

FLORA OF KERALA - GRASSES

P.V. SREEKUMAR

V.J. NAIR



BOTANICAL SURVEY OF INDIA

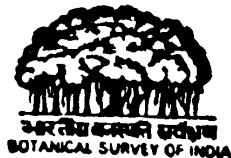


Flora of India Series 2

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P. V. SREEKUMAR

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FOREWORD

Botanical Survey of India is actively engaged in the preparation of detailed accounts on the Flora of India under different series namely (1) National Flora of India, (2) State Flora, (3) District Flora or Flora of other smaller botanically interesting areas and (4) Monographs and other works which would not be covered under the other three series. Flora of Kerala: Grasses is one such contribution coming under series 2.

The importance of the family Gramineae to mankind is well known. More than any other group of plants, grasses and bamboos contribute to mankind major staple food, fodder and shelter. Our present civilization roots squarely on this family. Scientists of the Botanical Survey of India have discovered several new species and varieties of grasses. The evolution of their potential uses has to be undertaken. The recent discovery of *Oryza indandamanica*, a wild rice from Andamans has given a wider genetic base for rice. The use of *Oryza malampuzhaensis* for genetic improvement against blast disease is well known. The number of new species and varieties added to the grass flora of Kerala itself shows the vast potential that requires discovery and evaluation.

Kerala supports a luxuriant flora including many endemic elements. This area has attracted the attention of many Botanists from the West, even from the very early times, as is evidenced by the fact that one of the pioneer works on Indian botany, namely *Hortus Malabaricus* (van Rheedee, 1678-1703) is based on the plants of the northern part of this state. Realizing the urgent need for a detailed study of the flora of this state, Botanical Survey of India has been concentrating on intensive explorations and detailed botanical studies of this area. The present publication on the grasses of Kerala is the result of such a study.

I am sure this publication will serve as a resource base for our genetic resources of Kerala.

Calcutta
12-1-1990

M.P. NAYAR
Director
Botanical Survey of India

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INTRODUCTION

The grasses forming a natural and homogenous group of plants with remarkable diversity, belong to Poaceae, the fourth largest family of flowering plants in the world, with over 700 genera and probably 10,000 species. It is an important family of plants playing significant role in the life of human beings and other animals. The economic importance of grasses lies in their paramount role as food : 70% of the world's farmland is planted with crop grasses, and over 50% of world's calories come from grasses. A good number of grasses are cultivated for their grains. In terms of world production of crops today, the first four are grasses : sugarcane, wheat, rice and corn. Several grasses are well-known for their rich fodder value. Grasses control erosion, make turf, form lawns and provide the major source for alcohol.

For proper utilization of raw materials in a developing country like India, the need for basic economic surveys and assessment of the natural resources is often emphasized. To undertake such surveys and investigations it is essential that the flora of the country should be well-known and only when all the plants are correctly named, described and classified it would be possible to recognize useful or potential plants of economic value. The study of grasses has not attracted the desired attention as the group is considered difficult for identification. Their spikelets being minute, the grasses require careful dissection for correct determination. Being a botanically "neglected group" grasses need a separate detailed taxonomic investigation. The present study has been carried out with the broad objective to present a comprehensive floristic account of the grasses of Kerala State, in India.

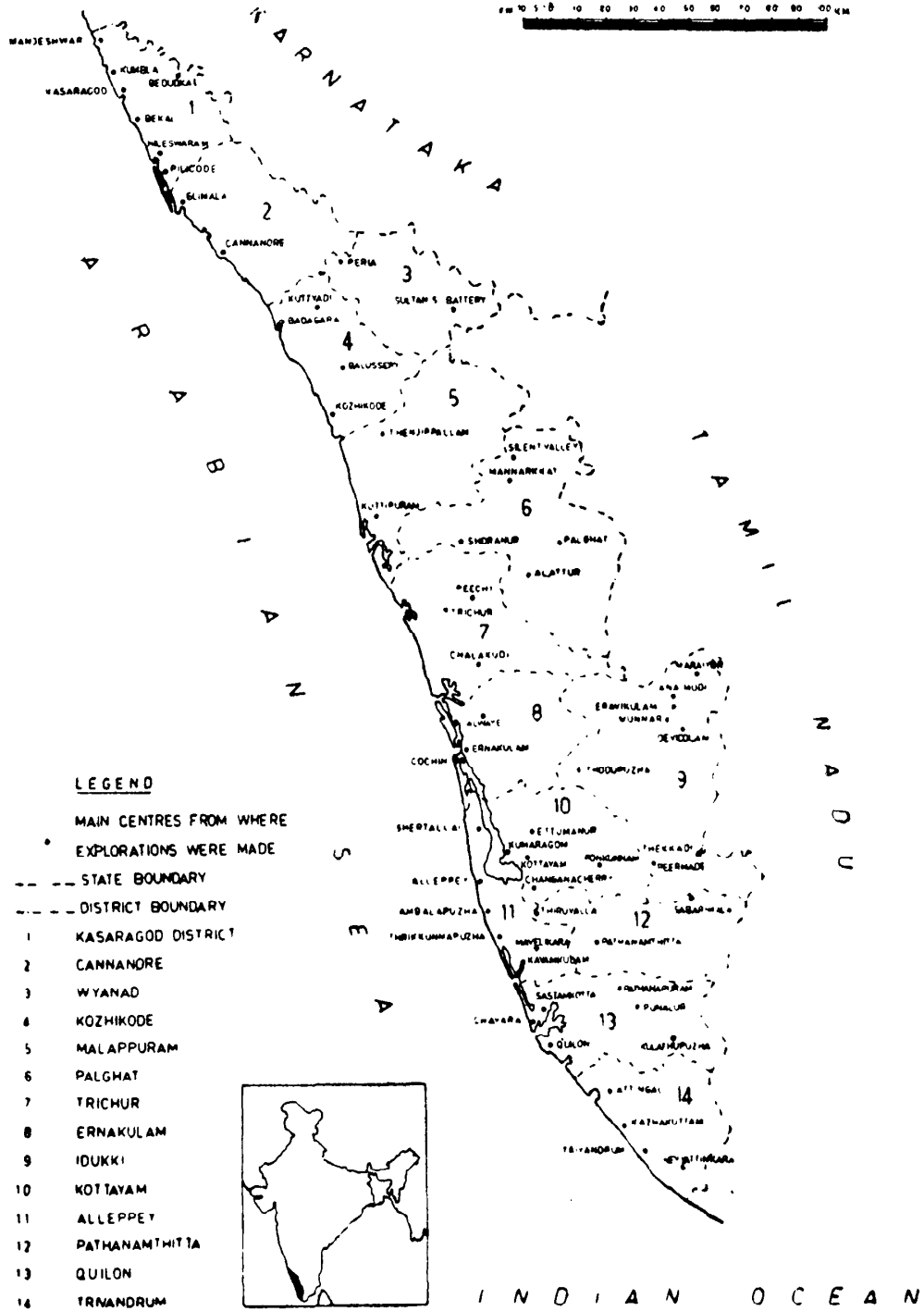
AREA OF STUDY

TOPOGRAPHY

The State of Kerala lies along the southern west coast of India, approximately between the latitudes 8° 18' and 12° 48' N and longitudes 74° 52' and 77° 22' E. It is bounded by Karnataka in the north, Tamil Nadu in the South, Western Ghats in the east and the Arabian Sea in the west. The total land area comes to about 38,864 km². Administratively the state consists of 14 districts. The entire area can be divided into three parallel strips in the north-south direction ;

KERALA STATE

0 10 20 30 40 50 60 70 80 90 100 KM



LEGEND

● MAIN CENTRES FROM WHERE EXPLORATIONS WERE MADE

--- STATE BOUNDARY

--- DISTRICT BOUNDARY

- 1 KASARAGOD DISTRICT
- 2 CANNANORE
- 3 WYANAD
- 4 KOZHIKODE
- 5 MALAPPURAM
- 6 PALGHAT
- 7 TRICHUR
- 8 ERNAKULAM
- 9 IDUKKI
- 10 KOTTAYAM
- 11 ALLEPET
- 12 PATHANAMTHITTA
- 13 QUILON
- 14 TRNANDRUM



INDIAN OCEAN

(i) Coastal Region

The coastal low-land region comprises flat, sandy belts with a series of back-waters and estuaries as intrusions from the sea.

(ii) Midland Region

Lying between the coastal region and the mountainous region, the midland consists of highly undulating, lateritic hilly tracts. Most of the midland and coastal regions are now thickly populated and are under aggressive cultivation. The major agricultural crop in the area is paddy and the tree crops being coconut, arecanut, cashew, jack and mango.

(iii) Mountainous Region

The mountainous region consists of a series of hilly ranges of Western Ghats clothed with dense forest vegetation. The eastern border of Kerala is bounded by an almost unbroken mountain wall, the Western Ghats, with major hills like Anamala, Choolamala, Elamala, Amruthamala etc. The continuity of the Ghats is broken by a prominent depression, the 'Palghat Saddle' ('Palghat Gap'). South of this gap lies the Anamalais range with the highest peak in Peninsular India (Anamudi, 2,695 m). On the lower south-western side of the Nilgiri Plateau lies the verdant Silent Valley. Along the south, the western Ghats is rather interrupted and extends up to Kanyakumari.

The most magnificent among the backwaters of Kerala are the 'Vembanad lake' which is the largest one in the State and the 'Ashtamudi lake' which is the deepest one. Other important backwaters include Veli, Katinamkulam, Anjango, Edava, Nadayara, Paravoor, Kayamkulam, Kodungallore and Chetua. The 'Sasthamkotta lake' is the only natural fresh water lake in Kerala.

More than forty rivers with their innumerable tributaries originate in Western Ghats and cutting across Kerala join the Arabian Sea. Among these 'Bharathapuzha' is the longest one in the State, which originates from Anamala and falls in the Arabian Sea. 'Pamba' is another important river of Kerala which is otherwise known as the 'Gift of Kuttanad'. Both these rivers are considered sacred by the Hindus. 'Periyaru' the second longest river in Kerala makes its origin from Sabarimala. Other important rivers include 'Meenachilaru', 'Manimalayaru', 'Achenkovilaru', 'Kalladayaru', 'Karamanayaru', 'Neyyaru', 'Chandragiripuzha', 'Valarpattanampuzha', 'Bepurpuzha', 'Chalakkudipuzha' and 'Kabani'. Most of these rivers originate from the western slopes of the Western Ghats and flow westward across the plains, with the exception of three rivers flowing east.

The highest peak is Anamudi (2,695 m) and the lowest land is one metre below the mean sea level in the 'Vembanad' area of Alleppey.

GEOLOGY AND SOIL

Four main types of geological formations occur in Kerala, like recent deposits, Late Tertiary beds (Warkalli beds), Laterite belts formed from the crystalline rocks and the crystalline peninsular gneisses. A small outcrop of Middle Tertiary lime stone is found in Quilon and fossiliferous Miocene beds near Varkala (warkalli beds). The greater part of Travancore is occupied by gneisses belonging to the Charnockites with granulitic structure (Sen Gupta & Chatterjee, 1936).

The main soil types met within Kerala State are (1) Alluvial Soil (2) Peaty Soil (3) Red Soil (4) Laterite and Lateritic Soil and (5) Forest Soil. In Kuttanad areas the soils are alluvial. The alluvia on the banks of the main rivers are fertile. Peaty Soils or 'Kari Soils' are found usually along those areas which get submerged during monsoon. The soils are black, heavy and highly acidic. A major portion of Kerala is covered by Red Soils which are generally well-drained and poor in nutrients. Laterite and Lateritic Soils are seen in the midland as well as parts of the highland regions. These soils are generally poor in NPK and organic matter. The ground of the forest is covered by vegetation and forest litter and hence Forest Soils are black in colour containing much decomposed organic matter.

