flowers white; capsule clavate with long barren base; bracteoles large leafy **1. *R. sibua***
- 1b. Inflorescence laxly cymose, many-flowered; flowers blue; capsule linear-oblong, with very short barren base; bracteoles not leafy **2. *R. tuberosa***

**1. *Ruellia sibua* (Nees) I.M.Turner, Ann. Bot. Fenn. 58(4-6): 208. 2021.** *Ruellia suffruticosa* Roxb., Fl. Ind. (Ed. Carey) 3: 53.1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 413. 1884; Haines, Bot. Bihar Orissa 675. 1922; Haines, Forest Fl. Chota Nagpur: 451. 1910 & Bot. Bihar Orissa 674. 1922; Mooney, Suppl. Bot. Bihar Orissa: 109. 1950. *Dipteracanthus suffruticosus* (Roxb.) Voigt, Hort. suburb. Calcutt. (Ed. Griff.) 483.1845. **Plate 57C**

Herb, scarcely suffruticose, roots woody, terminally tuberous. Often forming a rosette on the ground with very short stem, hairy. Leaves simple, sub-opposite, lanceolate or oblong-lanceolate, 2.5–10.5 × 1–2.7 cm, cuneate to attenuate at base entire at margins, acute to obtuse at apex, hairy intermixed with long and very short hairs; petioles 0.2–1.2 cm long. Flowers pale-purple or usually white; pedicels 2–2.5 cm long, hairy; peduncles shorter or longer than the leaves, bracteoles leaf-like, elliptic or ovate *c.* 2.2 × 1 cm, ciliate at margins, acute at apex, hairy. Calyx 5-partite, linear, puberulous or nearly glabrous. Corolla 5-lobed, white; tube 3–4 cm long; lobes 2.5–3.5 cm long. Style *c.* 3 cm long, filiform. Capsules oblong, 3–4 cm long, glabrous. Seeds few.

*Fl.*: May – September, *Fr.*: August – October.

*Habitat*: Under the shade of dry deciduous forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; rare. INDIA: Andaman & Nicobar Islands, East India, Upper Gangetic Plains.

*Specimen examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49560.

**2. *Ruellia tuberosa* L., Sp. Pl. 2: 635. 1753; Haines, Bot. Bihar Orissa 675. 1922; Mooney, Suppl. Bot. Bihar Orissa: 109. 1950; N.P. Singh & al., Fl. Bihar: 394. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 778. 2005.** **Plate 57D**

Herb 10–15 cm high; roots slender, elongated, tuberous. Stem angular, sparsely hairy. Leaves simple, alternate, oblong 2.5–5.7 × 1.6–2.4 cm, cuneate to attenuate at base, entire at margins, obtuse to rounded at apex, hairy intermixed with short and long hairs; petioles 0.5–1 cm long, hairy. Flowers blue-violet, solitary or in 1-3-flowered, terminal or axillary cymes; pedicels 2–2.5 cm hairy; bracts and bracteoles linear-lanceolate, *c.* 5 mm long. Calyx 5-lobed lobes linear, 1–2 cm long, ciliate, acute. Corolla 5-lobed, bluish; tube *c.* 3 cm long, abruptly narrowed at base, lobes ovate, *c.* 1.5 cm long, patent pubescent outside,. Stamens *c.* 4 mm long, anthers puberulous. Ovary oblong, *c.* 4 mm long, glabrous; style 2.3–2.5 cm long. Capsule linear-obovate or oblong, 1.5–1.8 × *c.* 0.5 cm, glabrous or scabrescent, 24–28-seeded, minutely beaked at tip. Seeds flattened, orbicular, *c.* 2 mm across, hairy.

*Fl. & Fr.*: September – March.

*Habitat*: Under the shades, Dry deciduous forests.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar; common. A native of Tropical America; introduced and naturalized in Africa, Pakistan, India to Southeast Asia.

*Specimen examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49560.

## 11. *RUNGIA* Nees

Tropical regions, Old World, *c.* 50 species, 15 in India, 2 in Jharkhand and 1 in KWLS.

**Rungia pectinata** (L.) Nees in DC., Prodr. (Ed. A. DC.) 11: 470. 1847; N.P. Singh & al., Fl. Bihar: 394. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 479. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 779. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:172. 2014. *Justica pectinata* L., Cent. Pl. 2: 3. 1756 & Amoen. Acad. 4: 299. 1759. *Rungia parviflora* (Retz.) Nees var. *pectinata* (L.) C.B. Clarke in Hook.f., Fl. Brit India 4: 550. 1885; Haines, Forest Fl. Chota Nagpur: 456. 1910 & Bot. Bihar Orissa: 690. 1922.

#### Plate 57E

Herb, procumbent, much branched. Stems terete, hairy. Leaves simple, opposite, ovate or lanceolate or elliptic-lanceolate,  $0.7-5 \times 0.3-1.8$  cm, tapering at base, entire at margins, obtuse to rounded at apex, hairy on both surface; petioles 1–7 mm long. Inflorescence of short sessile, 1-sided axillary and terminal spikes, 0.5–3 cm long; bracts dimorphic; sterile ones in two rows, ovate-oblong, *c.*  $4 \times 3$  mm, cuspidate, scarious-margined, ciliate; fertile ones obovoid-orbicular,  $3-4 \times 3-3.5$  mm, scarious-margined, cuspidate, ciliate; bracteoles elliptic-oblong, 2.5–3 mm long, concave, scarious margined. Calyx 5-lobed, lobes linear,  $3-3.5 \times 0.5$  mm, acuminate translucent, ciliate. Corolla 2.5–3.5 mm long, pubescent outside, blue; upper lip broadly ovate, lower lip 3-lobed. Stamens 2; anthers 2-celled; cells usually superposed, the lower cell often with a white basal appendage. Ovary 0.5–1 mm, yellowish-white, ovules 2 in each ovary-locule; style filiform, 1.5–2 mm long, yellowish-white, glabrous; stigma clavate-shaped. Capsules ovoid-oblong, compressed,  $1.8-2.5 \times 1.2-1.5$  mm, glabrous. Seeds 2–4, orbicular, *c.*  $0.5 \times 0.5$  mm, brownish.

*Fl. & Fr.*: November – April.

*Habitat*: On grassland vegetation and ground vegetation on the shades of Dry deciduous forest.

*Distribution*: KWLS: Near the river Dhanarjaynadi, Meghatari Taraghati forest, way to Muglamaram forest road; common. INDIA: Throughout including Andaman & Nicobar Islands. WORLD: Bangladesh, Bhutan, China, Laos, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam.

*Specimens examined*: Near the river Dhanarjaynadi, Meghatari, 182 m,  $24^{\circ}34'44.3''$  N,  $85^{\circ}34'43.2''$  E, 7th March 2011, *Shyam Biswa* 49688; Taraghati forest, way to Muglamaram forest road, 321m,  $24^{\circ}32'13.5''$  N,  $85^{\circ}35'12.3''$  E, 23rd February 2012, *Shyam Biswa* 49859.

### 12. STROBILANTHES Blume

Tropical & Subtropical Asia to Pacific, 463 species, *c.* 150 in India, 4 in Jharkhand and 1 in KWLS.

**Strobilanthes pavala** J.R.I.Wood, Novon 23(3): 392. 2014. *Hemigraphis latebrosa* (B. Heyne ex Roth) Nees in DC., Prodr. (Ed. A. DC.) 11: 723. 1847; C.B. Clarke in Hook.f., Fl. Brit. India 4: 423. 1884; Haines, Forest Fl. Chota Nagpur: 452. 1910 & Bot. Bihar Orissa: 672. 1922; Mooney, Suppl. Bot. Bihar Orissa: 108. 1950; N.P. Singh & al., Fl. Bihar: 385. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 470. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 759. 2005. *Ruellia latebrosa* B. Heyne ex Roth, Nov. Pl. Sp.: 307. 1821. **Plate 56A**

Herb 20–40 cm high. Stems quadrangular hairy. Leaves simple, opposite, upper leaves larger compared to the lower ones, broadly ovate or ovate-oblong,  $0.6-4 \times 0.5-3.5$  cm, attenuate base crenate-dentate at margins acute to acuminate at apex, lower surface with small hair interspersed with few large ones upper surface with more larger white hair. Flowers in heads, usually borne on small, axillary branches; bracts ovate or elliptic, of outer flowers much longer, ciliate on margin,

glandular pubescent. Calyx-lobes 5, linear-lanceolate,  $5-8 \times c. 1$  mm, unequal with one lobe longer than the other,  $\frac{3}{4}$  of upper part united, hairy and ciliate. Corolla 1–2 cm long, funnel-shaped; tube yellowish to white; lobes rounded, with narrowed basal part, blue, glabrous, pubescent on the outer surface of the lobes. Stamens 4, in pairs; anthers oblong, 1–2 mm long; filaments 2–4 mm long, the longer filaments bearded with papillose hairs in upper part, the shorter filaments glabrous. Ovary  $2-3 \times c. 1$  mm, slightly pubescent at apex; style 4–6 mm long. Capsules oblong-ellipsoid, subtetragonous, with a small beak at the tip, 5–6 mm long, pubescent, 6-seeded. Seeds suborbicular,  $c. 1.5$  mm, clothed with hairs, yellowish brown.

*Fl. & Fr.*: November – March.

*Habitat*: On the rocky hill forests.

*Distribution*: KWLS: Dhawjadhari Pahar, mid of the Pahar; Bherwa tan, Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Dhawjadhari Pahar, mid of the pahar, 411 m,  $24^{\circ}28'47.7''$  N,  $85^{\circ}35'49.6''$  E, 29th February 2012, *Shyam Biswa* 54019; Bherwa tan, Koderma NRF on the fallow crop field, 397 m,  $24^{\circ}28'43.6''$  N,  $85^{\circ}36'26.7''$  E, 5th March 2012, *Shyam Biswa* 54161.

## 92. BIGNONIACEAE Juss., nom. cons.

Tropical regions, 82 genera and  $c. 810$  species;  $c. 20$  genera 34 species in India.

### Key to genera

- 1a. Evergreen trees; flowers white, in pendulous panicles; corolla tubular; stamens 4 (2+2), didynomous **1. Millingtonia**
- 1b. Deciduous trees; flowers not white, in erect panicles or racemes; corolla broad, campanulate-ventricose; stamens fertile 5 or 4 with 1 staminode 2
- 2a. Leaflets serrate at margins; capsules not woody, tapering at ends **4. Tecoma**
- 2b. Leaflets entire at margins; capsules woody, not tapering at ends 3
- 3a. Stamens 5, fertile; capsules sword-shaped, 6–8 cm broad, flat; straight; seeds roundish,  $5.5-7 \times 2.5-4$  cm, including papery wing, shiny, whitish **2. Oroxylum**
- 3b. Stamens 4, fertile; capsule terete,  $c. 2$  cm broad, slightly curved, prominently ridged, twisted when mature; seeds ovoid,  $5-6 \times c. 13$  mm including wing; brownish **3. Stereospermum**

### 1. MILLINGTONIA L.f.

Southeast Asia, monotypic.

**Millingtonia hortensis** L.f., Suppl. Pl.: 291. 1782; C.B. Clarke in Hook.f., Fl. Brit. India 4: 377. 1884; Haines, Forest Fl. Chota Nagpur: 444. 1910 & Bot. Bihar Orissa: 650. 1922; N.P. Singh & al., Fl. Bihar: 372. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 789. 2005. **Plate 58A**

Vern. Name: *Akas-nim* (Hindi).

Tree, 20–30 m high, deciduous; trunk blackish; branches with numerous lenticels, light brownish or whitish. Leaves compound, imparipinnate; leaflets 5–7, broadly ovate,  $3-8 \times 2-6$  cm, obliquely subcuneate, rounded or subcordate at base, entire or sparsely serrate at margins, acuminate at apex, glabrous; petioles pulvinous at the base; petiolules  $c. 5$  mm long. Inflorescence a panicle. Flowers long tubular,  $6.5-7 \times 2.5-3$  cm, having a very pleasing sweet



fragrance; pedicels *c.* 1 cm long. Calyx cup-shaped, 3–5 mm, long, green. Corolla white, tubular; tube *c.* 5 cm long, 4 (3+1)-lobed; 3 equal lobes  $1.3\text{--}1.5 \times c.$  0.8 cm; larger lobe bisected, *c.*  $1.3 \times 1$  cm. Stamens 4 (2+2), didynous; shorter stamens 6–8 mm long; longer stamens 1.2–1.5 cm long; anthers 3–4 mm long, white. Ovary 5–7 mm long; style 7–7.2 cm long; stigma of 2-fid; lobes spatulate, 2–3 mm long, flat, whitish or light green.

*Fl. & Fr.*: October – December.

*Habitat*: May be planted in the village.

*Distribution*: KWLS: Meghatari NRF, near the village; common. INDIA: Almost throughout. WORLD: Cambodia, China, Indonesia, Laos, Malaysia, Myanmar, Thailand and Vietnam.

*Specimen examined*: Meghatari NRF, near the village, 270 m, 24°33'28.0" N, 85°35'14.6" E, 27th November 2012, *Shyam Biswa* 54090.

*Note*: Only one tree was found during the present study. The tree is having shallow root and growing slanting, with the support of another tree.

## 2. OROXYLUM Vent.

Sri Lanka to Sulawesi, Timor, 1 species.

**Oroxylum indicum** (L.) Kurz, Forest Fl. Burma 2: 237 1877; C.B. Clarke in Hook.f., Fl. Brit. India 4: 378. 1884; Mooney, Suppl. Bot. Bihar Orissa: 104. 1950; N.P. Singh & al., Fl. Bihar: 373. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 790. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 162. 2014. *Bignonia indica* L., Sp. Pl. 2: 625. 1753; Haines, Forest Fl. Chota Nagpur: 443. 1910 & Bot. Bihar Orissa: 650. 1922.

**Plate**

**58B**

Vern. Names: *Sona Chal* (Hindi); *Sonpatta* (Kharwari).

Tree, 4–10 m high, deciduous; bark grey with large leaf scars. Leaves compound, opposite, 2- or 3-pinnate, usually near branch end, 0.25–1.5 m long; leaflets alternate, ovate to oblong,  $9\text{--}13.5 \times 4.5\text{--}7.5$  cm, obliquely subcuneate, rounded or subcordate at base, entire at margins, long-acuminate at apex, pubescent when young, basally 3-veined; petiolules 0.5–3 cm long. Racemes 30–60 cm long or more; pedicels 0.8–2.5 cm long with a few bracteoles in lower part. Calyx campanulate, 2–3 cm long, truncate or irregularly shallow-toothed, becoming woody in fruits, dark violet. Corolla tube 4–8 cm long, reddish-purple outside, yellow inside; lobes suborbicular,  $2\text{--}4.5 \times 2\text{--}4$  cm, reflexed, narrowing at base, crenate and irregularly lacinulate at margins, creamy. Stamens 5, 3–4.5 cm long; filaments hairy at base. Disk large, fleshy, dark violet. Ovary 2-loculed; style 4–6 cm long, dark violet; stigma of 2 semicircular lobes. Capsules sword-shaped, pendent,  $50\text{--}60 \times 6\text{--}8$  cm, flat with woody valves. Seeds roundish,  $5.5\text{--}7 \times 2.5\text{--}4$  cm, including papery wing, shiny, whitish.

*Fl.*: July – August, *Fr.*: December – March.

*Habitat*: Dry deciduous mixed forests on the hills.

*Distribution*: KWLS: Near Dhanarjay nadi, Bishnutikar jungle, Meghatari; Not common. INDIA: Almost throughout. WORLD: Bhutan, Cambodia, China, Indonesia (Java, Sumatra), Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Taiwan, Thailand and Vietnam.

*Specimen examined*: Near Dhanarjay nadi, Bishnutikar jungle, Meghatari, 189 m, 24°34'58.1" N, 85°35'05.8" E, 13th September 2010, *Shyam Biswa* 49614.

### 3. STEREOSPERMUM Cham.

Old world, Tropical regions, 19, 4 in India, 2 in Jharkhand and 1 in KWLS.

**Stereospermum colais** (Buch.-Ham. ex Dillwyn) Mabb., Taxon 27(5-6): 553. 1979. *Stereospermum tetragonum* DC., Biblioth. Universelle Genève xvii. 124. 1838; Prod. ix. 210. 1845; Haines, Bot. Bihar Orissa 655. 1922. *Stereospermum chelonoides* DC., Bibl. Univ. Geneve II. 17: 124. 1838, p.p. quoad ref. Rheede, t. 26 & DC., Prodr. 9: 210. 1845; C.B. Clarke in Hook.f. Fl. Brit. India 4: 382. 1884; Ranjan, Fl. Parasnath Wildlife Sanct.: 162. 2014. *Bignonia colais* Dillwyn, Rev. Hortus Malab. 28. 1839.

Vern. Name: *Adkapari* (Birhore).

Tree to 15 m high. Leaves compound, opposite, 25–50 cm long; leaflets 3–7, elliptic, 5–14 × 2–6 cm, acute or cuneate at base, entire at margins, caudate-acuminate at apex, glabrous; petiolule conspicuous, 3–10 mm long, glabrous. Inflorescences paniculate, terminal, 20–40 cm long; peduncle pubescent or glabrous; bract deciduous. Flowers many; pedicel 3–4 mm, glabrous. Calyx 3–5-lobed, campanulate, 4–10 × 4–5 mm, glabrous. Corolla slightly curved, white with purplish or crimson markings, tube terete, 1.2–2 cm long, glabrous outside, densely tomentose within; upper lip 2-lobed, lower lip 3-lobed, 0.8–1 cm long, pale yellow. Stamens 4, fertile, filaments *c.* 1 cm, glabrous; staminode usually rudimentary. Stigma 2-lobed. Capsule terete, 30–80 × *c.* 2 cm, slightly curved, prominently ridged, twisted when mature, pericarp thick, subwoody; septum *c.* 8 mm in diam. Seeds ovoid, 5–6 × *c.* 13 mm including wing.

*Fl. & Fr.*: April – February.

*Habitat*: Dry deciduous forest.

*Distribution*: KWLS: Dhodhakola near BirhoreTola, Safinalwa; not common. INDIA: Bihar, Kerala, Maharashtra, Western ghats. WORLD: Bangladesh, Bhutan, Cambodia, China, Indonesia (Sumatra), Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam.

*Specimen examined*: Dhodhakola near BirhoreTola, Safinalwa, 380 m, 24°33'15.1" N, 85°39'37.9" E, 27th February 2012, *Shyam Biswa* 53930.

### 4. TECOMA Juss.

Tropical regions, 14 species, 2 in Jharkhand and 1 in KWLS.

**Tecoma stans** (L.) Juss. ex Kunth, Nov. Gen. Sp. 3: 144. 1819; Haines, Bot. Bihar Orissa: 654. 1922; N.P. Singh & al., Fl. Bihar: 275. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 459. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 794. 2005. *Bignonia stans* L., Sp. Pl. ed. 2. 2: 871. 1762.

**Plate**

**58C**

Vern. Name: *Peela phool*.

Tree, 2–5 m high. Leaves compound, opposite, imparipinnate or digitate; leaflets 3–7, lanceolate or elliptic, 6–14 × 2–5 cm, cuneate to attenuate at base, deeply serrate at margins, acuminate at apex, glabrous; petiolules 0.1–1.5 cm long. Flowers in panicles or terminal racemes, yellow, fragrant; pedicels 4–8 mm long. Calyx tube 4–5 mm long; lobes triangular *c.* 1 mm long, acuminate at apex, finely glandular-pubescent at margins. Corolla campanulate, sweet-scented,

yellow; tube 4–4.5 cm long; lobes suborbicular, *c.* 1 × 1–1.5 cm overlapping, entire at margins. Stamens fertile 4, one long and one short pair, 1.5–2 cm long; staminode 1. Disk shallow, cupular, 5-lobed, fleshy. Ovary *c.* 3 mm long, elongated, minutely papillose; style 1.5–2 cm long; stigma 2-lobed; lobes ovate, *c.* 1.5 mm long. Capsules linear-cylindrical, 7–14 × 0.5–1 cm, tapering at ends; septum flat. Seeds ovate, 1.5–2.5 × 4–5 mm, including oblong wing, dark brown; wings papery, whitish.

*Fl. & Fr.*: August – March.

*Habitat*: Near the village.

*Distribution*: KWLS: Bishnutikar jungle, Meghatari; grown as an ornamental plant. INDIA: Almost throughout. WORLD: Native to Tropical America, grown as an ornamental plant elsewhere.

*Specimen examined*: Bishnutikar jungle, Meghatari, 189 m, 24°34'58.1" N, 85°35'05.8" E, 2nd March 2012, *Shyam Biswa* 54036.

### 93. VERBENACEAE J. St-Hil., nom. cons.

Tropical with few temperate regions, 35 genera and *c.* 1150 species; 23 genera and *c.* 140 species in India.

#### Key to genera

- 1a. Herb, creeping, rooting at nodes; spike globose or cylindrical; fruit a schizocarp **2. Phyla**
- 1b. Shrub, erect, not rooting at nodes; spike pseudo- or sub-umbellate; fruit a drupe **1. Lantana**

#### 1. LANTANA L., nom. cons.

Tropical regions, *c.* 150 species, 4 in India, 1 in Jharkhand.

**Lantana camara** L., Sp. Pl. 2: 627. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 562. 1885; Haines, Forest Fl. Chota Nagpur: 488. 1910 & Bot. Bihar Orissa: 705. 1922; Mooney, Suppl. Bot. Bihar Orissa: 120. 1950; A. Rajendran & P. Daniel, Indian Verbenac.: 180. 2002; N.P. Singh & al., Fl. Bihar: 401. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 487. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 675. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 175. 2014.

Vern. Name: *Putus* (Hindi).

Shrub, 1–3 m high, foetid. Stems quadrangular, much-branched, armed with recurved prickles. Leaves simple, opposite, ovate or ovate-lanceolate, 2.5–10.5 × 1–5.6 cm, attenuate or truncate at base, crenate or serrate at margins, acute to acuminate at apex, scabrous above, stiff-hairy and sparsely minute gland-dotted beneath; lateral veins 5–7 pairs, distinct beneath; petioles slender, 0.5–2.5 cm long, conspicuously prickled. Inflorescence axillary, pseudo- umbellate or subumbellate. Flowers showy, sessile, fragrant, in round flat-topped heads of 2–3 cm across, with buds at centre of head; peduncles slender, 1–8 cm long, prickled; bracts linear-lanceolate or lanceolate-oblong, 3–7 mm long, ciliate at margins, hairy. Calyx tube *c.* 1.5 mm long, 2-lobed; lobes triangular, *c.* 0.5 mm long. Corolla hypocrateriform, red, yellow, orange, pinkish, white or purplish pink; tube cylindric, *c.* 9 × 1 mm, pubescent outside, 2-lipped, 5-lobed; upper lip 2-lobed; lobes subrotund; lower lip 3-lobed; midlobe subrotund, recurved, *c.* 4 × 3 mm; lateral lobes obtuse, *c.* 2 × 1 mm. Stamens 4, didynamous; filaments *c.* 1 mm long; anthers ovoid, *c.* 0.5 mm long, basifixed. Ovary conical, *c.* 3 mm long; style stout, *c.* 3 mm long; stigma obliquely

subcapitate. Drupes obovoid, *c.* 4 mm long, fleshy, smooth, glossy, greenish turning purplish black on maturity.

*Fl. & Fr.*: August – April.

*Habitat*: On roadsides and in scrub and dry deciduous forests, forming a gregarious population.

*Distribution*: KWLS: Baghi tan forest, Koderma NRF; very common. INDIA: Throughout.

WORLD: Native to tropical America, now almost throughout the world.

*Specimens examined*: Baghi tan forest, 398 m, 24°29'03.6" N, 85°36'13.7" E, 10th March 2011, Shyam Biswa 49752; Koderma NRF, 401 m, 24°28'46.5" N, 85°35'57.3" E, 29th September 2013, Shyam Biswa 54196.

## 2. PHYLA Lour.

Tropical and subtropical regions, 11 species, 1 in India.

**Phyla nodiflora** (L.) Greene, Pittonia 4: 46. 1899; N.P. Singh & al., Fl. Bihar: 402. 2001; A. Rajendran & P. Daniel, Indian Verbenac.: 206. 2002; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 488. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 679. 2005. *Verbena nodiflora* L., Sp. Pl. 1: 20. 1753. *Lippia nodiflora* (L.) Rich. in Michx., Fl. Bor.-Amer. 2: 15. 1803; C.B. Clarke in Hook.f., Fl. Brit. India 4: 563. 1885; Haines, Bot. Bihar Orissa: 706. 1922; Mooney, Suppl. Bot. Bihar Orissa: 120. 1950.

**Plate 58D**

Herb, prostrate, creeping, rooting at nodes. Stems and branches slender, quadrangular pubescent. Leaves simple, opposite, variable, oblanceolate to obovate, spathulate, 0.5–1.5 × 0.2–0.5 cm, cuneate at base, sharply serrate above middle and entire below at margins, obtuse at apex, densely adpressed strigillose-pubescent on both surfaces; veins obscure; petioles 1–4 mm long. Spikes axillary, solitary, capitate, becoming cylindric later, elongation with age, 0.3–1.2 × 0.4–0.5 cm; peduncles 1–3 cm long, densely or sparsely appressed-strigose; bracts ovate or obovate-subrhomboid, *c.* 2 mm long, apiculate, appressed-white-hairy outside. Flowers many. Calyx cupular; tube short, *c.* 0.5 mm long; lobes *c.* 0.8 mm long, hairy. Corolla hypocrateriform, 2-lipped, 5-lobed, white with yellow patches at centre or rose purple; tube narrow, *c.* 2 mm long, glabrous; upper lip slightly 2-lobed, *c.* 0.5 mm long; lower lip 3-lobed; lobes suborbicular, 0.5–1 mm long, retuse or obtuse, glabrous. Stamens 4, didynamous; filaments *c.* 0.5 mm long, curved, included; anthers ovoid, *c.* 0.2 mm long, yellow. Ovary subglobose, *c.* 0.5 mm long, cream-coloured; style stout, *c.* 0.5 mm long; stigma subcapitate, oblique. Drupes subglobose, 1–1.5 mm long, separating into 2- or 1-seeded stone, enclosed by persistent calyx.

*Fl. & Fr.*: Almost throughout the year.

*Habitat*: Open moist localities, forming a gregarious population.

*Distribution*: KWLS: Dengra Pahar, near RIT Institute, Chattarbar; common. INDIA: Throughout. WORLD: Almost throughout the world.

*Specimen examined*: Dengra Pahar, near RIT Institute, Chattarbar, 422 m, 24°28'09.3" N, 85°34'14.9" E, 13th August 2011, Shyam Biswa 49793.

## 94. LAMIACEAE Martinov, nom. cons. (LABIATAE Juss., nom. cons.)

Cosmopolitan, 238 genera and *c.* 6500 species, 72 genera and *c.* 435 species in India.

### Key to genera

|                                                                                             |                        |
|---------------------------------------------------------------------------------------------|------------------------|
| 1a. Calyx bilabiate; style gynobasic; ovary 4-lobed; fruits nutlets                         | 4                      |
| 1b. Calyx more or less actinomorphic; style terminal; ovary entire; fruit berries or drupes | 2                      |
| 2a. Trees                                                                                   | <b>10. Tectona</b>     |
| 2b. Herbs or shrubs                                                                         | 3                      |
| 3a. Leaves compound                                                                         | <b>11. Vitex</b>       |
| 3b. Leaves simple                                                                           | <b>2. Clerodendrum</b> |
| 4a. Flowers white                                                                           | 5                      |
| 4b. Flowers other than white (orange, purple or blue or pink)                               | 7                      |
| 5a. Stamens erect or spreading or ascending                                                 | <b>5. Leucas</b>       |
| 5b. Stamens declinate anther cells at length confluent                                      | 6                      |
| 6a. Plants aromatic; calyx as long as corolla                                               | <b>7. Ocimum</b>       |
| 6b. Plants not aromatic; calyx shorter than corolla tube                                    | <b>8. Orthosiphon</b>  |
| 7a. Stamens didynamous; filaments not bearded all over                                      | 8                      |
| 7b. Stamens subequal; filaments bearded all over                                            | <b>9. Pogostemon</b>   |
| 8a. Calyx 8–10 toothed; flowers orange                                                      | <b>4. Leonotis</b>     |
| 8b. Calyx 5 lobed or toothed; flowers other than orange                                     | 9                      |
| 9a. Calyx 5 lobed or toothed                                                                | 10                     |
| 9b. Calyx 2-lipped                                                                          | <b>3. Coleus</b>       |
| 10a. Flowers in axillary verticils and cymes; corolla blue                                  | <b>6. Mesosphaerum</b> |
| 10b. Flowers in terminal spicate panicles; corolla pink                                     | <b>1. Anisomeles</b>   |

### 1. ANISOMELES R. Br.

Old World tropical regions, 3 species, 3 in India, 2 in Jharkhand and 1 in KWLS.

**Anisomeles indica** (L.) Kuntze, Revis. Gen. Pl. 2: 512. 1891; Haines, Bot. Bihar Orissa: 745. 1922; N.P. Singh & al., Fl. Bihar: 409. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 496. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 689. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 178. 2014. *Nepeta indica* L., Sp. Pl. 2: 571. 1753. *Anisomeles ovata* R. Br. in W.T. Aiton, Hortus Kew. ed. 2, 3: 364. 1811; Hook.f., Fl. Brit. India 4: 672. 1885; Haines, Forest Fl. Chota Nagpur: 492. 1910.

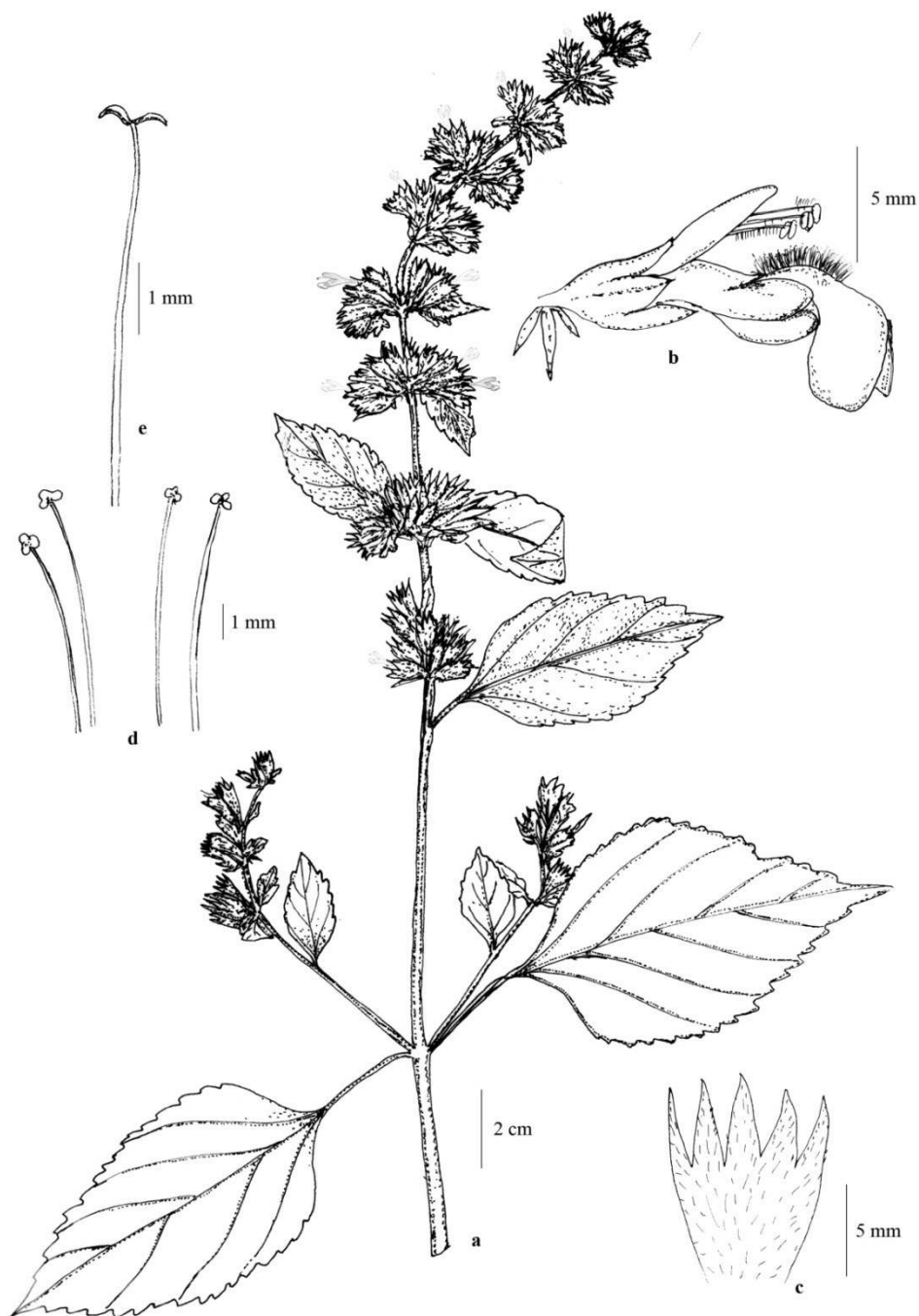
**Fig. 51; Plate 58F**

Herb, to 1 m high. Stems 4-angular, grooved on opposite sides, much-branched, densely pubescent. Leaves simple, opposite, ovate, 2–11 × 1–7 cm, cuneate to attenuate at base, bluntly serrate at margins, acuminate at apex, pubescent on both surfaces, densely so on veins; petioles 0.5–4.5 cm long, densely hairy. Flowers c. 1.5 cm long, sessile, borne in few to many-flowered verticillasters, the whorls distant below, approximate above in a spicate inflorescence; bracts linear, 4–6 mm long, pilose. Calyx campanulate, 1–1.2 cm long, hairy on both surfaces, 5-lobed; lobes acute, 3–4 mm long. Corolla c. 1.3 cm long; tube to 8 mm long, bilipped; upper lip flat, to 6 mm long, hairy on both surfaces, light greenish yellow; lower lip 3-lobed, pinkish-white; midlobe laterally compressed, notched, to 8 mm long, hairy on mouth, dark pink. Stamens 4, straight, exserted; filaments to 5 mm long, hairy; anthers 0.5–0.6 mm long, dark pink; upper pair 2-celled; lower pair 1-celled. Ovary c. 0.5 mm long; style 1.3–1.5 cm long, slender, 2-fid; stigma c. 1 mm long, 2-lobed; lobes equal, subulate. Nutlets ovoid, c. 1.5 mm long, subcompressed, black when ripe.

*Fl. & Fr.*: September – March.



*Habitat:* Dry deciduous forests.



**Fig. 51. *Anisomeles indica* (L.) Kuntze:** a. flowering shoot; b. flower; c. calyx; d. stamens; e. carpel.

*Distribution:* KWLS: Taraghati forest; common. INDIA: Throughout. WORLD: Native to temperate Asia; China and Malaysia.