The soils of Chavara and Neendakara contain rare materials like ilmenite, monasite, silicon, etc., which are isolated by the Titanium Factory at Trivandrum and Rare Earth Factory at Alwaye. Glass is manufactured from the peculiar sandy soils available at Shertallay. Shells obtained from the Vembanad lake are utilised for the manufacture of cement by the Nattakom Factory at Kottayam. Workable reserves of bauxite in Kumbala of Cannanore District, iron ore in Cherupa, Eliottumala, Nanminda and Naduvannoor of Calicut District and graphite reserves in Thodupuzha of Idukki District have been discovered, offering scope for industrial expansion.

CLIMATE

Kerala has a warm, humid, tropical climate with an average rainfall of 3,020 mm per year and a relative humidity ranging between 75 and 92 percent. The State receives both the south-west and the north-east monsoons. A major portion of the annual precipitation is received from the south-west monsoon which showers between June and September. North-east monsoon brings light showers between October and November. March and April are the hottest months. The average annual

rainfall ranges between 1,016 mm to over 7,620 mm in hilly areas like 'Pettimudi'. The average day temperature of plains varies from 23.9-37.7°C and in hilly areas it ranges between 7.2 to 32.2°C.

PREVIOUS WORK

Botanically, the area remained underexplored, and no comprehensive floristic account, especially on the grasses of this region is available.

van Rheede (1678-1703) was one of the pioneers to prepare an account on the plants of this area. In his monumental work, "*Hortus Malabaricus*", among the 784 plants illustrated and described, there are only 20 plates of grasses. But in Hooker's *Flora of British India*, only 13 out of the 20 of these plates belonging to Gramineae have been considered. Moreover, the present concept of plant nomenclature was not adopted in Rheede's work and hence its utility for the determination of plants is limited.

Hooker (1872-1897), in his "*Flora of British India*" treats about 700 species of grasses in 130 genera but mentions only about 20-25 species including one or two endemics, as occurring in Kerala. Rama Rao (1914, in his "*Flowering Plants of Travancore*" gives a mere list of about 21 grasses in 68 genera. Ranga Achariyar & Tadulinga Mudaliyar (1921) in their "*Handbook of Some Common South Indian Grasses*" describe and illustrate about 103 species of Poaceae, but unfortunately, most of them are from the plains and only a few grasses are from Kerala State. Fischer (1934-'36) in Gamble's *Flora of Presidency of Madras*, describes more than 350 species of grasses in 126 genera. Out of which, about 200 species according to him, are distributed in Kerala which include 10-15 endemics.

Jacob (1947) published two new species of *Dimeria* and a new variety of *Eragrostis* from Kerala. Puri (1960) included a list of grasses in his publication. Rao (1964) reported the occurrence of *Leptaspis urceolata* in India from Thenmala Forest Division of Quilon. Shetty *et al.* (1973) reported *Eulalia thwaitesii* in India from Anamudi slopes. Ellis and Karthikeyan (1973) published a new variety of *Alloteropsis* sp. from Kerala. Patil & D'Cruz (1974) described a new species of *Ischaemum* from Alleppey. Mitra & Jain (1980) have made critical notes on the identity of four graminaceous plants treated in "*Hortus Malabaricus*". Nair V. J. & Ramchandran (1980) reported the occurrence of *Eragrostis zeylanica* and *Ischaemum zeylanicum* in South India from Cannanore District. Nair *et al.* (1980) reported the occurrence of *Isachne gracilis* in Kerala from Silent Valley. Nair & Bhargavan (1982) published critical notes on a rare grass from Silent Valley.

The herbarium specimens of grasses deposited in MH represent only meagre collections from Kerala. Most of these were made by C. A. Barber (1900-1915), K. C. Jacob (1925-1945), C. E. C. Fischer (1910), G. V. Narayana (1931), P. J. Tommy (1937), K. M. Sebastine (1962-1966), J. L. Ellis (1964-1970) and a few others.

GENERAL PATTERN OF VEGETATION

The following main types of tropical vegetation are met within Kerala :

A. Wet Evergreen Forests

The tropical evergreen forests of Kerala have been continuously subjected to interference by man and are highly deteriorated. Still, patches of typical evergreen forests can be noticed along the western slopes of Agastyamala, Nilgiri complex including Silent Valley, Sabarigiri etc.

The dominant plants in these forests are *Palaquium ellipticum*, *Cullenia exarillata*, *Mangifera indica*, *Canarium strictum*, etc. As a rule, under the full canopy of the evergreen forests, grasses will not develop except the very shade tolerant species like *Centotheca lappacea*, *Leptaspis urceolata*, *Oplismenus compositus*, *Lophatherum gracile*, etc. Most of these grasses have comparatively broader leaves.

B. Semi-evergreen Forests

These forests usually occur between the upland wet evergreen above and the lowland moist deciduous below consisting of a mixture of both evergreen and deciduous elements. In Kerala, we come across these forests mainly in Nilambur, Wynad, Palghat, Ranni, Thenmala, etc.

The trees generally found in the semi-evergreen type are *Xylia xylocarpa*, *Vateria indica*, *Terminalia paniculata*, *Mangifera indica*, etc. Along the fringes of these forests *Centotheca lappacea*, *Cyrtococcum oxyphyllum*, *Ichnanthus vicinus*, *Themeda cymbaria*, *Pennisetum polystachyon*, etc. are the few examples of grasses commonly seen.

C. Moist Deciduous Forests

This type is very characteristic in Kerala and it has replaced evergreen forests in several places (Chandrasekharan, 1962).

The most characteristic tree species of this type in Kerala are *Terminalia paniculata* associated with *T. tomentosa*, *Lagerstroemia lanceolata*, *Tectona grandis*, etc. *Bambusa arundinacea* is a typical component of the understory. A few other grasses like *Cymbopogon flexuosus*, *Themeda cymbaria*, *Pennisetum polystachyon*, *Oplismenus compositus*, etc. have also been noticed as secondary growths.

D. Dry Deciduous Forests

These forests are of limited occurrence in Kerala, and are found mainly in Walayar, Marayur, and Anjanad Valleys. Occurrence of natural 'sandal forests' in Marayur and 'teak plantations' in Nilambur have also been noticed. Most of the species are deciduous during the dry spell.

The common species are *Tectona grandis*, *Santalum album*, *Butea monosperma*, *Pterocarpus marsupium*, etc. Some grasses like *Aristida setacea*, *Rhynchelytrum repens*, *Panicum notatum*, *Pennisetum polystachyon*, *Digitaria ciliaris*, etc. have also been observed along the scrub jungles.

E. Grasslands

The grasslands of Kerala can broadly be classified into two main types (i) Low Level Grasslands and (ii) High Altitude Grasslands.

(i) Low Level Grasslands

These grasslands lie up to 1000 m altitude and are very scattered and often intermixed with forests. Based on the habitat features, this type can again be divided into (a) Dry Grasslands and (b) Wet Grasslands.

(a) Dry Grasslands

These occur along dry rocky plateau and isolated hills of Kerala in places like Taliparamba, Kasaragod and Bendudka areas of Cannanore and Kasaragod Districts, Pokkunnamala and Chelanur of Calicut District and parts of lower Wynad. Large areas of such grasslands have been noticed in the northern-most areas of Kerala. These grasslands are interspersed here and there with a few scrub jungles of common plants like *Bridelia retusa*, *Butea monosperma*, *Maca-ranga peltata*, etc. The common herbaceous plants in these grasslands are *Celosia argentea*, *Polycarpaea aurea*, *Striga lutea*, *Exacum bicolor*, etc.

The common grass species in these grasslands are *Pseudanthistiria heteroclita*, *Dimeria bialata*, *Heteropogon contortus*, *Ischaemum indicum*, *Arundinella mesophylla*, *Dimeria* spp. etc., along open grasslands and *Arundinella cannanorica*, *Bhidea burnsiiana*, *Danthonidium gammiei*, *Dimeria* spp., etc. along the dry rocky places.

(b) *Wet Grasslands*

These are seen along the margins of water-courses like pools, puddles, backwaters, along marshy places and coastal regions. Along the low-lands reclaimed from Vembanad and Ashtamudi lakes of Alleppey, Kottayam and Kayamkulam areas we can come across this types of grasslands. Some of such areas are below the mean sea-level. Thousands of hectares of such low lying wet grasslands have been noticed at 'R. Block' and 'Chithira-Marthandam' areas of Alleppey.

Common species of grasses along such grasslands are *Eriochloa procera*, *Paspalum conjugatum*, *Paspalidium geminatum*, *Panicum repens*, *Imperata cylindrica*, *Brachiaria mutica*, etc. and most of these species are highly adaptable to their semiaquatic habitat.

Along the coastal margins of Thrikkunnappuzha, Alleppey, Chavara, Neendakara and 'Munrothuruthu' of Quilon, Cochin and Veli a peculiar type of wet grasslands have been noticed. Due to the salinity of water and some other soil conditions met with, most of the species here are stunted in growth and they form 'mattresses' along the banks of lakes and backwaters, and also along estuaries, helping to prevent tidal erosion. The most dominant grass species in such grasslands are *Zoysia matrella*, *Cynodon dactylon*, *Paspalum scrobiculatum*, *Sporobolus virginicus*, etc. along with a few sedges like *Cyperus rotundus*, *C. triceps*, *Fimbristylis* spp. etc.

(ii) *High Altitude Grasslands*

High Altitude Grasslands or 'Montane Grasslands' lie normally above an altitude of 1000 m. Bourdillon designates these grasslands as 'Patenas' which show close resemblance to the 'Patenas of Ceylon'

Such grasslands were observed in Eravikulam, Munnar, Devicolam and Ponnambalamedu of Idukki District, Pokkunnamala of Calicut, Silent Valley in Palghat and western slopes of Agastyamala in Trivandrum. But most of these grasslands are highly deteriorated due to misuse and overgrazing leading to excessive soil erosion.

The Eravikulam National Park, or the 'Hamilton Plateau' is one of the most magnificent grasslands of South India, which is situated along the western slopes of Anamudi. These grasslands are subjected to biotic interference to a lesser degree compared to the Nilgiri and Pulney Hills (Shetty & Vivekananthan, 1971). This national park holds probably half of the total world population of 'Nilgiri Tahr' (*Hemitragus hylocrius* Ogilby), a species which is said to be in danger of extinction (Schaller, 1970).

Grasslands cover 85 percent of the area of the Park and include many grass species other types of herbs, undershrubs and a few shrubs. In the south-west part of Umayamala we come across very extensive grasslands which are dominated by *Chrysopogon zeylanicus* and *Eulalia phaeothrix*. Other species of grasses dominating in these open grasslands are *Dichanthium polytychum*, *Arundinella purpurea*, *A. vaginata*, *Andropogon lividus*, *Helictotrichon virescens*, *Agrostis pilosula*, *Tripogon bromoides*, etc. Along with grasses, terrestrial orchids, balsams and other herbaceous plants are plenty in these grasslands. *Brachycorythis splendida*, *Habenaria heyneana*, *Peristylus aristatus*, *Juncus effusus*, *Viola serpens*, *Swertia corymbosa*, *Impatiens cordata*, *Drosera peltata*, etc. are examples for the ground flora other than grasses.

The vast stretches of grasslands here are interspersed with isolated 'sholas'. *Eurya japonica*, *Ilex denticulata*, *Photonia notoniana* etc. are some of the common trees found in these sholas.

The grasslands of Ponnambalamedu and Sabarigiri areas of Idukki and Quilon districts and Pokkunnamala of Calicut are dominated by grasses like *Chrysopogon zeylanicus*, *Cymbopogon flexuosus*, *Themeda cymbaria*, *Ischaemum indicum*, *Eulalia trispicata*, *Tripogon bromoides* etc. These hilltop grasslands are dotted with *Phoenix humilis*, a fire resistant species.