*Specimen examined:* Taraghati forest, 320 m, 24°32'.321" N, 85°35'.060" E, 27th September 2013, *Shyam Biswa* 54172.

## 2. CLERODENDRUM L.

Tropical and subtropical regions, *c.* 250 species, 23 in India, 5 in Jharkhand and 1 in KWLS.

**Clerodendrum infortunatum** L., Sp. Pl. 2: 637. 1753, "*infortunata*"; C.B. Clarke in Hook.f., Fl. Brit. India 4: 594. 1885; Haines, Forest Fl. Chota Nagpur: 485. 1910 & Bot. Bihar Orissa: 721. 1922; A. Rajendran & P. Daniel, Indian Verbenac.: 116, f. 21. 2002. *Clerodendrum viscosum* auct. non Vent. 1804; N.P. Singh & al., Fl. Bihar: 400. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 485. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 671. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 174. 2014. **Plate 59A**

Vern. Name: *Bhant* (Hindi).

Shrub, 0.5–2 m high. Stems and branchlets obtusely 4-angled, densely white-villous; upper branches pinkish. Leaves simple, opposite, cordate or ovate-cordate, 9–15 × 4–10.6 cm, cordate or roundish at base, serrate at margins, abruptly short-acuminate at apex, thin, smooth, sparsely whitish or yellowish long-pubescent above, densely so beneath, dark green; venation sub-palmate; petioles 1–12 cm long, densely yellowish pubescent. Inflorescence a cymose panicle, decussately branched, terminal, 10–25 cm long; peduncles obtusely 4-angled, 1–6 cm long, red or purplish; bracts foliaceous, ovate-elliptic, acuminate at apex, *c.* 3 × 1.5 cm, densely yellowish pubescent; bractlets caducous. Flowers fragrant; pedicels slender, 0.8–2 cm long, red or purple. Calyx green, 5-lobed; lobes not overlapping, lanceolate, 1–1.2 × *c.* 0.5 cm, densely pubescent, with distinct midrib. Corolla hypocrateriform, white, pinkish or purple-tinged at mouth; tube narrow, 1.2–1.5 cm long, 5-lobed; lobes ovate-oblong, subequal, obtusely apiculate at apex, 8–9 mm long. Stamens 4, didynamous; filaments filiform, 2.5–3 cm long, glabrous, white; anthers elliptic, *c.* 2 mm long, dorsifixed, versatile, violet. Ovary oblong, depressed at apex, *c.* 2 mm long, glabrous; style slender, 3.8–4 cm long; stigma 2-lobed; lobes equal, subulate. Drupes subglobose, 0.6–1.1 × 0.8–1 cm, shiny, green turns black when mature, enclosed by accrescent, bright red calyx; pyrenes 4.

*Fl. & Fr.:* February – March.

*Habitat:* Scrub forests.

*Distribution:* KWLS: Inderwa Chittarpur, near road; common. INDIA: Andaman and Nicobar Islands, Karnataka, Kerala and Tamil Nadu. WORLD: Sri Lanka, Thailand, and also cultivated in England and the Netherlands.

*Specimens examined:* Inderwa Chittarpur, near road, 375 m, 24°30'33.9" N, 85°39'42.2" E, 5th March 2011, *Shyam Biswa* 49685; Bagitan Panbasa Nala, Lokai forest, 382 m, 24°28'57.6" N, 85°37'20.5" E, 4th February 2012, *Shyam Biswa* 49862; near the bank of Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 31st March 2013, *Shyam Biswa* 54130.

## 3. COLEUS Lour.

Old World tropical and subtropical regions, *c.* 302 species, 16 in India, 2 in Jharkhand and 1 in KWLS.

**Coleus strobilifer** (Roxb.) A.J.Paton, PhytoKeys 129: 100. 2019. *Lavandula carnosa* L.f., Suppl. Pl.: 273. 1782. *Anisochilus carnosus* (L.f.) Wall. ex Benth. in Wall., Pl. Asiat. Rar. 2: 18. 1830;

Hook.f., Fl. Brit. India 4: 627. 1885; Haines, Forest Fl. Chota Nagpur: 492. 1910 & Bot. Bihar Orissa: 733. 1922; Mooney, Suppl. Bot. Bihar Orissa: 123. 1950; N.P. Singh & al., Fl. Bihar: 408. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 495. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 687. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 177. 2014.

**Fig. 52; Plate 58E**

Vern. Name: *Panjiri* (Hindi).

Herb, 30–70 cm high. Stems 4-angled, appressed-hairy, pinkish red. Leaves simple, opposite, broadly ovate, rounded or ovate-orbicular or rhomboid,  $1.5\text{--}10.5 \times 1.2\text{--}7$  cm, cuneate to rounded at base, crenate-serrate at margins, subacute or obtuse to rounded at apex, glabrous above, densely scabrid beneath, pink-dotted glandular; petioles 0.5–6.5 cm long, puberulous. Panicles diffusely branched; spikes subglobose to oblong-ovoid, 1.5–5 cm long; bracts broadly ovate, *c.* 4 mm long, truncate at base, acute at apex, hairy. Flowers  $6\text{--}8 \times 2.5\text{--}3$  mm. Calyx tubular; tube 4–5 mm long, glabrous or pubescent outside with minute hairs, 5-lobed, 2-lipped; upper lip deltoid-lanceolate, *c.*  $2.5 \times 2$  mm, erect in flower but deflexed in fruit; lower lip reduced. Corolla to 8 mm long, bilabiate; tube truncate, *c.* 4 mm long, white with small brownish dots, 5-lobed; lobes distinctly (4+1); upper lip entire, *c.* 2.5 mm long, white with brown dots; lower lip concave or boat-shaped, *c.* 4 mm long, pubescent outside on lobes, violet. Stamens 4 (2+2), declinate;

filament pairs 1 and 2 mm long; anthers *c.* 0.5 mm long. Ovary 0.5–1 mm long; style branches subequal, 7–8 mm long, glabrous; stigma bifid. Nutlets *c.*  $1 \times 1$  mm, compressed, punctate, brown.

*Fl. & Fr.*: November – February.

*Habitat*: On rocky hill slopes in dry deciduous forests.

*Distribution*: KWLS: Near base of Dhawjadhari Pahar, Koderma NRF; common. INDIA: Throughout. WORLD: Myanmar and Sri Lanka.

*Specimen examined*: Near base of Dhawjadhari Pahar, Koderma NRF, 435 m,  $24^{\circ}28'58.3''$  N,  $85^{\circ}35'48.5''$  E, 19th November 2012, *Shyam Biswa* 54053.

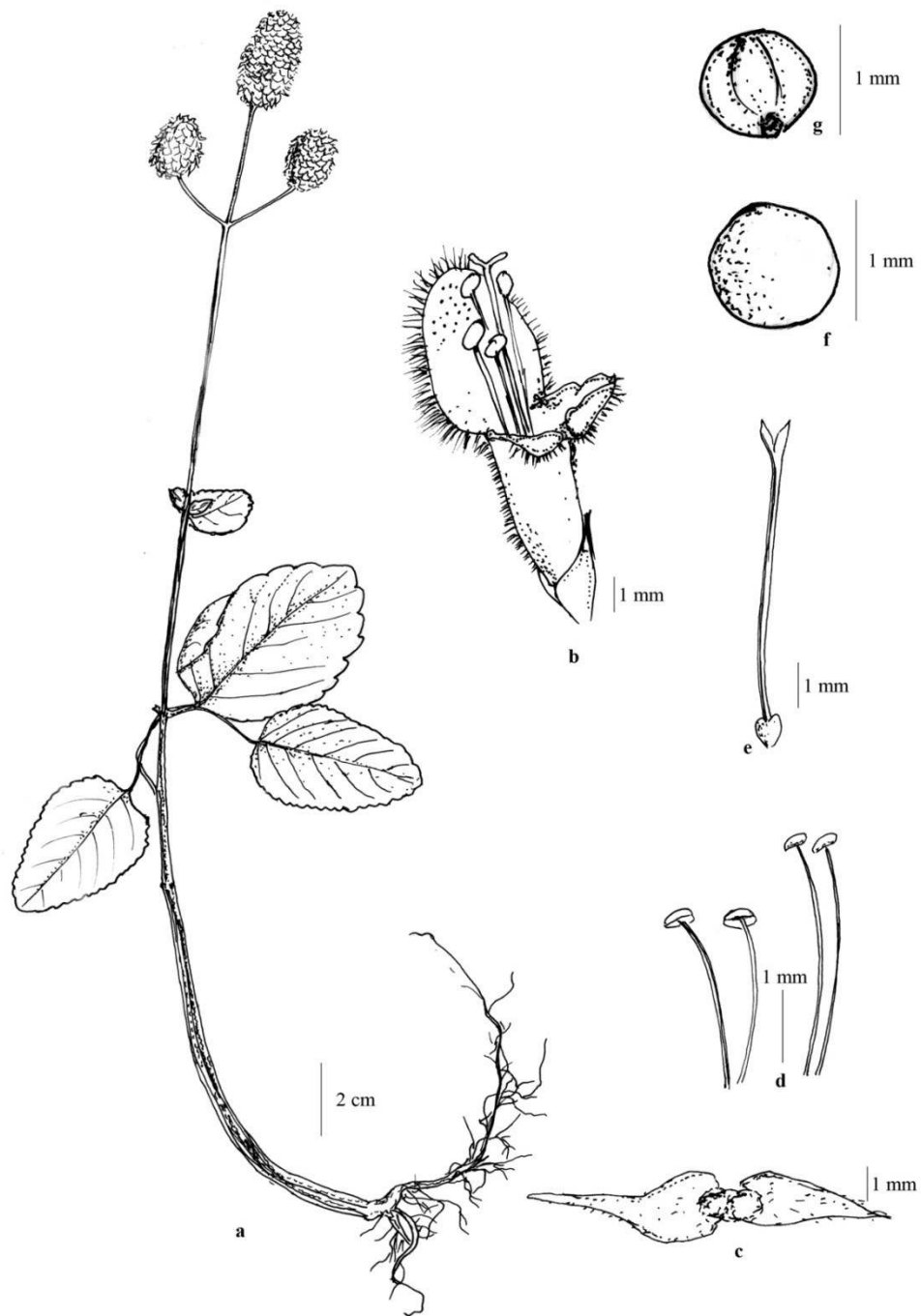
#### 4. **LEONOTIS** (Pers.) R. Br.

Tropical regions, 9 species, 2 in India, 1 in Jharkhand.

**Leonotis nepetifolia** (L.) R.Br., in W.T. Aiton, Hort. Kew., ed. 2. 3: 409. 1811. *Phlomis nepetifolia* L., Sp. Pl. 2: 586. 1753. Hook.f., Fl. Brit. India 4: 691. 1885; Haines, Forest Fl. Chota Nagpur: 493. 1910 & Bot. Bihar Orissa: 752. 1922; N.P. Singh & al., Fl. Bihar: 412. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 499. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 692. 2005., “*nepetaefolia*”.

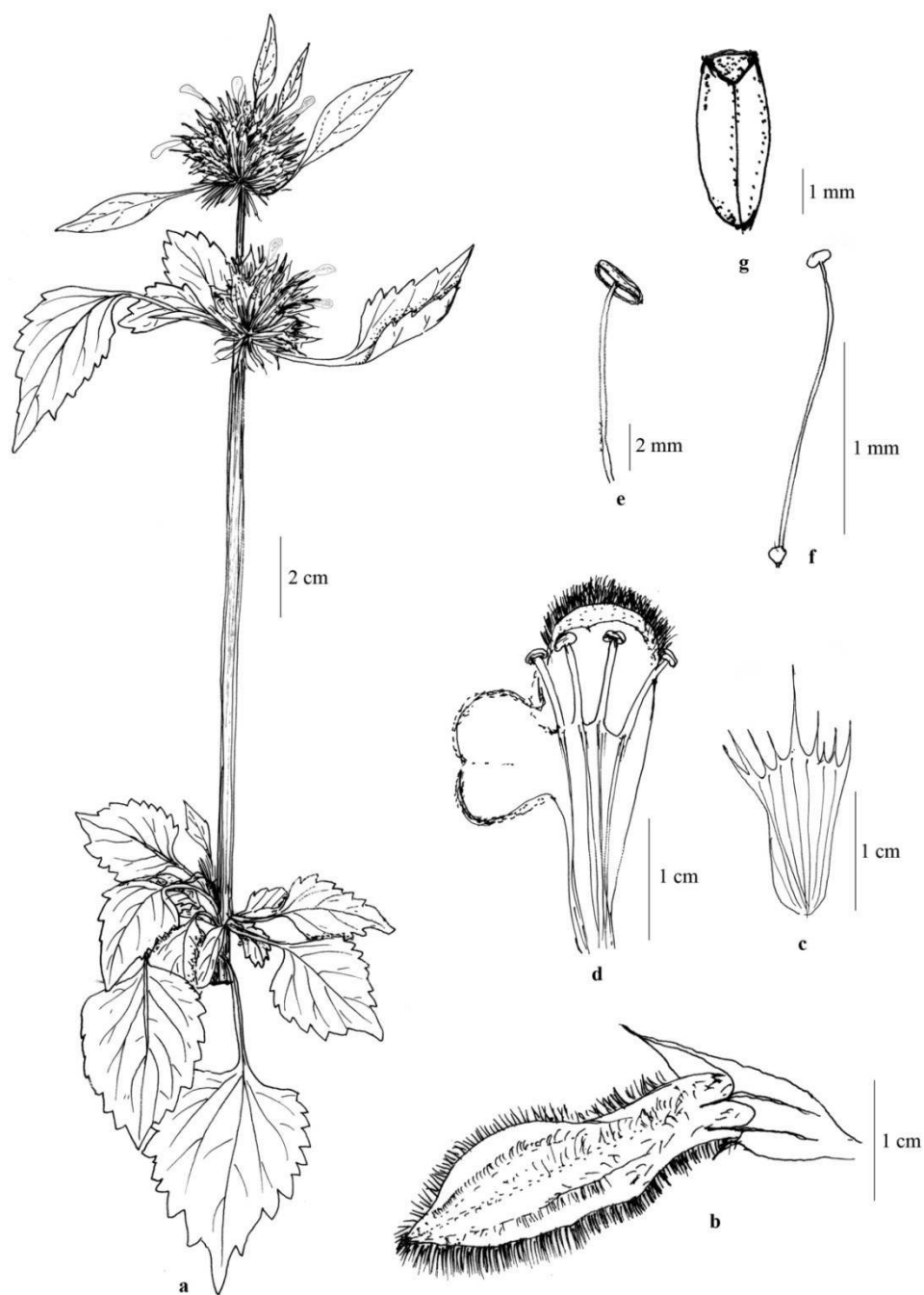
**Fig. 53; Plate 59C**

Undershrub, to 1.5 m high. Stems 4-angular, woody, deeply grooved, pubescent. Leaves simple, opposite, ovate or ovate-lanceolate,  $3\text{--}9 \times 2\text{--}5$  cm, attenuate at base, bluntly serrate at margins, acuminate at apex, puberulent on both surfaces; petioles 1.5–5 cm long, hairy. Flowers *c.* 3 mm long, sessile, borne in few to many-flowered verticillasters, *c.* 7 cm across; bracts at nodes, linear,



**Fig. 52. *Coleus strobilifer* (Roxb.)** A.J.Paton: a. habit; b. flower; c. bracts; d. stamens; e. carpel; f., g. nut.





**Fig. 53. *Leonotis nepetifolia* (L.) R. Br.:** a. flowering shoot; b. flower; c. calyx; d. corolla split open; e. stamen; f. carpel; g. nut.

1–2 cm long spinescent, pubescent. Calyx tubular, 0.7–1 × c. 2 cm, tube hairy, mouth oblique, teeth 8–10 spinescent, unequal upper tooth longest. Corolla 2.5–3 cm long, orange; tube to 1.5 cm long, bilipped; upper lip erect, to 10 mm long, hooded, entire, densely woolly; lower lip small, 4-lobed,. Stamens 4, didynamous, anterior pair longest; filaments 5–8 mm long, hairy; anthers c. 2 × 0.5 mm long. Ovary c. 0.5 mm long; style 1.2–1.8 cm long, slender, subulate; stigma unequally bifid. Nutlets linear-oblong, 3–4 × 1.5–2 mm, triquetrous truncate, glabrous, yellowish black.

*Fl. & Fr.*: August – March.

*Habitat*: On hillslopes in dry deciduous forests.

*Distribution*: KWLS: Dhawjadhari Pahar. INDIA: Almost throughout. WORLD: Native to tropical Africa, but widely naturalised as a weed in tropical regions.

*Specimen examined*: Dhawjadhari Pahar, 390 m, 24°29'21.2" N, 85°35'54.0" E, 2nd March 2011, *Shyam Biswa* 49652; Dhawjadhari Pahar, 563 m, 24°28'53.1" N, 85°35'39.4" E, 14th August 2011, *Shyam Biswa* 49799.

### 5. LEUCAS R. Br.

Africa and Arabia to Indomalesia, c. 100 species, 40 in India, 13 in Jharkhand and 2 in KWLS.

#### Key to species

- 1a. Annual; verticillasters terminal, solitary; bracts lanceolate, overlapping to largely conceal flowers; calyx mouth oblique **1. *L. cephalotes***
- 1b. Perennial; verticillasters usually more than 1 per stem; bracts not concealing flowers; calyx mouth straight **2. *L. decemdentata***

**1. *Leucas cephalotes*** (Roth) Spreng., Syst. Veg., ed. 16. 2: 743. 1825; Hook.f., Fl. Brit. India 4: 689. 1885; Haines, Bot. Bihar Orissa: 750. 1922; N.P. Singh & al., Fl. Bihar: 413. 2001; V. Singh, Monogr. Indian Leucas: 53, f. 6. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 500. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 696. 2005. *Phlomis cephalotes* J. König ex Roth, Nov. Pl. Sp.: 262. 1821. **Plate 59D**

Vern. Name: *Sun sunwa*.

Herb, 20–40 cm high. Stems simple or branched, quadrangular, hairy. Leaves simple, opposite, linear-lanceolate or ovate-lanceolate, 3–5.5 × 1.2–2 cm, cuneate or attenuate at base, sparsely serrate or crenate-serrate at margins, acute at apex, soft-pubescent; petioles 0.6–1.5 cm long, pubescent. Inflorescence a verticillaster, usually terminal, globose, c. 3.5 cm, densely many-flowered. Flowers 1.8–2 cm long; bracts many, lanceolate or ovate, 1–1.2 × 0.3–0.6 cm, truncate at base, ciliate at margins, acute, awned at apex, imbricately involucrate, covering the floral heads. Calyx tubular, slightly curved, 8–10 mm long, hairy above with villous mouth, 10-ribbed; lobe sub-aristate, c. 2 mm long, hispidulous. Corolla 1.5–2 cm long, white; tube shortly exserted; lower lip c. 5 mm long; upper lip c. 3 mm long, hooded, lanate. Stamens 4(2+2), didynamous, straight; filament pairs c. 4 and c. 5 mm long; anthers 0.5–0.8 mm long. Ovary c. 0.5 mm long; style 1.3–1.5 mm long; stigma obliquely 2-fid. Nutlets ovoid, c. 3 × 2 mm, triquetrous, smooth, brown.

*Fl. & Fr.*: September – March.

*Habitat*: Open localities.

*Distribution:* KWLS: Khararia jungle, Meghatari, near Chirkundi village; common. INDIA: Throughout. WORLD: Afghanistan, Bangladesh, Bhutan, China, Fiji, Iran, Nepal and Sri Lanka. *Specimen examined:* Khararia jungle, Meghatari, near Chirkundi village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 13th September 2010, *Shyam Biswa* 49619; Khararia jungle, Meghatari, near Chirkundi village, 210 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49714.

**2. *Leucas decemdentata*** (Willd.) Sm. in A. Rees, Cycl. 20(2): 6. 1812; V. Singh, Monogr. Indian Leucas: 67, f. 10. 2001. *Leucas mollissima* Wall. ex Benth. in Wall., Pl. Asiat. Rar. 1: 62. 1830; Hook.f., Fl. Brit. India 4: 682. 1885. *Leucas montana* (Roth) Spreng. var. *mollissima* (Wall. ex Benth.) Haines, Bot. Bihar Orissa: 748. 1922; N.P. Singh & al., Fl. Bihar: 415. 2001.

#### Plate 59E

Herb or undershrub, perennial, 30–70 cm high; rootstocks woody. Stems 4-angular, erect, branched, densely retrorsely appressed-hairy. Leaves simple, opposite, ovate or ovate-oblong, 1–5.5 × 0.5–4 cm, cuneate to rounded at base, broadly and bluntly serrate at margins, obtuse to acute at apex, villous-tomentose on both surfaces, more so on lower surface; petioles 0.3–2 cm long, tomentose. Verticillasters distant, in leaf axils, 8–12-flowered. Flowers 1.2–1.5 cm long; bracts linear, 2–3 mm long, villous. Calyx tubular or cupular, 7–8 × c. 3 mm, straight; teeth 10, triangular, mucronulate, 0.5–1.2 mm long, pubescent to densely pilose. Corolla 1–1.5 cm long, white; tube 7–8 mm long, puberulent near throat outside; upper lip straight or somewhat falcate, 4–5 mm long, densely white-bearded; lower lip 7–9 mm long; middle lobe largest. Stamens 4, didynamous; filaments 2–3 mm long; anthers c. 0.5 mm long, dorsifixed. Style shortly 2-lobed. Nutlets trigonous, 1.5–2 × c. 1 mm.

*Fl. & Fr.:* November – February.

*Habitat:* Scrub and dry deciduous forests.

*Distribution:* KWLS: Bon Kali, Pipra Tan; very common. INDIA: Odisha, Subtropical Himalaya, West Bengal and Western Peninsular regions. WORLD: China, Indonesia, Japan, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand and Vietnam. *Specimen examined:* Bon Kali, Pipra Tan, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 49877.

### 6. **MESOSPHAERUM** P.Browne

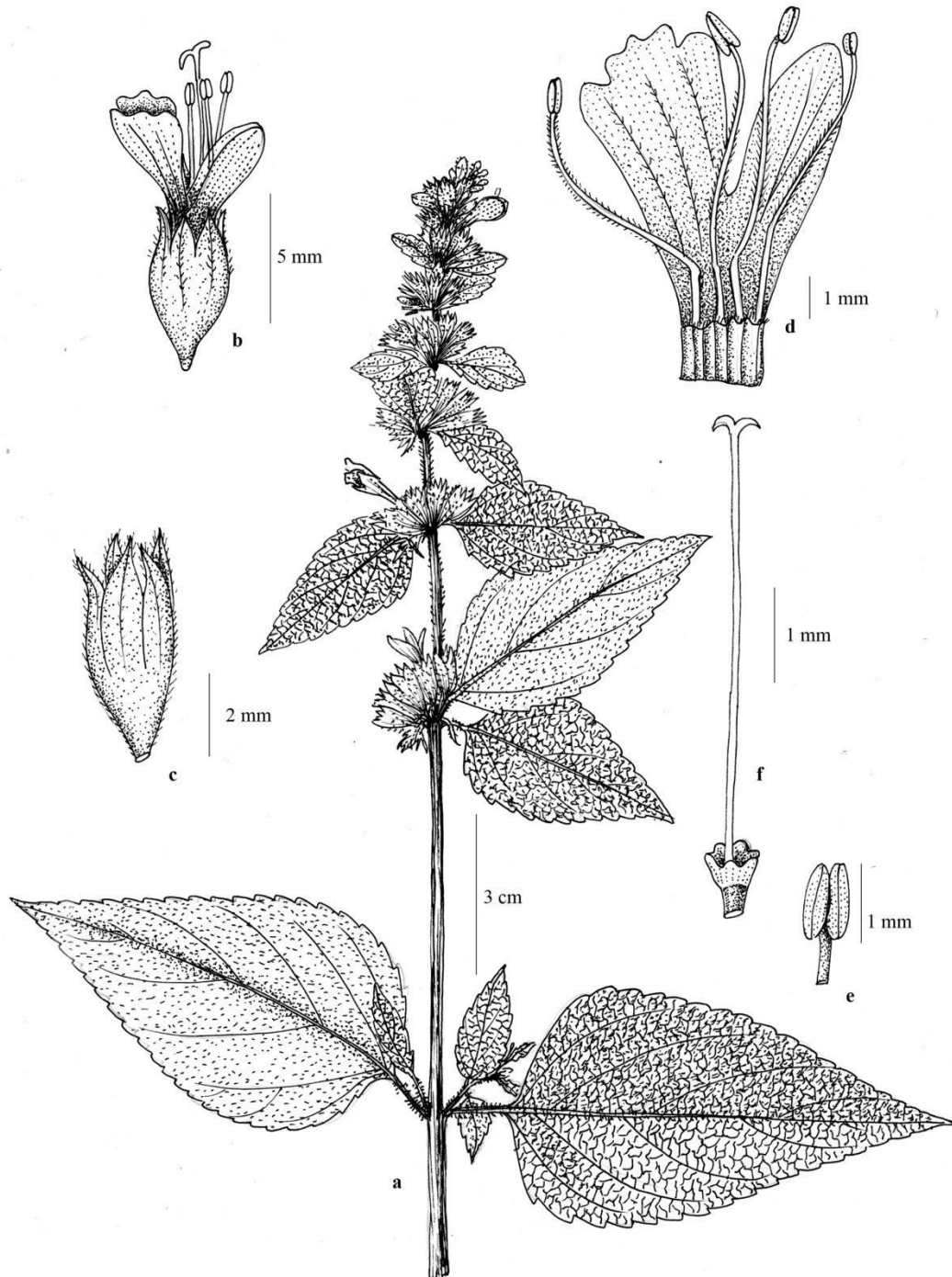
Tropical & Subtropical America c. 24 species, 1 in India.

***Mesosphaerum suaveolens*** (L.) Kuntze, Revis. Gen. Pl. 2: 525. 1891. *Hyptis suaveolens* (L.) Poit., Ann. Mus. Hist. Nat. 7: 472, t. 29, f. 2. 1806; Hook.f., Fl. Brit. India 4: 630. 1885; Haines, Forest Fl. Chota Nagpur: 492. 1901 & Bot. Bihar Orissa: 736. 1922; N.P. Singh & al., Fl. Bihar: 411. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 497. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 690. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 179. 2014. *Ballato suaveolens* L., Syst. Nat. ed. 10: 1100. 1759.

**Fig. 54; Plate 59B**

Vern. Names: *Wilayati tulsi* (Hindi); *Ban tulsi*.

Herb, 0.5–1 m high. Stems much-branched, congested, patently hirsute. Leaves simple, opposite, broadly ovate or ovate-lanceolate, 1.5–8 × 1–6.2 cm, cordate to rounded at base, irregularly crenate-serrate to serrulate or double serrate at margins, subacute or acute at apex, pubescent on both surfaces, more so on veins beneath; petioles 0.3–5.5 cm long. Flowers in



**Fig. 54. *Mesosphaerum suaveolens* (L.) Kuntze:** a. flowering twig; b. flower; c. calyx; d. corolla split open; e. stamen; f. carpel.

verticillasters or in short-stalked cymes, or both, 2–6-flowered, axillary; pedicels to 1 cm long. Calyx campanulate; tube 6–8 mm long, 10-ribbed, 5-lobed or toothed; lobes or teeth subequal, subulate or linear, 2–4 mm long, acuminate. Corolla 6–8 mm long, blue or blue-purple; tube *c.* 4 mm long, 5-lobed; lobes sub-bilabiate (2+3); upper lip erect, *c.* 3 mm long; lower lip deflexed, saccate, short, bifid, membranous, finely hispid outside, pubescent beneath the stamens inside. Stamens 4, didynamous, declinate, descending into the lower lip, partly exserted; filaments *c.* 3 mm long, bearded; anthers *c.* 1 mm long, 2-celled. Ovary *c.* 1 mm long, one lobe slightly smaller; style gynobasic, *c.* 4.5 mm long; stigma minutely bifid. Disk anteriorly developed. Nutlets 2, ovoid or oblong, *c.* 4 × 2–2.5 mm, apically emarginated, with a white V-shaped attachment scar, brownish red.

*Fl. & Fr.*: September – February

*Habitat*: Dry deciduous and scrub forests.

*Distribution*: KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Andaman and Nicobar Islands, Assam, Deccan Peninsula and West Bengal. WORLD: Mexico to tropical America, widely introduced elsewhere.

*Specimen examined*: Near Dhanarjay Nadi, Meghatari, 186 m, 24°35'00.7" N, 85°34'56.3" E, 13th September 2010, *Shyam Biswa* 49618, 49629.

## 7. OCIMUM L.

Tropical and subtropical regions, especially Africa, *c.* 65 species, 5 in India, 5 in Jharkhand and 1 in KWLS.

***Ocimum tenuiflorum*** L., Sp. Pl. 2: 597. 1753; Keng in Steenis, Fl. Males. ser. 1, 8: 378. 1978; N.P. Singh & al., Fl. Bihar: 418. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 704. 2005. *Ocimum sanctum* L., Mant. Pl.: 85. 1767; Hook.f., Fl. Brit. India 4: 609. 1885; Haines, Bot. Bihar Orissa: 729. 1922; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 506. 2002.

Vern. Name: *Tulsi* (Hindi).

Herb, perennial, 20–60 cm high. Stems erect, 4-angular, woody at base, with short and long spreading hairs. Leaves simple, opposite, lanceolate or ovate-oblong to elliptic, 6–15 × 3–8 mm, acute or attenuate at base, serrate to serrulate at margins, acute at apex, pubescent on both surfaces; petioles 2–5 mm long, hairy. Verticillasters 8–10, separated, 3–6-flowered. Flowers with strong fragrant; bracts *c.* 2 mm long; pedicels 2–3 mm long, spreading in fruit; pedicels spreading in fruit, terete or more or less so. Calyx campanulate, *c.* 3 mm long, villous; tube *c.* 1.5 mm long; tube glabrous inside in fruit; middle tooth of upper lip broadly oblate, abruptly acute; lateral teeth broadly triangular, shorter than lower lip teeth, spinescent; lower lip teeth lanceolate, spinescent at apex; fruiting calyx 5–6 × 4–5 mm, conspicuously veined. Corolla *c.* 3 mm long, slightly exserted, sparsely puberulent, white; tube *c.* 2 mm long, dilated at throat; upper lip *c.* 1 × 2.5 mm; lobes ovate; lower lip oblong, *c.* 1 × 0.6 mm, flat. Stamens slightly exserted, free; posterior filaments puberulent at base. Nutlets oblong-ellipsoid, *c.* 2 × 1 mm, foveolate, brownish.

*Fl. & Fr.*: Throughout the year.

*Habitat*: Open localities.



*Distribution:* KWLS: Neru Pahari; very common. INDIA: Throughout, grown as a religious and medicinal plant. WORLD: Africa, South-west Asia, Australia, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam.

*Specimen examined:* Neru Pahari, 415 m, 24°29'20.8" N, 85°39'36.5" E, 5th March 2011, *Shyam Biswa* 49670.

## 8. ORTHOSIPHON Benth.

Old World tropical regions, *c.* 40 species, *c.* 10 in India, 4 in Jharkhand and 1 in KWLS.

**Orthosiphon pallidus** Royle ex Benth. in Hook., Bot. Misc. 3: 370. 1833; Hook.f., Fl. Brit. India 4: 613. 1885; Haines, Bot. Bihar Orissa: 730. 1922; N.P. Singh & al., Fl. Bihar: 418. 2001.

### Plate 59F

Herb, 20–40 cm high; branches numerous from the woody rootstock. Stems 4-angled, hairy. Leaves sessile, simple, opposite, lanceolate-oblong, 6.5–12 × 2–5 cm, attenuate at base, serrate or coarsely dentate or crenate at margins, acute at apex, scabrid. Verticillasters distant, 6-flowered, in short racemes; pedicels *c.* 5 mm long, pubescent. Calyx *c.* 1 cm long; 2 lowest teeth with long, upcurved awns; throat naked. Corolla exceeding calyx, white or pale lilac; upper lip shorter than the suborbicular, concave lower lip. Stamens 4, declinate, usually exserted; filaments free, without any basal appendage; anther cells confluent. Disk usually globose. Ovary *c.* 0.5 mm long; style entire or slightly notched; stigma capitate, minute. Nutlets 4, subglobose, compressed, nearly smooth, yellowish brown.

*Fl. & Fr.:* August – November.

*Habitat:* Shade localities in dry deciduous forests.

*Distribution:* KWLS: Khalaktambi forest; common. INDIA: Almost throughout. WORLD: Africa to India.

*Specimen examined:* Khalaktambi forest, 371 m, 24°30'29.2" N, 85°33'54.9" E, 12th August 2011, *Shyam Biswa* 49784.

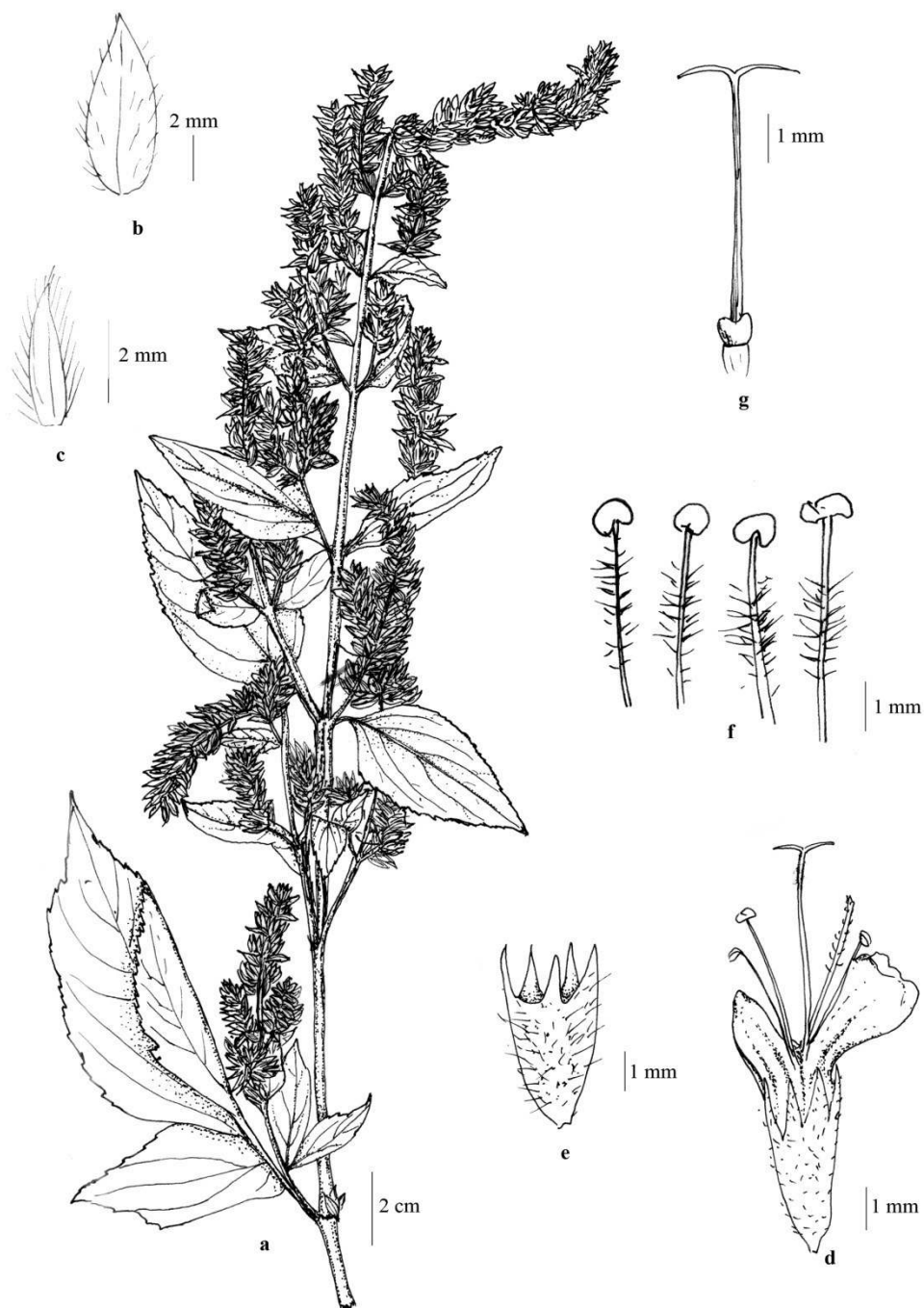
## 9. POGOSTEMON Desf.

South and East Asia to Japan and Australia, a few in south tropical Africa, *c.* 85 species, 54 in India, 8 in Jharkhand and 1 in KWLS.

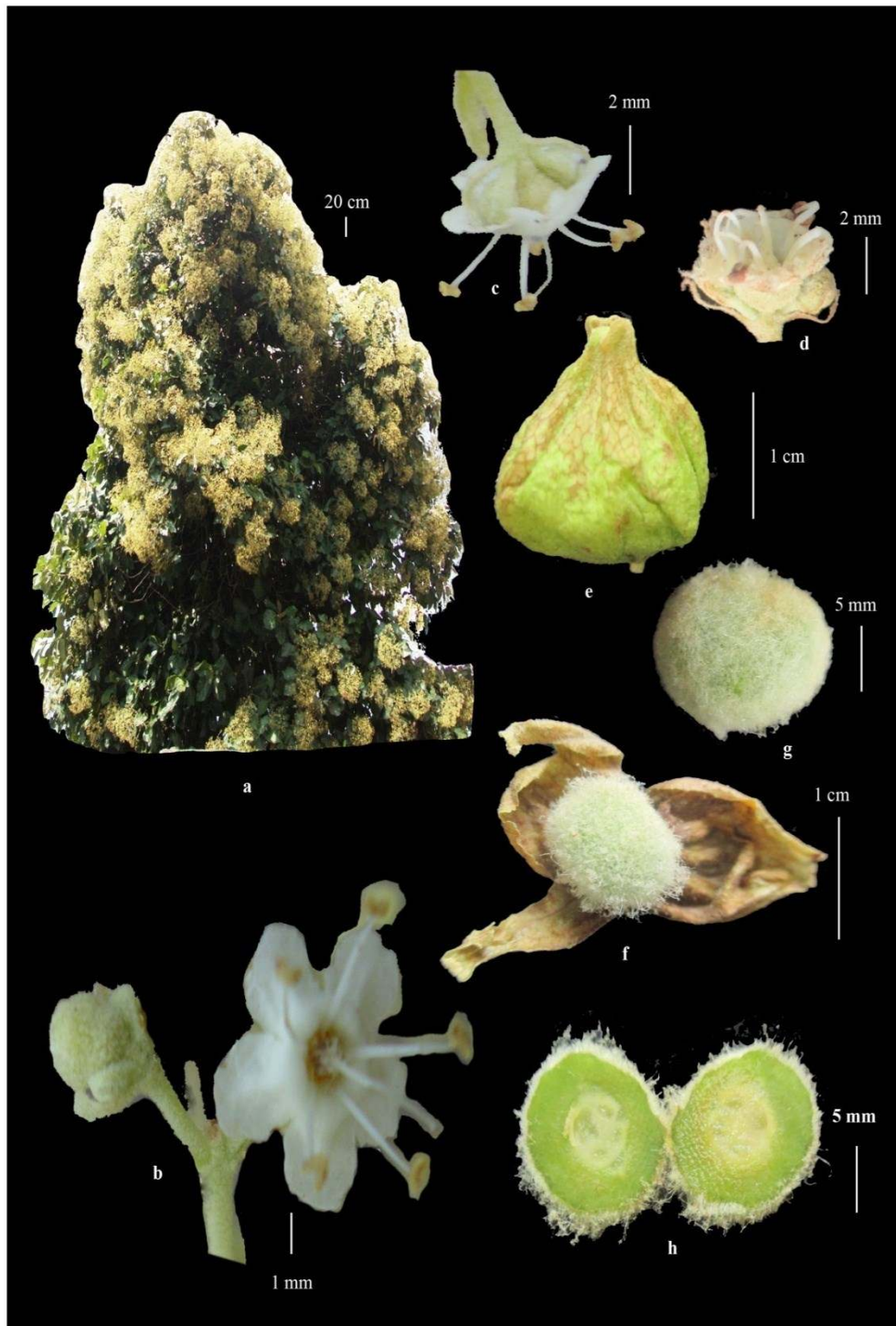
**Pogostemon benghalensis** (Burm.f.) Kuntze, Revis. Gen. Pl. 2: 529. 1891; N.P. Singh & al., Fl. Bihar: 421. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 508. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 708. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 183. 2014. *Origanum benghalense* Burm.f., Fl. Ind.: 128, t. 38, f. 3. 1768. *Pogostemon plectranthoides* Desf., Ann. Mus. Nat. Hist. Paris 2: 155, t. 6. 1803; Hook.f., Fl. Brit. India 4: 632. 1885; Haines, Forest Fl. Chota Nagpur: 490. 1910 & Bot. Bihar Orissa: 737. 1922; Mooney, Suppl. Bot. Bihar Orissa: 124. 1950.

### Fig. 55; Plate 59G

Undershrub, 0.5–2 m high. Stems 4-angular, slightly grooved. Leaves simple, opposite, ovate or ovate-lanceolate, 2–10 × 0.6–5 cm, cuneate to acute at base, serrate at margins, acute to acuminate at apex, sparsely hairy or glabrous; lower leaves larger, upper ones smaller; petioles 1–3 mm long. Flowers 1–1.2 cm long, in subcapitate whorls or cymes arranged in densely paniced spikes or contracted racemes of 1.5–7 cm long, strongly fragrant; bracts 5–8 × 2–3.5 mm, ovate



**Fig. 55. *Pogostemon benghalensis* (Burm.f.) Kuntze:** a. flowering twig; b. bract; c. bracteole; d. flower; e. calyx; f. stamens; g. carpel.



**Fig. 56.** *Tectona grandis* L.f.: a. habit; b flower and flower bud; c.,d. flower (lower and upper views); e. fruit; f. fruit split open; g. fruit with bracts removed; h. tranverse section of fruit.

or oblong-rhomboid, villous, overtopping the flower buds; pedicels hairy. Calyx 5-toothed, 4–4.5 mm long, with pink dots, hairy on the outer surface. Corolla 5–7 mm long, hairy outside, white or cream-coloured; lips diverging; tube slender, *c.* 5 mm long; upper lip 3-lobed; lower lip 1-lobed, entire. Stamens 4, epipetalous, exerted beyond corolla lobes; filaments 3–5 mm long, bearded or hairy all over, pinkish or purplish; anthers *c.* 0.5 mm long, light yellowish white, dorsifixed. Carpels 6–10 mm long; ovary 0.2–0.4 mm long, hypogynous, 4-partite; style gynobasic, 5–6 mm long; stigma bifid, 0.5–1 mm long, purplish. Nutlets ovoid or oblong, *c.* 1 mm long, smooth, brownish.

*Fl. & Fr.*: February – April.

*Habitat*: Moist and shade localities near river.

*Distribution*: KWLS: Phutlaiya Nala; occasional. INDIA: Andhra Pradesh, Assam, Bihar, Goa, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Tripura, West Bengal and Western Himalayas. WORLD: Bangladesh and Myanmar.

*Specimen examined*: Phutlaiya Nala, 328 m, 24°30'36.3" N, 85°39'30.1" E, 27th February 2012, Shyam Biswa 54009.

#### 10. **TECTONA** L.f., nom. cons.

Southeast Asia to Malesia, 4 species and 1 in India.

**Tectona grandis** L.f., Suppl. Pl.: 151. 1782; C.B. Clarke in Hook.f., Fl. Brit. India 4: 570. 1885; Haines, Forest Fl. Chota Nagpur: 478. 1910 & Bot. Bihar Orissa: 710. 1922; N.P. Singh & al., Fl. Bihar: 404. 2001; A. Rajendran & P. Daniel, Indian Verbenac.: 320. 2002; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 492. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 681. 2005.

**Fig. 56; Plate 60A**

Vern. Names: *Sagwan*, *Sagun* (Hindi).

Tree, 12–25 m high; branches quadrangular, stellate-hairy. Leaves simple, opposite or in whorls, broadly ovate or elliptic or obovate, 15–40 × 12–30 cm, attenuate at base, entire at margins, acute or obtuse at apex, scabrid with few stellate hair above, densely stellate and tomentose beneath; petioles 3–5 cm long. Inflorescence a panicle, stellate-tomentose. Flower 5–9 mm across, short-pedicellate; bracts 2, linear to lanceolate, 5–10 mm long, foliaceous at terminal branchlets. Calyx 6-lobed; lobes 3–4 mm long, densely stellate-tomentose outside. Corolla white; tube 0.5–1.5 mm long, 5-lobed; lobes rounded, 3–4 mm. Stamens 6; filaments epipetalous, 2–3 mm long, glabrous, white; anthers basifixed, yellow. Carpels 4; ovary *c.* 1 mm across; style slender, 3–4 mm long, 4-lobed, one ovule in each lobe. Drupes subglobose, 1.2–1.4 cm diam., enclosed in a membranous bladder-like calyx, 1.5–2.5 cm diam., densely tomentose.

*Fl. & Fr.*: August – January.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: Almost throughout. WORLD: Malaya Peninsula, Myanmar to Malacca; cultivated almost throughout the tropical regions, for its valuable timber.

*Specimen examined:* Chattarbar forest, 375 m, 24°28'36.5" N, 85°32'20.5" E, 19th August 2011, *Shyam Biswa* 49838.

### 11. VITEX L.

Tropical to temperate regions, *c.* 250 species, 13 in India, 6 in Jharkhand and 1 in KWLS.

**Vitex negundo** L., Sp. Pl. 2: 638. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 4: 538. 1885; Haines, Forest Fl. Chota Nagpur: 478. 1910 & Bot. Bihar Orissa: 711. 1922; N.P. Singh & al., Fl. Bihar: 406. 2001; A. Rajendran & P. Daniel, Indian Verbenac.: 361. 2002; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 49. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 682. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 175. 2014. **Plate 60B & C**

Vern. Name: *Shivari* (Hindi).

Shrub, 2–5 m high. Stems and branches 4-angular, slender, white or grey-pubescent. Leaves palmately 3–5-foliolate, opposite; petioles 1–4.5 cm long, canaliculate, pubescent; leaflets linear-lanceolate or elliptic-lanceolate, 2.5–9 × 0.8–2 cm, cuenate to attenuate at base, entire at margins, acuminate at apex; middle leaflet largest with petiolule 0.1–2 cm long; petiolules of lateral leaflets *c.* 1 mm long, sparsely pubescent above, grey or white-pubescent beneath, dark green; lateral veins 12–18 pairs, subparallel. Inflorescence a panicle, terminal, 15–20 cm long; peduncles obtusely 4-angular, sulcate between angles, 3–7 cm long, pubescent; bracts foliaceous, lanceolate, caducous. Flowers fragrant; pedicels 0.5–1 mm long, pubescent. Calyx campanulate or cup-shaped, 2–2.5 × *c.* 2 mm, 5-toothed; teeth acute, *c.* 1 mm long, pubescent outside, greyish. Corolla hypocrateriform, 6–8 mm long, 2-lipped, 5-lobed, bluish violet; upper lip 2-lobed; lobes ovate, 1.5–2 mm long; lower lip 3-lobed; midlobe obovate, subentire, concave, 3–4 mm long; lateral lobes ovate, acute, *c.* 2 mm long; tube narrow, ampliate towards apex, 3–4 × 1–2 mm, densely villous at throat, pubescent outside. Stamens 4, didynamous; filaments slender, 3–5 mm long, exserted, glabrous above, densely villous at base, white or light purple; anthers oblong, *c.* 1 mm long, basifixed, purplish. Ovary oblong, *c.* 2 mm long, glabrous; style slender, *c.* 6 mm long, exserted, glabrous, blue; stigma 2-lobed; lobes subulate, subequal. Drupes subglobose, 5–6 × 4–5 mm, glabrous, shiny, black; fruiting-calyx cupular, 3–3.5 × 4–5 mm, shallowly toothed, densely pubescent.

*Fl. & Fr.:* August – December.

*Habitat:* Scrub forests and on hedges.

*Distribution:* KWLS: Dhodhakola forest; common. INDIA: Throughout. WORLD: Afghanistan, Bangladesh, Brazil, Cambodia, China, Japan, Iran, Kenya, Madagascar, Maldives, Mascarene Islands, Mozambique, Nepal, Pakistan, Philippines, Tanzania, Taiwan, USA and Vietnam.

*Specimen examined:* Dhodhakola forest, 381 m, 24°33'15.1" N, 85°39'37.9" E, 17th August 2011, *Shyam Biswa* 49826.

### 95. MAZACEAE Reveal

Asia, Australia, New Zealand and Russia, 3 genera and 33 species; 2 genera and 5 species in India

#### MAZUS Lour.

East and Southeast Asia to Australia and New Zealand, *c.* 30, 3 in India and 1 in Jharkhand.



**Mazus pumilus** (Burm.f.) Steenis, Nova Guinea Ser. 2, 9: 31. 1958; N.P. Singh & al., Fl. Bihar: 359. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 450. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 740. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 159. 2014. *Lobelia pumila* Burm.f., Fl. Ind.: 186, t. 60, f. 3. 1768. *Lindernia japonica* Thunb. in J.A. Murray, Syst. Veg., ed. 14: 567. 1784. *Mazus japonicus* (Thunb.) Kuntze, Revis. Gen. Pl. 2: 462. 1891; Mooney, Suppl. Bot. Bihar Orissa: 94. 1950. 1891. *Mazus rugosus* Lour., Fl. Cochinch. 2: 385. 1790; Hook.f., Fl. Brit. India 4: 259. 1884; Haines, Bot. Bihar Orissa: 621. 1922. **Plate 60D**

Herb, procumbent. Stems terete, pubescent. Leaves simple, basal, obovate-spathulate to ovate-oblongate, 2–4.5 × 0.4–1.2 cm, cuneate or attenuate at base, shallowly dentate or crenate or irregularly toothed at margins, obtuse at apex, subglabrous or with scattered hairs; petioles of basal leaves to 10 mm long. Racemes terminal, elongated, usually 3–15-flowered, lax; pedicels 2–10 mm long; bracts 0.5–1.5 mm long in flowers, to 3 mm in fruits. Calyx campanulate, 4–6 mm long, 5-lobed, enlarged in fruits; lobes ovate, almost as long as tube, acute at apex, stellate-spreading. Corolla c. 1 cm across, white; lower and middle lobes smaller than lateral lobes, obovate, slightly exserted; upper lip lobes ovate-triangular. Stamens 4, didynamous, inserted on corolla tube; anther locules divergent, apically connivent. Ovary glabrous; style c. 7 mm long, white; stigma 2-lamellate, white. Capsules subglobose, 3–4 mm long, indehiscent. Seeds c. 0.4 mm long, light brownish or yellowish brown.

*Fl. & Fr.*: February – March.

*Habitat*: Damp or moist localities.

*Distribution*: KWLS: Bon Kali, Pipra Tan; common. INDIA: Almost throughout. WORLD: Bhutan, China, Indonesia, Japan, Kashmir, Korea, Nepal, New Guinea, Philippines, Russia, Thailand and Vietnam.

*Specimen examined*: Bon Kali, Pipra Tan, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 49872.

## 96. OROBANCHACEAE Vent., nom. cons.

Northern Hemisphere to tropical regions, 96 genera and c. 2100 species; 7 genera and 32 species in India.

### STRIGA Lour.

Old World, tropical regions to South Africa, 33 species, 7 in India, 3 in Jharkhand and 1 in KWLS.

**Striga angustifolia** (D. Don) C.J. Saldanha in Bull. Bot. Surv. India 5: 70. 1963; N.P. Singh & al., Fl. Bihar: 362. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 452. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 746. 2005. *Buchnera angustifolia* D. Don, Prodr. Fl. Nepal.: 91. 1825. **Plate 60E**

Herb, 20–40 cm high, hemi-parasite. Stems erect, subquadrangular, simple, unbranched or rarely apically branched, hispidulous. Leaves simple, alternate, sessile, linear, 1.2–3 × 1–2 mm, truncate at base, entire at margins, acute at apex, pubescent, lower ones smaller, scabrous hairy. Inflorescence a spike; flowers in axils of long, alternate sessile bracts; bracts similar to leaves in

shape and size; pedicels 1–2 mm long. Bracteoles linear, *c.* 1 mm long. Calyx 8–10 mm long, 15-ribbed, hispidulous along ribs, 5-lobed; lobes almost as long as tube, subulate. Corolla 1.2–1.5 cm long, white; tube 8–1.3 × *c.* 1 mm, bent near limb, shortly glandular-pubescent; upper lip of limb emarginate, 1–3 mm long; lower lip 3-lobed; lobes 3–5 mm long. Stamens 4, didynamous, inserted in upper part of tube; anthers basifixed, 1-locular. Ovary with a nectary at base; style terete; stigma bifid. Capsules obovoid-oblong, *c.* 4.5 × 3 mm. Seeds brown, minute.

*Fl. & Fr.*: September – November.

*Habitat*: On hillslopes, dry deciduous forest.

*Distribution*: KWLS: Dhawjadhari Pahar; occasional. INDIA: Almost throughout. WORLD: Africa, Bangladesh Bhutan, China, Indonesia, Myanmar, Nepal, Oman, Pakistan, Sri Lanka and Vietnam.

*Specimen examined*: Dhawjadhari Pahar, 561 m, 24°28'53.1" N, 85°35'39.3" E, 7th September 2010, *Shyam Biswa* 49595.

## 97. CAMPANULACEAE Juss., nom. cons.

Cosmopolitan, 79 genera and *c.* 1900 species; 12 genera and 46 species in India.

### Key to genera

- 1a. Herbs prostrate; corolla zygomorphic with 2 unequal lips; 2-lobed lip divided to base; anthers fused at anthesis **1. Lobelia**
- 1b. Herbs erect; corolla actinomorphic with all lobes equal and equally divided; anthers free at anthesis **2. Wahlenbergia**

### 1. LOBELIA L.

Tropical, subtropical, and few temperate regions, *c.* 300 species, 16 in India, 3 in Jharkhand and 1 in KWLS.

**Lobelia alsinoides** Lam., *Encycl.* 3: 588. 1792; N.P. Singh & al., *Fl. Bihar*: 283. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 364. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 803. 2005. *Lobelia trigona* Roxb., *Fl. Ind.* 2: 111. 1824; C.B. Clarke in Hook.f., *Fl. Brit. India* 3: 423. 1881; Haines, *Bot. Bihar Orissa*: 500. 1922. *Lobelia terminalis* C.B. Clarke in Hook.f., *Fl. Brit. India* 3: 424. 1881; Haines, *Bot. Bihar Orissa*: 500. 1922.

Annual. Stems procumbent to ascending, triangular, glabrous. Leaves simple, alternate, sessile or subsessile, suborbicular to ovate, 6–15 × 4–14 mm, truncate or cuneate or rounded at base, usually serrulate at margins, acute or rounded at apex, glabrous. Flowers axillary, forming a lax raceme; bracts 2, small; bracteoles lanceolate, 2–5 mm long; pedicels 1–2.5 cm long, slender, glabrous. Calyx 3–5 mm long; lobes linear, 2–3 mm long. Corolla 2-lipped, 3–5 mm long, blue. Stamens connate above middle of filaments; filament tube glabrous; anthers 1–1.5 mm long, glabrous at back, bearded at apex. Ovary inferior, 2-locular; ovules numerous; stigma 2-fid. Capsules 5–8 × 3–4 mm. Seeds angularly trigonous, *c.* 0.5 mm long, dark brown.

*Fl. & Fr.*: February – March.

*Habitat*: Near the pond and in moist localities.

*Distribution:* KWLS: Bon Kali, Pipra Tan; Near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Almost throughout. WORLD: Bangladesh, China, Japan, Laos, Malaysia, Myanmar, Nepal, New Guinea, Sri Lanka, Thailand and Vietnam.

*Specimens examined:* Bon Kali, Pipra Tan, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 49875; Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, *Shyam Biswa* 49884.

## 2. **WAHLENBERGIA** Schrad. ex Roth, nom. cons.

Sub-cosmopolitan, *c.* 125 species, 6 in India, 4 in Jharkhand and 1 in KWLS.

**Wahlenbergia marginata** (Thunb.) DC., Monogr. Campan.: 143. 1830; N.P. Singh & al., Fl. Bihar: 285. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 363. 2002. *Campanula marginata* Thunb. in Murray, Syst. Veg., ed. 14: 211. 1784. *Wahlenbergia gracilis* DC., Monogr. Campan.: 142. 1830; C.B. Clarke in Hook.f., Fl. Brit. India 3: 429. 1881; Haines, Bot. Bihar Orissa: 503. 1922; Mooney, Suppl. Bot. Bihar Orissa: 82. 1950. **Plate 60F**

Herb, 10–30 cm high. Stems terete, erect, branched at base, glabrous or sparsely hairy. Leaves simple, alternate, sessile, linear to oblong, 8–20 × 2–4 mm, attenuate at base, undulate, obscurely denticulate at margins, acute to obtuse at apex, sparsely pilose, upper leaves reduced to bracts of 5–7 mm long, hairy. Panicles usually bifurcate. Flowers narrowly campanulate, *c.* 6 mm long; pedicels 3–20 mm long. Calyx 4–5 mm long, 5-lobed; lobes linear, *c.* 2 mm long. Corolla campanulate, 5-lobed; lobes narrowly ovate, 4–5 mm long, glabrous, white. Stamens free from corolla; filaments often dilated at base as a rhomboid membrane, inclined inwards, filiform above; anthers oblong, free. Ovary *c.* 2 × 2 mm, 3-loculed; style slender, *c.* 2 mm long; stigma 3-lobed, *c.* 1 mm long. Capsules erect, obconical, 5–7 mm long; seeds many, compressed-ellipsoid, *c.* 0.5 mm long.

*Fl. & Fr.:* February – April.

*Habitat:* Near the pond or in moist places.

*Distribution:* KWLS: Near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Almost throughout. WORLD: Bhutan, China, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Sri Lanka and Vietnam; naturalized in the Pacific Islands (Hawaiian Islands) and North America.

*Specimen examined:* Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49886.

## 98. **MENYANTHACEAE** Dumort., nom. cons.

Cosmopolitan, 5 genera and *c.* 55 species; 1 genus and 4 species in India.

### **NYMPHOIDES** Ség.

Cosmopolitan, 38 species, 5 in India, 2 in Jharkhand and KWLS.

### **Key to species**

- 1a. Leaves thick, to 7 cm long; corolla lobes densely fimbriate-pilose outside; seeds subglobose, 1.2–1.5 mm long, smooth, shiny **2. N. indica**
- 1b. Leaves thin, to 14.5 cm long; corolla lobes glabrous inside, with a longitudinal fold; seeds globose, 1.5–2 mm, scabrous **1. N. hydrophyllum**

**1. *Nymphoides hydrophyllum* (Lour.) Kuntze, Revis. Gen. Pl. 2: 429. 1891. *Nymphoides cristata* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 429 1891. *Menyanthes cristata* Roxb., Pl. Coromandel 2(1): 3, t. 105. 1799; N.P. Singh & al., Fl. Bihar: 321. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 405. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 647. 2005. *Limnanthemum cristatum* (Roxb.) Griseb., Gen. Sp. Gent.: 342. 1838; C.B. Clarke in Hook.f., Fl. Brit. India 4: 131. 1883; Haines, Bot. Bihar Orissa: 571. 1922. **Plate 60G****

Herb, floating. Stems unbranched, terete, rooting at nodes, slender, submerged. Leaves simple, broadly ovate or ovate-orbicular, 2.5–7 × 2–6 cm, deeply cordate at base, entire or slightly crenate at margins, obtuse or rounded at apex, thin, green with rim dark pinkish. Each petioloid stem bearing a single umbel of 2.5–7 cm long below leaf; peduncles usually 5–20 cm long, 1 or 2-flowered; pedicels 0.5–7 cm long. Sepals 5, lanceolate or linear-oblong, 4–6 × 1–1.5 mm, acute. Corolla white, and yellow towards base; tube 1–2 mm long; lobes ovate-oblong or obovate, 5–10 × 4–8 mm, obtuse, with a median longitudinal, undulate fold on inner surface, undulate at margins, emarginate at apex. Stamens alternating with staminodes; fertile stamens 5; filaments linear, 1–2 mm long; anthers 0.5–1 mm long. Ovary ovoid, 2–3 × 1–2 mm; style c. 0.5 mm long; stigma lobes triangular, greenish. Capsules broadly subglobose, 3–5 × 2–4 mm, 5–10-seeded. Seeds sub-globose, 1.5–2 mm long, scabrous, whitish.

*Fl. & Fr.*: April – November.

*Habitat*: Freshwater ponds and lakes.

*Distribution*: KWLS: Lokai pond, near the road; common. INDIA: Almost throughout. WORLD: China and Pakistan .

*Specimen examined*: Lokai pond, near the road, 399 m, 24°29'01.4" N, 85°36'52.9" E, 22nd November 2012, *Shyam Biswa* 54079.

**2. *Nymphoides indica* (L.) Kuntze, Revis. Gen. Pl. 2: 429. 1891; N.P. Singh & al., Fl. Bihar: 321. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 405. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 648. 2005. *Menyanthes indica* L., Sp. Pl. 1: 145. 1753. *Limnanthemum indicum* (L.) Griseb., Gen. Sp. Gent.: 343. 1838; C.B. Clarke in Hook.f., Fl. Brit. India 4: 131. 1883; Haines, Bot. Bihar Orissa: 570. 1922. **Plate 60H****

Herb, floating. Stems terete, unbranched, submerged. Leaves simple, broadly ovate or sub-orbicular, 3–14.5 × 3–13.5 cm, deeply cordate at base, slightly undulating or crenate at margins, rounded at apex, sub-coriaceous, densely glandular brownish dots beneath; veins palmate, indistinct; petioles tubular, 0.5–3 cm long. Flowers many, clustered at nodes; pedicels tubular, 2–8 cm long. Sepals 5 (or 7), lanceolate to narrowly elliptic, 4–8 × 1–2 mm, acute at apex. Corolla white with a yellow centre, 7-lobed; lobes linear-oblong or ovate-elliptic, 8–12 × 4–8 mm, obtuse to acute at apex, densely fimbriate-pilose outside. Stamens 7; filaments linear, 1.5–1.7 mm long, flat; anthers sagittate, 2–2.2 mm long, yellowish black. Style tubular; stigma lobes triangular. Capsules ellipsoid, 4–8 × 3–7 mm, few-seeded. Seeds globose, 1.2–1.5 mm, smooth, shiny, yellowish light brown or yellowish white.

*Fl. & Fr.*: February – April.

*Habitat*: Freshwater ponds and lakes.

*Distribution:* KWLS: Near Rheio Ghoghar Dam, Chattarbar; common. INDIA: Almost throughout. WORLD: Australia, Cambodia, China, Indonesia, Japan, Korea, Malaysia, Myanmar, Nepal, Pacific Islands, Sri Lanka and Vietnam.

*Specimens examined:* Near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.0" N, 85°33'00.0" E, 26th February 2012, *Shyam Biswa* 49880; near Rheio Ghoghar Dam, Chattarbar, 379 m, 24°27'50.2" N, 85°33'00.2" E, 3rd April 2013, *Shyam Biswa* 54153.

*Note:* Flowers in the present collections invariably with 7-lobed corolla, and the lobes dissected almost to the base, besides the flowers also have 7 stamens with yellow-coloured anthers having black strips.

## 99. ASTERACEAE Bercht. & J. Presl, nom. cons.

(= **COMPOSITAE** Giseke, nom. cons.)

Cosmopolitan, excluding Antarctica, c. 1590 genera and c. 23600 species; 166 genera and c. 800 species in India

### Key to genera

- |                                                                                             |    |                         |
|---------------------------------------------------------------------------------------------|----|-------------------------|
| 1a. Herbs prostrate, ascending or decumbent                                                 | 2  |                         |
| 1b. Herbs or shrubs, erect                                                                  | 7  |                         |
| 2a. Capitula homogamous                                                                     | 3  |                         |
| 2b. Capitula heterogamous                                                                   | 6  |                         |
| 3a. Stems winged; capitula pinkish or purple                                                |    | <b>21. Sphaeranthus</b> |
| 3b. Stems not winged; capitula yellow or whitish                                            | 4  |                         |
| 4a. Leaves serrate at margins                                                               |    | <b>1. Acmella</b>       |
| 4b. Leaves entire at margins                                                                | 5  |                         |
| 5a. Heads in terminal, globose clusters; pappus hairs free                                  |    | <b>16. Gnaphalium</b>   |
| 5b. Heads in spikes; pappus hairs united at base                                            |    | <b>15. Gamochaeta</b>   |
| 6a. Leaves pinnatisect; achenes ciliate at margins; pappus of 2 awns                        |    | <b>14. Glossocardia</b> |
| 6b. Leaves entire; achenes entire at margins; pappus of silky coma                          |    | <b>22. Tridax</b>       |
| 7a. Capitula homogenous                                                                     | 8  |                         |
| 7b. Capitula heterogenous                                                                   | 17 |                         |
| 8a. Plants armed; capitula spinescent                                                       |    | <b>10. Echinops</b>     |
| 8b. Plants not armed; capitula not spinescent                                               | 9  |                         |
| 9a. Plants spinulose-scabrid; achenes spinulose glandular-hispid                            |    | <b>24. Xanthium</b>     |
| 9b. Plants not spinulose glandular-hispid; achenes not as above                             | 10 |                         |
| 10a. Capitula radiate                                                                       | 11 |                         |
| 10b. Capitula discoid                                                                       | 12 |                         |
| 11a. Achenes narrowed at base, truncate at apex                                             |    | <b>20. Sonchus</b>      |
| 11b. Achenes truncate at base as well as at apex                                            |    | <b>18. Launaea</b>      |
| 12a. Leaves opposite, at least on lower part of stem                                        | 13 |                         |
| 12b. Leaves alternate                                                                       | 14 |                         |
| 13a. Pappus paleaceous; receptacles sometimes paleaceous                                    |    | <b>2. Ageratum</b>      |
| 13b. Pappus of slender hairs; receptacles always naked                                      |    | <b>7. Chormolaena</b>   |
| 14a. Heads distinct, many-flowered; pappus long-copious                                     | 15 |                         |
| 14b. Heads 1- or a few-flowered, crowded into dense masses like single heads; pappus chaffy |    | <b>12. Elephantopus</b> |



|                                                                                                                   |                        |
|-------------------------------------------------------------------------------------------------------------------|------------------------|
| 15a. Involucral bracts many                                                                                       | 16                     |
| 15b. Involucral bracts 2                                                                                          | <b>6. Caesulia</b>     |
| 16a. Phyllaries 1-seriate, interlocked at least below                                                             | <b>13. Emilia</b>      |
| 16b. Phyllaries 2–6-seriate, imbricate or outermost series largest                                                | <b>8. Cyanthillium</b> |
| 17a. Leaves simple, not pinnatifid                                                                                | 18                     |
| 17b. Leaves pinnatifid                                                                                            | 22                     |
| 18a. Heads with the outer florets ligulate, inner tubular                                                         | <b>23. Vicoa</b>       |
| 18b. Heads with the florets all tubular, but outer filiform 2-3-toothed                                           | 19                     |
| 19a. Florets white or greenish white                                                                              | 20                     |
| 19b. Florets yellow or pink or purple                                                                             | 21                     |
| 20a. Leaves 3-veined from base; phyllaries multiseriate                                                           | <b>3. Blainvillea</b>  |
| 20b. Leaves penni-veined; phyllaries biseriate                                                                    | <b>11. Eclipta</b>     |
| 21a. Leaves elliptic-oblongate                                                                                    | <b>4. Blumea</b>       |
| 21b. Leaves obovate or obovate-elliptic                                                                           | <b>5. Blumeopsis</b>   |
| 22a. Capitula or florets white                                                                                    | <b>19. Parthenium</b>  |
| 22b. Capitula or florets pink or yellow                                                                           | 23                     |
| 23a. Herbs erect; achenes minute, oblong, smooth; pappus absent                                                   | <b>9. Cyathocline</b>  |
| 23b. Herbs decumbent or prostrate; achenes flattened or subterete, with a terminal toothed or bristly pappus-ring | <b>17. Grangea</b>     |

1. **ACMELLA** Rich. ex Pers.

Tropical with some Pantropical regions, *c.* 30 species, 3 in India, [3 in Jharkhand (*Spilanthes*)], and 1 in KWLS.

**Acmella paniculata** (Wall. ex DC.) R.K. Jansen, Syst. Bot. Monogr. 8: 67. 1985. *Spilanthes paniculata* Wall. ex DC., Prodr. 5: 625. 1836; Sivar. & Remesan, J. Econ. Taxon. Bot. 10: 143. 1987; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 357. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.: 128. 2014; H.J. Chowdhery in Hajra & al., Fl. India 12: 410. 1995; Hook.f., Fl. Brit. India 3: 307. 1881.

**Plate 61A**

Herb, 10–30 cm high. Stems terete, glabrous. Leaves simple, opposite, ovate-lanceolate, 1–1.5 × 0.2–0.7 cm, attenuate at base, slightly serrate at margins, acute at apex, glabrous; petioles 0.6–1.5 cm long, pubescent. Capitula in corymbose panicle, terminal, heterogamous, discoid, 5–10 × 5–8 mm; peduncles 1–5 cm long, glabrous. Phyllaries 1 or 2-seriate, elliptic or oblanceolate, 2–3 mm long; paleae oblong, 2.5–3 mm long, concave. Ray florets: unisexual, female only; corolla 1.5–2 mm long; stamens 0; pistil 1–1.2 mm long; stigma bifid 0.5–0.8 mm across. Disk florets: corolla 1–1.5 mm long, 4- or 5-lobed in same head; stamens 3 or 5, *c.* 0.5 mm long; anthers basifixed, purplish blackish; pistil 1–1.5 mm long bifid. Achenes oblong, 1.5–1.8 × 0.8–1 mm, truncate at apex, border ciliate, dark blackish; pappus bristles present, *c.* 0.8 mm long, often not exceeding cilia but scabridulous.