The shola grassland vegetation of Silent Valley and its surrounding areas is not very far different from that of the adjoining Nilgiri Plateau (Nair et al. 1980). *Cymbopogon flexuosus*, *Themeda cymbaria*, *Chrysopogon zeylanicus*, *Oplismenus compositus*, *Tripogon bromoides*, etc. are examples of some dominant grasses here.

Ecological Status of Shola-grasslands

The ecological status of the shola-grassland formation has been a subject of controversy over the years. It is considered a climatic climax by most of the workers like Ranganathan (1936) with ground

frost as the 'master factor' Bor (1938) considered it to be a 'biotic complex' and he showed the importance of fire. The latter view is commonly accepted by De Rosayro (1945, 47), Holmes (1951), Shankaranarayan (1958), Legris (1960), Gupta (1960), Gupta & Shaqkaranarayan (1962), Chandrasekharan (1962) and Noble (1967).

The explanation that the fire is the only factor preventing the re-establishment of the shola has been found inadequate (Meher-Homji, 1967). In conclusion, we may say that there are two adverse factors preventing the spread of shola-forest i. e. frost during the cold season and fire during the drier months.

Succession in Grasslands

According to Agarwal *et al.* (1961) *Arundinella* spp. form a higher stage in succession. In a denuded grassland after 2-3 years' protection species like *Chrysopogon zeylanicus* and *Tripogon bromoides* dominate. After a while, *Themeda* sp., *Heteropogon contortus* and *Ischaemum indicum* also appear. Gradually the plant cover percentage increases and now *Arundinella* spp. attain a dominating stand.

The observations and ecological studies made in the high altitude grasslands of Eravikulam National Park (Clifford Rice, unpub.) indicate that *Dichanthium polyptychum* represents the highest stage in these grasslands. Small patches of this species have been noticed to occur in some marshy areas also, near 'Subsidiary Turner's Valley' in Eravikulam. So, it can be safely stated that *Dichanthium polyptychum* represents the highest stage in grassland development in the areas where it occurs.

Grassland Communities

The forest or tree communities develop a specific floristic composition only under definite ecological conditions. This fact is true even in the case of grassland communities to some extent. The high altitude grasslands of South Indian Hills come under the broad *Sehima-Dichanthium* type (Gupta, *et al.* 1967). This association can be noticed along some low level grasslands of the dry rock plateau in Taliparamba, Kasaragod and Wynad areas. *Heteropogon contortus*, *Sehima nervosum*, *Dichanthium* spp., etc. are the dominant species. *Cymbopogon - Themeda cymbaria* type grassland associations occur in the vicinity of Sabrimala, Ponnambalamedu of Idukki District and Peruvannamuzhi, Kakkayam areas of Calicut District. The dominating species of such association are *Cymbopogon flexuosus*, *Themeda cymbaria*, etc. *Saccharum - Imperata - Phragmites* associations have

been noticed along Achenkovil and Kulathupuzha areas of Quilon and also low lying areas of Alleppey like R. Block and Thrikkunnapuzha areas and composed of grasses like *Phragmites karka*, *Saccharum spontaneum*, *Imperata cylindrica*, *Paspalum conjugatum*, etc. *Zoysia-Sporobolus* communities have been observed along the estuaries and coastal margins of littoral vegetation predominant in Thrikkunnapuzha, Alleppey, Cochin, Chavara, Neendakara and Veli. These communities include species like *Zoysia matrella*, *Sporobolus virginicus*, *Cynodon dactylon*, etc.

Secondary Communities of Grasses

In addition to the main and the subtypes of grasslands, the grasses are found to occupy various other situations which are peculiar and specific to certain species. These are :

(i) Wall Grasses

Immediately after monsoon, along the mud walls, rocky fences and broken compound walls of houses and forts, a large number of herbaceous grasses make their appearance. The commonest among these wall grasses are *Arthraxon lancifolius*, *Dimeria ornithopoda*, *Garnotia courtallensis*, *Sporobolus piliferus*, etc., in high ranges and *Aristida depressa*, *Chloris barbata*, *Arundinella pumila*, etc., in the plains.

(ii) Grasses Along Rocky Places

Certain species of grasses are found to be growing in the crevices of moist or dry rocky substrata. In higher altitudes, grasses like *Zenkeria elegans*, *Zenkeria sebastinei*, *Tripogon bromoides*, *Isachne fischeri*, etc. prefer the moist rocky habitat. While in the lower elevations *Bhidea burnsiana*, *Danthonidium gammiei*, *Arundinella cannanorica*, *Dimeria spp.*, etc. grow along dry rocky plateau.

(iii) Grasses Along Water-courses

The common grasses along the water-courses include *Phragmites karka*, *Arundo donax*, *Saccharum spontaneum*, *Paspalum conjugatum*, etc. as marginal species along the banks of rivers, streams and backwaters. In stagnant waters and marshy areas *Hygroryza aristata*, *Pseudoraphis spinescens*, *Leersia hexandra*, *Sacciolepis interrupta*, *Paspalum distichum*, *Isachne miliacea*, *Paspalidium geminatum*, etc. are invading.

(iv) *Wasteland Grasses*

The uncultivated wastelands along the village areas are dominated by grasses like *Eleusine indica*, *Chloris barbata*, *Panicum repens*, *Dactyloctenium aegyptium*, *Eragrostis tenella*, *E. unioloides*, *Paspalum scrobiculatum*, *Axonopus compressus*, *Alloteropsis cimicina*, etc.

(v) *Grasses as Weeds*

Cultivated fields, plantations and estates are mostly invaded by a large number of obnoxious weedy grasses. Based on their habitat features the weedy grasses can be divided into :

(a) **Wetland weeds :** The weeds along the paddy fields and other wetlands include species like *Echinochloa colona*, *E. crusgalli*, *E. stagnina*, *Eriochloa procera*, *Oryza rufipogon*, *Sacciolepis interrupta*, etc.

(b) **Dryland Weeds :** In plantations, estates and other upland cultivated areas grass weeds are a real menace. Some such common grass weeds are *Panicum repens*, *Chrysopogon aciculatus*, *Alloteropsis cimicina*, *Axonopus compressus*, *Dactyloctenium aegyptium*, *Eleusine indica*, etc.

OBSERVATIONS AND DISCUSSION

A. ENDEMIC GRASSES

J. D. Hooker (1896) reported about 135 genera, 734 species, 2 subspecies and 39 varieties of grasses from the areas of the present day India. Bor (1960) reported about 220 genera and 1165 infrageneric taxa from the present boundary of India, which include about 370 infrageneric taxa (32.7 %) endemic to this continent. Karthikeyan (1983) stated that 16 genera, 299 species, 2 sub-species and 43 varieties are found to be endemic to India.

According to Nayar (1980) there are about 141 endemic genera distributed over 47 families in India, and Acanthaceae and Gramineae have the largest number of endemic genera. It is found that about 16 genera of Gramineae are endemic to India. (Karthikeyan, 1983; Shukla, 1983). Two more genera have been added during the present study.

(i) Grass Genera Endemic to India

The following are the genera of grasses found endemic to Indian sub-continent :

- | | |
|------------------------------|-----------------------------|
| 1. <i>Bhidea</i> | 2. <i>Cahndrasekharania</i> |
| 3. <i>Cyathopus</i> | 4. <i>Danthonidium</i> |
| 5. <i>Glyphochloa</i> | 6. <i>Hubbardia</i> |
| 7. <i>Indochloa</i> | 8. <i>Indopoa</i> |
| 9. <i>Ischnochloa</i> | 10. <i>Limnopoa</i> |
| 11. <i>Lophopogon</i> | 12. <i>Normanboria</i> |
| 13. <i>Pogonachne</i> | 14. <i>Pseudodanthonia</i> |
| 15. <i>Pseudodichanthium</i> | 16. <i>Silentvalleya</i> |
| 17. <i>Trilobachne</i> | 18. <i>Triplopogon</i> |

(ii) Grasses Endemic to Peninsular India

Out of the 18 genera endemic to India, about 13 are found endemic to Peninsular India. The grass genera listed above excluding *Cyathopus*, *Indochloa*, *Ischnochloa*, *Lophopogon* and *Pseudodanthonia* are endemic to peninsular India.

(iii) Grasses Endemic to Kerala

The present study reveals that about 37 endemic species of grasses do occur in Kerala, which is about 11.8% of the total number of species of grasses from the study area. (The species shown with asterisk marks are new discoveries during the present study).

Arundinella kannanorica *, *Bhidea fischeri* *, *Bothriochloa parameswaranii* *, *Chrysopogon tadulingamii* *, *Dimeria borii* *, *D. copeana* *, *D. jainii* *, *D. kanjirappallilana*, *D. keralae* *, *D. kurumthotticalana*, *D. raizadae* *, *Garnotia puchiparensis*, *Isachne fischeri*, *I. setosa*, *Ischaemum agastyamalayyanum* *, *I. calicutensis* *, *I. kannanorensis* *, *I. copeanum* *, *I. elimalayanum* *, *I. jayachandranii* *, *I. keralensis* *, *I. malabaricum* *, *I. nairii* *, *I. raii* *, *I. tadulingamii* *, *I. travancorensis*, *I. vembnadense*, *Limnopoa meeboldii*, *Ochlandra ebracteata*, *O. scriptoria*, *O. travancorica* var. *hirsuta*, *O. wightii*, *Oxytenanthera bourdillonii*, *Silentvalleya nairii* *, *Tripogon anantaswamianus* *, *T. naranianii* *, *Zenkeria jainii* *.

B. RARE GRASSES

The following are some of the rare grass species occurring in Kerala :

<i>Anthoxanthum borii</i>	<i>Artharxon lanceolatus</i>
<i>Arundinella vaginata</i>	<i>Bhidea burnsiana</i>
<i>Cleisatchne sorghoides</i>	<i>Danthonidium gammiei</i>
<i>Dimeria connivens</i>	<i>Dimeria deccanensis</i>
<i>Dimeria fischeri</i>	<i>Dimeria hohenackeri</i>
<i>Isachne fischeri</i>	<i>Isachne gracilis</i>
<i>Ischaemum barbatum</i>	<i>Ischaemum thomsonianum</i>
<i>Ischaemum tumidum</i>	<i>Limnopoa meeboldii</i>
<i>Panicum auritum</i>	<i>Setaria barbata</i>
<i>Streptogyna crinita</i>	etc.

C. COMMON GRASSES

The following are some of the very common grasses found in the wastelands, marshes, wetlands, roadsides and hill slopes in almost all districts of Kerala.

<i>Alloteropsis cimicina</i>	<i>Apluda mutica</i>
<i>Brachiaria miliiformis</i>	<i>Brachiaria ramosa</i>
<i>Chloris barbata</i>	<i>Chrysopogon aciculatus</i>
<i>Coix lacryma-jobi</i>	<i>Cymbopogon flexuosus</i>
<i>Cynodon dactylon</i>	<i>Dactyloctenium aegyptium</i>
<i>Digitaria ciliaris</i>	<i>Digitaria longiflora</i>
<i>Echinochloa colona</i>	<i>Eleusine indica</i>
<i>Eragrostis atrovirens</i>	<i>Eragrostis tenella</i>
<i>Eragrostis unioloides</i>	<i>Isachne miliacea</i>
<i>Panicum repens</i>	<i>Paspalum scrobiculatum</i>
<i>Pennisetum polystachyon</i>	<i>Perotis indica</i>
<i>Sacciolepis interrupta</i>	<i>Setaria pumila</i>

STATISTICAL ANALYSIS OF THE GRASS FLORA OF THE REGION

The present systematic study on the grass flora of Kerala for a period of over six years has resulted in the collection of about

1500 field numbers, comprising about 4500 grass specimens. These specimens belong to a total of 296 species distributed in 103 genera (including 10 species and 5 genera of the tribe 'Bambuseae').