*Fl. & Fr.*: September – March.

*Habitat*: Marshy and wet localities.

*Distribution*: KWLS: near the river Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Indonesia (Java) and Sri Lanka.

*Specimen examined:* Near the river Dhanarjay Nadi, Meghatari, 181 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49687.

## 2. **AGERATUM** L.

Tropical America, *c.* 40 species, 2 in India, 2 in Jharkhand and 1 in KWLS.

**Ageratum conyzoides** L., Sp. Pl. 2: 839. 1753; Hook.f., Fl. Brit. India 3: 243. 1881; Haines, Forest Fl. Chota Nagpur: 514. 1910 & Bot. Bihar Orissa: 462. 1922; Uniyal in Hajra & al., Fl. India 12: 348. 1995; Ranjan, Fl. Parasnath Wildlife Sanct.: 119. 2014. *Ageratum cordifolium* Roxb., Fl. Ind. 3: 415. 1832. N.P. Singh & al., Fl. Bihar: 251. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 322. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 863. 2005.

**Plate 61B**

Herb, 10–40 cm high, aromatic. Stems, terete, decumbent sparsely puberulous. Leaves simple, opposite, broadly ovate, 0.6–4.5 × 0.2–3 cm subcordate at base, bluntly serrate at margins, acute to obtuse at apex, sparsely puberulous on both surface, palmately 3-veined at base; petioles 0.1–2 cm long, puberulous. Capitula terminal, branched corymbs, 4–8 × 5–10 mm, homogamous, white or violet; peduncles 0.5–2 cm long, pubescent. Phyllaries 2 or 3-seriate, linear-oblong, 3–4 × 0.5–1 mm, abruptly acuminate at apex, sparingly hairy, 2 or 3-veined. Paleae *c.* 3 mm long, finely ciliate at margins. Disk florets: Corolla 2.5–3 mm long, white or purplish; tube *c.* 2.5 mm long, lobes 5 acute at apex. Stamens 5; anthers 0.5–0.8 mm long apiculate at apex, filament *c.* 0.5 mm long. Ovary oblong, *c.* 1.2 mm long; style *c.* 2–3 mm long; stigma *c.* 1 mm long bifid, obtuse. Achenes oblong-obconic, 1.5–2 mm long, 5-angled, glabrous or minutely hirsute on angles; pappus scales 5, lanceolate, barbellate awned at apex, scabrous on margins, 2–2.5–0.2–0.3 mm, glabrous.

*Fl. & Fr.:* Throughout the year.

*Habitat:* Ground vegetation of Dry deciduous forests or open forests.

*Distribution:* KWLS: Koderma NRF, near the Koderma Rest House; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined:* Koderma NRF, near the Koderma Rest House, 396 m, 24°29'04.4" N, 85°35'49.6" E, 10th March 2011, *Shyam Biswa* 49743; near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 31st March 2013, *Shyam Biswa* 54137.

## 3. **BLAINVILLEA** Cass.

America, some now Pantropical, *c.* 10 species, 1 in India.

**Blainvillea acmella** (L.) Philipson, Blumea 6: 350. 1950; Chowdhery in Hajra & al., Fl. India 12: 377, f. 101. 1995; N.P. Singh & al., Fl. Bihar: 254. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 325. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 866. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 120. 2014. *Verbesina acmella* L., Sp. Pl. 2: 901. 1753. *Blainvillea latifolia* (L.f.) DC. ex Wight, Contr. Bot. India: 71. 1834; Hook.f., Fl. Brit. India 3: 305. 1881; Haines, Bot. Bihar Orissa: 480. 1922.

**Plate 61C**

Annual. Stems erect, 50–65 cm high, branched. Leaves, simple, opposite, ovate to ovate-lanceolate  $3\text{--}10.5 \times 1.2\text{--}5.5$  cm, cuneate to attenuate at base, serrate at margin acute to acuminate at apex, both surfaces scabrid; petioles 1.5–2.5 cm long; upper leaves smaller. Capitula heterogamous, axillary or terminal, 0.8–1.2 cm in diameter; peduncles slender, 15–40 mm, with spreading hairs; phyllaries 2-seriate, outer papery, green, ovate-oblong, 6–7 mm, dorsally densely hairy, apex shortly acute or obtuse, inner ovate to oblong-linear, c. 5 mm, sparsely pubescent, apex acute; paleae oblong-lanceolate, 5–6 mm, dorsally pubescent, apex aristiform. Ray florets 1-seriate, white, lamina 3 mm, apex 2–4-toothed. Disk florets campanulate, lobes 5-toothed, 3.2–3.5 mm long, stamens 5 filament 0.2–0.4 mm long, anthers 0.5–0.7 mm long blackish, basifixed. Achenes densely pubescent, those in female florets 3-angled  $c. 4 \times 2$  mm, those in bisexual florets compressed, c. 4 mm; pappus short, unequal, 2–5.

*Fl. & Fr.*: April – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: inside the enclosure forest Koderma NRF; occasional. INDIA: Andhra Pradesh, Bihar, Gujarat, Jammu & Kashmir, Karnataka, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. WORLD: Indonesia, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam; Africa, Australia, South America.

*Specimen examined*: Inside the enclosure forest, Koderma NRF, 390 m,  $24^{\circ}29'18.7''$  N,  $24^{\circ}29'18.7''$  E, 16th September 2010 *Shyam Biswa* 49631 & 49828.

#### 4. BLUMEA DC.

Old World Tropical regions, c. 100 species, c. 30 in India, 12 in Jharkhand and 1 in KWLS.

**Blumea lacera** (Burm.f.) DC. in Wight, Contr. Bot. India: 14. 1834; Hook.f., Fl. Brit. India 3: 263. 1881; Forest Fl. Chota Nagpur: 516. 1910 & Bot. Bihar Orissa: 470. 1922. S. Kumar in Hajra & al., Fl. India 13:128. 1995; N.P. Singh & al., Fl. Bihar: 256. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 326. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 868. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.: 121. 2014. *Conyza lacera* Burm.f., Fl. Ind. 180. t. 59. f.1. 1768.

**Plate 61D**

Herb, 15–70 cm high. Stems terete, ribbed, hollow, branched usually from base; branches hairy and stipitate glands particularly in younger parts. Leaves simple, alternate, basal and cauline, elliptic-oblong,  $1\text{--}10.5 \times 0.6\text{--}4.5$  cm, acute to shortly decurrent at base, irregularly crenate-dentate at margins, subacute to rounded at apex, lyrate-lobed, densely hairy on both surfaces; petioles 0.5–2 cm; petioles upto c. 2.5 cm long, hairy. Capitula  $5\text{--}6 \times 5\text{--}10$  mm, heterogamous, disciform, in large, terminal, corymbose panicles; peduncles 0.5–1.5 cm long, glandular pubescent. Phyllaries linear-lanceolate to oblong-lanceolate,  $2\text{--}4 \times 0.3\text{--}0.5$  mm, usually tinged with purple, reflexed at maturity, villous, glandular. Receptacles 2.5–5 mm in diameter, alveolate, pilose around alveolate. Bisexual florets: Corolla, tubular 2–2.5 mm long, 5-lobed, yellow; lobes triangular, pubescent with colleters. Stamens sub-exserted, 1–1.2 mm long; filaments c. 0.5 mm long. Ovary oblong, c. 0.5 mm long, subangulate, puberulous; style c. 2.5 mm; stigma acute, puberulous. Female florets: Corolla 2.5–3 mm long, 2–3 lobed; minutely toothed. Ovary oblong, 0.5 mm, smooth or angled; style 3.5–4.5 mm; stigma subulate, bifid. Achenes oblong, angular, terete, 0.5–1 mm long, sparsely pubescent, yellowish-brown; pappus white, 2.5–3 mm long.

*Fl. & Fr.*: February – March.

*Habitat*: Scrub forests.

*Distribution*: KWLS: Dhodhakola forest near Chota more; common. INDIA: Throughout the plains. WORLD: Pantropical.

*Specimens examined*: Dhodhakola, Chota More, 343 m, 24°33'08.8" N, 85°39'42.1" E, 5th March 2011, *Shyam Biswa* 49677; Rajdah, Meghatari, 188 m, 24°34'47.8" N, 85°35'56.0" E, 8th March 2011, *Shyam Biswa* 49727.

## 5. **BLUMEOPSIS** Gagnep.

India to West Malesia, Probably monotypic.

**Blumeopsis flava** (DC.) Gagnep., Bull. Mus. Natl. Hist. Nat. 26: 76. 1920; S. Kumar in Hajra & al., Fl. India 13:145, f. 45. 1995; N.P. Singh & al., Fl. Bihar: 258. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 329. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 872. 2005. *Blumea flava* DC., Prodr. 5: 439. 1836; Haines, Bot. Bihar Orissa 472. 1922. *Laggera flava* (DC.) Benth. in Gen. Pl. 2(1): 290. 1873; Hook.f., Fl. Brit. India 3: 270. 1881.

**Plate 61E**

Herb, 15–45 cm high, erect; stems terete ribbed, glabrous. Leaves simple, alternate, obovate or obovate-elliptic, 2–9.5 × 1–4 cm amplexicaul at base, spinulose-dentate at margins, rounded at apex; glabrate or thinly hairy, sessile. Bracts linear c. 2 mm long hairy. Capitula terminal and axillary, golden yellow 5–6 mm long. Peduncle 5–6 mm long hairy. Phyllary / Involucral bracts 1 to 3 seriate, linear-lanceolate, 5–6 × 0.5 mm, acuminate at apex, glabrous. Corolla of disk florets 4.5–5 mm long. Anthers tailless. Stigma bi-fid; style 3–3.5 mm long. Corolla of marginal florets 2–3 mm long. Achenes very small, glabrous; pappus white, 3–3.5 mm long.

*Fl. & Fr.* November – December.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: Near base of Dhawjadhari Pahar Koderma NRF; not common. INDIA: Major part of India in plains up to 1800 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim, Bihar, Karnataka and Andaman & Nicobar Island. WORLD: Bangladesh, Myanmar, Malaya, Sumatra and Hainan.

*Specimen examined*: near base of Dhawjadhari Pahar Koderma NRF, 440 m, 24°28'54.4" N, 85°35'50.5" E, 19th November 2012, *Shyam Biswa*, 54050.

## 6. **CAESULIA** Roxb.

India, A monotypic genus.

**Caesulia axillaris** Roxb. Pl. Coromandel. 1: 64. t. 93. 1798; Hook.f. Fl. Brit. India 3: 291. 1881; Haines, Bot. Bihar Orissa 475. 1922; P.C. Pant in Hajra & al., Fl. India 13:2, f.1. 1995; N.P. Singh & al., Fl. Bihar: 259. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 330. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 874. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:122. 2014.

**Plate 61F**

Herb, prostrate or suberect, upto 45 cm high. Stem terete, reddish or purplish-red at lower portion. Leaves, simple, alternate, 2.5–9 × 0.2–0.8 cm, narrowed at base, distantly serrulate at

margins, acute at apex, glabrous, sessile, stem clasping, purplish at base. Capitula axillary, 0.5–1 × 1–1.5 cm across, sessile, homogenous, purplish-white. Involucral bracts 2, membranous, orbicular or broadly ovate, *c.* 3 mm long, crenulate or dentate. All florets bluish or white, bisexual; outer florets intermixed with linear, acute paleae; inner without paleae. Corolla tubular, 3–4 mm long, 5-lobed, lobes half or more than half incised, stamens 5, anthers *c.* 2 mm long, filament *c.* 1 mm long; stigma bifid, filament 2–2.3 mm long. Achenes obovoid, *c.* 1.5 × 1 mm, flat, winged and sparsely hairy; pappus of bi-seriate ovate scales, ribbed on the back.

*Fl. & Fr.*: August – January.

*Habitat*: On the damp or moist areas.

*Distribution*: KWLS: Gulli Mahato Tallao, Safia; common. INDIA: Throughout in plains, ascending to 1000 m. in Himalayas, commonly found in paddy fields, shallow ditches, moist low lying areas and also along river banks. WORLD: Pakistan, Nepal, Bangladesh and Myanmar.

*Specimen examined*: Gulli Mahato Tallao, Safia, 380 m, 24°33'15.1" N, 85°39'37.9" E, 27th February 2012, *Shyam Biswa* 54007.

## 7. CHROMOLAENA DC.

Tropical and subtropical America, 165 species, 7 in India, 3 in Jharkhand (1 cultivated) and 1 in KWLS.

**Chromolaena odorata** (L.) R.M. King & H. Rob. *Phytologia* 20: 204. 1970; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 876. 2005. *Eupatorium odoratum* L., *Syst. Nat.* ed. 10, 2: 1205. 1759; Hook.f., *Fl. Brit. India* 3: 244. 1881; Uniyal in Hajra & al., *Fl. India* 12: 354. 1995; N.P. Singh & al., *Fl. Bihar*: 265. 2001; Ranjan, *Fl. Parasnath Wildlife Sanct.*:125. 2014. **Plate 62A**

Under shrub or shrub, 1–1.5 m high; stem terete, striated, purplish pubescent. Leaves simple, opposite, ovate, 2–11.5 × 1–5.5 cm, cunate or acute at base, distantly serrate at margins, acute at apex, sparsely pubescent on upper surface, pubescent beneath, prominent 3–veined from base; petioles 0.5–2 cm long, pubescent on both surface more beneath. Capitula ovoid, 10–12 × 3–5mm, solitary, white, homogenous, corymbose, much-branched. Peduncle 0.5–1 cm long. Phyllaries 3 or 4-seriate, scarious, unequal; outer ovate, 7–10 × 1–1.2 mm acute at apex, scale on mid vein; middle ones ovate-oblong to oblong, 10–12 mm long inner ones oblong to linear, 5 × 0.5–1 mm acute at apex. Receptacles flat or slightly convex, pitted. Bisexual florets: Corolla tubular-campanulate, white; tube gradually widened above, *c.* 12–15 mm long, 5-lobed; lobes ovate, *c.* 0.5 mm long acute at apex. Stamens 5, filaments filiform, linear, 0.5–0.8 mm long, anther adnate 1. 5–2 mm long, base sagitate or with small tails. Ovary oval or roundish *c.* 1–1.5 mm long, angular, narrowed below; style 10–12 mm long, linearly 2-fid; stigma truncate, puberulous *c.* 1–2mm long. Achenes linear-oblong, 3–4 × 0.5–0.8 mm, with 5 pale sparsely pubescent ribs, blackish; pappus of 1-seriate hairs, 8–9 mm long, white, barbellate.

*Fl. & Fr.*: February – May.

*Habitat*: Scrub forests.

*Distribution*: KWLS: Lokai forest; very common. INDIA: Throughout. WORLD: Malaya, Myanmar, Nepal and Thailand.

*Specimen examined*: Lokai forest, 397 m, 24° 29'02.9" N, 85°37'04.4" E, 28th November 2012, *Shyam Biswa* 54096.



## 8. CYANTHILLIUM Blume

Old World tropical regions, 1–2 species, 1 in India.

**Cyanthillium cinereum** (L.) H. Rob., Proc. Biol. Soc. Washington 103(1): 252. 1990; Ranjan, Fl. Parasnath Wildlife Sanct.:124. 2014. *Conyza cinerea* L., Sp. Pl. 2: 862. 1753. *Vernonia cinerea* (L.) Less., Linnaea 4: 291. 1829; Hook.f., Fl. Brit. India 2: 233. 1881; Haines, Bot. Bihar Orissa: 460. 1992; Uniyal in Hajra & al., Fl. India 13: 367. 1995; N.P. Singh & al., Fl. Bihar: 279. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 360. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 915. 2005.

**Plate 62B**

Vern. Names: *Dandotpala* (Hindi); *Kukroura*.

Herb, 10–40 cm high; stems terete, finely striate, pubescent. Leaves simple, alternate, lanceolate 0.6–3.5 × 0.3–1.5 cm attenuate at base, repand-serrate at margins, acute at apex, pubescent on both surface more beneath, petioled or subsessile. Capitula in terminal corymbose panicles, 6–8 × 6–10 mm; peduncles hairy, 0.3–2 cm long. Phyllaries linear-lanceolate, 3–4 seriate, 1-veined, acuminate with awned tip, pubescent, often purple tinged at apex, 3–5 mm long. Corolla 5–6 mm long, bluish mauve, pink or rarely white; lobes hairy, stamens 5, anthers 1.5 mm long sstigma bifid, style 4–5 mm long. Achenes terete, 1.5–2 mm long, appressedly silky, sometimes dimorphic; pappus 2-seriate of hairs, whitish; outer ones 0.5–0.6 mm long; inner ones 4–4.5 mm long, hairy.

*Fl. & Fr.*: September – March .

*Habitat*: Near the shady places or near the rivers.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; Near the Koderma Rest House, Koderma NRF; Near Dhanarjay Nadi; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Near the Phulwarwaria jungle, Koderma NRF, 394m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010, *Shyam Biswa* 49557; Near the Koderma Rest House, Koderma NRF, 396 m, 24°29'04.4" N, 85°36'00.0" E, 10th March 2011, 49746; Near Dhanarjay Nadi, 189 m, 24°34'58.1" N, 85°35'21.4" E, 27th November 2012, *Shyam Biswa* 54093.

## 9. CYATHOCLLNE Cass.

Tropical Asia, 3 species, 1 in Jharkhand.

**Cyathocline purpurea** (Buch.-Ham. ex D.Don) Kuntze, Revis. Gen. Pl.: 333. 1891; Hajra in Hajra & al., Fl. India 12: 111, f. 32. 1995; N.P. Singh & al., Fl. Bihar: 263. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 337. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 880. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:124. 2014. *Tanacetum purpureum* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.: 181. 1825. *Cyathocline lyrata* Cass., Ann. Sci. Nat. (Paris) 17: 420. 1829; Hook.f., Fl. Brit. India 3: 246. 1881; Haines, Bot. Bihar Orissa: 463. 1922.

**Plate 62C**

Herb, 40–60 cm high, aromatic, glandular-hairy; stems branched, terete, pubescent, reddish purple-tinged. Leaves alternate, sessile, 1 to 2-pinnatipartite, 0.6–10 cm long; segments serrate-dentate to lobed at margins, acute at apex, hairy. Capitula in terminal corymbose panicles,

heterogamous, disciform, 2–5 mm across; peduncles 1–5 mm long. Phyllaries linear-lanceolate, 2–2.5 × 0.5 mm, scarious and densely ciliate at margins, acute at apex, pilose. Receptacles elevated with a contracted base and naked concave tip. Ray floret: 1.5–2 mm long, pinkish-purple, female stigma linear, style *c.* 1.5 mm long. Disk florets *c.* 2 mm long, 5-lobed, pinkish 2mm in across when opened, stamens 5 anthers 1mm long, filament *c.* 0.5 mm long, style *c.* 2 mm long linear. Achenes fusiform-oblong, *c.* 0.5 × 0.2 mm, smooth, straw coloured; pappus absent.

*Fl. & Fr.:* December – March.

*Habitat:* Near the river bank or moist area.

*Distribution:* KWLS: Phutlaiya Nala; common. INDIA: Throughout. WORLD: Bangladesh, Bhutan and Myanmar.

*Specimen examined:* Phutlaiya Nala, 343 m, 24°30'33.9" N, 85°39'31.8" E, 5th March 2011, Shyam Biswa 49674.

#### 10. ECHINOPS L.

Europe, Mediterrian to Cental Asia and tropical African, *c.*120 species, 4 in India, 1 in Jharkhad.

**Echinops echinatus** Roxb. Fl. Ind. 3: 447. 1832; Hook.f., Fl. Brit. India 3: 358. 1881; Haines, Bot. Bihar Orissa 490. 1922; Hajra in Hajra & al., Fl. India 12: 180. 1995; N.P. Singh & al., Fl. Bihar: 264. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 338. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 881. 2005. **Fig. 57; Plate 62D**

Undershrub, annual, branched, spreading, rigid, 25–70 cm high, stem ribbed hairy, branches cottony pubescent. Leaves 2–12 × 2.5–5 cm, simple, alternate sessile, lanceolate amplexicaul, pinnatifid, sinuate lobe, strongly spinose, spines *c.*4 cm long, scabridly puberulous above, cottony beneath. Capitula homogenous florets, aggregated in globose involuncrate balls, 2.3–4.2 cm, in diameter, white or bluish-white with a common involuncre of short tricuspidate spinose bracts, innermost proper involuncres with 5–8, 0.8–1.2 cm long, outer oblanceolate bracts of which 1 or 2 as often produced into a long spine 2.8 cm long. Segments of corolla limb 5–7 × 0.8–1 mm linear acute. Anthers tails fimbriate. Achenes obconic densely villous 3.5–6 mm long; pappus bristles short, yellowish forming a brush above achenes.

*Fl. & Fr.:* February – March.

*Habitat:* On the dry scrub forests or waste lands.

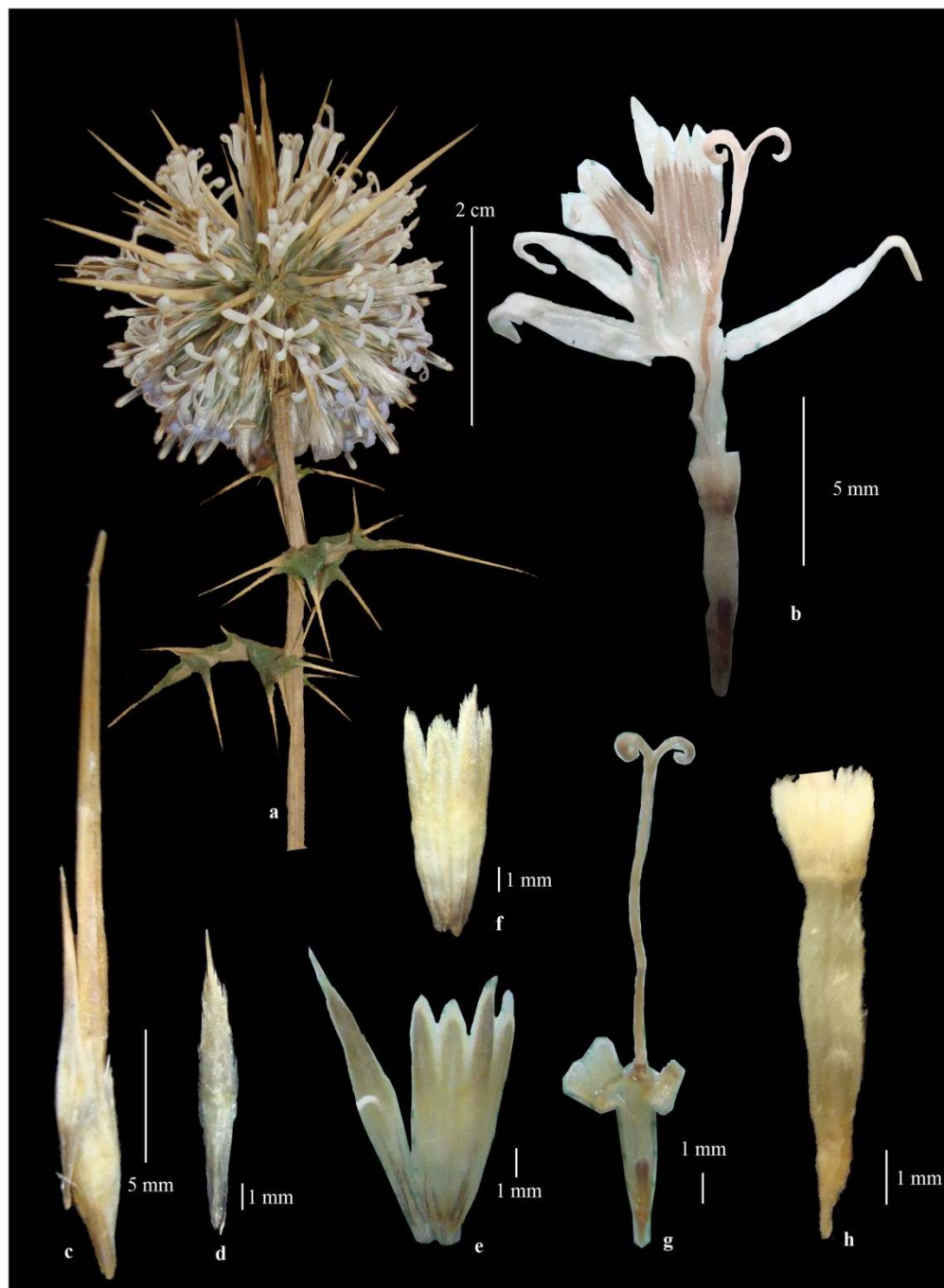
*Distribution:* KWLS: Bherwa tan; Lokai forest; common; INDIA: Andhra Pradesh, Bihar, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar. Pradesh and W. Bengal. WORLD: Afghanistan, Myanmar, Pakistan and and Sri Lanka.

*Specimens examined:* Bherwa tan, 382m, 24°28'57.6" N, 85°37'20.5" E, 24th February 2012, Shyam Biswa 49871; Lokai forest 397 m, 24°29'02.5" N, 85°37'04.4" E, 29th March 2013, Shyam Biswa 54122.

#### 11. ECLIPTA L.

Subtropical America, Old World, 1–4 species, 1 in India.

**Eclipta prostrata** (L.) L., Mant. Pl. 2: 286; H.J. Chowdhery in Hajra & al., Fl. India 12: 381, f. 103. 1995; N.P. Singh & al., Fl. Bihar: 264. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh &



**Fig. 57. *Echinops echinatus* Roxb.:** a. flowering twig; b. floret split open; c. spine; d. bract; e., f. innermost involucre bract; g. carpel; h. achene.

P.S.N. Rao, Fl. Palamau: 338. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 882. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:124. 2014. *Verbesina prostrata* L., Sp. Pl. 2: 902. 1753. *Verbesina alba* L., Sp. Pl. 2: 902. 1753. *Eclipta alba* (L.) Hassk., Pl. Jav. Rar.: 528. 1848; Hook.f., Fl. Brit. India 3: 304. 1881; Haines, Bot. Bihar Orissa: 480. 1922. **Plate 62E**

Herb, diffuse or erect, 10–15 cm high, much-branched, often rooting at nodes; stems appressed-pilose, reddish. Leaves subsessile, opposite, elliptic-lanceolate,  $0.8-7 \times 0.2-1.2$  cm, attenuate or narrowed at base, subentire or obscurely serrate at margins, acute or subacute at apex, strigillose on both surfaces, 3-veined at base. Capitula heterogamous, solitary or fascicled, axillary, 1–1.5 cm in diameter, white; peduncles unequal, 0.5–3.5 cm long. Phyllaries 2-seriate, herbaceous, pubescent outside; outer ovate-obovate,  $3.5-4 \times c. 2$  mm; inner ones oblong-lanceolate,  $2.5-3 \times c. 1.5$  mm. Outer florets female; inner bisexual. Disk florets: Corolla shortly tubular-campanulate,  $2.6-3 \times c. 1$  mm, 4-lobed; oblong, acute at apex. Stamens 4, subexserted; anthers linear,  $c. 1$  mm long, basifixed, light blackish, filament  $c. 0.5$  mm long. Ovary oblong,  $c. 1.5$  mm long, pubescent above; stigma bipartite, style  $c. 1.5$  mm long. Ray florets: Corolla shortly tubular,  $c. 3.5-4$  mm long, white; ray oblong,  $c. 3 \times 0.4$  mm. Ovary oblong,  $c. 1.5$  mm long, 3-quetrous, pubescent; stigma bipartite, style  $c. 2$  mm long; thick. Achenes oblong,  $2-2.8 \times c. 1$  mm, trigonous, minutely pubescent at apex; pappus very short at apex.

*Fl. & Fr.*: August – March.

*Habitat*: On the damp or moist grassland areas.

*Distribution*: KWLS: Baghitan forest; Near the river Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimens examined*: Baghitan forest, 400 m,  $24^{\circ}29'06.7''$  N,  $85^{\circ}36'12.8''$  E, 3rd March 2011 *Shyam Biswa* 49657; Near the river Dhanarjay Nadi, Meghatari, 188 m,  $24^{\circ}34'32.9''$  N,  $85^{\circ}34'41.6''$  E, 7th March 2011 *Shyam Biswa* 49700.

*Note*: Disk floret corolla 4 lobed and with 4 stamens anther slightly blackish.

## 12. ELEPHANTOPUS L.

Tropical and subtropical regions, 12–15 species, 1 in India.

**Elephantopus scaber** L., Sp. Pl. 2: 814. 1753; Hook.f., Fl. Brit. India 3: 242. 1881; Haines, Bot. Bihar Orissa: 461. 1922; Uniyal in Hajra & al., Fl. India 13: 333, f. 102. 1995; N.P. Singh & al., Fl. Bihar: 264. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 339. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 884. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:125. 2014. **Plate 62F**

Vern. Name: *Gobhi* (Hindi).

Herb, 20–50 cm high, somewhat scapose with creeping rhizomatous rootstock; stems terete, simple below, dichotomously branched at apex, appressed-strigose. Leaves, simple, basal or at nodes, oblanceolate or obovate-oblong,  $2.5-22 \times 1.5-6$  cm, attenuate at base, coarsely crenate-serrate at margins, subacute to obtuse or rounded at apex, chartaceous, ciliate, sparsely hairy above, densely appressed-pubescent more on the veins and glandular-punctate beneath; cauline leaves sessile, shorter, ovate or oblong, semi-amplexicaul at base. Capitula homogamous, disciform, sessile, aggregated in dense, stalked glomerules,  $c. 1$  cm across, subtended by 3, ovate

or cordate, floral leaves, 0.5–1.5 × 0.5–1 cm, pubescent. Phyllaries 2-seriate, oblanceolate, scarious; outer 4, shortly acuminate, 5–6 × c. 1 mm, glabrous. inner 4 lanceolate, 10–11 × 2–3 mm, glabrous inner glabrous, outer pubescent in middle. Florets 3–5. Corolla c. 4 mm across, purplish-pink; tube cylindric, 6–8 mm long, 5-lobed; lobes equal, oblong, 3–4 mm long, acute at apex, palmately spreading. Stamens 5, exserted; filaments filiform, c. 1 mm long; anthers linear-oblong, auricled at base, c. 1.5–2 mm long; connectives acute. Ovary oblong, narrowed below, c. 3 mm long, faintly ribbed, hairy; style 6–8 mm long, dilated and hairy above, shortly 2-fid, recurved. Achenes c. 3–4 mm long, pubescent, finely 10-ribbed; pappus 1-seriate of 5 straight, stiff, setose hairs, to c. 5 mm long, dilated at base.

*Fl. & Fr.*: September – November.

*Habitat*: Ground vegetation of Dry deciduous forests .

*Distribution*: KWLS: Koderma NRF near the Phulwarwaria jungle; Bagitan jungle; common. INDIA: Throughout. WORLD: Sri Lanka, Southeast Asia and Tropical Africa.

*Specimens examined*: Koderma NRF near the Phulwarwaria jungle, 394m, 24°29'06.6" N, 85°35'49.8" E, 4th September 2010 *Shyam Biswa* 49533; Bagitan jungle, 398 m, 24°29'33.1" N, 85°35'48.6" E, 20th November 2012, *Shyam Biswa* 54068.

*Note.*: The ground is dominated by *Elephantopus scaber* during all the season in core and buffer zone of the dry deciduous forest. Observed 4 achenes in one floret.

### 13. **EMILIA** Cass.

Old World tropical regions, c. 90 species, 4 in India, 2 in Jharkhand and 1 in KWLS.

**Emilia sonchifolia** (L.) DC. in Wight, Contr. Bot. India: 24. 1834; Hook.f., Fl. Brit. India 3: 336. 1881; Haines, Bot. Bihar Orissa: 489. 1922; Mathur in Hajra & al., Fl. India 13: 212. 1995; N.P. Singh & al., Fl. Bihar: 264. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 341. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 885. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:125. 2014. *Cacalia sonchifolia* L., Sp. Pl. 2: 835. 1753. **Plate 63A**

Vern. Names: *Hirankhuri* (Hindi); *Kukroura*.

Herb, 20–30 cm high, glabrescent to sparsely pilose; stems much-branched at base, often decumbent-ascending; internodes to 3.5 cm long. Leaves simple, all sessile or basal and the lower ones petioled, lyrate-pinnatifid with triangular-ovate terminal lobes and irregularly toothed lateral lobes, 2–7 × 1–3 cm, attenuate or cuneate at base, lobed at margins, rounded or acute at apex, membranous, glabrous to sparsely puberulous, pale green to dark blackish green; petioles winged, 2–5 cm long; cauline leaves obovate, auricled or amplexicaul, acute to subobtus. Capitula homogamous, discoid, 5–12 mm long, peduncled; peduncles 2 or 3-bracteate; bracts cordate, clasping at base. Phyllaries cylindrical, 7–12 × 1–3 mm, glabrous to sparsely puberulous; bracts linear-lanceolate, c. 7 × 1 mm, narrow, scarious at margins, acute at apex, 3–5-veined. Disk florets 7–12 mm long. Corolla 7–8 mm long, pink 5 lobed; tube 5–7 mm long. Stamens 5; anthers c. 1.3 mm long. Ovary c. 1.5 mm long; style c. 5.5 mm long with dilated arms; stigma acute, hispid. Achenes 2.5–3 mm long, scabrid-ribbed, brown or reddish brown; pappus hairs copious, 0.5–0.8 mm long, soft, white.

*Fl. & Fr.*: November – January.

*Habitat*: Dry deciduous forests. .



*Distribution:* KWLS: Near Dhanarjay Nadi, Meghatari; common. INDIA: Throughout. WORLD: Myanmar and Sri Lanka.

*Specimen examined:* Near Dhanarjay Nadi, Meghatari, 189 m, 24°34'58.1" N, 85°35'21.4" E, 27th November 2012, *Shyam Biswa* 54093.

#### 14. **GAMOCHAETA** Wedd.

New World c.56 species;

**Gamochaeta purpurea** (L.) Cabrera, Bol. Soc. Argent. Bot. 9: 377. 1961. *Gnaphalium purpureum* L. Sp. Pl. 2: 854. 1753; Hook.f., Fl. Brit. India 3: 289. 1881; Haines, Bot. Bihar Orissa 474. 1922; Mooney, Suppl. Bot. Bihar Orissa: 76. 1950; P.C. Pant in Hajra & al., Fl. India 13: 92, f. 30. 1995; N.P. Singh & al., Fl. Bihar: 268. 2001; Ranjan, Fl. Parasnath Wildlife Sanct.:125. 2014. *Gamochaeta pensylvanica* (Willd.) Cabrera, Bol. Soc. Argent. Bot. 9: 375.1961. *Gnaphalium pensylvanicum* Willd., Enum. Pl. 2: 867.1809; Paria & Chattopadhyay, Fl. Hazaribagh 2: 891. 2005. **Plate 63D**

Vern. Name: *Dhobam*

Annual, erect, 20–40 cm high, taprooted. Stems terete ribbed, hairy. Leaves simple, alternate, oblanceolate to spatulate, 1.5–4 × 0.3–1 cm, attenuate or narrowed at base, entire at margin, rounded at apex, puberulous on upper surface, white panose on lower surface. Capitula disciform, in short spicate clusters, 6–8 mm across; peduncle c. 1 mm long. Involucral bracts 3–4-seriate; outermost, 2.5–3 × 0.5–0.8 mm, yellowish brown. Pappus 1.5–2 mm, hairs white, united at base. Ray florets female, with filiform corolla, c. 2 mm long, pink at mouth. Disk florets bisexual, c. 2 mm long, 5-toothed. Achenes oblong, c. 0.5 × 0.2 mm, yellowish smooth, slightly dotted.

*Fl. & Fr.:* August – March.

*Habitat:* On the waste lands.

*Distribution:* KWLS: Koderma NRF, near the Koderma Rest House; common. INDIA: Himalayas, W. Ghats, as a weed of tea gardens in Nilgiris, up to 1600 m. Jammu & Kashmir, West Bengal, Tamil Nadu and Maharashtra. WORLD: Pakistan, North and South America.

*Specimen examined:* Koderma NRF, near the Koderma Rest House, 396 m, 24°29'04.4" N, 85°35'49.6" E, 10th March 2011 *Shyam Biswa* 49742.

#### 15. **GLOSSOCARDIA** Cass.

South East Asia to Pacific 12 species, 2 in India, 1 in Jharkhand.

**Glossocardia bosvallia** (L.f.) DC., Wight, Contrib. Bot. Ind. 19. 1834; H.J. Chowdhery in Hajra & al., Fl. India 12: 391, f. 107. 1995; N.P. Singh & al., Fl. Bihar: 266. 2001; Paria & Chattopadhyay, Fl. Hazaribagh 2: 888. 2005. *Verbesina bosvallea* L. f., Suppl. Pl. 379. 1782. *Glossocardia linearifolia* Cass., Dict. Sci. Nat. 19: 62. 1821; Hook.f, Fl. Brit. India 3: 308. 1881; Haines, Bot. Bihar Orissa 485. 1922. **Plate 63B**

Herb, 5–10 cm high, with slender tap-root, branches grooved, glabrous. Leaves deeply pinnatisect, 1.5–3 cm long, pinnules linear, 3–5 × 0.5 mm, decurrent at base acute-apiculate at apex, glabrous; petioles 1–2 cm long. Capitula heterogamous, solitary, terminal or axillary, 5–10

mm long. Phyllaries 1–4 -seriate; outer oblong-lanceolate, *c.* 3 × 1 mm, greenish; inner oblanceolate, *c.* 7 × 1 mm, glabrous, subtending ray and disk flowers; paleae flat. Ray florets female, 3–3.5 mm long, few; corolla tube obsolete, ligule short, 3-toothed at apex, yellowish; style slightly bifid, 2 mm long; stigma obtuse. Disk florets bisexual, 2–2.5 mm long, few; corolla narrowly tubular campanulate, 4-toothed, yellowish; stamens 4, anthers *c.* 0.5 mm long; style *c.* 2 mm; stigma puberulous. Achenes oblong, *c.* 5 × 1 mm, compressed, 3-ribbed on each face, hairy on rib; pappus with barbed awns.

*Fl. & Fr.*: September – October.

*Habitat*: On the rocky hill, base of rocks.

*Distribution*: Jharkhand Koderma, KWLS: Near Rishi Dhurwasha Pahar, Meghatari; rare. INDIA: Delhi, Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. WORLD:

*Specimen examined*: Near Rishi Dhurwasha Pahar, Meghatari, 226 m, 24°35'24.54"N, 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 49820.

*Note*: Endemic to India.

## 16. GNAPHALIUM L.

Cosmopolitan, *c.* 38 species, 8 in India, 4 in Jharkhand and 1 in KWLS.

**1. *Gnaphalium polycaulon*** Pers., Syn. Pl. 2(2): 421. 1807; P.C. Pant in Hajra & al., Fl. India 13: 91. 1995; N.P. Singh & al., Fl. Bihar: 268. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 345. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 892. 2005. *Gnaphalium indicum auct. non* L., 1753: Hook.f., Fl. Brit. India 3: 289. 1881; Haines, Bot. Bihar Orissa 474. 1922.

**Plate 63C**

Herb prostrate; stems herbaceous, terete, much branched, white cottony tomentose. Leaves simple alternate, sessile, obovate to spatulate, 1–5 × 0.1–1 cm, attenuate at base, entire at margins, rounded with apiculate tip at apex, veins inconspicuous except mid vein; mid vein impressed to faintly raised on both surfaces, white cottony above, tomentose beneath. Capitula campanulate, 4–5 × 5–6 mm, disciform, covered by white cottony hairs, yellowish; phyllaries 2–3-seriate; outer ones, ovate-lanceolate, *c.* 1.5 × 0.6 mm, acute at apex, yellowish, glabrous; inner ones oblong-lanceolate, *c.* 2 mm long, otherwise same as outer ones. Disk florets: corolla white, tubular, 1–1.5 mm long, shallowly 2–3 -lobed at apex, glabrous. Ovary light brown, oblong, 0.3–0.5 mm long small, pappus at apex, papillose; style slender, 0.8–10 mm long, glabrous; stigma bifid, slightly exserted, puberulent. Bisexual: corolla green yellow, narrowly funnelform; tube *c.* 1.5 mm long, glabrous; lobes 5, triangular, small, acute and papillose at apex. Stamens 5, filaments filiform, 0.2–0.4 mm long, glabrous; anthers fused, 0.7 –0.8 mm long, sagitate at base, acute at apex stigma *c.* 0.3 mm. Ovary oblong, *c.* 0.4 mm long, yellowish; style slender, *c.* 0.8 mm long, swollen at base, glabrous; stigma bifid, puberulent. Achenes yellowish, elliptic-oblong, 0.4–0.5 mm long, papillose; pappus, many, *c.* 1 mm long, free at base, deciduous, white.

*Fl. & Fr.*: December – March.

*Habitat*: Dry deciduous forests.

*Distribution:* KWLS: Near the river Dhanarjay Nadi, Meghatari; not common. INDIA: Throughout, common along banks of canals, river beds, sandy soil, dried ponds and as weed of cultivated fields, ascending to 750 m. WORLD: Pakistan, Nepal, Myanmar, Egypt, China, Japan, Senegal, Brazil, Australia and Tropical Africa.

*Specimen examined:* Near the river Dhanarjay Nadi, Meghatari, 185 m, 24°34'44.3" N, 85°34'43.2" E, 7th March 2011, *Shyam Biswa* 49695.

#### 17. **GRANGEA** Adans.

Tropical and subtropical regions, *c.* 10 species, 1 in India.

**Grangea maderaspatana** (L.) Poir. in Lam., *Encycl. Suppl.* 2(2): 825. 1812; Hook.f., *Fl. Brit. India* 3: 247. 1881; Haines, *Bot. Bihar Orissa*: 464. 1922; Hajra in Hajra & al., *Fl. India* 12: 127, f. 37. 1995; N.P. Singh & al., *Fl. Bihar*: 268. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 346. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 893. 2005. *Artemisia maderaspatana* L., *Sp. Pl.* 2: 849. 1753. **Plate 63E**

Vern. Name: *Mustaru* (Hindi).

Herb, prostrate or ascending, aromatic; stems glandular and densely white-pubescent. Leaves simple, sinuately pinnatifid, 0.5–6 × 0.2–0.5 cm, with 2–4 pairs of opposite or subopposite lobes, smaller towards base, largest at apex, coarsely serrate-dentate at margin, pubescent on both surfaces. Capitula globose, solitary, axillary and terminal, 8–10 mm, heterogamous, disciform. Phyllaries biseriate, oblong, scarious, fimbriate at margins, 4–4.5 mm long, herbaceous, pubescent; inner ones narrow. Outer florets female, 2 or 3-seriate; inner ones bisexual. Bisexual florets: Corolla tubular-campanulate, *c.* 1.5 mm long, sessile-glandular outside, yellow, 5-lobed; lobes linear-ovate, acute at apex. Stamens 5, subexserted; anthers oblong, obtuse at base, *c.* 0.5 mm long; connectives acute, filament *c.* 0.5 mm long. Ovary in both florets 1–2 mm long, angular, sessile-glandular outside; style *c.* 3 mm long; stigma triangular-ovate, acute. Male florets: Corolla *c.* 0.3 mm across; tube filiform, 1.5 mm long, sessile-glandular outside, lobes 2–4-cleft, sometimes 1 or 2 enlarged. Style *c.* 2 mm, shortly 2-fid; stigma linear, acute. Achenes oblong, truncate, 3–5-gonous; pappus *c.* 0.5 mm long, connate into a fimbriate cup, whitish.

*Fl. & Fr.:* November – March.

*Habitat:* On fallow fields and on open grasslands.

*Distribution:* KWLS: Bherwa tan Koderma NRF on the fallow crop field; common. INDIA: Throughout. WORLD: China, Egypt, Malaya and Sri Lanka, Tropical Africa.

*Specimen examined:* Bherwa tan Koderma NRF, on the fallow crop field, 397m, 24°28'43.6" N, 85°36'26.7" E, 2nd March 2012, *Shyam Biswa* 53918.

#### 18. **LAUNAEA** Cass.

Canaries to South Africa and East Asia, West Indies, 54 species, 7 in India, 4 in Jharkhand and 1 in KWLS.

**Launaea procumbens** (Roxb.) Ramayya & Rajagopal, *Kew Bull.* 23(3): 465. 1969. Mamgain & R. Rao in Hajra & al., *Fl. India* 12: 309. 1995; N.P. Singh & al., *Fl. Bihar*: 273. 2001; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 898. 2005. *Prenanthes procumbens* Roxb., *Fl. Ind.* 3: 404. 1832. *Launaea nudicaulis sensu auct.* Plur. Ind. non *Launaea nudicaulis* (L.) Hook.f. *sensu*

*stricto*. Fl. Brit. India 3: 416. 1881; Haines, Bot. Bihar Orissa 496. 1922. *Paramicrorhynchus procumbens* (Roxb.) Kirp., Kom., Fl. URSS (Eds. Schischk. & Bobrov) 29:237.1964.

Herb, annuals, procumbent, 10–25 cm high. Stems terete, branched. Leaves simple, rosette, whorled, pinnatifid,  $3-9 \times 0.8-2.5$  cm, tapering at base; denticulate along margins, obtuse to rounded at apex, terminating with a spine. Capitula homogamous, terminal and axillary in paniculate raceme, cylindrical,  $1-1.8 \times 1-1.5$  cm, yellow; peduncle, 2–10 mm; bracts, triangular-ovate,  $1-3 \times 0.5-1$  mm, entire and scarious along margins, obtuse at apex, midvein prominent, glabrous, green. Phyllaries / Involucre bracts 2 to 3-seriate, outer rows much smaller than inner rows, linear-lanceolate,  $4-10 \times 1-2$  mm, glabrous, green. Corolla, tubular, ligulate, glabrous, yellow; ligule lanceolate,  $10-12 \times 1-1.5$  mm, 5-lobed at apex, tube small, 2–3 mm. Stamens 5; filaments c. 1 mm, yellow; anthers linear, 2.5–3 mm, yellow. Ovary oblong, yellow; style 1–1.1 mm, stigma bifid, yellow. Achenes oblong,  $2.5-3 \times 0.5-0.8$  mm, 5–6 ridges/winged; pappus acicular, 7–8 mm, whitish.

*Fl. & Fr.*: March – September.

*Habitat*: On open forests.

*Distribution*: KWLS: Near Meghatari Rest House; common. INDIA: In fields, marshy places and wastelands, 1100-1800 m. Andhra Pradesh. Jammu & Kashmir, Himachal Pradesh, Madhya Pradesh Uttar Pradesh, West Bengal, Gujarat, Rajasthan, Maharashtra, and Tamil Nadu. WORLD: Afghanistan, Pakistan, Central Asia, Egypt and Iran.

*Specimen examined*: Near Meghatari Rest House, 190 m,  $24^{\circ}34'39.6''$  N,  $85^{\circ}34'37.6''$  E, 9th March 2011, *Shyam Biswa* 49728.

## 19. PARTHENIUM L.

North America and West Indies, 16 species, 1 in India.

**Parthenium hysterophorus** L., Sp. Pl. 2: 988. 1753; Rao, J. Bombay Nat. Hist. Soc. 54: 218. 1956; H.J. Chowdhery in Hajra & al., Fl. India 12: 403, f. 113. 1995; N.P. Singh & al., Fl. Bihar: 273. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 351. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 900. 2005. **Plate 63F**

Herb, to 20–75 cm high; stems terete, striated much-branched, puberulous. Leaves simple, alternate, pinnately dissected, lanceolate-oblong,  $5-15 \times 2-8$  cm, decurrent at base, lobed and entire at margins, acute at apex, pubescent on both surfaces pilose on mid-vein; lobes opposite to subopposite; petioles 0.5–1 cm long. Inflorescences head lax panicles of numerous small heads, Capitula 5–7 mm across, heterogamous white; peduncles 2–8 mm long. Receptacle convex, small. Phyllaries 1-seriate, elliptic,  $1-1.5 \times 0.6-0.8$  mm, acute at apex, pubescent. Ray florets with 2 sterile disk florets on either side, covered by palea, white. Paleae concave, obtuse at apex, c.  $2.5 \times 2.3$  mm, scarious, papillose. Corolla white, tube minute; ligule ovate-orbicular, c.  $0.5 \times 0.8$  mm, shallowly bilobed at apex. Ovary broadly obovoid, shortly beaked, c.  $1.2 \times 0.6$  mm, compressed, 3-quetrous; style c. 1 mm long; stigmas stout, obtuse. Disk florets: Paleae linear c. 1.5 mm longlacerate at apex. Corolla 0.8–1.5 mm long, 5-lobed; lobes ovate, acute at apex. Stamens 5, included; anthers linear, acute at base, c. 0.8 mm long; filament filiform minute. Ovary linear, c. 0.5 mm long; style entire, 0.8–1.2 mm long, puberulous, stigma minutely bilobed, puberulent.

Achenes *c. obovate* 2.5–3 × 1–1.5 mm, black, flattened; pappus scale ovate minute, acute at apex, *c.* 0.5 mm long, puberulous.

*Fl. & Fr.*: July–March.

*Habitat*: Weeds on waste land or open localities.

*Distribution*: KWLS: Koderma NRF; common. INDIA: Throughout, as a weed. WORLD: Native of America.

*Specimen examined*: Koderma NRF, 396 m, 24°29'04.4" N, 85°35'49.6" E, 10th March 2011, *Shyam Biswa* 49744.

## 20. **SONCHUS** L.

Eurasia to Australia and tropical regions, 62 species, 5 in India, 3 species in Jharkhand and 1 in KWLS.

**Sonchus asper** (L.) Hill, *Herb. Brit.* 1: 47. 1769; Hook.f., *Fl. Brit. India* 3: 414. 1881; Haines, *Bot. Bihar Orissa*: 498. 1922; Mangain & R. Rao in Hajra & al., *Fl. India* 12: 321, f. 83. 1995; N.P. Singh & al., *Fl. Bihar*: 277. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, *Fl. Palamau*: 356. 2002; Paria & Chattopadhyay, *Fl. Hazaribagh* 2: 905. 2005. **Plate 64B**

Vern. Names: *Dudhi*, *Dodak* (Hindi).

Herb annual 15–75 cm high, stems terete, hollow ribbed, glabrous. Peduncles 0.5–4.5 cm long, glandular hairy. Leaves simple or pinnatifid, 3–20 × 1–8 cm, rounded auricles or amphixicaul at base, segments triangular, sharply dentate or denticulate at margins, acute or acuminate at apex terminating with spine, glabrous, shiny above, gradually reduces in size from base to apex. Capitula 1–2 × 1–2.5 cm, homogamous. Involucre 5–7 mm diameter, without cottony hair; outer phyllaries sometimes bearing few coarse glandular hairs; inner phyllaries 8–15 mm. Corolla tube 7–8 mm, ligule 5–6 × 1 mm, shorter than tube, stamens 5, anthers oblong tip blackish. Ovary roundish *c.* 0.5 mm, style 7–7.5 mm stigma bifid *c.* 1 mm. Achene obovate-ellipsoid, strongly compressed *c.* 3 × 1–1.5 mm, distinctly winged, smooth or remotely scabridulous on wings and ribs or barbed on margins, most with 3 ribs on each face; pappus 8–9 mm, creamy white.

*Fl.*: December – March & *Fr.*: April – September.

*Habitat*: Dry deciduous forests.

*Distribution*: KWLS: near the Koderma Rest house; Bon Kali, Pipra Tan; very common INDIA: Throughout, by the road sides, wastelands and cultivated fields ascending up to 3500 m. WORLD: Africa, Afghanistan, Algeria, Central Asia, Egypt, Ethiopia, Europe, Iran, Iraq, Libya, Morocco, North America and South America, Pakistan and Syria.

*Specimens examined*: near the Koderma Rest house, 394 m, 24°29'06.6" N, 85°35'49.8" E, 2nd March 2011, *Shyam Biswa* 49653; Bon Kali, Pipra Tan, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 49876.

## 21. **SPHAERANTHUS** L.

Old World Tropical regions to Iran & Egypt, *c.* 40 species, 3 in India and 1 in KWLS.

**Sphaeranthus indicus** L., *Sp. Pl.* 2: 927. 1753; Hook.f., *Fl. Brit. India* 3: 275. 1881, p.p.; Haines, *Bot. Bihar Orissa*: 473. 1922; Kumar in Hajra & al., *Fl. India* 13: 160, f. 49. 1995; C.D.K. Cook, *Aquat. Wetland Pl. India*: 72. 1996; N.P. Singh & al., *Fl. Bihar*: 277. 2001; T.K. Sharma & A.K.



Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 356. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 906. 2005; Ranjan, Fl. Parasnath Wildlife Sanct.:127. 2014. **Plate 64C**

Herb, 10–20 cm high, aromatic; stems divaricately much-branched with irregularly toothed wings, pubescent. Leaves simple, sessile, alternate, obovate-oblong or spatulate,  $0.5\text{--}2.5 \times 0.2\text{--}1$  cm, decurrent at base, coarsely serrate-dentate at margins, spinulose-mucronate at apex, minutely stipitate-glandular and white pubescent on both surface. Capitula heterogamous, disciform, aggregated on an elongated receptacle forming an ovoid-globose glomerule,  $0.8\text{--}1.5 \times 0.5\text{--}1.2$  cm, terminal on branchlets, few-flowered, pinkish-purple, subtended by a few, lanceolate bracts. Phyllaries a few, linear-lanceolate,  $c. 3\text{--}4 \times 0.5\text{--}1$  mm, narrowed below, ciliate; outer herbaceous; inner scarious. Outer florets male, tubular,  $c. 2.5\text{--}3 \times 0.2$  mm; inner bisexual, fewer than outer. Bisexual florets: Corolla tubular-campanulate,  $c. 2.8\text{--}3 \times 0.6\text{--}1$  mm; 5-lobed; lobes ovate, acute at apex. Stamens 5, included, attached at base; anthers linear, sagittate at base,  $c. 1.5$  mm long filaments  $c. 0.5$  mm long; acute at apex; stigma acute, style  $c. 2$  mm long. Female florets:  $2.5\text{--}3 \times 0.1$  mm; corolla tube  $c. 2$  mm long, minutely lobed above. Ovary oblong, entire,  $c. 0.8$  mm long, densely hairy; style  $c. 2.5$  mm long, linearly 2-fid, acute at apex. Achenes smooth or angled, glabrous or villous  $0.8\text{--}1 \times 0.2\text{--}0.3$  mm; pappus absent.

*Fl. & Fr.*: February – March.

*Habitat*: Scrub forests or on waste lands.

*Distribution*: KWLS: Bherwa tan; common. INDIA: Throughout. WORLD: Archipelago, Australia, Bangladesh, Malaya and Myanmar.

*Specimen examined*: Bherwa tan, 382 m,  $24^{\circ}28'57.6''$  N,  $85^{\circ}37'20.5''$  E, 24th February 2012, Shyam Biswa 49870.

## 22. TRIDAX L.

America especially Mexico,  $c. 26$  species, 1 in India.

**Tridax procumbens** (L.) L., Sp. Pl. 2: 900. 1753; Hook.f., Fl. Brit. India 3: 311. 1881; Haines, Bot. Bihar Orissa: 486. 1922; Mooney, Suppl. Bot. Bihar Orissa: 79. 1950; H.J. Chowdhery in Hajra & al., Fl. India 12: 418, f. 119. 1995; N.P. Singh & al., Fl. Bihar: 279. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 359. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 913. 2005. **Plate 64D**

Vern. Name: *Khohari*.

Herb, decumbent 20–40 cm high; stems, terete, hirsute. Leaves simple, opposite, elliptic-ovate or lanceolate,  $1.5\text{--}4.5 \times 0.5\text{--}2.5$  cm, cuneate at base, distantly serrate to incised-dentate at margins, acute to acuminate at apex, coriaceous, hirsute on both surfaces; 3-veined prominent from base; petioles 2–4 mm long, hirsute. Capitula solitary,  $0.8\text{--}1.2 \times 0.7\text{--}1.5$  cm, heterogamous; peduncles 12–25 cm long, slender, hirsute, glandular. phyllaries 2–3 -seriate; outer ones lanceolate to oblong-ovate,  $c. 5 \times 2\text{--}3$  mm, short acuminate at apex, hairy along margins, hirsute; inner ones obovate-oblong,  $c. 6 \times 3$  mm, hairy along margins, obtuse with apiculate tip at apex, innermost obtuse at apex, many veined, hirsute along veins only, otherwise glabrous. Ray florets female: Corolla obovate-oblong, ligulate,  $5\text{--}7 \times 2.5\text{--}3$ , pale yellow to creamy white, 2 or 3-lobed at apex. Ovary oblong, truncate,  $c. 1.5$  mm long mm long, pubescent outside; style  $c. 6$  mm long, linearly

2-fid; stigma subulate. Disk florets: Corolla, yellow; 5-lobed; lobes oblong, ciliate, acute at apex, *c.* 5–6 mm long, spreading. Stamens 5, subexserted; anthers linear, *c.* 2.5 mm long, filaments *c.* 1.5 mm long; Ovary oblong, *c.* 2 mm long, pubescent; style *c.* 7.5 mm long, stigma linearly 2-fid, acute, pubescent. Achenes narrowly obconic, truncate at apex, 2–2.5 × 1 mm long, sericeous, blackish; pappus awns 15–20, unequal, 4–6 mm long, plumose.

*Fl. & Fr.*: Throughout the year.

*Habitat*: On open forests.

*Distribution*: KWLS: Chattarbar forest; common. INDIA: Throughout. WORLD: Native of Central America, widespread as a weed throughout the tropical and subtropical regions of the world.

*Specimen examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49532.

### 23. **VICOA** Cass.

Cape Verde, Tropical Africa, Arabian Peninsula to South China and Indo-China 15 species, 3 in India and 1 in Jharkhand.

***Vicoa indica*** (L.) DC. in Wight, Contr. Bot. India: 10. 1834; Haines, Bot. Bihar Orissa: 476. 1922; Paria & Chattopadhyay, Fl. Hazaribagh 2: 917. 2005. *Inula indica* L., Sp. Pl. ed. 2. 2: 1236. 1763. *Vicoa auriculata* Cass., Ann. Sci. Nat. (Paris) 17: 418. 1829; Hook.f., Fl. Brit. India 3: 297. 1881. *Pentanema indicum* (L.) Ling, Acta Phytotaxa. Sin. 10: 179. 1965; Gould in Hara, Enum. Fl. Pl. Nepal 3: 35. 1982; Kumar in Hajra & al., Fl. India 13: 28, f. 9. 1995; N.P. Singh & al., Fl. Bihar: 274. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 352. 2002; Ranjan, Fl. Parasnath Wildlife Sanct.:126. 2014. **Plate 64A**

Herb, 20–60 cm high, rootstock woody, simple or branched at top; stems terete, hispid. Leaves simple, alternate, sessile, oblong-lanceolate, 0.7–4 × 0.1–0.8 cm, semi-amplexicaul at base, entire or serrate-dentate, recurved at margins, acuminate at apex, pubescent in both surface. Capitula heterogamous solitary, axillary or terminal, 1–1.5 cm across, yellow; peduncles 0.6–3.5 cm long, slender, spreading. Receptacle convex, pitted. Phyllaries linear-lanceolate, 3–4 × 0.5–1 mm, pubescent on midrib. Ray florets 1-seriate, female, 7–8 × 1–1.5 mm, shortly 3-toothed; corolla bright yellow, style 1.5–2 mm long, stigma bifid. Disk florets bisexual, 4.5–5 mm long, corolla *c.* 4 mm long, yellow, 5-lobed, stamens 5 epipetalous, anthers 1.5–1.8 mm long, basifixed, filament *c.* 0.5 mm long, stigma bifid, style 3–3.5 mm long. Achenes oblong, terete, 1–0.5 mm, appressed-pubescent, brown; pappus hairs few, 2.5–3 mm long, free at base, white.

*Fl. & Fr.*: March – April.

*Habitat*: On open places in Dry deciduous forests and on open fallow fields.

*Distribution*: KWLS: Near the Koderma Rest House, Koderma NRF; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near the Koderma Rest House, Koderma NRF, 395 m, 24°29'02.3" N, 85°35'55.3" E, 10th March 2011, *Shyam Biswa* 49738.

### 24. **XANTHIUM** L.

Cosmopolitan, *c.* 3 species, 2 in India, 1 in Jharkhand.

**Xanthium strumarium** L., Sp. Pl. 2: 987. 1753, p.p.; Hook.f., Fl. Brit. India 3: 303. 1881; Haines, Bot. Bihar & Orissa: 478. 1922; Ranjan, Fl. Parasnath Wildlife Sanct.:130. 2014. *Xanthium indicum* J. König. ex Roxb., Fl. Ind. 3: 601. 1832; H.J. Chowdhery in Hajra & al., Fl. Ind. 12: 427, f. 123. 1995; N.P. Singh & al., Fl. Bihar: 281. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 361. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 919. 2005.

**Plate 64E**

Herb or shrub, 0.5–2 m high, robust. Stems, terete, white puberulous, slightly purplish-green. Leaves simple, alternate, broadly triangular-ovate or suborbicular, 2–18 × 2–17.5 cm, palmately 3–5 -lobed, cordate at base, irregularly dentate at margins, acute at apex, 3-veined at base, hispidulous on both surface; petioles 4–9 cm long, hairy. Capitula monoecious in axillary or terminal clusters, male above, female below. Male capitula subsessile, 1-flowered, aggregate on a conical receptacle, c. 7 mm long. Phyllaries 1 or 2-seriate, lanceolate to linear, 2.5–3 mm long, pubescent. Florets unisexual; male numerous. Paleae spatulate-rhomboid, acute at apex, c. 2 × 0.7 mm, pubescent. Corolla campanulate, 2–2.5 mm long, greenish, 6-lobed; lobes lanceolate, acute, free near apex, glandular-pubescent outside. Stamens 5, exserted; anthers free, erect, oblong, c. 1 mm long, subacute or acute at apex, spreading after anthesis, incurved; filaments connate. Ovary sterile; style rudimentary, c. 1.5 mm long. Female capitula ovoid, c. 8 mm long, 2-flowered. Phyllaries 2-seriate; outer one many, free, elliptic-ovate to lanceolate, acute at apex, 2–3 × 0.7–1.5 mm, pubescent; inner ones connate, covered with uncinat spines, ending in 2 stout, rostra above. Corolla absent. Ovary obovoid, c. 2 mm long; style c. 2 mm long, linearly 2-fid, running through the rostra. Achenes, tapering at both ends, 1.5–2 × c. 1 mm enclosed in prickly spines, spines 2–5 mm long, spreading hooked; beaks c. 5 mm finely hooked at apex, pappus absent in both.

*Fl. & Fr.*: February – December.

*Habitat*: Scrub forests or on waste lands.

*Distribution*: KWLS: Bon Kali, Pipra Tan; very common. INDIA: Throughout. WORLD: Indonesia (Java, Sumatra) and Malaya.

*Specimen examined*: Bon Kali, Pipra Tan, 366 m, 24°28'36.5" N, 85°32'20.5" E, 25th February 2012, *Shyam Biswa* 49878.

**100. APIACEAE** Lindl., nom. cons. (= **UMBELLIFERAE** Juss., nom. cons.)

Cosmopolitan, 428 genera and c. 3500 species; 72 genera and 288 species in India

**Key to genera**

- 1a. Leaves simple, sub-orbicular or reniform; petioles very long; umbels simple, solitary or 2–5; mericarps reniform or ellipsoid, strongly ridged, sparsely hairy when young **1. Centella**
- 1b. Leaves 2- or 3-pinnate; petioles short sheathing at base; umbels compound, 6–20; mericarps broadly ellipsoid, 5-ribbed, densely covered with fine whitish minute hairs or papillae

**2. Trachyspermum****1. CENTELLA** L.

Subtropical regions, c. 50 species, 1 in India.

**Centella asiatica** (L.) Urb. in Mart., Fl. Bras. 11: 287. 1879; Mooney, Suppl. Bot. Bihar Orissa: 68. 1950; P.K. Mukh. & Constance, Umbell. India: 15. 1993; Paria & Chattopadhyay, Fl.

Hazaribagh 2: 553. 2000; N.P. Singh & al., Fl. Bihar: 225. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 292. 2002. *Hydrocotyle asiatica* L., Sp. Pl. 1: 234. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 2: 669. 1879; Haines, Bot. Bihar Orissa: 405. 1922.

Vern. Name: *Brahm-manduki* (Hindi).

Herb with creeping and stoloniferous stems; rootstock perennial. Stems nearly glabrous or puberulous when young, rooting at nodes. Leaves simple, alternate or rosette, sub-orbicular or reniform, 1–2 × 1.5–3.5 cm, deeply cordate at base, crenate or dentate at margins, rounded at apex, glabrous or sparsely hairy, palmately 5–7-prominent-veined; petioles 2–5(–10) cm long, sheathing at base, sometimes puberulous. Umbels simple, solitary or 2–5 together from axils of bracts; involucel bracts 2, 2–3 mm long, membranous. Flowers usually 3 or 4 in each umbel; middle one sessile, lateral ones short-pedicellate. Calyx teeth obsolete. Petals ovate-rounded, 1.2–1.5 mm long, brown. Stamens 5; filaments *c.* 0.5 mm long, flat; anthers *c.* 0.5 mm long. Ovary inferior, 2-loculed; styles 2, to 0.5 mm long. Mericarps reniform or ellipsoid, *c.* 2.5 × 1.5 mm, cordate to truncate at base, strongly ridged, strongly laterally compressed, sparsely hairy when young.

*Fl. & Fr.*: February – November.

*Habitat*: Moist grassy localities.

*Distribution*: KWLS: Near the river Dhanarjay nadi, Meghatari; common. INDIA: Throughout. WORLD: Pantropical.

*Specimen examined*: Near the river Dhanarjay nadi, Meghatari, 190 m, 24°34'32.9" N, 85°34'41.6" E, 7th March 2011, *Shyam Biswa* 49699.

## 2. TRACHYSPERMUM Link, nom. cons.

Tropical regions, 15 species, 3 in India, 1 in Jharkhand.

**Trachyspermum ammi** (L.) Sprague, Bull. Misc. Inform. Kew 1929: 228. 1929; N.P. Singh & al., Fl. Bihar: 229. 2001; T.K. Sharma & A.K. Sarkar in N.P. Singh & P.S.N. Rao, Fl. Palamau: 295. 2002; Paria & Chattopadhyay, Fl. Hazaribagh 2: 559. 2005. *Sison ammi* L., Sp. Pl. 1: 252. 1753. *Carum copticum* Benth. & Hook.f., Gen. Pl. 1(3): 891. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 2: 682. 1879; Haines, Bot. Bihar Orissa: 407. 1922. **Plate 64F & G**

Vern. Name: *Ajwain* (Hindi).

Annual, 5–10 cm high. Stems erect, terete and corymbosely branched, glabrous. Leaves 2- or 3-pinnate, 1–3 × 0.5–1.5 cm, ultimate segments filiform, hairy; petioles narrowly sheathing at base. Umbels compound, 1.5–3 cm in diam., 6–20-rayed; rays 1–3 cm long; bracts linear; bracteoles 4–5 × 0.5–1 mm, ciliate. Flowers 1–1.5 mm across; pedicels *c.* 2 mm long. Calyx teeth obsolete. Petals obovate, *c.* 1 mm long, emarginate and inflexed at apex, with few hairs at base, white. Stamens 5, *c.* 1 mm long; anthers *c.* 0.5 mm long, dorsifixed. Ovary inferior, *c.* 1 mm across, 2-loculed; stylopodium dome-shaped, 2-lobed; styles reflexed in fruit. Mericarps broadly ellipsoid, *c.* 1 × 1 mm, slightly compressed laterally, densely covered with fine whitish minute hairs or papillae, 5-ribbed.

*Fl. & Fr.*: April – May.

*Habitat*: Fallow fields.

*Distribution:* KWLS: Bherwa tan Koderma NRF; common. INDIA: Presumably native to India. WORLD: Extensively cultivated throughout Central, South and Southwest Asia.

*Specimen examined:* Bherwa tan Koderma NRF, 397 m, 24°28'43.6" N, 85°36'26.7" E, 5th April 2013, *Shyam Biswa* 54159.

## PTERIDOPHYTES

### Key to family

- 1a Climbers; spore borne on the apex **2. Schizaeaceae**
- 1b. Herbs; sporangia borne marginal at fronds or apex of the branchlets 2
- 2a. Plants heterosporous; sporangia borne on axils of sporophylls which are aggregated in terminal strobili **3. Selaginellaceae**
- 2b. Plant homosporous; sporangia not borne on the axils of sporophylls **1. Pteridaceae**

### 1. PTERIDACEAE Kirchn.

Cosmopolitan, c. 45 genera and c. 1100 species; 8 genera in India.

#### Key to genera

- 1a. Sporangia borne on the margins of abaxial surface of fronds, protected by in rolled margins **3. Pteris**
- 1b. Sporangia borne on the under side of the fronds, under the sharply reflexed leaf margin 2
- 2a. Fronds bipinnate, or tripinnate; sori confluent on the inside of the recurved margin of the lobes of the frond **1. Adiantum**
- 2b Fronds simple pinnate; sori not confluent on the inside of the recurved margins of the frond **2. Hemionitis**

### 1. ADIANTUM L.

Cosmopolitan, especially tropical America, c. 200 species, 26 in India and 2 in Jharkhand and KWLS.