The distribution of the genera and species with respect to each tribe is tabulated below : (Infra-specific taxa are not included here)

Sl. No.	Name of Tribes	Number of genera	Number of species
1.	Andropogoneae	31	108
2.	Maydeae	2	2
3.	Paniceae	25	78
4.	Aeluropodeae	1	1
5.	Agrostideae	1	2
6.	Aristideae	1	3
7.	Arundineae	2	2
8.	Arundinelleae	3	12
9.	Aveneae	2	2
10.	Bambuseae ★	5	10
11.	Centotheceae	2	2
12.	Chlorideae	2	4
13.	Danthonieae	2	4
14.	Eragrosteae	9	31
15.	Festuceae	2	2
16.	Garnotieae	1	6
17.	Isachneae	3	11
18.	Oryzeae	3	6
19.	Perotideae	1	1
20.	Phareae	1	1
21.	Sporoboleae	1	5
22.	Streptogyneae	1	1
23.	Thysanolaeneae	1	1
24.	Zoysieae	1	1
TOTAL		103	296

★ The study of the tribe "Bambuseae" excluded from the present work, will be carried out in due course. The common 'Bamboos' reported to be occurring in Kerala are *Arundinaria densifolia*, *Bambusa arundinacea*, *Ochlandra beddomei*, *O. rheedii*, *O. scriptoria*, *O. travancorica*, *O. wightii*, *Oxytenanthera bourdillonii*, *O. monodelpha*, *O. riicheyi*, etc.

RESULTS AND CONCLUSIONS

Through well-planned seasonal exploration trips, most of the grasses previously recorded for the area together with a large number of additions, including several new discoveries, new, rare or endemic records, etc. have been collected and documented.

This first step towards the study on the grasses of Kerala State, yielded about 296 species distributed in 103 genera, which consists of about 26 taxa new to science (2 new genera and 26 new species). In addition to the above novelties about 50 interesting grasses have also been collected from the area. Out of which, 4 are new records to India, 6 new records to South India and the rest form new distribution records or rare grasses for Kerala.

A. NEW DISCOVERIES

(i) New Genera Discovered : (2)

1. *Chandrasekharania* V. J. Nair, V. S. Ramachandran & P. V. Sree-kumar
2. *Silentvalleya* V. J. Nair, P. V. Sreekumar, E. Vajravelu & P. Bhargavan

(ii) New Species Discovered (26)

1. *Arundinella kannanorica* V. J. Nair, P. V. Sreekumar & N. C. Nair,
2. *Bhidea fischeri* P. V. Sreekumar & B.V. Shetty
3. *Bothriochloa parameswaranii* P. V. Sreekumar, C. P. Malathi & V. J. Nair
4. *Chandrasekharania keralensis* V. J. Nair, V. S. Ramachandran & P. V. Sreekumar
5. *Chrysopogon tadulingamii* P. V. Sreekumar, V. J. Nair & N. C. Nair
6. *Dimeria borii* P. V. Sreekumar, V. J. Nair & N. C. Nair
7. *Dimeria copeana* P. V. Sreekumar, V. J. Nair & N. C. Nair
8. *Dimeria jainii* P. V. Sreekumar, V. J. Nair & N. C. Nair
9. *Dimeria keralae* N. C. Nair, P. V. Sreekumar, & V. J. Nair
10. *Dimeria raizadae* V. J. Nair, P. V. Sreekumar & N. C. Nair
11. *Ischaemum agastyamalayanum* P. V. Sreekumar, Janarthanam & Henry
12. *Ischaemum calicutensis* P. V. Sreekumar, V. J. Nair & N. C. Nair

13. *Ischaemum kannanorensis* P. V. Sreekumar, V. J. Nair & N. C. Nair
14. *Ischaemum copeanum* P. V. Sreekumar, V. J. Nair & N. C. Nair
15. *Ischaemum elimalayanum* P. V. Sreekumar, V. J. Nair & N. C. Nair
16. *Ischaemum jayachandranii* R. Ansari, V. S. Ramachandran & P. V. Sreekumar
17. *Ischaemum keralensis* P. V. Sreekumar, V. J. Nair & N. C. Nair
18. *Ischaemum malabaricum* P. V. Sreekumar, V. J. Nair & N. C. Nair
19. *Ischaemum nairii* V. J. Nair & P. V. Sreekumar
20. *Ischaemum raii* P. V. Sreekumar, V. J. Nair & N. C. Nair
21. *Ischaemum tadulingamii* N. C. Nair & P. V. Sreekumar
22. *Silentvalleya nairii* V. J. Nair, P. V. Sreekumar, E. Vajravelu & P. Bhargavan
23. *Themeda sabarimalayana* P. V. Sreekumar & V. J. Nair
24. *Tripogon anantaswamianus* P. V. Sreekumar, V. J. Nair & N. C. Nair
25. *Tripogon narayanii* P. V. Sreekumar, V. J. Nair & N. C. Nair
26. *Zenkeria jainii* N. C. Nair, P. V. Sreekumar & V. J. Nair

B. NEW RECORDS

(i) New Records to India

1. *Eragrostis cumingii* Steud.

Previously reported from Burma, Malaysia, Philippines and Australia. Recently collected from Veli, Trivandrum and reported (Mohanani & Sreekumar 1982) first time for India.

2. *Eragrostis subsecunda* (Lam.) Fourn.

Distributed in Assam (Haflong), Bangla Desh (Sylhet, Chittagong) and Sri Lanka, but missed by N. L. Bor, when he wrote his Grass. Bur. Cey. Ind. Pak. Now it has been collected from Thrikkunnapuzha (Alleppey District).

3. *Ischaemum indicum* var. *longipilum* (Hack.) Bor

Previously reported only from Sri Lanka. There are a few collections from Cannanore in MH.

4. *Ischaemum indicum* sub-var. *scrobiculatum* (Nees ex Steud.) Bor

This sub-variety was previously known from Sri Lanka. The

present collections from Kerala available in MH, reveal its occurrence in India also.

(ii) New Records to South India

1. *Acroceras munroanum* (Balansa) Henr.

Distributed in Eastern India, Burma, Malaya and Malaysia. Recently reported from Alleppey and Quilon of Kerala (Sreekumar *et al.* (1982).

2. *Dimeria connivens* Hack.

It was previously reported from Bihar and Orissa. The present collection of this rare grass from Cannanore District in Kerala State forms a new record to South India.

3. *Ischaemum indicum* sub-var. *villosum* (Nees) Bor

Previously known from Sri Lanka and Madhya Pradesh. Present collections from Kerala extend its known distribution to South India.

4. *Ischaemum indicum* var. *wallichii* (Hack.) Bor

This variety was earlier known only from Assam. The present collection from Chandanathode in Kerala extends its known range of distribution to Southern India.

5. *Panicum humidorum* Buch. -Ham. ex Hook. f.

Earlier known in India only from Assam and has recently been recorded by Ramachandran *et al.* (1984) for the first time from South India.

6. *Pennisetum orientale* L. C. Rich.

Previously reported from North India. Now it has been collected and reported from Trivandrum (V. J. Nair *et al.* 1982).

(iii) New Distribution Records for Kerala

1. *Anthoxanthum borii* Jain *et al.*

Known earlier only from Nilgiris. Now it has been collected from Idukki, Kerala.

2. *Apocopsis mangalorensis* (Hochst.) Henr.

Known earlier to be confined to Bombay, Madras and Sri Lanka. Recently collected from Kasaragod, Kerala.

3. *Arthraxon villosus* Fischer

Previously known only from Mahabaleshwar and North Canara. Now it has been gathered from Munnar, Kerala.

4. *Bhidea burnsiiana* Bor

A very rare grass so far known only from Bombay and North Canara. Recently collected from Kasaragod, Kerala.

5. *Danthonidium gammiei* (Bhide) C. E. Hubb.

A rare grass reported from Bombay and North Canara. Now it has been collected from Cannanore, Kerala. The present collections of this endemic grass form new representation in MH.

6. *Eragrostis tef* (Zucc.) Trotter

This rare grass was not previously reported from Kerala. The present collection from Alleppey form a new addition to MH.

7. *Ischaemum dalzellii* Stapf ex Bor

So far known only from North Canara and Bombay. Now it has been collected from Cannanore, Kerala.

SYSTEMATIC TREATMENT

KEY TO THE SUB-FAMILIES OF GRAMINEAE

- 1a. Spikelets with 1-several florets, breaking up at maturity above the glumes, or if falling entire, but then not with 2 florets, often more or less laterally compressed POOIDEAE
- 1b. Spikelets strictly with 2 florets, falling entire at maturity, articulated below the glumes, usually with an upper bisexual floret and a lower male or barren, or the latter reduced to lemmas, often dorsally compressed PANICOIDEAE

PANICOIDEAE

Key to the tribes of Panicoideae

- 1a. Spikelets unisexual, male and female spikelets in separate inflorescence or in different positions of the same inflorescence MAYDEAE
- 1b. Spikelets bisexual, or with male or barren and bisexual spikelets mixed in the same inflorescence :
- 2a. Spikelets similar, solitary or paired, glumes usually membranous, the lower often smaller or suppressed, lower lemma more or less similar to upper glume in texture; upper lemma usually without awns PANICEAE
- 2b. Spikelets dissimilar, often in pairs or in threes, one sessile and the other pedicelled, rarely solitary but then the upper lemma awned; glumes as long as the spikelets and enclosing the florets, more or less rigid; upper lemma usually awned ANDROPOGONEAE

PANICOIDEAE ANDROPOGONEAE

ANDROPOGONEAE Dumort

Dumort, Obs. Gram. Belg. 84 : 141. 1823 ; Bor, Grass. Bur. Cey. Ind, Pak. 79. 1960.