#### Key to species

- 1a. Pinnae with petiolules/stipelli, 3–10 mm long, not-perpendicular to rachis, entire at lower margin, incised-lobate at outer margin; sori oblong to linear, often continuous along the upper margin interrupted by a few narrow notches **2. A. philippense**
- 1b. Pinnae sessile or subsessile, perpendicular to the rachis, deeply and broadly lobed at upper margins which are usually forked again; sori oblong or reniform, 3–6 on each pinna, marginal **2. A. incisum**

**1. Adiantum incisum** Forssk., Fl. Aegypt.-Arab.: 187. 1775.

**Plate 65D**

Herb, terrestrial; rhizomes erect, densely scaly, scales lanceolate, to 8 mm long, reddish brown, acuminate or acicular at apex; stipes numerous, tufted, terete, 4.5–8 cm long, reddish brown, glossy, covered by long, soft, slender, pale brown, multicellular hairs. Lamina linear-lanceolate, slender, to c. 35 × 3 cm, simply pinnate; pinnae to 20 pairs, sessile or subsessile, alternate or subopposite, deflexed, distal most pairs progressively reduced and widely spaced; pinna c. 2 × 1 cm, dimidiate, truncate at upper base and parallel to the rachis, entire at lower margins, more or less perpendicular to the rachis, deeply and broadly lobed at upper margins which are usually



forked again, rounded at apex; veins slightly distinct above and below, repeatedly forked, flabellate, free, reaching the margin, pinnae pale green, glabrous above and beneath. Sori marginal, 3–6 on each pinna, oblong or reniform, *c.* 1 mm long, brown.

*Fl. & Fr.*: September.

*Habitat*: On rock crevices of dry deciduous forest.

*Distribution*: KWLS: Near the base of Dhawjadhari Pahar.

*Specimen examined*: Near the base of Dhawjadhari Pahar, 404 m, 24°29'03.1" N, 85°35'43.3" E, 5th September 2010, *Shyam Biswa* 49568.

**2. *Adiantum philippense* L.**, Sp. Pl. 2: 1094. 1753. *Adiantum lunulatum* Burm.f., Fl. Ind.: 235. 1768; Bedd., Ferns S. India: t. 1. 1863 & Handb. Ferns Brit. India: 82. 1883; C.B. Clarke, Trans. Linn. Soc. London 1: 452. 1880; Haines, Bot. Bihar Orissa 3: 1254. 1924. **Plate 65G**

Herb, to 55 cm long; rhizomes short, unbranched, ascending, densely tufted. Scales linear-lanceolate, *c.* 3 mm long, dark brown. Stipe clumped on rhizome, 9–15 cm long, slender, reddish black, glabrous, glossy. Lamina simple pinnate, linear-oblong, 15–45 cm long with subconform terminal pinna or extended rachis rooting at apex, glabrous all over. Pinnae 8–15 pairs, alternate, suborbicular to obliquely oblong-ovate or lunate, 1–3 × 0.8–1.5 cm, cuneate, articulate at base, entire at lower margins, straight to concave, incised-lobate at outer margins, lobes round; veins slightly raised, flabellate free; stipelli 3–10 mm long, filiform, reddish black. Sori oblong to linear, often continuous along the upper margins interrupted by a few narrow notches, brownish.

*Fl. & Fr.*: March.

*Habitat*: Shady rocky localities in dry deciduous forest

*Distribution*: KWLS: Lokai forest; common. INDIA: Throughout. WORLD: Tropical and subtropical regions of the world.

*Specimen examined*: Lokai forest, 397 m, 24°29'02.9" N, 85°37'04.4" E, 9th March 2013, *Shyam Biswa* 53926.

## 2. **HEMIONITIS** L.

Cosmopolitan, *c.* 439 species, 2 in Jharkhand and KWLS.

### Key to species

1a. Frond silvery beneath

**2. *H. farinosa***

1b. Fronds not silvery beneath

**1. *H. tenuifolia***

**1. *Hemionitis tenuifolia* (Burm.f.) Christenh.**, Global Fl. 4: 22. 2018. *Cheilanthes tenuifolia* (Burm.f.) Sw., Syn. Fil.: 129, 332. 1806. **Plate 65E &**

Herb, 30–40 cm high, tufted; rhizomes short, ascending, covered with scales; scales 3–4 mm long, brown. Stipes terete, to 20 cm long, polished, slightly swollen and densely scaly at base, sparsely and minutely scaly upwards, grooved on adaxial surface. Fronds dimorphic; sterile lamina smaller, deltoid in outline. Fertile lamina tripinnate or quadripinnatifid, ovate-lanceolate or sub-deltoid in outline, to 20 × 7 cm; pinnae opposite or subopposite, distinctly

stalked, basal ones the largest, subtriangular, acute at apex; middle pinnae oblong-subtriangular; larger pinnules pinnatisect with a few pairs of lobes and a large terminal one; terminal lobes of pinnules like terminal pinnae and pinnules, oblong,  $2-10 \times 1-5$  mm, round at apex, ultimate lobes round or oval,  $2-5 \times c. 1$  mm, green; veins free, obscure. Sori confined to the end of veins but appearing continuous at margins of lobes, when young protected by reflexed margin of lobes.

*Fl. & Fr.*: September.

*Habitat*: Near moist and damp localities.

*Distribution*: KWLS: Near the Phulwarwaria jungle, Koderma NRF; common. INDIA: WORLD: Tropical Asia and Oceania, Australia and New Zealand.

*Specimen examined*: Near the Phulwarwaria jungle, Koderma NRF, 394 m,  $24^{\circ}29'06.6''$  N,  $85^{\circ}35'49.8''$  E, 4th September 2010, *Shyam Biswa* 49550.

**2. *Hemionitis farinosa* (Forssk.) Christenh.** Global Fl. 4: 13 2018. *Cheilanthes farinosa* (Forssk.) Kaulf., Enum. Fil.: 212. 1824. *Pteris farinosa* Forssk., Fl. Aegypt.-Arab.: 187. 1775. **Plate 65I**

Vern. Name: *Silver fern*.

Terrestrial herb with erect rhizome,  $c. 2.5 \times 2$  cm with fibrous roots at the base and scales above. Scales lanceolate,  $5-6 \times 1-1.1$  mm, entire at margins, acuminate at apex, dark brownish to black in the middle, paler along margins. Fronds  $25-45 \times 6-8$  cm, bipinnate; stipe 10–22 cm long, sparsely scaly above, densely so beneath, dark pinkish brown to black; lamina lanceolate, acuminate in outline; primary pinnae triangularly ovate, to  $c. 6 \times 3$  cm, acute or obtuse in outline, progressively reduced towards apex; pinnules oblong,  $1-2.5 \times 0.5-0.7$  cm, obtuse, lobed to crenate; lobes oblong or ovate, to  $c. 2 \times 2$  mm, obtuse at apex; acroscopic pinnules smaller; costa and costules raised beneath, grooved above. Sori linear, marginal, not continuous, yellowish brown.

*Fl. & Fr.*: September – November.

*Habitat*: Shady localities in dry deciduous forest.

*Distribution*: KWLS: Taraghati forest

*Specimen examined*: Taraghati forest, 333 m,  $24^{\circ}32'02.2''$  N,  $85^{\circ}34'47.0''$  E, 21st November 2012, *Shyam Biswa* 53927.

### 3. **PTERIS L.**

Cosmopolitan,  $c. 250$  species, 54 in India,  $c. 5$  in Jharkhand and 1 in KWLS.

***Pteris vittata* L.**, Sp. Pl. 2: 1074. 1753; Panigrahi, Bull. Bot. Surv. India 2: 312. 1960. **Plate 65H**

Herb, to 80 cm high; rhizomes erect to short, creeping, scaly. Stipes 4–10 mm long, grooved above, rounded beneath, densely scaly with either narrowly lanceolate white or yellowish brown scales beneath; rachis similar. Lamina pinnate, oblanceolate,  $6-50 \times 4-20$  cm, tufted; pinnae 10–35 pairs, opposite or subopposite, sessile, linear to linear-lanceolate,  $1-15 \times 0.3-0.9$  cm, sessile, auricled or cordate at base, entire or serrulate at margins, acute to obtuse at apex, largest pinnae in apical, gradually reduced downwards to the base into small sub-opposite auricles; terminal-

pinnae like other pinnae but not auricled at base; veins simple to twice forked, prominent, ending into margin, dark green above pale beneath. Sori marginal, elongated, uninterrupted golden yellowish or light brown.

*Fl. & Fr.*: January – April.

*Habitat*: Near the waste land and on rock crevices with sandy soil.

*Distribution*: KWLS: Near the mica factory, Chattarbar; common. INDIA: Throughout. WORLD: Cosmopolitan.

*Specimen examined*: Near the mica factory, Chattarbar, 375 m, 24°28'36.5" N, 85°32'20.5" E, 28th February 2012, *Shyam Biswa* 54013.

## 2. SCHIZAEACEAE Kaulf.

Tropical and subtropical regions, 2 genus and *c.* 44 species; 1 genus and 10 species in India  
Tropical and subtropical regions, 1 genus and *c.* 25 species; 1 genus and 10 species in India.

LYGODIUM Sw., nom. cons.

Tropical and subtropical regions, *c.* 25 species, *c.* 10 in India, 3 in Jharkhnad and 1 in KWLS.

**Lygodium flexuosum** (L.) Sw. in Schrad., J. Bot. 1800: 106. 1801; Bedd., Ferns S. India: t. 63. 1863 & Handb. Ferns Brit. India: 457, t. 283. 1883; C.B. Clarke, Trans. Linn. Soc. London Bot. 1: 534. 1880; Haines, Forest Fl. Chota Nagpur: 136. 1910 & Bot. Bihar Orissa 3: 1264. 1924; Baishya & Rao, Ferns & Fern-allies Meghalaya: 37. 1982. *Ophioglossum flexuosum* L., Sp. Pl. 2: 1063. 1753. **Plate 65A**

Climbing fern; rhizomes short, erect with filiform stipe and rachis, glabrous or slightly hairy. Primary rachis-branches not elongated; secondary rachis-branches opposite, 6–20 cm long, bearing alternate pinnules; pinnules lanceolate to linear-lanceolate, 3–10 cm long, cuneate to cordate or auricled at base, serrulate at margins, acute at apex, deeply cut into 2 or 5 distinct basal lobes, appearing pinnate, coriaceous or chartaceous, hairy on the veins and midrib; terminal pinnule longer and larger than the lateral ones. Fertile pinnules slightly contracted, narrower. Spikes on marginal protruding lobes, oblong-cylindrical; indusium covered with few slender hairs.

*Fl. & Fr.*: September – November.

*Habitat*: Open forest.

*Distribution*: KWLS: Inside the enclosure forest, Koderma NRF; Bherwa tan Lokai forest; common. INDIA: Andamans and Peninsular India. WORLD: China, Malaysia to Australia and Sri Lanka.

*Specimen examined*: Inside the enclosure forest, Koderma NRF, 390 m, 24°29'18.7" N, 85°35'15.1" E, 8th September 2010, *Shyam Biswa* 49601.

## 3. SELAGINELLACEAE Willk.

Cosmopolitan, 1 genus and *c.* 700 species; 1 genus and 62 species in India.

SELAGINELLA P. Beauv., nom. cons.

Cosmopolitan, *c.* 700 species, 62 in India, 9 in Jharkhand and 2 in KWLS.

**Key to species**

- |                                                                                        |                                |
|----------------------------------------------------------------------------------------|--------------------------------|
| 1a. Frond curling especially in drought, deep green above very pale or silvery beneath | <b>1. <i>S. bryopteris</i></b> |
| 1b. Frond not curling in drought, light green on both surfaces                         | <b>2. <i>S. vaginata</i></b>   |

**1. *Selaginella bryopteris* (L.) Baker, J. Bot. 22 (Za): 376. 1884; Haines, Bot. Bihar Orissa 3: 1225. 1924. *Lycopodium bryopteris* L., Sp. Pl. 2: 1103. 1753.** **Plate 65B**

Vern. Name: *Sanjeeveni* (Hindi).

Erect or suberect, to 15 cm high. Stems scaly, often half to two-thirds as long. Fronds deltoid or decompound, deep green above, pale or silvery beneath, readily curling up on dry or hot condition. Primary and secondary branching pinnate, ultimate divisions between pinnate and flabellate. Larger leaves much-imbricate, ascending, ovate, cuspidate, 1–1.5 mm long or attaining on the stem (including the cusp); upper leaves nearly as long, oblique ovate with fine arista or cusp often as long as the blade. Spikes or flowers short square, *c.* 1 mm across with ovate cuspidately acuminate strongly keeled bracts or sporophylls.

*Fl. & Fr.*: July – November.

*Habitat*: On the rocky hill slopes.

*Distribution*: KWLS: Near Rishi Dhurwasha Pahar, Meghatari

*Specimen examined*: Near Rishi Dhurwasha Pahar, Meghatari, 226 m, 24°35'24.54" N, 85°34'33.2" E, 16th August 2011, *Shyam Biswa* 53925.

**2. *Selaginella vaginata* Spring, Mém. Acad. Roy. Sci. Belgique 24: 87. 1850.** **Plate 65C**

Herb, terrestrial or epilithic, prostrate, ascending, 6–20 cm long. Stems terete, slender, branched throughout from the base. Rhizophores many, wiry, short. Leaves heteromorphic, thin but firm in texture; lateral leaves asymmetrical, oblong, or ovate triangular, 1.5–2 × 1–1.2 mm, rounded or exauriculate at base, ciliate at margins, acute at apex; median leaves symmetrical, ovate, *c.* 1 × 0.5 cm, rounded at base, dentate or ciliate at base, acuminate or aristate at apex. Strobili single at the apex of branchlets, tetragonal or cylindrical, 2–5 × 1–2 mm, compact. Sporophylls uniform, ovate lanceolate, *c.* 1.5 × 1 mm, rounded at base, ciliolate or denticulate at margins, acuminate at apex. Megaspores dark brown. Microspores orange-red.

*Fl. & Fr.*: September – November.

*Habitat*: Shady localities on the rocks of dry deciduous forest and near the river.

*Distribution*: KWLS: Chattarbar forest; near Dhanarjay nadi; occasional. INDIA: WORLD: Bhutan, China, Myanmar, Nepal, Pakistan, Thailand and Vietnam.

*Specimens examined*: Chattarbar forest, 379 m, 24°28'01.9" N, 85°32'13.1" E, 3rd September 2010, *Shyam Biswa* 49527; Lokai forest, 399 m, 24°29'01.4" N, 85°36'52.9" E, 28th September 2013, *Shyam Biswa* 54198.

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# INDEX (SCIENTIFIC NAMES)

## A

|                                                           |     |  |  |
|-----------------------------------------------------------|-----|--|--|
| <b>ABILDGAARDIA</b> Vahl                                  | 57  |  |  |
| <i>ovata</i> (Burm.f.) Kral                               | 57  |  |  |
| <b>ABRUS</b> Adans.                                       | 114 |  |  |
| <i>precatorius</i> L.                                     | 114 |  |  |
| <b>ACACIA</b> Mill.                                       | 147 |  |  |
| <i>arabica</i> (Lam.) Willd.                              | 161 |  |  |
| var. <i>indica</i> Benth.                                 | 161 |  |  |
| <i>arabica auct. non</i> (Lam.) Willd.                    | 161 |  |  |
| <b>Acacia auriculiformis</b> A. Cunn. ex Benth.           | 147 |  |  |
| <i>caesia</i> (L.) Willd.                                 | 155 |  |  |
| <i>catechu</i> (L.f.) Willd.                              | 156 |  |  |
| var. <i>catechuoides</i> (Roxb.) Prain                    | 156 |  |  |
| <i>catechu</i> (L.f.) Willd.                              | 156 |  |  |
| <i>farnesiana</i> (L.) Willd.                             | 160 |  |  |
| <i>intsia</i> (L.) Willd.                                 | 155 |  |  |
| var. <i>caesia</i> (L.) Wight & Arn. ex Baker             | 155 |  |  |
| <i>nilotica</i> (L.) Willd. ex Delile                     | 161 |  |  |
| subsp. <i>indica</i> (Benth.) Brenan                      | 161 |  |  |
| <i>pennata</i> Baker <i>p p. auct non</i> (L.) Willd.     | 156 |  |  |
| <i>torta</i> (Roxb.) Craib                                | 156 |  |  |
| <b>ACANTHACEAE</b>                                        | 339 |  |  |
| <b>ACHYRANTHES</b> L.                                     | 267 |  |  |
| <i>alternifolia</i> L.                                    | 276 |  |  |
| <i>aspera</i> L.                                          | 267 |  |  |
| <i>corymbosa</i> L.                                       | 266 |  |  |
| <i>lanata</i> L.                                          | 268 |  |  |
| <i>muricata</i> L.                                        | 276 |  |  |
| <i>sanguinolenta</i> L.                                   | 268 |  |  |
| <i>scandens</i> Roxb.                                     | 268 |  |  |
| <b>ACMELLA</b> Rich. ex Pers.                             | 377 |  |  |
| <i>paniculata</i> (Wall. ex DC.) R.K. Jansen              | 377 |  |  |
| <i>Adhatoda vasica</i> Nees                               | 347 |  |  |
| <i>zeylanica</i> Medik.                                   | 347 |  |  |
| <b>ADIANTUM</b> L.                                        | 396 |  |  |
| <i>lunulatum</i> Burm.f.                                  | 397 |  |  |
| <i>philippense</i> L.                                     | 397 |  |  |
| <i>incisum</i> Forssk.                                    | 396 |  |  |
| <b>ADINA</b> Salisb.                                      | 288 |  |  |
| <i>cordifolia</i> (Roxb.) Hook.f. & Benth.                | 288 |  |  |
| <b>AEGLE</b> Corrêa                                       | 231 |  |  |
| <i>marmelos</i> (L.) Corrêa                               | 231 |  |  |
| <b>AERVA</b> Forssk.                                      | 268 |  |  |
| <b>Aerva lanata</b> (L.) Juss. ex Schult.                 | 268 |  |  |
| <i>monsonia</i> (Retz.) Mart.                             | 278 |  |  |
| <i>scandens</i> (Roxb.) Wall. ex Moq.                     | 268 |  |  |
| <i>sanguinolenta</i> (L.) Blume                           | 268 |  |  |
| <b>AESCHYNOMENE</b> L.                                    | 115 |  |  |
| <i>indica</i> L.                                          | 115 |  |  |
| <b>AGAVE</b> L.                                           | 38  |  |  |
| <i>americana</i> L.                                       | 38  |  |  |
| <b>AGERATUM</b> L.                                        | 378 |  |  |
| <i>conyzoides</i> L.                                      | 378 |  |  |
| <i>cordifolium</i> Roxb.                                  | 378 |  |  |
| <i>Agrostis maxima</i> Roxb.                              | 101 |  |  |
| <b>AILANTHUS</b> Desf.                                    | 232 |  |  |
| <i>excelsa</i> Roxb.                                      | 232 |  |  |
| <b>ALBIZIA</b> Durazz.                                    | 148 |  |  |
| <i>lebbeck</i> (L.) Benth.                                | 148 |  |  |
| <i>procera</i> (Roxb.) Benth.                             | 148 |  |  |
| <b>ALISMATACEAE</b>                                       | 26  |  |  |
| <b>ALLMANIA</b> R. Br. ex Wight.                          | 269 |  |  |
| <i>albida</i> R. Br. ex Hook.f.                           | 269 |  |  |
| <i>nodiflora</i> (L.) R. Br. ex Wight                     | 269 |  |  |
| <b>ALLOTEROPSIS</b> C.B. Presl                            | 75  |  |  |
| <i>cimicina</i> (L.) Stapf                                | 75  |  |  |
| <b>ALSTONIA</b> R. Br.                                    | 304 |  |  |
| <i>scholaris</i> (L.) R. Br.                              | 304 |  |  |
| <b>ALTERNANTHERA</b> Forssk.                              | 269 |  |  |
| <i>bettzickiana</i> (Regel) G. Nicholson                  | 270 |  |  |
| <i>echinata</i> sensu Mooney                              | 272 |  |  |
| <i>ficoidea</i> (L.) P. Beauv.                            | 270 |  |  |
| <i>polygonoides</i> R. Br. ex Sweet                       | 272 |  |  |
| <b>Alternanthera pungens</b> Kunth                        | 272 |  |  |
| <i>tenella</i> Colla                                      | 270 |  |  |
| <i>paronychioides</i> A.St.-Hil.                          | 272 |  |  |
| <b>ALYSICARPUS</b> Necker ex Desv.                        | 115 |  |  |
| <i>monilifer</i> (L.) DC.                                 | 116 |  |  |
| <i>vaginalis</i> (L.) DC.                                 | 116 |  |  |
| <b>AMARANTHACEAE</b>                                      | 266 |  |  |
| <b>AMARANTHUS</b> L.                                      | 273 |  |  |
| <i>spinosus</i> L.                                        | 273 |  |  |
| <i>Amischophacelus axillaris</i> (L.) R.S. Rao & Kammathy | 44  |  |  |
| <i>cucullata</i> (Roth) R.S. Rao & Kammathy               | 45  |  |  |
| <b>AMMANNIA</b> L.                                        | 214 |  |  |
| <i>baccifera</i> L.                                       | 214 |  |  |
| <i>densiflora</i> Roth ex Roem. & Schult.                 | 216 |  |  |
| <i>pentandra</i> sensu C.B. Clarke                        | 216 |  |  |
| <b>AMPELOCISSUS</b> Planch.                               | 109 |  |  |
| <i>latifolia</i> (Roxb.) Planch.                          | 109 |  |  |
| <i>tomentosa</i> (Roth) Planch.                           | 110 |  |  |

|                                                                    |            |
|--------------------------------------------------------------------|------------|
| <b>ANACARDIACEAE</b>                                               | <b>223</b> |
| <i>Anagallis arvensis</i> L.                                       | 286        |
| <b>ANDROGRAPHIS</b> Wall. ex Nees                                  | <b>340</b> |
| <b>echioides</b> (L.) Nees                                         | <b>340</b> |
| <b>longipedunculata</b> (Sreem.) L.H. Cramer                       | <b>340</b> |
| <i>Andropogon aciculatus</i> Retz.                                 | 77         |
| <i>annulatus</i> Forssk.                                           | 82         |
| <i>hamiltonii</i> Hook.f.                                          | 78         |
| <i>martini</i> Roxb.                                               | 80         |
| <i>schoenanthus</i> L.                                             | 80         |
| var. <i>martini</i> (Roxb.) Benth.                                 | 80         |
| <i>trispicatus</i> Schult.                                         | 95         |
| <i>Aneilema nudiflorum</i> Wall. ex Hook.f.                        | 47         |
| <i>spiratum</i> (L.) R. Br.                                        | 47         |
| <i>Anisochilus carnosus</i> (L.f.) Wall. ex Benth.                 | 360        |
| <b>ANISOMELES</b> R. Br.                                           | <b>357</b> |
| <b>indica</b> (L.) Kuntze                                          | <b>357</b> |
| <i>ovata</i> R. Br.                                                | 357        |
| <b>ANNONACEAE</b>                                                  | <b>23</b>  |
| <b>ANNONA</b> L.                                                   | <b>23</b>  |
| <b>squamosa</b> L.                                                 | <b>24</b>  |
| <i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill. & Perr. | 212        |
| <i>Anthistiria imberbis</i> Retz.                                  | 100        |
| <i>Anthocephalus cadamba</i> (Roxb.) Miq.                          | 296        |
| <i>chinensis</i> auct. non (Lam.) A. Rich. ex Walp.                | 296        |
| <i>Anthoxanthum indicum</i> L.                                     | 94         |
| <b>ANTIDESMA</b> L.                                                | <b>204</b> |
| <b>acidum</b> Retz.                                                | <b>204</b> |
| <i>diandrum</i> B. Heyne ex Roth                                   | 204        |
| <i>ghaesembilla</i> sensu Hook.f.                                  | 204        |
| <b>ANTIGONON</b> Endl.                                             | <b>263</b> |
| <b>leptopus</b> Hook. & Arn.                                       | <b>263</b> |
| <b>APIACEAE</b>                                                    | <b>394</b> |
| <b>APOCYNACEAE</b>                                                 | <b>303</b> |
| <i>Apocynum frutescens</i> L.                                      | 314        |
| <b>ARACEAE</b>                                                     | <b>25</b>  |
| <b>ARECACEAE</b> Bercht. & J. Presl                                | <b>41</b>  |
| <b>ARGEMONE</b> L.                                                 | <b>106</b> |
| <b>mexicana</b> L.                                                 | <b>106</b> |
| <b>ochroleuca</b> Sweet                                            | <b>106</b> |
| <i>Artemisia maderaspatana</i> L.                                  | 389        |
| <b>ARTOCARPUS</b> J.R. Forst. & G. Forst.                          | <b>169</b> |
| <b>heterophyllus</b> Lam.                                          | <b>169</b> |
| <i>integrifolia</i> auct. non L.f.                                 | 170        |
| <b>lacucha</b> Roxb. ex Buch.-Ham.                                 | <b>170</b> |
| <i>lakoocha</i> Roxb.                                              | 170        |

## B

|                                                        |     |                                                  |     |
|--------------------------------------------------------|-----|--------------------------------------------------|-----|
| <i>retusa</i> Roxb.                                    | 144 | <b>barbata</b> (Rottb.) C.B. Clarke              | 58  |
| <i>roxburghiana</i> Voigt                              | 144 | <b>BURSERACEAE</b>                               | 221 |
| <i>vahlII</i> Wight & Arn.                             | 144 | <b>BUTEA</b> König ex Willd.                     | 118 |
| <b>BERGIA</b> L.                                       | 189 | <i>frondosa</i> Roxb. ex Willd.                  | 118 |
| <b>ammannioides</b> Roxb. ex Roth                      | 189 | <b>monosperma</b> Kuntze                         | 118 |
| <i>Bignonia colais</i> Dillwyn                         | 354 | <i>parviflora</i> Roxb.                          | 139 |
| <i>indica</i> L.                                       | 353 | <b>superba</b> Roxb. ex Willd.                   | 118 |
| <i>stans</i> L.                                        | 354 | <b>BUTOMOPSIS</b> Kunth                          | 26  |
| <b>BIGNONIACEAE</b>                                    | 352 | <i>lanceolata</i> (Roxb.) Kunth                  | 26  |
| <b>BIOPHYTUM</b> DC.                                   | 187 | <b>latifolia</b> (D. Don) Kunth                  | 26  |
| <b>sensitivum</b> (L.) DC.                             | 187 | <i>Butomus lanceolatus</i> Roxb.                 | 26  |
| <b>BIXACEAE</b> Kunth                                  | 253 | <i>latifolius</i> D. Don                         | 26  |
| <b>BLAINVILLEA</b> Cass.                               | 378 | <i>Byttneria herbacea</i> Roxb.                  | 237 |
| <b>acmella</b> (L.) Philipson                          | 378 |                                                  |     |
| <i>latifolia</i> (L.f.) DC. ex Wight                   | 378 |                                                  |     |
| <b>BLUMEA</b> DC.                                      | 379 |                                                  |     |
| <b>lacera</b> (Burm.f.) DC.                            | 379 |                                                  |     |
| <b>BLUMEOPSIS</b> Gagnep.                              | 380 |                                                  |     |
| <b>flava</b> (DC.) Gagnep.                             | 380 |                                                  |     |
| <i>Boerhavia repens</i> L.                             | 280 |                                                  |     |
| var. <i>diffusa</i> (L.) Hook.f.                       | 280 |                                                  |     |
| <b>BOERHAVIA</b> L.                                    | 280 |                                                  |     |
| <b>diffusa</b> L.                                      | 280 |                                                  |     |
| <b>BOMBAX</b> L.                                       | 238 |                                                  |     |
| <b>ceiba</b> L.                                        | 238 |                                                  |     |
| <i>malabricum</i> DC.                                  | 238 |                                                  |     |
| <i>religiosum</i> L.                                   | 253 |                                                  |     |
| <b>BONNAYA</b> Link & Otto                             | 336 |                                                  |     |
| <i>brachiata</i> Link & Otto                           | 336 |                                                  |     |
| <b>ciliata</b> (Colsm.) Spreng.                        | 336 |                                                  |     |
| <b>BORAGINACEAE</b>                                    | 317 |                                                  |     |
| <i>Borreria articularis</i> (L.f.) F.N. Williams       | 298 |                                                  |     |
| <b>BOSWELLIA</b> Roxb. ex Colebr.                      | 221 |                                                  |     |
| <i>glabra</i> Roxb.                                    | 221 |                                                  |     |
| <i>serrata</i> Roxb. ex Colebr.                        | 221 |                                                  |     |
| var. <i>glabra</i> (Roxb.) A.W. Benn.                  | 221 |                                                  |     |
| <b>serrata</b> Roxb. ex Colebr.                        | 221 |                                                  |     |
| <i>Brachiaria reptans</i> (L.) C.A.Gardner & C.E.Hubb. | 103 |                                                  |     |
| <b>BRASSICACEAE</b>                                    | 259 |                                                  |     |
| <b>BRIDELIA</b> Willd.                                 | 205 |                                                  |     |
| <b>retusa</b> (L.) Spreng.                             | 205 |                                                  |     |
| <i>Bryonia grandis</i> L.                              | 176 |                                                  |     |
| <i>palmata</i> L.                                      | 178 |                                                  |     |
| <i>Bryonopsis laciniosa</i> (L.) Naudin                | 178 |                                                  |     |
| var. <i>walkerii</i> Chakrav.                          | 178 |                                                  |     |
| <b>BUCHANANIA</b> Spreng.                              | 223 |                                                  |     |
| <b>lanzan</b> Spreng.                                  | 223 |                                                  |     |
| <i>latifolia</i> Roxb.                                 | 223 |                                                  |     |
| <i>Buchnera angustifolia</i> D. Don                    | 372 |                                                  |     |
| <b>BULBOSTYLIS</b> Kunth                               | 58  |                                                  |     |
|                                                        |     | <b>C</b>                                         |     |
|                                                        |     | <i>Cacalia sonchifolia</i> L.                    | 386 |
|                                                        |     | <b>Caesalpinioideae</b>                          | 112 |
|                                                        |     | <b>CAESULIA</b> Roxb.                            | 380 |
|                                                        |     | <b>axillaris</b> Roxb.                           | 380 |
|                                                        |     | <b>CAJANUS</b> Adans.                            | 119 |
|                                                        |     | <b>scarabaeoides</b> (L.) Thouars                | 119 |
|                                                        |     | <i>Calonyction muricatum</i> (L.) G. Don         | 322 |
|                                                        |     | <b>CALOTROPIS</b> R. Br.                         | 305 |
|                                                        |     | <b>gigantea</b> (L.) W.T.Aiton                   | 305 |
|                                                        |     | <b>procera</b> W.T. Aiton                        | 306 |
|                                                        |     | <i>Campanula marginata</i> Thunb.                | 374 |
|                                                        |     | <b>CAMPANULACEAE</b>                             | 373 |
|                                                        |     | <b>CANNACEAE</b>                                 | 49  |
|                                                        |     | <b>CANNA</b> L.                                  | 49  |
|                                                        |     | <i>indica</i>                                    | 50  |
|                                                        |     | var. <i>orientalis</i> (Roscoe) Baker            | 50  |
|                                                        |     | <b>indica</b> L.                                 | 50  |
|                                                        |     | <b>CANSCORA</b> Lam.                             | 300 |
|                                                        |     | <b>alata</b> (Roth) Wall.                        | 301 |
|                                                        |     | <i>decussata</i> (Roxb.) Roem. & Schult.         | 301 |
|                                                        |     | <b>diffusa</b> (Vahl) R. Br. ex Roem. & Schult.  | 301 |
|                                                        |     | <i>diffusa</i> (Vahl) R. Br.                     | 301 |
|                                                        |     | var. <i>tenella</i> (Wight) C.B. Clarke          | 301 |
|                                                        |     | <i>tenella</i> Wight                             | 301 |
|                                                        |     | <i>Cantharospermum scarabaeoides</i> (L.) Baill. | 119 |
|                                                        |     | <b>CAPPARACEAE</b>                               | 256 |
|                                                        |     | <b>CAPPARIS</b> L.                               | 256 |
|                                                        |     | <i>horrida</i> L.f.                              | 256 |
|                                                        |     | <b>zeylanica</b> L.                              | 256 |
|                                                        |     | <i>Capraria crustacea</i> L.                     | 337 |
|                                                        |     | <b>CARDIOSPERMUM</b> L.                          | 228 |
|                                                        |     | <b>halicacabum</b> L.                            | 228 |
|                                                        |     | <i>Carex ovata</i> Burm.f.                       | 57  |
|                                                        |     | <b>CARISSA</b> L.                                | 306 |