Key to the genera of Andropogoneae

- 1a. Spikelets solitary, usually sessile and awned :
- 2a. Inflorescence a solitary, binate, digitate or sub-digitate raceme ; spikelets laterally compressed, flat *Dimeria* 12
- 2b. Inflorescence a panicle ; spikelets not laterally compressed, terete, chestnut-brown or black when mature *Cleistachne* 9
- 1b. Spikelets paired or rarely in threes, both sessile and pedicelled spikelets present or rarely the pedicelled spikelet reduced :
- 3a. Inflorescence a true or false panicle :
- 4a. Panicles of racemes interrupted by spathes :
- 5a. Aromatic grasses ; racemes paired, usually one sessile and the other peduncled, collected into a much branched panicle *Cymbopogon* 10
- 5b. Grasses not aromatic ; racemes fascicled :
- 6a. Basal joints of racemes bulbous ; spikelets in threes, one sessile and the other two pedicelled ; the terminal spikelet reduced to a broad, glume like pedicel *Apluda* 2
- 6b. Basal joints of racemes not bulbous ; spikelets not as above :
- 7a. Racemes with 2 pairs of sessile involucrel spikelets at base ; awnless spikelets either sessile or pedicelled *Themeda* 30

- 7b. Racemes without 2 pairs of sessile involucre spikelets at base; awnless spikelets always pedicelled *Pseudanthistiria* 22

4b. Panicles not interrupted by spathes :

8a. Panicles densely silky villous :

- 9a. Spikelets awned; leaves petiolate, elliptic or elliptic-lanceolate; lower glumes truncate and toothed at apex, with 5-9 prominent nerves *Spodiopogon* 29

- 9b. Spikelets awnless; leaves not distinctly petiolate, lanceolate or linear-lanceolate; lower glumes acute or acuminate, with 2-5 faint nerves :

- 10a. Panicles contracted, spiciform, up to 20 cm long; both spikelets in a pair pedicelled; low grasses, culms up to 150 cm high *Imperata* 17

- 10b. Panicles effuse, up to 50 cm long or more; one of the spikelets in a pair sessile, the other pedicelled; rather tall grasses, culms up to 3 m or more high *Saccharum* 25

8b. Panicles not silky villous :

- 11a. Lower glumes muricate or spinulose; spikelets awnless; branches of panicles whorled *Vetiveria* 31

- 11b. Lower glumes smooth, not muricate or spinulose; spikelets awned or awnless :

- 12a. Joints and pedicels with a translucent median line; upper lemma of the sessile spikelet reduced to a hyaline base of the awn :

- 13a. Branches and branchlets of panicles capillary, leaves up to 20 cm long; glumes never pitted; decumbent or trailing grasses *Capillipedium* 7

- 13b. Branches and branchlets of panicles not capillary; leaves larger, up to 100 cm long; glumes pitted or not, erect grasses *Bothriochloa* 6
- 12b. Joints and pedicels solid, without a translucent median line; upper lemma of the sessile spikelet well-developed, often bifid and awned in the sinus:
- 14a. Spikelets in threes, one sessile, the other two pedicelled; callus often sharp, golden-yellow or rufous-brown hairy; glumes usually aristate, rarely without arista but then low decumbent grasses *Chrysopogon* 8
- 14b. Spikelets paired; callus not as above; glumes never aristate:
- 15a. Spikelets of few pairs in racemes, dorsally compressed; panicles up to 60 cm or more long; primary branches verticillate or alternate; upper lemma of the sessile spikelet entire, 2-toothed or notched at apex *Sorghum* 28
- 15b. Spikelets of many pairs in racemes, not dorsally compressed; panicles up to 15 cm long; primary branches often solitary, alternate; upper lemma of the sessile spikelet deeply notched *Pseudosorghum* 23
- 3b. Inflorescence a solitary, digitate or sub-digitate raceme:
- 16a. Raceme solitary:
- 17a. Joints and pedicels fused; racemes cylindrical; upper lemma of the sessile spikelet awnless:
- 18a. Lower glume of the sessile spikelet orbicular cartilaginous, pitted; racemes fasciated *Hackelochloa* 15

- 18b. Lower glume of the sessile spikelet not as above; racemes not fascicled:
- 19a. Lower glume of the sessile spikelet either winged, or awned or both, often ridged, perforated or muricate *Glyphochloa* 14
- 19b. Lower glume of the sessile spikelet neither winged nor awned, often smooth and glabrous:
- 20a. Sessile spikelets solitary at each node; pedicelled spikelets present; joints and spikelets reduced to a tail like appendage towards apex *Rottboellia* 24
- 20b. Sessile spikelets paired at each node; Pedicelled spikelets absent; joints and spikelets uniformly developed, without a tail like appendage *Mnesithea* 20
- 17b. Joints and pedicels not fused; racemes not strictly cylindrical; upper lemma of the sessile spikelet awned:
- 21a. Lower glume of the sessile spikelet deeply grooved, with lyriform venation; upper glume awned; joints and pedicels clavate; groups of spikelets easily disarticulating *Sehima* 27
- 21b. Lower glume of the sessile spikelet not grooved; upper glume awned or not; joints and pedicels slender, not clavate; spikelets not disarticulating in groups:
- 22a. Upper glume awned; joints, pedicels and callus long bearded; racemes fragile *Pogonatherum* 21
- 22b. Upper-glume not awned; joints, pedicels and callus not as above racemes not fragile:

- 23a. Racemes terete; callus pungent; pedicelled spikelets twisted around the sessile spikelets; awns hairy, up to 10 cm long *Heteropogon* 17
- 23b. Racemes not terete; callus obtuse, not pungent; spikelets not as above; awns more or less glabrous, up to 5 cm long *Dichanthium* 11
- 16b. Racemes two to many:
- 24a. Lower glume of the sessile spikelet truncate or emarginate at apex; spikelets closely imbricate; pedicelled spikelets much reduced, usually represented by vestigial pedicels *Apocopsis* 3
- 24b. Lower glume of the sessile spikelet acute or acuminate, rarely rounded but never truncate or emarginate; spikelets not as above:
- 25a. Upper lemma of the sessile spikelet reduced to a hyaline base of the awn:
- 26a. Joints and pedicels with a translucent median line; glumes often pitted *Bothriochloa* 6
- 26b. Joints and pedicels opaque or solid, glumes never pitted *Dichanthium* 11
- 25b. Upper lemma of the sessile spikelet well-developed, often cleft at apex into 2 lobes, awned in the sinus:
- 27a. Lower glume of the sessile spikelet with a median furrow on dorsal side *Microstegium* 19
- 27b. Lower glume without a median furrow on dorsal side:
- 28a. Upper lemma of the sessile spikelet awned from the back, often just above the base; lower glumes often muricate or spinulose, rarely smooth; pedicelled spikelets reduced or not *Arthraxon* 4
- 28b. Upper lemma of the sessile spikelet awned from the sinus, often from the middle; lower glumes not as above; pedicelled spikelets usually well-developed, rarely reduced but then the joints toothed:

- 29a. Pedicelled spikelets usually reduced to small aristate glumes; joints and pedicels toothed; racemes solitary, frequently collected into a false panicle *Schizachyrium* 26
- 29b. Pedicelled spikelets well-developed; joints and pedicels not toothed; racemes binate, digitate or corymbose, but never paniced:
- 30a. Spikelets disarticulating in groups; upper glume of the sessile spikelet deeply notched and awned from the sinus; racemes always two *Bhidea* 5
- 30b. Spikelets not disarticulating in groups; upper glume not deeply notched; racemes two to many:
- 31a. Spikelets of each pair similar, bisexual; racemes usually densely hairy, often 3-15, rarely solitary or 2 but then the glumes brownish *Eulalia* 13
- 31b. Spikelets of each pair dissimilar; sessile spikelets with male and bisexual florets; pedicelled spikelets usually male or rarely bisexual; racemes hairy or glabrous, often binate, rarely more than 3 but then the joints and pedicels slender, toothed:
- 32a. Lower glume of the sessile spikelet always smooth and chartaceous; joints and pedicels slender, solid, rarely toothed *Andropogon* 1
- 32b. Lower glume of the sessile spikelet usually coriaceous with several nodules and wrinkles, rarely smooth and chartaceous, but then racemes binate; joints and pedicels stouter, hollow, never toothed *Ischaemum* 18

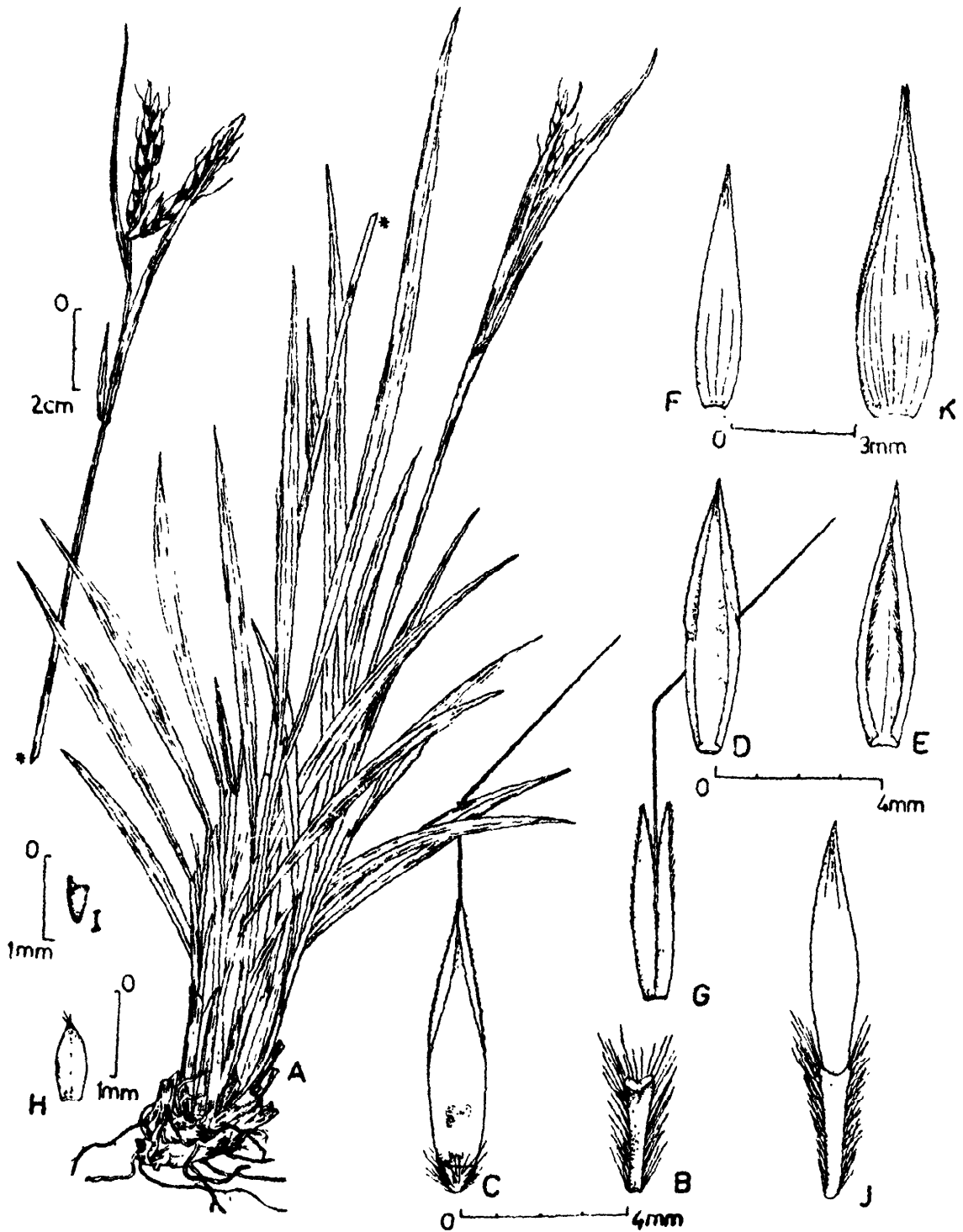


PLATE No. 1: *ANDROPOGON LIVIDUS* Thw.

A. Habit; B. Joint of raceme; C. Sessile spikelet; D. Lower glume of sessile spikelet; E. Upper glume; F. First lemma; G. Second lemma. H. Palea of the second lemma; I. Lodicule; J. Pedicelled spikelet; K. Lower glume of pedicelled spikelet.

1. ANDROPOGON Linn.

Linn. Gen. Pl, ed. 5. 468. 1754; Hook. f. Fl. Brit. Ind. 7: 164. 1896, p. p.; Fischer in Gamble, Fl. Pres. Madr. 1752. 1934 (Repr. ed. 3: 1214. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 89. 1960.

A genus of about 100 species distributed in the tropical regions of the world, of which about 9 occur in India and 2 in Kerala.

Key to the species

- 1a. Keels of the lower glumes of the sessile spikelets winged in the upper half; joints of racemes with denticulate tips *A. lividus* 1
- 1b. Keels of the lower glumes of the sessile spikelets not winged; joints of racemes without denticulate tips *A. polytychus* 2

1. **Andropogon lividus** Thw. Enum. Pl. Zeyl. 367. 1864; Hook. f. Fl. Brit. Ind. 7: 209. 1896; Fischer in Gamble, Fl. Pres. Madr. 1753. 1934 (Repr. ed. 3: 1255. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 91. 1960. PLATE No. 1

Tufted perennials. Culms 15-80 cm high, stout; nodes glabrous. Leaves lanceolate or linear-lanceolate, 5-20 x 0.2-0.6 cm, usually clustered at base, glabrous. Sheaths keeled. Ligules oblong, acute, membranous, 1-3 mm long. Racemes 1-3 together, 2-5 cm long, purplish, stout, sparsely villous; joints 2.5-3 mm, densely ciliate along the margins. Sessile spikelets elliptic-lanceolate, 6-8 mm long; callus shortly bearded; lower glume elliptic-lanceolate, 6-7 x 1-1.25 mm, 2-toothed or mucronate at apex, subcoriaceous, flat with a shallow depression near the base, 3-5-nerved, 2-keeled; upper glume boat-shaped, 6-7 x 1.5-1.75 mm, subcoriaceous, 3-nerved, margins infolded, hyaline, ciliate in the upper 2/3; lower floret empty; upper floret bisexual; first lemma lanceolate, 6-7 mm long, faintly 3-7-nerved, delicate, hyaline, margins infolded, ciliate in the upper 2/3; palea absent; second lemma notched, 4-5 x 0.5-0.7 mm, 3-nerved, median nerve prominent, delicate, hyaline, lobes sharply acute, ciliate on both the margins; awns 10-15 mm long, geniculate, column 5-6 mm long, bristles scabrid; palea oblong, 0.5-1 x 0.4-0.5 mm, acute, delicate, hyaline, with 2-3 long hairs at the tip; lodicules obovate, 0.5 x 0.25 mm, concave and 2 horned at apex; stamens 3, anthers

2-3 mm long; ovary *c.* 0.5 x 0.25 mm, styles 1-1.25 mm, slender stigmas 1-2 mm, feathery. Pedicelled spikelets elliptic-lanceolate, 6-9 mm long; pedicles *c.* 3 mm long, margins ciliate; lower glume elliptic-lanceolate, 7-9 x 1.5-2 mm, 2-toothed or mucronate at apex, subcoriaceous, 13-15-nerved, margins minutely winged and scabrid in the upper half; upper glume similar to that of sessile spikelet; lower floret empty; upper floret male; first lemma similar to that of sessile spikelet; second lemma oblong, 3.5-4 x 0.5-1 mm, notched, 3-nerved, delicate, hyaline, margins ciliate in the upper half; awn reduced to a mucron; palea similar to that of the sessile spikelet; stamens 3, anthers *c.* 2 mm long.

Occasional in grasslands of higher elevations.

Fl. & Fr. : August-February.

Notes : This highly variable species can be distinguished in the field by its peculiar purplish racemes with easily breaking joints.

IDUKKI : Eravikulam National Park, Umayamala, Anamudi slopes.

2. *Andropogon polytychus* Steud. Syn. Pl. Glum. 1 : 380. 1854; Hook. f. Fl. Brit. Ind. 7 : 198. 1896; Bor, Grass. Burm. Cey. Ind. Pak. 91. t. 1. 1960 (incl. var. *deccanensis*); Gupte in Madr. Agri. J. 51 : 398. 1969; Shetty *et al.* in Bull. Bot. Surv. Ind. 15 : 276. 1973. *A. polytychus* Steud. var. *deccanensis* Bor ex W. D. Clayton in Kew Bull. 27 : 448. 1972. *Dichanthium polytychum* (Steud.) A. Camus in Bull. Mus. Hist. Nat. Paris 27 : 549. 1921; Fischer in Gamble, Fl. Pres. Madr. 1741. 1934 (Repr. ed. 3 : 1207. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 135. 1960.

Densely tufted perennials. Culms 50-90 cm high, stout; nodes bearded. Leaves linear-lanceolate or oblanceolate, 5-40 x 0.3-0.8 cm, erect, rigid, mid-rib broad, covered with dense tubercle-based hairs on both sides. Sheaths sparsely villous. Ligules very short, ovate, membranous. Racemes 2-5, 3-10 cm long, shortly peduncled, alternate, axils hairy; peduncle villous or glabrous below; joints 3-4 mm, margins long ciliate. Sessile spikelets oblong-lanceolate, 5-7 x 1-1.5 mm, callus bearded; lower glume lanceolate, 5-6 x 1.5-1.75 mm, chartaceous, 9-nerved, margins infolded, hispid in the upper half; upper glume boat-shaped or ovate-lanceolate when spread, 5-6 x 1-1.75 mm, chartaceous, 3-5-nerved, margins densely ciliate in the upper half. Lower floret empty. Upper floret bisexual. First lemma lanceolate, 6 mm long, delicate, faintly 3-5-nerved, margins ciliate in

the upper half; palea minute or absent. Second lemma shortly notched 2-3 mm long, delicate; awn 12-15 mm long, geniculate, column 5-6 mm long, brownish, bristle pale, scabrid; palea minute or absent, lodicules 2, obovate, each c. 0.5 x 0.25 mm, 2-horned at apex. Stamens 3; anthers 2-2.5 mm long, white with violet margins; ovary oblong, c. 0.5 mm, style 0.5-1 mm long, slender, stigmas 1.5-2.5 mm long, feathery, pink coloured. Pedicelled spikelets oblong-lanceolate, 5-7 x 1-2 mm; pedicels 2-3.5 mm long, ciliate along the margins; lower glume oblong, 5-7 mm long, acute, chartaceous, 13-15-nerved, margins minutely winged, hispid in the upper 3/4; upper glume boat-shaped, 5-5 mm long, chartaceous, 5-nerved, margins hyaline, ciliate in the upper 2/3. Lower floret empty. Upper floret male. First lemma and palea similar to those of sessile spikelet. Second lemma 4-5 mm long, oblong, delicate, faintly 3-nerved median nerve prominent, margins ciliolate in the upper half; palea minute or absent. Stamens 3.

Fairly common along shallow streams, in high altitude grasslands, usually in swamps.

Fl. & Fr. : June-February.

Notes : In this species upper lemma of the sessile spikelet is not prominently 2-lobed, unlike other species of the genus. Probably due to this reason, Bor (*l. c.*) has treated this taxon under *Andropogon* Linn. as well as *Dichanthium* Willemet. But later on Clayton (*l. c.*) evaluated the species and treated it under *Andropogon* Linn.

Bor (*l. c.*) thought that the Indian materials belonged to a new variety *deccanensis* Bor and the typical variety is confined to Sri Lanka and Burma. He differentiated the varieties *polyptychus* and *deccanensis* as follows :

- | | |
|--|--|
| <p>1a. Leaves flat; racemes several; peduncle below inflorescence glabrous; awn 1.5 cm long</p> | <p><i>A. polyptychus</i> var <i>polyptychus</i></p> |
| <p>1b. Leaves filiform; racemes 1 or 2; peduncle hairy below inflorescence; awn over 2 cm long</p> | <p><i>A. polyptychus</i> var. <i>deccanensis</i></p> |

Gupte (*l. c.*) reported the occurrence of *A. polyptychus* Steud. var. *polyptychus* for the first time in India based on the collections from the high altitudes of Nilgiris. After a critical study of Sri Lankan specimens available in MH and other fresh materials collected from

Nilgiris and Anamudi, Shetty *et al.* (*l. c.*) concluded that the two varieties show overlapping characters and all the diagnostic features mentioned by Bor are unreliable. Recent collections from Kerala also exhibit intermediate characters. A varietal or subspecific status for the Indian plant does not seem to be justifiable.

IDUKKI : Eravikulam National Park, Anamudi slopes, Umayamala.

2. APLUDA Linn.

Linn. Gen. Pl. ed. 5. 35. 1754; Hook. f. Fl. Brit. Ind. 7: 150, 1896; Bor, Grass. Bur. Cey. Ind. Pak. 93, 1960.

A monotypic genus in tropical regions of the world.

Apluda mutica Linn Sp. Pl. 82. 1753; Fischer in Gamble, Fl. Pres. Madr. 1750. 1934 (Repr. ed. 3: 1212. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 93. t. 7. 1960; Manilal & Sivaraj. Fl. Calic. 344, 1982. *A. aristata* Linn. Amoen. Acad. 4: 303. 1756; Fischer in Gamble, Fl. Pres. Madr. 1750. 1934 (Repr. ed. 3: 1212. 1957). *A. varia* Hack. in DC. Monogr. Phan. 6: 197. 1889, nom. superfl. based on *A. mutica* Linn.; Hook. f. Fl. Brit. Ind. 7: 150. 1896; Rang. & Tad. Handb. S. Ind. Grass. 171. t. 142-143. 1921.

Annuals or perennials. Culms 30-200 cm or more long, creeping or erect; nodes glabrous. Leaves elliptic-lanceolate or linear-lanceolate, 2-35 x 0.2-1.5 cm, attenuate, usually petiolate, glabrous or shortly villous on nerves. Ligules 1-3 mm, membranous. False panicles 5-50 cm long, interrupted. Racemes solitary from a peduncled spatheole, glabrous. Spatheole broadly-elliptic or ovate, 3-8 x 1-4 mm, acuminate or caudate, several nerved, margins hyaline, purple or green, ciliolate or glabrous. Sessile spikelets 3-8 mm long, laterally compressed, awned; lower glume lanceolate, 3-8 x 1-2 mm, shortly bifid, chartaceous or coriaceous, 9-15-nerved, margins narrowly winged in the upper half; upper glume boat-shaped, 3-6 x 1-3 mm, beaked, keeled, chartaceous, faintly 5-11-nerved, keel ciliolate or glabrous; lower floret male. Upper floret bisexual. First lemma oblong-lanceolate, 2.5-5 x 0.5-1 mm, delicate, hyaline, faintly 3-5-nerved. Palea equal to lemma, 2-keeled, 2-nerved. Lodicule obovate, 0.25-0.5 mm, truncate. Stamens 3, anthers 1-2 mm long. Second lemma as long as the sessile spikelet, notched, delicate, hyaline, 3-nerved. Awn 5-15 mm long, glabrous; column 3-6 mm.

chestnut-brown. Palea ovate-acute, 1.5-2.5 x 0.5-1 mm, 2-keeled, delicate, hyaline. Stamens 3, anthers 2-4 mm long, cream with violet margins. Ovary oblong, 0.5-1 mm; styles 1-2 mm long, slender; stigmas 1.5-3 mm, pink, feathery. Sterile pedicelled spikelet lanceolate or slightly falcate, 3-8 x 0.5-1.5 mm, shortly bifid, flat, sub-coriaceous, 5-7-nerved, rarely pubescent, margins ciliate or ciliolate in the upper half. Pedicelled spikelet oblong-lanceolate, 3-6 x 1-1.5 mm; pedicel oblong, 2-5 mm long, flat, faintly 3-5-nerved, margins ciliolate. Lower glume lanceolate, 3-6 x 1-1.5 mm, chartaceous, 11-13-nerved. Upper glume ovate-lanceolate, equal in size and texture, 5-11-nerved, margins infolded. Florets more or less similar to those of sessile spikelet; upper lemma entire, unawned.

Very common, along the margins of streams, in scrub jungles of plains as well as hilly regions, in wastelands and hedges. Usually in shades.

Fl. & Fr. : August-December.

Notes : A highly variable species. Small, slender, annual forms with creeping and rooting culms as well as tall, stout perennial forms with erect and tufted culms were observed in the area. Hackel described several varieties within this species. As Bor (*l. c.*) states, none of them can be maintained as separate entities.

CANNANORE : Ezhimala ; IDUKKI : Munnar, Pullupara, Thekadi ; KOTTAYAM : Mundakkayam ; PALGHAT : Aruvampara, Silent Valley ; TRICHUR : Thumbermozhi, Peechi ; TRIVANDRUM : Kariavattom, Sreekaryam, Klamala R.F., Neyyar, Kovalam, Kottur ; WYNAAD : Meppadi.