|                                             |     |                                               |     |
|---------------------------------------------|-----|-----------------------------------------------|-----|
| <b>carandas</b> L.                          | 306 | <i>Cheilocostus speciosus</i> (J. König) C.D. |     |
| <i>Carum copticum</i> Benth.                | 395 | Specht                                        | 50  |
| <b>CARYOPHYLLACEAE</b>                      | 266 | <b>CHENOPODIUM</b> L.                         | 275 |
| <b>CASCABELA</b> Raf.                       | 307 | <b>album</b> L.                               | 275 |
| <b>thevetia</b> (L.) Lippold                | 307 | <i>Chironia centaureoides</i> Roxb.           | 302 |
| <b>CASEARIA</b> Jacq.                       | 191 | <b>CHLOROPHYTUM</b> Ker Gawl.                 | 41  |
| <i>elliptica</i> Willd.                     | 191 | <b>arundinaceum</b> Baker                     | 41  |
| <b>tomentosa</b> Roxb.                      | 191 | <b>CHROMOLAENA</b> DC.                        | 381 |
| <b>CASSIA</b> L.                            | 149 | <b>odorata</b> (L.) R.M. King & H. Rob.       | 381 |
| <i>alata</i> L.                             | 157 | <b>CHROZOPHORA</b> Neck. ex Juss.             | 193 |
| <b>fistula</b> L.                           | 149 | <b>rottleri</b> (Geiseler) Spreng.            | 193 |
| <i>hirsuta</i> L.                           | 158 | <i>tinctoria</i> sensu Hook.f.                | 193 |
| <i>occidentalis</i> L.                      | 158 | <b>CHRYSOPOGON</b> Trin.                      | 77  |
| <i>pumila</i> Lam.                          | 151 | <b>hamiltonii</b> (Hook.f.) Haines            | 78  |
| <i>siamea</i> Lam.                          | 159 | <b>aciculatus</b> (Retz.) Trin.               | 77  |
| <i>tora</i> L.                              | 160 | <i>Cinchona orixensis</i> Roxb.               | 291 |
| <i>Cassine albens</i> sensu Ramam.          | 185 | <b>CISSAMPELOS</b> L.                         | 107 |
| <i>Cassine glauca</i> (Rottb.) Kuntze       | 185 | <i>pareira</i> L.                             | 107 |
| <b>CASSYTHA</b> Osbeck                      | 24  | var. <i>hirsuta</i> (Buch.-Ham. ex DC.)       |     |
| <b>filiformis</b> L.                        | 24  | Forman                                        | 107 |
| <b>CATHARANTHUS</b> G. Don                  | 307 | <b>Cissampelos pareira</b> L.                 | 107 |
| <b>pusillus</b> (Murr.) G. Don              | 308 | <i>hirsuta</i> Buch.-Ham. ex DC.              | 107 |
| <b>CATUNAREGAM</b> Wolf                     | 288 | <i>Cissus auriculata</i> Roxb.                | 111 |
| <b>spinosa</b> (Thunb.) Tirveng.            | 288 | <b>CLEOMACEAE</b>                             | 258 |
| <i>Cayratia auriculata</i> (Roxb.) Gamble   | 111 | <b>CLEOME</b> L.                              | 258 |
| <b>CELASTRACEAE</b>                         | 185 | <b>viscosa</b> L.                             | 258 |
| <b>CELOSIA</b> L.                           | 275 | <b>CLERODENDRUM</b> L.                        | 359 |
| <i>monsonia</i> Retz.                       | 278 | <b>infortunatum</b> L.                        | 359 |
| <i>nodiflora</i> L.                         | 269 | <i>viscosum</i> auct. non Vent.               | 359 |
| <i>cristata</i> L.                          | 275 | <b>CLITORIA</b> L.                            | 120 |
| <b>argentea</b> L.                          | 275 | <b>ternatea</b> L.                            | 120 |
| <i>Celsia coromandeliana</i> Vahl           | 335 | <i>Clutia retusa</i> L.                       | 205 |
| <b>CENCHRUS</b> L.                          | 76  | <b>COCCINIA</b> Wight & Arn.                  | 176 |
| <i>granularis</i> L.                        | 92  | <b>grandis</b> (L.) Voigt                     | 176 |
| <b>pedicellatus</b> (Trin.) Morrone         | 76  | <i>indica</i> Wight & Arn.                    | 176 |
| <b>CENTAURIUM</b> Hill.                     | 302 | <i>palmata</i> M. Roem.                       | 178 |
| <b>centaurioides</b> (Roxb.) S.R. Rao &     |     | <b>COCHLOSPERMUM</b> Kunth                    | 253 |
| Hemadri                                     | 302 | <i>gossypium</i> DC.                          | 253 |
| <b>CENTELLA</b> L.                          | 394 | <b>religiosum</b> (L.) Alston                 | 253 |
| <b>asiatica</b> (L.) Urb.                   | 394 | <b>COLCHICACEAE</b>                           | 31  |
| <i>Cephalandra indica</i> Naudin            | 176 | <b>COLEUS</b> Lour.                           | 359 |
| <i>Cephalanthus chinensis</i> Lam.          | 296 | <b>strobilifer</b> (Roxb.) A.J.Paton          | 360 |
| <i>Cerbera peruviana</i> Pers.              | 307 | <b>COLOCASIA</b> Schott                       | 25  |
| <b>Cercidoideae</b>                         | 113 | <b>esculenta</b> (L.) Schott                  | 25  |
| <b>CEROPEGIA</b> L.                         | 308 | <b>COMBRETACEAE</b>                           | 208 |
| <b>hirsuta</b> Wight & Arn.                 | 308 | <b>COMBRETUM</b> Loefl.                       | 208 |
| <i>Chalcas paniculata</i> L.                | 232 | <i>album</i> Pers.                            | 208 |
| <b>CHAMAECRISTA</b> Moench                  | 151 | <i>decandrum</i> Roxb.                        | 208 |
| <b>pumila</b> (Lam.) V. Singh               | 151 | <b>roxburghii</b> Spreng.                     | 208 |
| <i>Cheilanthes farinosa</i> (Forssk.) Kauf. | 398 | <b>COMMELINACEAE</b>                          | 42  |
| <i>tenuifolia</i> (Burm.f.) Sw.             | 397 | <b>COMMELINA</b> L.                           | 42  |
|                                             |     | <i>axillaris</i> L.                           | 44  |



|                                          |     |                                                            |     |
|------------------------------------------|-----|------------------------------------------------------------|-----|
| <b>benghalensis</b> L.                   | 42  | var. <i>cucullata</i> (Roth) Nandikar & Gurav              | 45  |
| <i>cristata</i> L.                       | 44  | <b>axillaris</b> (L.) D. Don ex Sweet                      | 44  |
| <i>nudiflora</i> L.                      | 47  | <b>cucullata</b> (Roth) Kunth                              | 45  |
| <i>spirata</i> L.                        | 47  | <b>cristata</b> (L.) D. Don                                | 44  |
| <b>suffruticosa</b> Blume                | 43  | <b>CYANTHILLIUM</b> Blume                                  | 382 |
| <b>COMPOSITAE</b>                        | 376 | <b>cinereum</b> (L.) H. Rob.                               | 382 |
| <i>Conocarpus latifolia</i> Roxb. ex DC. | 212 | <b>CYATHOCLLNE</b> Cass.                                   | 382 |
| <b>CONVOLVULACEAE</b>                    | 318 | <i>lyrata</i> Cass.                                        | 382 |
| <i>Convolvulus alsinoides</i> L.         | 319 | <b>purpurea</b> (Buch.-Ham. ex D. Don) Kuntze              | 382 |
| <i>hypocrateriformis</i> Desr.           | 325 | <b>CYMBOPOGON</b> Spreng.                                  | 80  |
| <i>muricatus</i> L.                      | 322 | <b>martini</b> (Roxb.) Will. Watson                        | 80  |
| <i>nummularius</i> L.                    | 320 | <b>CYNANCHUM</b> L.                                        | 311 |
| <i>tridentatus</i> L.                    | 326 | <b>annularium</b> (Roxb.) Liede & Khanum                   | 311 |
| <i>Conyza lacera</i> Burm.f.             | 379 | <b>viminale</b> (L.) L.                                    | 311 |
| <b>CORCHORUS</b> L.                      | 241 | subsp. <i>viminale</i> Ulrich Meve & Sigrid Liede-Schumann | 311 |
| <b>olitorius</b> L.                      | 241 | <b>CYPERACEAE</b>                                          | 57  |
| <i>Coronopus didymus</i> (L.) Sm.        | 259 | <b>CYPERUS</b> L.                                          | 58  |
| <b>COSTACEAE</b>                         | 50  | <b>brevifolius</b> (Rottb.) Hassk.                         | 59  |
| <i>Costus speciosus</i> (J. König) Sm.   | 50  | <b>diaphanus</b> Schrad. ex Schult                         | 61  |
| <i>Crateva marmelos</i> L.               | 231 | <i>flavidus</i> C.B. Clarke                                | 64  |
| <b>CROTALARIA</b> L.                     | 120 | <b>neochinensis</b> (Tang & F.T. Wang) Bauters             | 62  |
| <b>albida</b> B. Heyne ex Roth           | 121 | <b>sanguinolentus</b> Vahl                                 | 64  |
| <b>prostrata</b> Rottler ex. Willd       | 121 | <i>tegetum</i> Roxb.                                       | 63  |
| var. <b>prostrata</b>                    | 122 | <b>compressus</b> L.                                       | 60  |
| var. <b>levis</b> Haines                 | 122 | var. <i>pangorei</i> (Rottb.) C.B. Clarke                  | 63  |
| <i>sericea</i> Retz.                     | 122 | <b>cyperoides</b> (L.) Kuntze                              | 60  |
| <b>spectabilis</b> Roth                  | 122 | <b>difformis</b> L.                                        | 61  |
| <b>CROTON</b> L.                         | 194 | <b>micelianus</b> (L.) Delile                              | 62  |
| <i>oblongifolium</i> .                   | 196 | <b>pangorei</b> Rottb.                                     | 63  |
| <i>oblongifolius</i> Roxb.               | 196 | <b>tenuispica</b> Steud.                                   | 64  |
| <b>persimilis</b> Müll.Arg.              | 196 | <b>CYPHOSTEMMA</b> (Planch.) Alston                        | 111 |
| <i>philippensis</i> Lam.                 | 201 | <b>auriculatum</b> (Roxb.) P. Singh & B.V. Shetty          | 111 |
| <i>rottleri</i> Geiseler                 | 193 | <i>Cytisus pinnatus</i> L.                                 | 136 |
| <i>roxburghii</i> N.P. Balakr.           | 196 |                                                            |     |
| <i>roxburghii</i> Wall. non              | 196 | <b>D</b>                                                   |     |
| <i>sparsiflorus</i> Morong               | 194 | <i>Daedalacanthus nervosus</i> (Vahl) T. Anderson          | 344 |
| <b>bonplandianus</b> Baill.              | 194 | <b>DALBERGIA</b> L.f.                                      | 124 |
| <b>CRUCIFERAE</b>                        | 259 | <i>oojeinensis</i> Roxb.                                   | 133 |
| <b>CRYPTOLEPIS</b> R. Br.                | 309 | <b>sissoo</b> Roxb. ex DC.                                 | 124 |
| <b>buchanani</b> Roem. & Schult.         | 309 | <b>volubilis</b> Roxb.                                     | 125 |
| <i>dubia</i> (Burm.f.) M.R. Almeida      | 309 | <b>DATURA</b> L.                                           | 327 |
| <b>CUCUMIS</b> L.                        | 178 | <i>fastuosa</i> L.                                         | 327 |
| <i>callosus</i> (Rottler) Cogn.          | 178 | <b>innoxia</b> Mill.                                       | 327 |
| <b>melo</b> L.                           | 178 |                                                            |     |
| var. <i>agrestis</i> Naudin              | 178 |                                                            |     |
| <b>CUCURBITACEAE</b>                     | 176 |                                                            |     |
| <b>CURCULIGO</b> Gaertn.                 | 37  |                                                            |     |
| <b>orchoides</b> Gaertn.                 | 37  |                                                            |     |
| <b>CUSCUTA</b> L.                        | 319 |                                                            |     |
| <b>reflexa</b> Roxb.                     | 319 |                                                            |     |
| <b>CYANOTIS</b> D. Don                   | 43  |                                                            |     |
| <i>axillaris</i> (L.) Sweet              | 45  |                                                            |     |

|                                                |            |                                                   |            |
|------------------------------------------------|------------|---------------------------------------------------|------------|
| <b>metel</b> L.                                | <b>327</b> | <b>glabra</b> Roxb.                               | <b>30</b>  |
| <i>metel</i> auct. non L.                      | 327        | <b>DIOSPYROS</b> L.                               | <b>286</b> |
| <b>DEBIA</b> Neupane & N. Wikstr.              | <b>289</b> | <b>melanoxylon</b> Roxb.                          | <b>286</b> |
| <b>ovatifolia</b> (Cav.) Neupane & N. Wikstr.  |            | var. <b>melanoxylon</b> V. Singh                  | <b>286</b> |
|                                                | <b>289</b> | <b>DIPLOCYCLOS</b> (Endl.) T. Post & Kuntze       |            |
| <b>DELONIX</b> Raf.                            | <b>152</b> |                                                   | <b>178</b> |
| <b>regia</b> (Bojer) Raf.                      | <b>152</b> | <b>palmatum</b> (L.) c. Jeffrey                   | <b>178</b> |
| <b>DENDROCALAMUS</b> Nees                      | <b>82</b>  | <i>palmatum</i>                                   | 178        |
| <b>strictus</b> (Roxb.) Nees                   | <b>82</b>  | var. <i>walkerii</i> (Chakrav.) Babu              | 178        |
| <b>DENDROPHTHOE</b> Mart.                      | <b>261</b> | <i>Dipteracanthus suffruticosus</i> (Roxb.) Voigt |            |
| <b>falcata</b> Blume                           | <b>261</b> |                                                   | 350        |
| <b>DENTELLA</b> J.R. Forst. & G. Forst.        | <b>290</b> | <b>DIPTEROCARPACEAE</b>                           | <b>255</b> |
| <b>repens</b> (L.) J.R. Forst. & G. Forst.     | <b>290</b> | <i>Dolichos pruriens</i> L.                       | 131        |
| <i>Desmodium heterocarpon</i> (L.) DC.         | 127        | <i>Dolichos scarabaeoides</i> L.                  | 119        |
| <i>latifolium</i> (Roxb.) DC.                  | 135        | <i>Dregea volubilis</i> (L.f.) Benth. ex Hook.f.  |            |
| <i>oojeinense</i> (Roxb.) H. Ohashi            | 133        | var. <i>lacuna</i> , Haines                       | 316        |
| <i>polycarpon</i> (Poir.) D                    | 127        | <b>DROSERACEAE</b>                                | <b>265</b> |
| var. <i>trichocaulon</i> (D) Baker             | 127        | <b>DROSERA</b> L.                                 | <b>265</b> |
| <i>polycarpon</i> (Poir.) DC.                  | 127        | <b>burmanni</b> Vahl                              | <b>265</b> |
| <i>pulchellum</i> (L.) Benth.                  | 134        | <i>Drypetes roxburghii</i> (Wall.) Hurus.         | 188        |
| <i>triflorum</i> (L.) DC.                      | 127        |                                                   |            |
| <i>velutinum</i> (Willd.) DC.                  | 135        |                                                   |            |
| <b>Detarioideae</b>                            | <b>113</b> |                                                   | <b>E</b>   |
| <i>Dialium coromandelicum</i> Houtt.           | 224        | <b>EBENACEAE</b>                                  | <b>285</b> |
| <i>Dianthera bicalyculata</i> Retz.            | 372        | <b>ECHINOPS</b> L.                                | <b>383</b> |
| <i>paniculata</i> Forssk.                      | 342        | <b>echinatus</b> Roxb.                            | <b>383</b> |
| <b>DICHANTHIUM</b> Willemet                    | <b>82</b>  | <i>Echites pubescens</i> Buch.-Ham.               | 314        |
| <b>annulatum</b> (Forssk.) Stapf               | <b>82</b>  | <i>Echites scholaris</i> L.                       | 304        |
| <b>DICHROSTACHYS</b> (DC.) Wight &             |            | <b>ECLIPTA</b> L.                                 | <b>383</b> |
| America                                        | <b>152</b> | <i>alba</i> (L.) Hassk.                           | 385        |
| <b>cinerea</b> (L.) Wight & Arn.               | <b>152</b> | <b>prostrata</b> (L.) L.                          | <b>383</b> |
| <i>nutans</i> (Pers.) Benth.                   | 152        | <b>aspera</b> Willd.                              | <b>317</b> |
| <b>DICLIPTERA</b> Juss.                        | <b>342</b> | <b>EHRETIA</b> P. Browne                          | <b>317</b> |
| <b>paniculata</b> (Forssk.) I.Darbysh. apud I. |            | <i>floribunda</i> Royle                           | 317        |
| Darbysh. & Vollesen                            | <b>342</b> | <i>laevis</i> Roxb.                               | 317        |
| <b>DIGERA</b> Forssk.                          | <b>276</b> | var. <i>floribunda</i> (Benth.) Brandis           | 317, 318   |
| <i>alternifolia</i> Aschers.                   | 276        |                                                   |            |
| <i>arvensis</i> Forssk.                        | 276        | <i>laevis</i> Roxb.                               | 317        |
| <b>muricata</b> (L.) Mart.                     | <b>276</b> | <b>ELAEODENDRON</b> Jacq.                         | <b>185</b> |
| <b>DIGITARIA</b> Heist, ex Fabr.               | <b>83</b>  | <b>glaucum</b> (Rottb.) Pers.                     | <b>185</b> |
| <b>abludens</b> (Roem. & Schult.) Veldkamp     |            | <i>Elate sylvestris</i> L.                        | 41         |
|                                                | <b>83</b>  | <b>ELATINACEAE</b>                                | <b>189</b> |
| <i>granularis</i> (Trin.) Henrard              | 83         | <b>ELEOCHARIS</b> R. Br.                          | <b>66</b>  |
| <i>pedicellaris</i> (Trin. ex Hook.f.) Prain   | 83         | <i>capitata</i> (L.) R.Br.                        | 66         |
| <b>bicornis</b> (Lam.) Roem. & Schult.         | <b>84</b>  | <b>geniculata</b> (L.) Roem. & Schult.            | <b>66</b>  |
| <b>DIOSCOREACEAE</b>                           | <b>29</b>  | <b>ELEPHANTOPUS</b> L.                            | <b>385</b> |
| <b>DIOSCOREA</b> L.                            | <b>29</b>  | <b>scaber</b> L.                                  | <b>385</b> |
| <b>bulbifera</b> L.                            | <b>29</b>  | <b>EMILIA</b> Cass.                               | <b>386</b> |
| <i>jacquemontii</i> Hook.f.                    | 31         | <b>sonchifolia</b> (L.) DC.                       | <b>386</b> |
| <i>nummularia</i> Roxb.                        | 30         | <i>Epidendrum tessellatum</i> Roxb.               | 37         |
| <b>pentaphylla</b> L.                          | <b>31</b>  | <b>ERAGROSTIELLA</b> Bor                          | <b>84</b>  |
| <i>sativa</i> Thunb.                           | 30         | <b>bifaria</b> (Vahl) Bor                         | <b>86</b>  |

|                                                  |     |                                            |     |
|--------------------------------------------------|-----|--------------------------------------------|-----|
| <b>ERAGROSTIS</b> Wolf                           | 86  | <b>F</b>                                   |     |
| <i>amabilis</i> Stapf                            | 91  |                                            |     |
| <b>coarctata</b> Stapf                           | 87  | <b>FABACEAE</b> Lindl.                     | 112 |
| <i>coromandeliana</i> (Koen. ex Rottl.) Trin.    | 86  | <b>FICUS</b> L.                            | 171 |
| <b>gangetica</b> (Roxb.) Steud.                  | 88  | <i>altissima</i> Blume                     | 171 |
| <i>stenophylla</i> Hochst. ex Miq.               | 88  | <i>arnottiana</i> (Miq.) Miq.              | 172 |
| <b>tenella</b> (L.) P. Beauv. ex Roem. & Schult. | 89  | <i>benghalensis</i> L.                     | 172 |
| <b>atrovirens</b> (Desf.) Trin. ex Steud.        | 87  | <i>glomerata</i> Roxb.                     | 174 |
| <b>minor</b> Host                                | 89  | <i>hispida</i> L.f.                        | 173 |
| <b>unioloides</b> (Retz.) Nees ex Steud.         | 91  | <i>mollis</i> Vahl                         | 173 |
| <b>ERANTHEMUM</b> L.                             | 344 | <i>oppositifolia</i> Roxb.                 | 173 |
| <i>nervosum</i> (Vahl) R. Br.                    | 344 | <b>racemosa</b> L.                         | 174 |
| <b>pulchellum</b> Andrews                        | 344 | <b>religiosa</b> L.                        | 174 |
| <i>Erianthera echioides</i> (L.) M. R. Almeida   | 340 | <i>tomentosa</i> Roxb. ex Willd.           | 173 |
| <i>longipedunculata</i> (Sreem.) M.R. Almeida    | 340 | <b>FIMBRISTYLIS</b> Vahl                   | 66  |
| <i>Erinus procumbens</i> Mill.                   | 333 | <i>aestivalis</i> (Retz.) Vahl             | 67  |
| <b>ERIOCAULACEAE</b>                             | 54  | <b>cymosa</b> R. Br.                       | 67  |
| <b>ERIOCAULON</b> L.                             | 54  | <b>dichotoma</b> (L.) Vahl                 | 69  |
| <b>quinquangulare</b> L.                         | 54  | <i>diphylla</i> (Retz.) Vahl               | 69  |
| <i>argenteum</i> Mart.                           | 54  | <i>miliacea</i> (L.) Vahl                  | 70  |
| <i>Erythrina monosperma</i> Lam.                 | 118 | <i>miliacea</i> sensu Vahl                 | 70  |
| <b>EUCALYPTUS</b> L'Hér.                         | 220 | <i>monostachyos</i> (L.) Hassk.            | 57  |
| <b>tereticornis</b> Sm.                          | 220 | <i>ovata</i> (Burm.f.) J.Kern              | 57  |
| <i>Eugenia jambolana</i> Lam.                    | 220 | <b>quinquangularis</b> (Vahl) Kunth        | 70  |
| <i>Eulalia argentea</i> Brongn                   | 96  | <i>spathacea</i> Roth                      | 67  |
| <i>trispicata</i> (Schult) Henrard               | 96  | <b>littoralis</b> Gaudich.                 | 70  |
| <i>tristachya</i> O. Kuntze                      | 96  | <b>schoenoides</b> (Retz.) Vahl            | 71  |
| <b>EULOPHIA</b> R.Br.                            | 35  | <b>FLACOURTIA</b> Comm. ex L' Her.         | 192 |
| <b>picta</b> (R.Br.) Ormerod                     | 35  | <b>indica</b> (Burm.f.) Merr.              | 192 |
| <i>Eupatorium odoratum</i> L.                    | 381 | <i>ramontchii</i> L'Her.                   | 192 |
| <b>EUPHORBIACEAE</b>                             | 193 | <i>sepiaria</i> Roxb.                      | 192 |
| <b>EUPHORBIA</b> L.                              | 196 | <b>FLEMINGIA</b> Roxb. ex W.T. Aiton       | 125 |
| <i>angustifolia</i> Buch.-Ham. ex D. Don         | 197 | <b>chappar</b> Buch.-Ham.ex Benth.         | 125 |
| <b>dracunculoides</b> Lam.                       | 197 | <b>FUIRENA</b> Rottb.                      | 71  |
| <b>hirta</b> L.                                  | 197 | <i>glomerata</i> Lam                       | 71  |
| <i>microphylla</i> Lam.                          | 199 | <b>ciliaris</b> (L.) Roxb.                 | 71  |
| <i>neriifolia</i> Roxb.                          | 198 | <b>G</b>                                   |     |
| <b>nivulia</b> Buch.-Ham.                        | 198 | <i>Galega pumila</i> Lam.                  | 140 |
| <i>pilulifera</i> L.                             | 198 | <b>GAMochaeta</b> Wedd.                    | 387 |
| <b>pulcherrima</b> Willd. ex Klotzsch            | 199 | <i>pensylvanica</i> (Willd.) Cabrera       | 387 |
| <b>thymifolia</b> L.                             | 199 | <b>purpurea</b> (L.) Cabrera               | 387 |
| <b>tithymaloides</b> L.                          | 200 | <b>GARDENIA</b> J. Ellis                   | 291 |
| <i>viminalis</i> L.                              | 311 | <b>latifolia</b> Aiton                     | 291 |
| <b>EVOLVULUS</b> L.                              | 319 | <i>spinosa</i> Thunb.                      | 289 |
| <b>alsinoides</b> (L.) L.                        | 319 | <b>GARUGA</b> Roxb.                        | 222 |
| <b>nummularius</b> (L.) L.                       | 320 | <b>pinnata</b> Roxb.                       | 222 |
| <i>Exacum alatum</i> Roth in Roem. & Schult.     | 301 | <i>Gentiana diffusa</i> Vahl               | 301 |
|                                                  |     | <b>GENTIANACEAE</b>                        | 300 |
|                                                  |     | <i>Geodorum densiflorum</i> (Lam.) Schltr. | 35  |
|                                                  |     | <i>dilatatum</i> auct. non R. Br.          | 35  |

|                                              |     |                                                 |     |
|----------------------------------------------|-----|-------------------------------------------------|-----|
| <i>purpureum</i> R. Br.                      | 35  | <i>tuberosum</i> Roxb. ex Willd.                | 137 |
| <b>GLIRICIDIA</b> Kunth.                     | 126 | <i>vaginale</i> L.                              | 116 |
| <i>maculata</i> Kunth                        | 126 | <i>velutinum</i> Willd.                         | 135 |
| <i>sepium</i> (Jacq.) Kunth ex Walp.         | 126 | <b>HELICTERES</b> L.                            | 243 |
| <b>GLOBBA</b> L.                             | 53  | <i>isora</i> L.                                 | 243 |
| <i>bulbifera</i> Roxb.                       | 53  | <b>HELLENIA</b> Willd.                          | 50  |
| <i>marantina</i> L.                          | 53  | <i>speciosa</i> (J.Koenig ex Sm.) S.R. Dutta    | 50  |
| <b>GLORIOSA</b> L.                           | 32  | <i>Hemiadelphis polyspermus</i> (Roxb.) Nees    | 344 |
| <i>superba</i> L.                            | 32  | <b>HEMIDESMUS</b> R. Br.                        | 312 |
| <b>GLOSSOCARDIA</b> Cass.                    | 387 | <i>indicus</i> (L.) W.T. Aiton                  | 312 |
| <i>bosvallia</i> (L.f.) DC.                  | 387 | <i>Hemigraphis latebrosa</i> (B. Heyne ex Roth) | 351 |
| <i>linearifolia</i> Cass.                    | 387 | Nees                                            | 351 |
| <i>Gmelina indica</i> Burm.f.                | 192 | <b>HEMIONITIS</b> L.                            | 397 |
| <b>GNAPHALIUM</b> L.                         | 388 | <i>farinosa</i> (Forssk.) Christenh.            | 398 |
| <i>indicum auct. non</i> L.                  | 388 | <i>tenuifolia</i> (Burm.f.) Christenh.          | 397 |
| <i>pensylvanicum</i> Willd.                  | 387 | <i>Herpestis monnieri</i> (L.) Kunth            | 332 |
| <i>polycaulon</i> Pers.                      | 388 | <i>Heynea trifoliolata</i> A. Juss.             | 235 |
| <i>purpureum</i> L.                          | 387 | <b>HIBISCUS</b> L.                              | 245 |
| <b>GOMPHRENA</b> L.                          | 278 | <i>lampas</i> Cav.                              | 237 |
| <i>ficoidea</i> L.                           | 270 | <i>lobatus</i> (Murray) Kuntze                  | 245 |
| <i>serrata</i> L.                            | 278 | <i>sabdariffa</i> L.                            | 245 |
| <i>celosioides</i> Mart.                     | 278 | <i>solandra</i> L'Hér.                          | 245 |
| <b>GRAMINEAE</b>                             | 73  | <b>HOLARRHENA</b> R. Br.                        | 312 |
| <b>GRANGEA</b> Adans.                        | 389 | <i>antidysenterica</i> Wall. ex A.DC            | 314 |
| <i>maderaspatana</i> (L.) Poir.              | 389 | <i>pubescens</i> Wall. ex G. Don                | 312 |
| <i>Gratiola parviflora</i> Roxb.             | 336 | <b>HOLOPTELEA</b> Planch.                       | 168 |
| <b>GREWIA</b> L.                             | 242 | <i>integrifolia</i> (Roxb.) Planch.             | 169 |
| <i>hirsuta</i> Vahl                          | 242 | <i>Holostemma ada-kodien</i> Schult.            | 311 |
| <i>tiliifolia</i> Vahl                       | 242 | <i>annulare</i> (Roth) K. Schum.                | 311 |
| <b>GRONA</b> Lour.                           | 127 | <i>rheedei</i> Wallich                          | 311 |
| <i>heterocarpos</i> (L.) H.Ohashi & K.Ohashi | 127 | <i>Hoya viridiflora</i> R.Br.                   | 316 |
| <i>triflora</i> (L.) H.Ohashi & K.Ohashi     | 127 | <b>HYBANTHUS</b> Jacq.                          | 189 |
| <i>Guidonia tomentosa</i> (Roxb.) Kurz       | 191 | <i>enneaspermus</i> (L.) F. Muell.              | 190 |
| <b>H</b>                                     |     |                                                 |     |
| <b>HABENARIA</b> Willd.                      | 35  | <b>HYDRILLA</b> Rich.                           | 27  |
| <i>plantaginea</i> Lindl.                    | 35  | <i>verticillata</i> (L.f.) Royle                | 27  |
| <b>HACKELOCHLOA</b> Kuntze                   | 92  | <b>HYDROCHARITACEAE</b>                         | 27  |
| <i>granularis</i> (L.) Kuntze                | 92  | <i>Hydrocotyle asiatica</i> L.                  | 395 |
| <i>Haldina cordifolia</i> (Roxb.) Ridsdale   | 288 | <b>HYGROPHILA</b> R. Br.                        | 344 |
| <i>Hamiltonia suaveolens</i> Roxb.           | 299 | <i>auriculata</i> (Schumach.) Heine             | 345 |
| <i>Hedyotis affinis</i> Roem. & Schult.      | 297 | <i>longifolia</i> (L.) Kurz                     | 345 |
| <i>corymbosa</i> (L.) Lam.                   | 298 | <i>schulli</i> (Buch.-Ham.) M.R. Almeida &      | 345 |
| <i>ovatifolia</i> Cav.                       | 289 | S.M. Almeida                                    | 345 |
| <i>Hedysarum heterocarpon</i> L.             | 127 | <i>spinosa</i> T. Anderson                      | 345 |
| <i>latifolium</i> Roxb.                      | 135 | <b>Hygrophila polysperma</b> (Roxb.)            | 344 |
| <i>linifolium</i> L.f.                       | 129 | T.Anderson                                      | 344 |
| <i>moniliferum</i> L.                        | 116 | <b>HYMENODICTYON</b> Wall.                      | 291 |
| <i>pulchellum</i> L.                         | 134 | <i>excelsum</i> (Roxb.) Wall.                   | 291 |
| <i>triflorum</i> L.                          | 127 | <i>orixense</i> (Roxb.) Mabb.                   | 291 |
|                                              |     | <b>HYPOXIDACEAE</b>                             | 37  |
|                                              |     | <i>Hyptis suaveolens</i> (L.) Poit.             | 364 |

|                                                    |            |                                                       |            |
|----------------------------------------------------|------------|-------------------------------------------------------|------------|
| <b>I</b>                                           |            | <b>JUNCACEAE</b>                                      | <b>56</b>  |
| <b>ICHNOCARPUS</b> R. Br.                          | <b>314</b> | <b>JUNCUS</b> L.                                      | <b>56</b>  |
| <b>frutescens</b> (L.) W.T.Aiton                   | <b>314</b> | <b>articulatus</b> L.                                 | <b>56</b>  |
| <i>Illecebrum monsoniae</i> L.f.                   | 278        | <i>lampocarpus</i> Ehrh. ex Hoffm.                    | 56         |
| <i>Ilysanthes parviflora</i> (Roxb.) Benth.        | 336        | <i>Jussiaea decurrens</i> (Walter) DC.                | 219        |
| <b>IMPATIENS</b> L.                                | <b>283</b> | <i>perennis</i> (L.) Brenan                           | 219        |
| <b>balsamina</b> L.                                | <b>283</b> | <b>JUSTICIA</b> L.                                    | <b>347</b> |
| <b>INDIGOFERA</b> L.                               | <b>128</b> | <i>pectinata</i> L.                                   | 351        |
| <b>astragalina</b> DC.                             | <b>128</b> | <b>adhatoda</b> L.                                    | <b>347</b> |
| <b>cassioides</b> Rottler ex DC.                   | <b>129</b> | <i>canescens</i> Lam.                                 | 348        |
| <i>hirsuta</i> auct. non L.                        | 128        | <i>echioides</i> L.                                   | 340        |
| <b>linifolia</b> (L.f.) Retz.                      | <b>129</b> | <i>polysperma</i> Roxb.                               | 344        |
| <i>pulchella</i> Roxb.                             | 129        |                                                       |            |
| <i>pulchella</i>                                   | 129        | <b>K</b>                                              |            |
| var. <i>purpurascens</i> (Roxb.) Haines            |            | <b>KNOXIA</b> L.                                      | <b>293</b> |
|                                                    | 129        | <i>corymbosa</i> Willd.                               | 293        |
| <i>Indoneesiella echioides</i> (L.) Sreemadh.      | 340        | <b>sumatrensis</b> (Retz.) DC.                        | <b>293</b> |
| <i>longipedunculata</i> (Sreem.) Sreem.            | 340        | <i>Kyllinga sumatrensis</i> Retz.                     | 60         |
| <i>Inula indica</i> L.                             | <b>393</b> | <i>brevifolia</i> Rottb.                              | 59         |
| <i>Ionidium suffruticosum</i> (L.) Roem. & Schult. |            |                                                       |            |
|                                                    | 190        | <b>L</b>                                              |            |
| <b>IPHIGENIA</b> Kunth                             | <b>32</b>  | <b>LABIATAE</b>                                       | <b>356</b> |
| <b>indica</b> (L.) A. Gray ex Kunth                | <b>32</b>  | <b>LAGERSTROEMIA</b> L.                               | <b>215</b> |
| <b>IPOMOEA</b> L.                                  | <b>321</b> | <b>parviflora</b> Roxb.                               | <b>215</b> |
| <i>carnea</i> Jacq.                                |            | <i>Laggera flava</i> (DC.) Benth.                     | 380        |
| subsp. <i>fistulosa</i> (Mart. ex Choisy)          |            | <b>LAMIACEAE</b>                                      | <b>356</b> |
| Austin                                             | 321        | <b>LANNEA</b> A. Rich.                                | <b>224</b> |
| <b>carnea</b> Jacq.                                | <b>321</b> | <b>coromandelica</b> (Houtt.) Merr.                   | <b>224</b> |
| <i>coccinea</i> auct. non L.                       | 322        | <i>grandis</i> (Dennst.) Engl                         | 224        |
| <i>fistulosa</i> Mart. ex Choisy                   | 321        | <b>LANTANA</b> L.                                     | <b>355</b> |
| <b>hederifolia</b> L.                              | <b>322</b> | <b>camara</b> L.                                      | <b>355</b> |
| <i>hepaticifolia</i> L.,                           | 323        | <b>LAUNAEA</b> Cass.                                  | <b>389</b> |
| <b>muricata</b> (L.) Jacq.                         | <b>322</b> | <i>nudicaulis</i> (L.) Hook.f. <i>sensu stricto</i> . | 389        |
| <i>pes-tigridis</i> L.                             | 323        | <i>nudicaulis sensu auct.</i> Plur                    | 389        |
| var. <i>hepaticifolia</i> (L.) C.B. Clarke         |            | <b>procumbens</b> (Roxb.) Ramayya &                   |            |
|                                                    | 323        | Rajagopal                                             | <b>389</b> |
| <b>pes-tigridis</b> L.                             | <b>323</b> | <b>LAURACEAE</b>                                      | <b>24</b>  |
| <b>quamoclit</b> L.                                | <b>323</b> | <i>Lavandula carnosae</i> L.f.                        | 360        |
| <i>tridentata</i> (L.) Roth                        | 326        | <b>LEGUMINOSAE</b>                                    | <b>112</b> |
| <i>turbinata</i> Lag.                              | 322        | <b>LEGUMINOSAE:</b>                                   |            |
| <b>IXORA</b> L.                                    | <b>292</b> | <b>CAESALPINIOIDEAE</b>                               | <b>146</b> |
| <i>arborea</i> Roxb. ex Sm.                        | 292        | <b>LEGUMINOSAE:CERCIDOIDEAE</b>                       | <b>142</b> |
| <i>parviflora</i> Vahl                             | 292        | <b>LEGUMINOSAE:DETARIOIDEAE</b>                       | <b>146</b> |
| <b>pavetta</b> Andrews                             | <b>292</b> | <i>Lemna polyrrhiza</i> L.                            | 25         |
|                                                    |            | <b>LEONOTIS</b> (Pers.) R. Br.                        | <b>360</b> |
| <b>J</b>                                           |            | <b>nepetifolia</b> (L.) R.Br.                         | <b>360</b> |
| <b>JASMINUM</b> L.                                 | <b>330</b> | <b>LEPIDAGATHIS</b>                                   | <b>347</b> |
| <b>arborescens</b> Roxb.                           | <b>330</b> | <b>hamiltoniana</b> Wall. ex Nees                     | <b>347</b> |
| <b>JATROPHA</b> L.                                 | <b>201</b> | <b>LEPIDIDIUM</b> L.                                  | <b>259</b> |
| <b>gossypifolia</b> L.                             | <b>201</b> |                                                       |            |