3. APOCOPIS Nees

Nees in Proc. Linn. Soc. Lond. 1 : 93. 1841 ; Bor, Grass. Bur. Cey. Ind. Pak. 94, 1960.

A genus of about 10 species, distributed in the eastern Asia, of which about 5 species occur in India and one in Kerala. Occurrence of *A. courtallumensis* in the study area is not certain.

Apocopis mangalorensis (Hochst.) Henr. in Blumea 4 : 523. 1941 ; Bor. Grass. Bur. Cey. Ind. Pak. 96. 1960 ; Manilal & Sivaraj. Fl. Calic. 332. 1982. *Amblyachyrum mangalorensis* Hochst. Flora 39 : 26. 1856.

PLATE No. 2

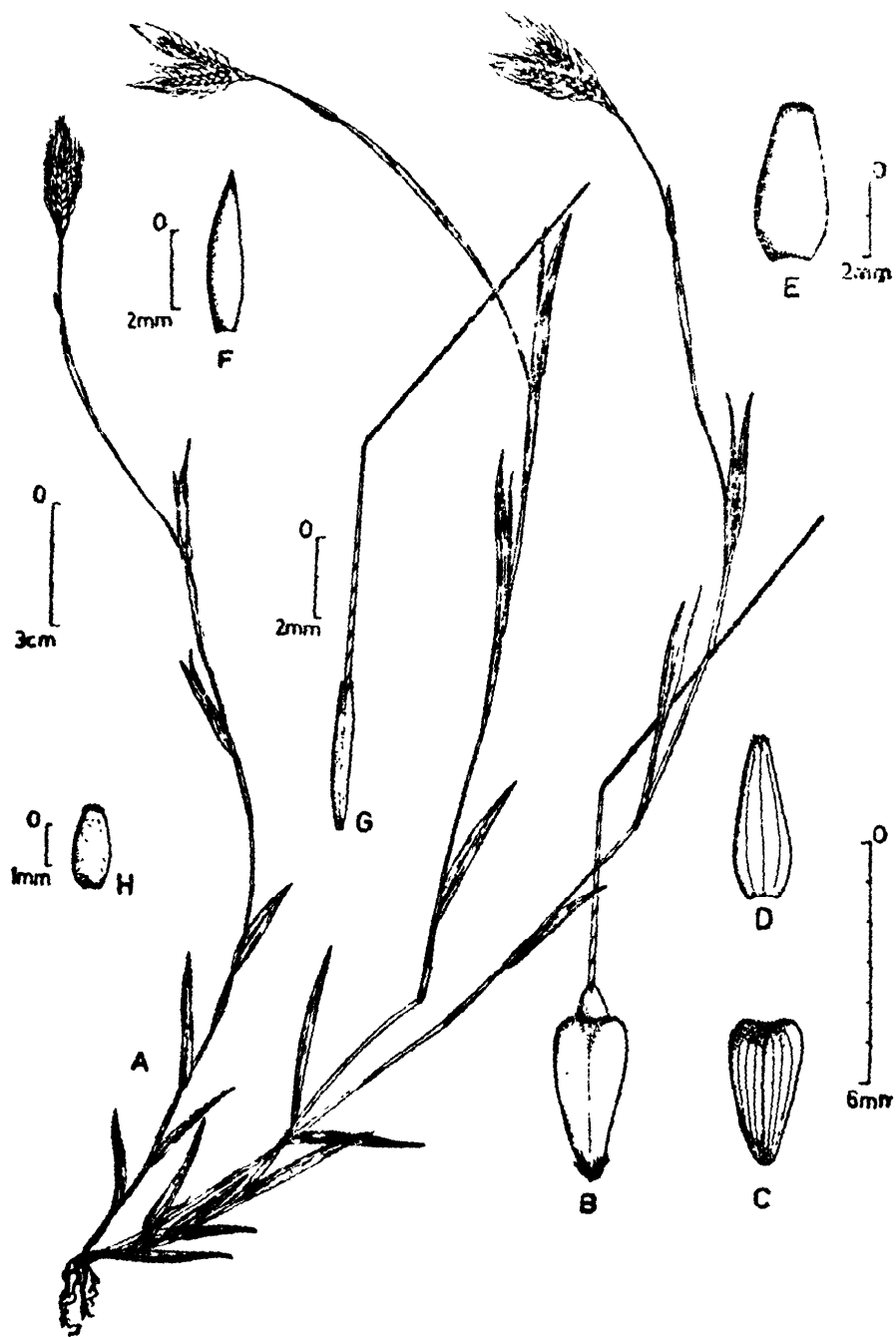


PLATE No. 2: *APOCOPIS MANGALORENSIS* (Hochst.) Henr.

A. Habit; B. Spikelet; C. Lower glume; D. Upper glume; E. First lemma; F. Palea of the first lemma; G. Second lemma; H. Palea of the second lemma.

Annuals. Culms 10-40 cm high, erect or decumbent; nodes glabrous. Leaves lanceolate, 1-4 x 0.2-0.4 cm, covered with tubercled hairs on dorsal side. Sheaths keeled, covered with tubercled hairs towards upper half. Ligules ovate, membranous. Racemes solitary or paired, 1-3 cm long. Spikelets oblanceolate, awned, 4-5 mm long, pale yellow to brown. Lower glume obovate, 3-4 x 2 mm, subcoriaceous, 7-nerved, retuse and ciliolate at apex, softly pubescent along the dorsal side. Upper glume oblong-lanceolate or linear, 3.5-4 x 1-1.5 cm, chartaceous, bifid and ciliolate at apex, 3-nerved, keeled. Lower floret male or empty. Upper floret bisexual. First lemma ovate-oblong, 3.5-4 x 1.5-2 mm, truncate and fimbriate at apex, delicate, hyaline. Palea lanceolate, 3.5-4 x 1 mm, delicate, hyaline. Stamens 2; anthers c. 1.5 mm long, dirty-yellow or pink. Second lemma linear, 3.5-4 x 0.5 mm, chartaceous, 3-nerved, slightly notched, awned; awn 10-15 mm long; column 5-8 mm long. Palea ovate-oblong, c. 2 x 1 mm, fimbriate at apex, delicate, hyaline, glabrous. Stamens 2; anthers c. 2.5 mm long, yellow or pink. Ovary oblong, c. 0.5 mm; styles 1-1.5 mm, stigmas 1-2 mm long, cream-yellow.

Fairly common in dry rocky grasslands, in association with grasses like *Dimeria bialata*, *Heteropogon contortus*, *Danthonidium gammiei*; usually in drier areas.

Fl. & Fr. : August-December.

Notes : This species is often wrongly identified in various herbaria as *A. courtallumensis*. Many specimens at MH wrongly identified as *A. courtallumensis*, turned out to be *A. mangalorensis*. It can easily be distinguished from the former, by the slender, annual habit and smaller spikelets.

CALICUT : Pokkunnamala; CANNANORE : Mukkarikandam, Paramba; PALGHAT : Thiruvizhamkunnu.

4. ARTHRAXON P. Beauv.

P. Beauv. Ess. Agrost. 111: t.11. 1812; Hook. f. Fl. Brit. Ind. 7: 143. 1896; Fischer in Gamble, Fl. Pres. Madr. 1726. 1934 (Repr. ed. 3: 1196. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 96. 1960; Jain in J. Ind. Bot. Soc. 51: 165. 1972; van Welzen in Blumea 27(1): 260. 1981.

A genus of about 50 species and 20 varieties distributed from Africa through Asia up to Japan in the East and Australia in the South-east, of which about 25 species and 3 varieties occur in India; 5 species in Kerala. Jain (*l.c.*) and van Welzen (*l.c.*) provide excellent treatments of the genus. van Welzen has reduced several Indian species to varieties. However, as the distinction between the different species are very clear within the region of the present study, the views of Bor (*l.c.*) and Jain (*l.c.*) are followed here.

Key to the species

- 1a. Pedicelled spikelets developed :
- 2a. Spikelets 2-3 mm long; glumes aristate; stamens 2; anthers up to 0.5 mm long *A. lancifolius* 2
- 2b. Spikelets 5-6 mm long; glumes not aristate; stamens 3; anthers 1-2 mm long;
- 3a. Lower glume of the sessile spikelets villous, margins ciliate; nerves on the glumes indistinct; leaves ovate, acute; anthers 1 mm long *A. villosus* 5
- 3b. Lower glume of the sessile spikelets not villous, margins spinulose; glumes with 5-7 distinct nerves; leaves lanceolate, acuminate; anthers 2 mm long *A. lanceolatus* 1
- 1b. Pedicelled spikelets not developed :
- 4a. Pedicels 2-3 mm long, linear; stamens 3; joints 4 mm long, glabrous *A. nudus* 3
- 4b. Pedicels reduced to minute points; stamens 2; joints 2-2.5 mm long, ciliate *A. quartinianus* 4
1. **Arthraxon lanceolatus** (Roxb.) Hochst. in Flora 39: 188. 1856; Hook. f. Fl. Brit Ind. 7: 143. 1896; Fischer in Gamble, Fl. Pres. Madr. 1728. 1934 (Repr. ed. 3: 1198. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 100. 1960; Jain in J. Ind. Bot. Soc. 51: 175. 1972; van Welzen in Blumea 27(1): 281. 1981, p.p. *Andropogon lanceolatus* Roxb. Fl. Ind. 1: 262. 1820. PLATE No. 3.

Annuals or stoloniferous perennials Culms, 20-80 cm long, geniculate; nodes glabrous. Leaves lanceolate, acuminate, 1-5 x 0.2-0.8 cm, rounded at base, margins ciliate towards base. Ligules membranous, thin. Racemes digitate, 2-4 in number, each 2-5 cm long. Joints 2.5-3 mm long, densely ciliate. Sessile spikelets lanceolate,