|                                               |     |                                               |     |
|-----------------------------------------------|-----|-----------------------------------------------|-----|
| <b>didymum</b> L.                             | 259 | <b>LYTHRACEAE</b>                             | 214 |
| <b>LEUCAENA</b> Benth.                        | 153 | <i>Lythrum fruticosum</i> L.                  | 217 |
| <i>latisiliqua</i> (L.) Gillis                | 153 |                                               |     |
| <b>leucocephala</b> (Lam.) de Wit.            | 153 | <b>M</b>                                      |     |
| <b>LEUCAS</b> R. Br.                          | 363 |                                               |     |
| <b>cephalotes</b> (Roth) Spreng.              | 363 | <i>Macraea oblongifolia</i> Wight             | 207 |
| <b>decemdentata</b> (Willd.) Sm.              | 364 | <b>MADHUCA</b> Buch.-Ham. ex J.F. Gmel.       | 285 |
| <i>mollissima</i> Wall. ex Benth.             | 364 |                                               |     |
| <i>montana</i>                                | 364 | <b>longifolia</b> (L.) J.F. Macbr.            | 285 |
| var. <i>mollissima</i> (Wall. ex Benth.)      |     | var. <b>latifolia</b> (Roxb.) A. Chev.        | 285 |
| Haines                                        | 364 | <b>MALLOTUS</b> Lour.                         | 201 |
| <i>Limnanthemum cristatum</i> (Roxb.) Griseb. | 375 | <b>philippensis</b> (Lam.) Müll.Arg.          | 201 |
| <i>indicum</i> (L.) Griseb.                   | 375 | <b>MALVA</b> L.                               | 246 |
| <i>Limodorum densiflorum</i> Lam              | 35  | <b>parviflora</b> L.                          | 246 |
| <b>LINDERNIACEAE</b>                          | 335 | var. <b>microcarpa</b> (Pers.) Loscos         | 246 |
| <b>LINDERNIA</b> All.                         | 336 | <b>MALVACEAE</b>                              | 236 |
| <i>ciliata</i> (Colsm.) Pennell               | 336 | <b>MANGIFERA</b> L.                           | 224 |
| <i>crustacea</i> (L.) F. Muell.               | 337 | <b>indica</b> L.                              | 224 |
| <i>japonica</i> Thunb.                        | 372 | <i>pinnata</i> L.f.                           | 227 |
| <b>parviflora</b> (Roxb.) Haines              | 336 | <i>Manisuris granularis</i> (L.) L.f., Amoen. | 92  |
| <i>Lipocarpha squarrosa</i> (L.) Goetgh       | 62  | <i>Mariscus sieberianus</i> Nees              | 60  |
| <i>Lippia nodiflora</i> (L.) Rich.            | 356 | <i>sumatrensis</i> (Retz.) Raynal             | 60  |
| <b>LITCHI</b> Sonn.                           | 228 | <i>Marsdenia volubilis</i> (L.f.) Cooke       | 316 |
| <b>chinensis</b> Sonn.                        | 228 | <b>MARTYNIACEAE</b>                           | 337 |
| <b>LOBELIA</b> L.                             | 373 | <b>MARTYNIA</b> L.                            | 337 |
| <b>alsinoides</b> Lam.                        | 373 | <b>annua</b> L.                               | 338 |
| <i>pumila</i> Burm.f.                         | 372 | <i>diandra</i> Gloxin                         | 338 |
| <i>terminalis</i> C.B. Clarke                 | 373 | <b>MAZACEAE</b>                               | 371 |
| <i>trigona</i> Roxb.                          | 373 | <b>MAZUS</b> Lour.                            | 371 |
| <i>Lochnera pusilla</i> K. Schum.             | 308 | <i>aponicus</i> (Thunb.) Kuntze               | 372 |
| <b>LOGANIACEAE</b>                            | 303 | <b>pumilus</b> (Burm.f.) Steenis              | 372 |
| <b>LORANTHACEAE</b>                           | 261 | <i>rugosus</i> Lour.                          | 372 |
| <i>Loranthus falcatus</i> L.f.                | 262 | <b>MECARDONIA</b> Ruiz & Pav.                 | 333 |
| <i>longiflorus</i> Desr.                      | 262 | <b>procumbens</b> Small                       | 333 |
| <i>longiflorus</i>                            | 262 | <i>Melanthium indicum</i> L.                  | 32  |
| var. <i>amplexifolia</i> (DC.) Thwaites       | 262 | <b>MELIACEAE</b>                              | 233 |
| <i>longiflorus</i>                            | 262 | <b>MELIA</b> L.                               | 234 |
| var. <i>falcata</i> (L.f.) Kurz               | 262 | <i>azadirachta</i> L.                         | 234 |
| <b>LUDWIGIA</b> L.                            | 217 | <b>azedarach</b> L.                           | 234 |
| <b>decurrens</b> Walter                       | 219 | <i>Melica latifolia</i> Roxb. ex Hornem       | 101 |
| <i>parviflora</i> Roxb.                       | 219 | <i>latifolia</i> Roxb. ex Hornem.             | 101 |
| <b>perennis</b> L.                            | 219 | <i>Melilotus alba</i> Medik. ex Desr.         | 130 |
| <b>LUFFA</b> Mill.                            | 179 | <b>MELILOTUS</b> Mill.                        | 130 |
| <i>aegyptiaca</i> Mill.                       | 179 | <b>albus</b> Medik.                           | 130 |
| <b>cylindrica</b> (L.) M. Roem.               | 179 | <i>officinalis</i> (L.) Lam.                  | 130 |
| <i>Lycopodium bryopteris</i> L.               | 400 | subsp. <i>albus</i> (Medik.) H. Ohashi &      |     |
| <b>LYGODIUM</b> Sw.                           | 399 | Tateishi                                      | 130 |
| <b>flexuosum</b> (L.) Sw.                     | 399 | <b>MELOCHIA</b> L.                            | 249 |
| <b>LYSIMACHIA</b> Tourn. ex L.                | 286 | <b>corchorifolia</b> L.                       | 249 |
| <b>arvensis</b> (L.) U.Manns & Anderb.        | 286 | <i>cordata</i> Burm.f.                        | 250 |
| <i>monnieri</i> L.                            | 332 | <b>MENISPERMACEAE</b>                         | 107 |
|                                               |     | <i>Menispermum cordifolium</i> Willd.         | 108 |



|                                                  |     |
|--------------------------------------------------|-----|
| <i>lotus</i> L.                                  |     |
| var. <i>rubra</i> (Roxb.) Haines                 | 23  |
| <i>lotus</i> sensu Hook.f. & Thomson             | 23  |
| <i>lotus</i>                                     | 22  |
| var. <i>pubescens</i> (Willd.) Hook.f. & Thomson | 22  |
| <b>pubescens</b> Willd.                          | 22  |
| <b>rubra</b> Roxb. ex Salisb.                    | 23  |
| <b>NYMPHOIDES</b> Ség.                           | 374 |
| <i>crinata</i> (Roxb.) Kuntze                    | 375 |
| <b>hydrophyllum</b> (Lour.) Kuntze               | 375 |
| <b>indica</b> (L.) Kuntze                        | 375 |

## O

|                                                |     |
|------------------------------------------------|-----|
| <b>OCIMUM</b> L.                               | 366 |
| <b>tenuiflorum</b> L.                          | 366 |
| <i>sanctum</i> L.                              | 366 |
| <i>Odina wodier</i> Roxb.                      | 224 |
| <b>OLACACEAE</b>                               | 260 |
| <b>OLAX</b> L.                                 | 260 |
| <b>scandens</b> Roxb.                          | 260 |
| <b>OLDENLANDIA</b> L.                          | 297 |
| <b>affinis</b> (Roem. & Schult.) DC.           | 297 |
| <b>corymbosa</b> L.                            | 298 |
| <i>dichotoma</i> (K.D. Koenig ex Roth) Hook.f. | 298 |
| <i>nudicaulis</i> Roth                         | 289 |
| <i>ovatifolia</i> (Cav.) DC.                   | 289 |
| <i>repens</i> L.                               | 290 |
| <b>OLEACEAE</b>                                | 330 |
| <b>ONAGRACEAE</b>                              | 217 |
| <i>Ophioglossum flexuosum</i> L.               | 399 |
| <b>OPLISMENUS</b> Beauv.                       | 92  |
| <b>burmanni</b> (Retz.) P. Beauv.              | 93  |
| <b>ORCHIDACEAE</b>                             | 34  |
| <i>Origanum benghalense</i> Burm.f.            | 367 |
| <b>OROBANCHACEAE</b>                           | 372 |
| <b>OROXYLUM</b> Vent.                          | 353 |
| <b>indicum</b> (L.) Kurz                       | 353 |
| <b>ORTHOSIPHON</b> Benth.                      | 367 |
| <b>pallidus</b> Royle ex Benth.                | 367 |
| <i>Otosema extensa</i> Benth.                  | 131 |
| <b>OTTELIA</b> Pers.                           | 27  |
| <b>alismoides</b> (L.) Pers.                   | 27  |
| <b>OUGEINIA</b> Benth.                         | 133 |
| <i>dalbergioides</i> Benth.                    | 133 |
| <b>oojeinensis</b> (Roxb.) Hochr.              | 133 |
| <b>OXALIDACEAE</b>                             | 187 |
| <b>OXALIS</b> L.                               | 187 |
| <b>corniculata</b> L.                          | 188 |
| <i>sensitiva</i> L.                            | 187 |

## P

|                                                              |          |
|--------------------------------------------------------------|----------|
| <b>PALMAE</b> Juss.                                          | 41       |
| <b>PANICUM</b> L.                                            | 93       |
| <i>abludens</i> Roem. & Schult.                              | 83       |
| <i>burmanni</i> Retz.                                        | 93       |
| <i>flavidum</i> Retz.                                        | 98       |
| <i>montanum</i> Roxb.                                        | 93       |
| <i>myosuroides</i> R. Br.                                    | 97       |
| <i>prostratum</i> Lam.                                       | 103      |
| <i>pumilum</i> Poir.                                         | 99       |
| <i>reptans</i> L.                                            | 103      |
| <i>verticillatum</i> L.                                      | 99       |
| <b>notatum</b> Retz.                                         | 93       |
| <b>PAPAVERACEAE</b>                                          | 104      |
| <b>Papilionoideae</b>                                        | 112, 113 |
| <i>Paramicrorhynchus procumbens</i> (Roxb.) Kirp.            | 399      |
| <b>PARTHENIUM</b> L.                                         | 390      |
| <b>hysterophorus</b> L.                                      | 390      |
| <i>Paspalidium flavidum</i> (Retz.) A. Camus                 | 98       |
| <i>Paspalum bicornis</i> Lam.                                | 84       |
| <b>PASSIFLORACEAE</b>                                        | 190      |
| <b>PASSIFLORA</b> L.                                         | 190      |
| <b>foetida</b> L.                                            | 190      |
| <b>PEDALIACEAE</b>                                           | 338      |
| <i>Pedilanthus tithymaloides</i> (L.) Poit.                  | 200      |
| <i>Pennisetum pedicellatum</i> Trin.                         | 76       |
| <i>Pentanema indicum</i> (L.) Ling                           | 393      |
| <i>Pentaptera arjuna</i> Roxb. ex DC.                        | 210      |
| <i>tomentosa</i> Roxb. ex DC.                                | 209      |
| <i>Periploca arborea</i> Dennst.                             | 317      |
| <i>indica</i> L.                                             | 312      |
| <i>Peristrophe bicalyculata</i> (Retz.) Nees                 | 372      |
| <i>paniculata</i> (Forssk.) Brummitt                         | 342      |
| <b>PEROTIS</b> Ait.                                          | 94       |
| <b>indica</b> (L.) Kuntze                                    | 94       |
| <i>latifolia</i> Aiton                                       | 94       |
| <b>PERSICARIA</b> (L.) Mill.                                 | 264      |
| <b>hydropiper</b> (L.) Delarbre                              | 264      |
| <b>PHANERA</b> Lour.                                         | 143      |
| <i>retusa</i> Benth.                                         | 144      |
| <b>roxburghiana</b> (Voigt) Bandyop., Anand Kumar & Chakrab. | 144      |
| <b>vahlilii</b> (Wight & Arn.) Benth.                        | 144      |
| <i>Phaseolus vexillatus</i> L.                               | 141      |
| <i>Phlomis cephalotes</i> J. König ex Roth                   | 363      |
| <i>nepetifolia</i> L.                                        | 360      |
| <b>PHOENIX</b> L.                                            | 41       |
| <b>sylvestris</b> (L.) Roxb.                                 | 41       |
| <b>PHRAGMITES</b> Adans.                                     | 95       |

|                                                    |     |                                                                               |     |
|----------------------------------------------------|-----|-------------------------------------------------------------------------------|-----|
| <b>karka</b> (Retz.) Trin. ex Steud.               | 95  | <b>plebeium</b> R.Br.                                                         | 264 |
| <b>PHYLA</b> Lour.                                 | 356 | <b>PONGAMIA</b> Vent.                                                         | 135 |
| <b>nodiflora</b> (L.) Greene                       | 356 | <i>glabra</i> Vent.                                                           | 136 |
| <b>PHYLLANTHACEAE</b>                              | 204 | <b>pinnata</b> (L.) Pierre                                                    | 135 |
| <b>PHYLLANTHUS</b> L.                              | 205 | <b>PONTEDERIACEAE</b>                                                         | 49  |
| <b>airy-shawii</b> Jean F. Brunel & Jacq.          | 206 | <b>PONTEDERIA</b> L.                                                          | 49  |
|                                                    | 206 | <b>vaginalis</b> Burm.f.                                                      | 49  |
| <i>debilis</i> Klein ex Willd.                     | 206 | <i>Porana paniculata</i> Roxb.                                                | 324 |
| <i>simplex</i> Retz.                               | 207 | <b>PORANOPSIS</b> Roberty                                                     | 324 |
| <i>simplex</i>                                     | 207 | <b>paniculata</b> (Roxb.) Roberty                                             | 324 |
| var. <i>oblongifolius</i> (Wight) Müll.Arg.        | 207 | <b>PORTULACACEAE</b>                                                          | 282 |
|                                                    | 207 | <b>PORTULACA</b> L.                                                           | 282 |
| <b>urinaria</b> L.                                 | 206 | <b>pilosa</b> L.                                                              | 282 |
| <b>virgatus</b> G.Forst.                           | 207 | <b>POTAMOGETONACEAE</b>                                                       | 28  |
| <b>PHYLLODIUM</b> Desv.                            | 134 | <b>POTAMOGETON</b> L.                                                         | 28  |
| <b>pulchellum</b> (L.) Desv.                       | 134 | <i>indicus</i> sensu Hook.f.                                                  | 29  |
| <b>PHYSALIS</b> L.                                 | 328 | <b>nodosus</b> Poir.                                                          | 29  |
| <b>angulata</b> L.                                 | 328 | <b>POTENTILLA</b> L.                                                          | 164 |
| <b>PILIOSTIGMA</b> Hochst.                         | 145 | <i>amurensis</i> Maxim.                                                       | 164 |
| <b>malabaricum</b> (Roxb.) Benth.                  | 145 | <b>supina</b> L.                                                              | 164 |
| <i>Pistacia oleosa</i> Lour.                       | 229 | <i>Prenanthes procumbens</i> Roxb.                                            | 389 |
| <i>Pladera decussata</i> Roxb.                     | 301 | <b>PRIMULACEAE</b>                                                            | 286 |
| <b>PLANTAGINACEAE</b>                              | 332 | <b>PSEUDOPOGONATHERUM</b> A.Camus                                             | 95  |
| <i>Poa atrovirens</i> Desf.                        | 87  |                                                                               | 95  |
| <i>bifaria</i> Vahl                                | 86  | <b>trispicatum</b> (Schult.) Ohwi                                             | 95  |
| <i>tenella</i> L.                                  | 89  | <b>PTERIDOPHYTES</b>                                                          | 396 |
| <i>unioloides</i> Retz.                            | 91  | <b>PTERIDACEAE</b>                                                            | 396 |
| <b>POACEAE</b>                                     | 73  | <b>PTERIS</b> L.                                                              | 398 |
| <b>POGOSTEMON</b> Desf.                            | 367 | <b>vittata</b> L.                                                             | 398 |
| <b>benghalensis</b> (Burm.f.) Kuntze               | 367 | <b>PTEROCARPUS</b> Jacq.                                                      | 136 |
| <i>plectranthoides</i> Desf.                       | 367 | <b>marsupium</b> Roxb.                                                        | 136 |
| <i>Poinciana regia</i> Bojer                       | 152 | <b>PUERARIA</b> DC.                                                           | 137 |
| <i>Poinsettia pulcherrima</i> (Willd. ex Klotzsch) |     | <b>tuberosa</b> (Roxb. ex Willd.) DC.                                         | 137 |
| Graham                                             | 199 | <b>PUTRANJIVACEAE</b>                                                         | 188 |
| <b>POLHILLIDES</b> H.Ohashi & K.Ohashi             | 135 | <b>PUTRANJIVA</b> Wall.                                                       | 188 |
|                                                    | 135 | <b>roxburghii</b> Wall.                                                       | 188 |
| <b>velutina</b> (Willd.) H.Ohashi & K.Ohashi       | 135 | <i>Pycnus diaphanus</i> (Schrader ex Roem. & Schult.) S.S. Hooper & T. Koyama | 61  |
| <i>Pollinia argentea</i> (Brongn.) Trin.           | 95  | <i>latespicatus</i> (Boeck.) C.B. Clarke                                      | 61  |
| <b>POLYCARPAEA</b> Lam.                            | 266 | <i>sanguinolentus</i> (Vahl) Nees ex C.B. Clarke                              | 64  |
| <b>corymbosa</b> (L.) Lam.                         | 266 |                                                                               |     |
| <b>POLYGALACEAE</b>                                | 162 |                                                                               |     |
| <b>POLYGALA</b> L.                                 | 162 |                                                                               |     |
| <b>arvensis</b> Willd.                             | 162 |                                                                               |     |
| <i>chinensis</i> auct. non L.                      | 162 |                                                                               |     |
| <i>chinensis</i> L.                                | 163 |                                                                               |     |
| var. <i>linarifolia</i> (Willd.) Chodat            | 163 |                                                                               |     |
| <b>crotalarioides</b> Buch.-Ham. ex DC.            | 163 |                                                                               |     |
| <b>linarifolia</b> Willd.                          | 163 |                                                                               |     |
| <b>POLYGONACEAE</b>                                | 263 |                                                                               |     |
| <b>POLYGONUM</b> L.                                | 264 |                                                                               |     |
| <i>hydropiper</i> L.                               | 264 |                                                                               |     |

## Q

|                                            |     |
|--------------------------------------------|-----|
| <i>Quamoclit coccinea</i> auct. non Moench | 322 |
| <i>vulgaris</i> Choisy                     | 324 |

## R

|                                       |     |
|---------------------------------------|-----|
| <i>Randia dumetorum</i> (Retz.) Poir. | 289 |
| <b>RANUNCULACEAE</b>                  | 108 |
| <b>RANUNCULUS</b> L.                  | 108 |

|                                             |     |                                                     |     |
|---------------------------------------------|-----|-----------------------------------------------------|-----|
| <b>sceleratus</b> L.                        | 109 | <i>trijuga</i> Willd.                               | 229 |
| <b>RAPHANUS</b> L.                          | 259 | <b>SCHOENOPLECTIELLA</b> Lye                        | 72  |
| <b>sativus</b> L.                           | 259 | <b>lateriflora</b> (J.F. Gmel.) Lye                 | 72  |
| <b>RAUVOLFIA</b> L.                         | 316 | <i>Schoenoplectus lateriflorus</i> (J.F. Gmel.) Lye | 72  |
| <b>tetraphylla</b> L.                       | 316 | <b>SCHREBERA</b> Roxb.                              | 331 |
| <i>canescens</i> L.                         | 316 | <b>swietenioides</b> Roxb.                          | 331 |
| <b>RHAMNACEAE</b>                           | 164 | <i>Scirpus squarrosus</i> L.                        | 62  |
| <i>Rhamnus oenopolia</i> L.                 | 167 | <i>barbatus</i> Rottb.                              | 58  |
| <b>RICINUS</b> L.                           | 203 | <i>ciliaris</i> L.                                  | 71  |
| <b>communis</b> L.                          | 203 | <i>cyperoides</i> L.                                | 60  |
| <i>Rikliella squarrosa</i> (L.) J. Raynal   | 62  | <i>dichotomus</i> L.                                | 69  |
| <b>RIVEA</b> Choisy                         | 325 | <i>diphyllus</i> Retz.                              | 69  |
| <b>hypocrateriformis</b> (Desr.) Choisy     | 325 | <i>geniculatus</i> L.                               | 66  |
| <i>Robinia sepium</i> Jacq.                 | 126 | <i>micelianus</i> L.                                | 62  |
| <i>Rondeletia tinctoria</i> Roxb.           | 300 | <i>miliaceus</i> L.                                 | 70  |
| <b>ROSACEAE</b>                             | 164 | <i>miliaceus</i> L.                                 | 70  |
| <b>ROSTELLULARIA</b> Rchb.                  | 349 | <i>quinquangularis</i> Vahl                         | 70  |
| <b>diffusa</b> (Willd.) Nees                | 349 | <i>schoenoides</i> Retz                             | 71  |
| <b>ROOTALA</b> L.                           | 215 | <i>supinus</i> Roxb.                                | 72  |
| <b>densiflora</b> (Roth ex Roem. & Schult.) |     | <i>supinus</i>                                      | 72  |
| Koehne                                      | 216 | var. <i>uninodis</i> auct. non (Del.) Asch.         |     |
| <b>RUBIACEAE</b>                            | 287 | & Schweinf                                          | 72  |
| <b>RUELLIA</b> L.                           | 349 | <b>SCROPHULARIACEAE</b>                             | 335 |
| <i>latebrosa</i> B. Heyne ex Roth           | 351 | <b>SCOPARIA</b> L.                                  | 333 |
| <b>sibua</b> (Nees) I.M. Turner             | 350 | <b>dulcis</b> L.                                    | 333 |
| <b>tuberosa</b> L.                          | 350 | <i>Sebastiania chamaelea</i> (L.) Müll. Arg.        | 202 |
| <i>suffruticosa</i> Roxb.                   | 350 | <b>SELAGINELLACEAE</b>                              | 399 |
| <b>RUNGIA</b> Nees                          | 350 | <b>SELAGINELLA</b> P. Beauv.                        | 399 |
| <i>parviflora</i> (Retz.) Nees              | 351 | <b>bryopteris</b> (L.) Baker                        | 400 |
| var. <i>pectinata</i> (L.) C.B. Clarke      | 351 | <b>vaginata</b> Spring                              | 400 |
| <b>pectinata</b> (L.) Nees                  | 351 | <b>SEMECARPUS</b> L.f.                              | 225 |
| <b>RUTACEAE</b>                             | 231 | <b>anacardium</b> L.f.                              | 225 |
| <b>S</b>                                    |     |                                                     |     |
| <b>SACCHARUM</b> L.                         | 96  | <i>Senebiera pinnatifida</i> DC.                    | 259 |
| <b>spontaneum</b> L.                        | 96  | <b>SENEGALIA</b> Raf.                               | 155 |
| <b>SACCIOLEPIS</b> Nash                     | 97  | <b>caesia</b> (L.) Maslin, Seigler & Ebinger        | 155 |
| <b>myosuroides</b> (R.Br.) Chase ex.        |     | <b>catechu</b> (L.f.) P.J.H. Hurter & Mabb.         | 156 |
| E.G. Camus & A. Camus                       | 97  | <b>torta</b> (Roxb.) Maslin                         | 156 |
| <b>SALICACEAE</b>                           | 191 | <b>SENNA</b> Mill.                                  | 157 |
| <b>SANTALACEAE</b>                          | 261 | <b>alata</b> (L.) Roxb.                             | 157 |
| <b>SAPINDACEAE</b>                          | 227 | <b>hirsuta</b> (L.) H.S. Irwin & Barneby            | 158 |
| <b>SAPOTACEAE</b>                           | 285 | <b>occidentalis</b> (L.) Link                       | 158 |
| <i>Sarcostemma acidum</i> (Roxb.) Voigt     | 311 | <b>siamea</b> (Lam.) H.S. Irwin & Barneby           | 159 |
| ssp. <i>viminale</i>                        | 311 | <b>tora</b> (L.) Roxb.                              | 160 |
| <i>annulare</i> Roth                        | 311 | <i>Serpicula verticillata</i> L.f.                  | 27  |
| <i>brevistigma</i> Wight & Arn.             | 311 | <b>SESAMUM</b> L.                                   | 338 |
| <i>viminale</i> (L.) R. Br.                 | 311 | <b>indicum</b> L.                                   | 338 |
| <b>SCHIZAEACEAE</b>                         | 399 | <b>SETARIA</b> Beauv.                               | 98  |
| <b>SCHLEICHERA</b> Willd.                   | 229 | <b>flavida</b> (Retz.) Veldkamp                     | 98  |
| <b>oleosa</b> (Lour.) Oken                  | 229 |                                                     |     |





|                                                       |            |                                                 |            |
|-------------------------------------------------------|------------|-------------------------------------------------|------------|
| <i>agrostis</i> Nees                                  | 101        | <b>V</b>                                        |            |
| <b>latifolia</b> (Roxb. ex Hornem.) Honda             | <b>101</b> | <b>VACHELLIA</b> Wight & Arn.                   | <b>160</b> |
| <i>maxima</i> (Roxb.) Kuntze                          | 101        | <b>farnesiana</b> (L.) Wight & Arn.             | <b>160</b> |
| <b>TINOSPORA</b> Miers                                | <b>108</b> | <b>nilotica</b>                                 | <b>161</b> |
| <b>cordifolia</b> (Willd.) Miers ex Hook.f. & Thomson | <b>108</b> | subsp. <b>indica</b> (Benth.) Kyal. & Boatwr.   | <b>161</b> |
| <i>Tonningia axillaris</i> (L.) Kuntze                | 44         | <b>VALLISNERIA</b> L.                           | <b>28</b>  |
| <i>cucullata</i> (Roth) Kuntze                        | 45         | <b>spiralis</b> L.                              | <b>28</b>  |
| <b>TORENIA</b> L.                                     | <b>337</b> | <b>VANDA</b> Jones ex R. Br.                    | <b>37</b>  |
| <b>crustacea</b> (L.) Cham. & Schltdl.                | <b>337</b> | <i>roxburghii</i> R. Br.                        | 37         |
| <b>TRACHYSPERMUM</b> Link                             | <b>395</b> | <b>tessellata</b> (Roxb.) Hook. ex G. Don       | <b>37</b>  |
| <b>ammi</b> (L.) Sprague                              | <b>395</b> | <i>Vandellia brachiata</i> (Link & Otto) Haines | 336        |
| <i>Tragia chamaelea</i> L.                            | 202        | <i>crustacea</i> (L.) Benth.                    | 337        |
| <b>TRAGUS</b> Hall.                                   | <b>101</b> | <b>VENTILAGO</b> Gaertn.                        | <b>166</b> |
| <b>racemosus</b> (L.) All.                            | <b>101</b> | <i>calyculata</i> Tul.                          | 166        |
| <i>roxburghii</i> Panigrahi.                          | 101        | <b>denticulata</b> Willd.                       | <b>166</b> |
| <b>TRAPA</b> L.                                       | <b>216</b> | <b>VERBASCUM</b> L.                             | <b>335</b> |
| <i>bispinosa</i> Roxb.                                | 216        | <i>chinense</i> (L.) Santapau                   | 335        |
| <b>natans</b> L.                                      | <b>216</b> | <b>coromandelianum</b> (Vahl) Hub.-Mor.         | <b>335</b> |
| var. <b>bispinosa</b> (Roxb.) Makino                  | <b>216</b> | <b>VERBENACEAE</b>                              | <b>355</b> |
| <b>TRICHOSANTHES</b> L.                               | <b>182</b> | <i>Verbena nodiflora</i> L.                     | 356        |
| <b>bracteata</b> (Lam.) Voigt                         | <b>182</b> | <i>Verbesina acmella</i> L.                     | 378        |
| <b>cucumerina</b> L.                                  | <b>183</b> | <i>alba</i> L.                                  | 385        |
| <i>palmata</i> Roxb.                                  | 182        | <i>bosvallea</i> L.f.                           | 387        |
| <b>tricuspidata</b> Lour.                             | <b>183</b> | <i>prostrata</i> L.                             | 385        |
| <b>TRICHURIELLA</b> Bennet                            | <b>278</b> | <i>Vernonia cinerea</i> (L.) Less.              | 382        |
| <b>monsoniae</b> (L.f.) Bennet                        | <b>278</b> | <b>VERONICA</b> L.                              | <b>334</b> |
| <i>Trichurus monsoniae</i> (L.f.) C.C. Towns.         | 278        | <b>anagallis-aquatica</b> L.                    | <b>334</b> |
| <b>TRIDAX</b> L.                                      | <b>392</b> | <b>VICOA</b> Cass.                              | <b>393</b> |
| <b>Tridax procumbens</b> (L.) L.                      | <b>392</b> | <i>auriculata</i> Cass.                         | 393        |
| <b>TRIUMFETTA</b> L.                                  | <b>251</b> | <b>indica</b> (L.) DC.                          | <b>393</b> |
| <b>rhomboidea</b> Jacq.                               | <b>251</b> | <b>VIGNA</b> Savi                               | <b>141</b> |
|                                                       |            | <b>vexillata</b> (L.) A. Rich.                  | <b>141</b> |
| <b>U</b>                                              |            | <i>Vinca pusilla</i> Murr.                      | 308        |
| <b>ULMACEAE</b>                                       | <b>168</b> | <b>VIOLACEAE</b>                                | <b>189</b> |
| <i>Ulmus integrifolia</i> Roxb.                       | 169        | <i>Viola enneasperma</i> L.                     | 190        |
| <b>UMBELLIFERAE</b>                                   | <b>394</b> | <b>VISCUM</b> L.                                | <b>261</b> |
| <b>URENA</b> L.                                       | <b>251</b> | <b>articulatum</b> Burm.f.                      | <b>261</b> |
| <b>lobata</b> L.                                      | <b>251</b> | <b>VITACEAE</b>                                 | <b>109</b> |
| subsp. <b>lobata</b>                                  | <b>251</b> | <b>VITEX</b> L.                                 | <b>371</b> |
| subsp. <b>sinuata</b> (L.) Borss.Waalk.               | <b>252</b> | <b>negundo</b> L.                               | <b>371</b> |
| <i>sinuata</i> L.                                     | 252        | <i>Vitis auriculata</i> Wight & Arn.            | 111        |
| <b>UROCHLOA</b> P.Beauv.                              | <b>103</b> | <i>latifolia</i> Roxb.                          | 110        |
| <b>reptans</b> (L.) Stapf                             | <b>103</b> | <i>tomentosa</i> Roth                           | 110        |
| <i>Urostigma arnottianum</i> Miq.                     | 172        | <i>Volvulopsis nummularium</i> (L.) Roberty     | 320        |

## W

|                                          |            |
|------------------------------------------|------------|
| <b>WAHLENBERGIA</b> Schrad. ex Roth      | <b>374</b> |
| <i>gracilis</i> DC.                      | 374        |
| <b>marginata</b> (Thunb.) DC.            | <b>374</b> |
| <b>WALSURA</b> Roxb.                     | <b>235</b> |
| <i>piscidia</i> Roxb.                    | 235        |
| <i>trifolia</i> S.S. Jain & Bennet       | 235        |
| <b>trifoliolata</b> (A. Juss.) Harms     | <b>235</b> |
| <i>Wattakaka volubilis</i> (L.f. ) Stapf | 316        |
| <b>WENDLANDIA</b> Bartl. ex DC.          | <b>300</b> |
| <b>tinctoria</b> (Roxb.) DC.             | <b>300</b> |
| <b>WOODFORDIA</b> Salisb.                | <b>217</b> |
| <i>floribunda</i> Salisb.                | 217        |
| <b>fruticosa</b> (L.) Kurz               | <b>217</b> |
| <b>WRIGHTIA</b> R. Br.                   | <b>317</b> |
| <b>arborea</b> (Dennst.) Mabb.           | <b>317</b> |
| <i>tomentosa</i> Roem. & Schult.         | 317        |

## X

|                                              |            |
|----------------------------------------------|------------|
| <b>XANTHIUM</b> L.                           | <b>393</b> |
| <i>indicum</i> J. König. ex Roxb.            | 394        |
| <b>strumarium</b> L.                         | <b>394</b> |
| <b>XENOSTEGIA</b> D.F.Austin & Staples       | <b>326</b> |
| <b>tridentata</b> (L.) D.F. Austin & Staples | <b>326</b> |

## Z

|                                 |            |
|---------------------------------|------------|
| <b>ZEALANDIA</b> L.             | <b>104</b> |
| <b>mays</b> L.                  | <b>104</b> |
| <b>ZINGIBERACEAE</b>            | <b>53</b>  |
| <b>ZINGIBER</b> Boehm.          | <b>54</b>  |
| <b>capitatum</b> Roxb.          | <b>54</b>  |
| <b>ZIZIPHUS</b> Mill.           | <b>166</b> |
| <b>jujuba</b> (L.) Gaertn.      | <b>166</b> |
| <i>mauritiana</i> Lam.          | 166        |
| <b>oenoplia</b> (L.) Mill.      | <b>167</b> |
| <b>xylopyrus</b> (Retz.) Willd. | <b>168</b> |
| <b>ZORNIA</b> J. Gmelin.        | <b>141</b> |
| <i>angustifolia</i> Sm.         | 141        |
| <b>gibbosa</b> Span.            | <b>141</b> |
| <i>graminea</i> Span.           | 141        |
| <b>ZYGOPHYLLACEAE</b>           | <b>111</b> |

## ABOUT THE BOOK

The book **Flora of Koderma Wildlife Sanctuary (KWLS), Jharkhand** provides an analytical study of the floristic composition of KWLS in Jharkhand. The book comprises 437 taxa including 429 species, 5 varieties and 3 subspecies in 328 genera belonging to 100 angiospermous families as per the APG IV system of classifications. In addition, 8 pteridophyte species have been recorded from the study area. The genera under a family and the species under a genus have been arranged in alphabetical order. The keys are provided for easy identification. The citation is followed by local vernacular name(s), if any. The detailed description of the specimen examined, including its flowering and fruiting periods, habitat, and distribution, was given along with GPS readings and with photographs/illustrations. This book will definitely prove to be a useful reference material for forest officials, biodiversity management committees, policy makers, conservationists, field workers, academicians, botany students, researchers, amateurs and plant enthusiasts.

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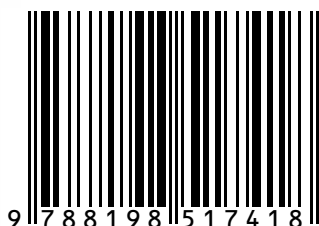
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ISBN 198517418-9



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