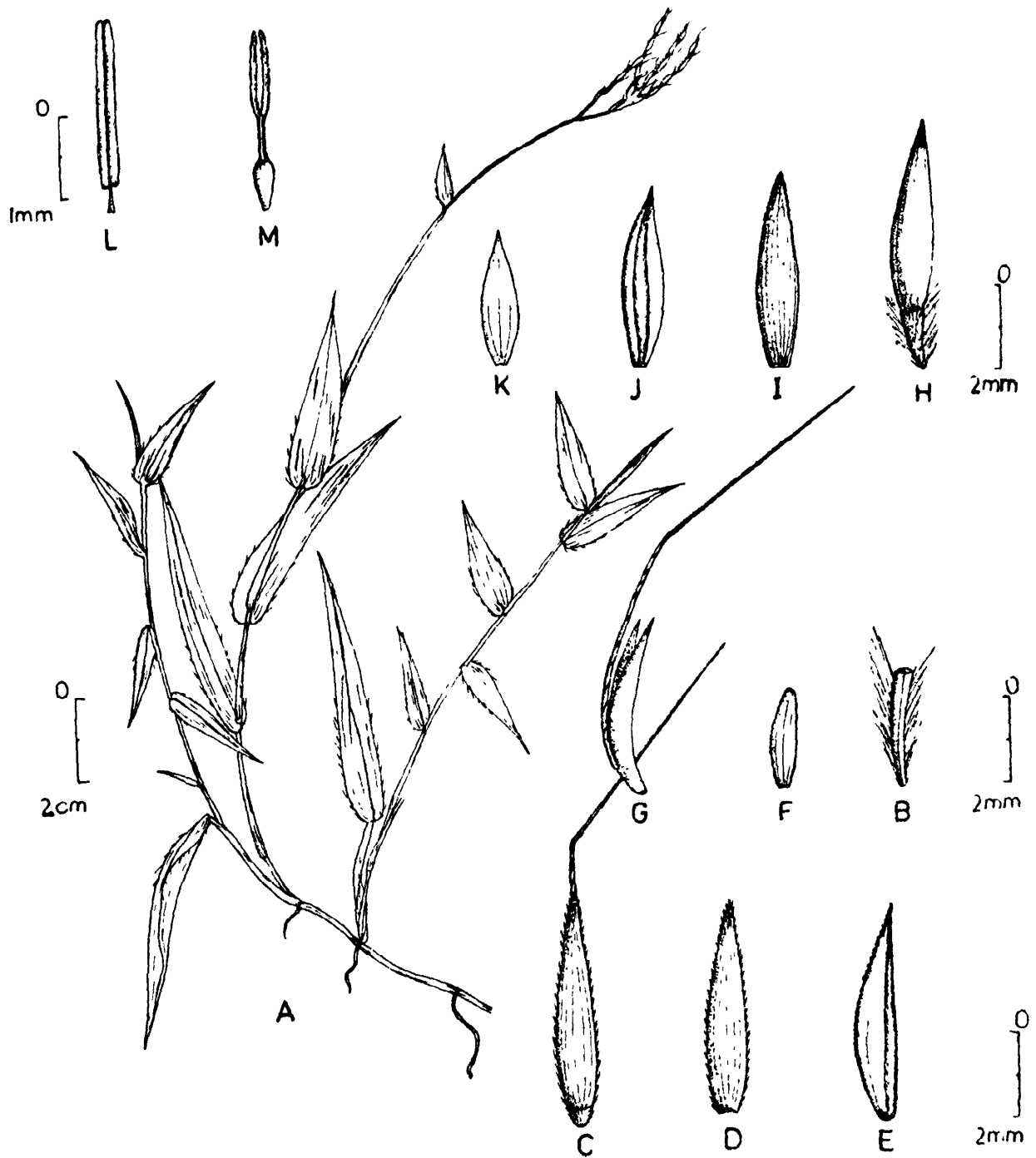


PLATE No. 3: *ARTHRAOXON LANCEOLATUS* (Roxb.) Hochst.

A. Habit; B. Joint of raceme; C. Sessile spikelet; D. Lower glume of sessile spikelet; E. Upper glume; F. First lemma; G. Second lemma; H. Pedicelled spikelet; I. Lower glume of pedicelled spikelet; J. Upper glume; K. Second lemma; L. Stamen; M. Pistil.

5-6 mm long, callus sparsely bearded. Lower glume lanceolate, 5-6 x 1 mm, chartaceous, 7-nerved, margins echinate. Upper glume boat-shaped, c. 5 x 1.5 mm, keeled, chartaceous, 3-nerved, scabrid towards apex, margins hyaline, retrorsely ciliate. Lower floret empty. Upper floret bisexual. First lemma linear-oblong, 2-3 x 0.5 mm, delicate, hyaline, faintly 2-3-nerved. Second lemma deeply notched, c. 4 x 1 mm, delicate, hyaline, awned. Awn 10-12 mm long, column 5-6 mm. Stamens 3, anthers c. 2 mm long. Ovary c. 0.5 mm, oblong or oblanceolate; styles c. 0.5 mm long; stigmas c. 1 mm long, cream coloured. Pedicelled spikelets lanceolate, 4-5 mm long. Pedicels 1-1.5 mm long. Lower glume elliptic-lanceolate, 4-5 x 1 mm, chartaceous, 6-7-nerved, scabrid towards apex. Upper glume elliptic-lanceolate, 4-4.5 x 1 mm chartaceous, faintly 3-5-nerved, margins infolded, hyaline, retrorsely ciliate. Second lemma elliptic-lanceolate, c. 3 x 1 mm, delicate, hyaline, faintly 3-nerved, glabrous. Palea similar to that of the sessile spikelets. Stamens 3; anthers 1-2 mm long.

Rare, along the hill slopes at higher altitudes, usually in moist situations.

Fl. & Fr. : August-December.

Notes : This rare and endemic grass is represented in MH only by two very old collections of C.A. Barber made in 1902 and 1905 from Tamil Nadu. While revising the *Arthraxon* in India, Jain recorded the following note on one of these sheets; 'Preserve this specimen carefully and try to collect the grass again' This clearly emphasizes the rarity of the species. Mehrotra (1979) also indicates the extreme rarity of this grass after analysing the available Indian collections. Recently, this grass was observed to be growing on hill tops in Munnar, Idukki district, where also it was rare.

This species is often confused with *Arthraxon prionodes* but can be distinguished by the peculiar striate ornamentation of the lower glumes.

IDUKKI : Munnar.

2. *Arthraxon lancifolius* (Trin.) Hochst, in Flora 39 : 188. 1856; Fischer in Gamble, Fl. Pres. Madr. 1729. 1934 (Repr. ed. 3 : 1193. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 100. 1960; Jain in J. Ind. Bot. Soc. 51 : 176. 1972; van Welzen in Blumea 27 : 288. 1981; Manilal & Sivaraj. Fl. Calic. 334. 1982. *Andropogon lancifolius* Trin. in Mem. Acad. Sci. Petersb. Ser. 6(2) :

271. 1832. *Arthraxon microphyllum* (Trin.) Hochst. in Flora 39 : 188. 1856; Hook. f. Fl. Brit. Ind. 7 : 147. 1896. *Andropogon microphyllum* Trin. l. c. 275.

Annuals. Culms creeping and geniculate; nodes softly hairy. Leaves ovate-lanceolate, acuminate, 0.5-5 x 0.2-1 cm, rounded at base, softly villous or glabrous. Sheaths slightly keeled. Ligule a row of hairs. Racemes digitate, 3-8 in number, each 0.5-3 cm long. Joints 1-1.5 mm long, densely villous, hairs 1-2 mm long. Sessile spikelets lanceolate-acuminate, 2.5-3 mm long, greenish-yellow. Lower glume lanceolate, 2-3 mm long, bifid, shortly aristate, chartaceous, faintly 5-nerved. Upper glume lanceolate, c. 2 mm long (excluding an arista of 1 mm), keeled, chartaceous, margins hyaline. Lower floret empty. Upper floret bisexual. First lemma oblong, 0.5-1 mm, delicate, hyaline, glabrous. Second lemma lanceolate, c. 1 x 0.5 mm, deeply notched, awned, delicate, hyaline. Awn 6-8 mm long, column 2-3 mm. Stamens 2; anthers 0.25-0.5 mm, pink. Ovary linear-oblong, 0.25-0.5 mm; styles very short; stigmas c. 0.5 mm long, white, feathery. Pedicelled spikelet lanceolate, 1.5-2 mm, empty. Lower glume ovate-lanceolate, c. 1.5 x 0.75 mm, chartaceous, faintly 5-nerved, glabrous. Upper glume ovate-lanceolate, 1-1.5 x 0.5 mm, chartaceous.

Fairly common along hill slopes, raised bunds, rocky places and on compound walls, old forts and fences; usually in moist situations.

Fl. & Fr. : September-December.

Notes : This grass can be confused with *Arthraxon quartinianus* by its apparently similar habit and habitat but can be distinguished from the latter by the presence of well developed pedicelled spikelets.

IDUKKI : Peermade; KASARAGOD : Kasaragod.

3. *Arthraxon nudus* (Steud.) Hochst. in Flora 39: 188. 1856; Bor, Grass. Bur. Cey. Ind. Pak. 101. 1960; Jain in J. Ind. Bot. Soc, 51 : 178. 1972. *Andropogon nudus* Steud. Syn. Pl. Glum. 1 : 383. 1854. *Arthraxon hispidus* auct. non Makino 1912 : Fischer in Gamble, Fl. Pres. Madr. 1728. 1934 (Repr. ed. 3 : 1198. 1957); van Welzen in Blumea 27 : 266. 1981, p. p. *A. ciliaris* sensu Hook. f. Fl. Brit. Ind. 7 : 145. 1896, p. p. non P. Beauv. 1812.

Annuals. Culms 20-100 cm long, creeping and geniculate; nodes bearded. Leaves ovate-lanceolate, 1-8 x 0.4-2 cm, cordate or auriculate at base, ciliate along the margins. Sheaths villous and ciliate along the margins. Ligules membranous, thin, fimbriate. Racemes digitate or subdigitate, 3-12 in number, 2-6 cm long. Joint *c.* 4 mm long, angular. Sessile spikelets lanceolate, 4-5 mm long, callus sparsely bearded. Lower glume lanceolate, *c.* 4 x 1 mm, chartaceous, 9-nerved, scabrid along the nerves. Upper glume boat-shaped or lanceolate when spread, 3-4 mm long, margins hyaline, retrorsely ciliate. Lower floret empty. Upper floret bisexual. First lemma linear, 2.5-3 x 0.5 mm, 1-nerved, delicate, hyaline, glabrous. Second lemma deeply notched, 2-3 mm long, awned, delicate, hyaline. Awn 10-12 mm, slender, column 4-5 mm long. Stamens 3; anthers 0.25-0.5 mm long, deep violet coloured. Ovary oblong, *c.* 0.3 mm; styles *c.* 0.5 mm long; stigmas *c.* 0.5 mm, pinkish. Pedicelled spikelets reduced to linear pedicels, *c.* 3 mm long.

Occasional along raised bunds, creeping along the fences, hill slopes and growing as a weed in pepper plantations; usually in moist and shady places.

Fl. & Fr. : September-March.

Notes : This species very closely resembles *Arthraxon hispidus* and to a certain extent *A. quartinianus*, but can be easily distinguished from them by the presence of 3 perfect stamens, minute anthers and long slender pedicels. Fischer (*l. c.*) wrongly identified this species and kept it under *A. hispidus*. He has cited the collections of C. A. Barber from Malabar. But, all the specimens represented in MH including Barber's collections from Malabar belong to *A. nudus* only. Moreover, the other species, *A. hispidus* seems to be confined to eastern India. Bor (*l. c.*) could observe the latter species only from Naga Hills. Jain (*l. c.*) in his revision also says, 'though this grass has been reported from eastern India, I have not seen any specimen which I could refer to this species with certainty'. Critical study of the specimens available in MH reveals that the south Indian material is only *A. nudus*.

This grass has leaves with a very bitter taste; hence cattle and buffaloes do not prefer it.

CANNANORE : Taliparamba ; **KASARAGOD :** Bandudka ;
WYNAAD : Meppadi.

4. *Arthraxon quartinianus* (A. Rich.) Nash in N. Amer. Fl. 17: 99. 1912; Fischer in Gamble, Fl. Pres. Madr. 1728. 1934 (3: 1198. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 102. 1960; Jain in J. Ind. Bot. Soc. 51: 179. 1972; Manilal & Sivaraj. Fl. Calic. 334. 1982. *Alectoridia quartiniana* A. Rich. Tent. Fl. Abyss. 2: 448. t. 99. 1851. *Arthraxon hispidus* sensu van Welzen in Blumea 27: 266. 1981, p. p., non Makino 1912. *A. ciliaris* sensu Hook. f. Fl. Brit. Ind. 7: 145. 1896, p. p., non P. Beauv. 1812.

Annuals. Culms 10-50 cm long, slender, creeping or geniculate; nodes bearded. Leaves ovate-acuminate or lanceolate, 1-5 x 0.3-1 cm, rounded or shallowly cordate at base, villous or glabrous, margins ciliate towards base. Sheaths covered with tubercled hairs. Ligules ovate, membranous, fimbriate. Racemes 3-8 in number, each 1-3 cm long. Joints linear, 2-2.5 mm long, ventrally grooved, ciliate. Sessile spikelets lanceolate, 3-3.5 mm long, laterally compressed, purplish-green; callus shortly bearded. Lower glume ovate-lanceolate when spread, 3-3.5 x 1 mm, acuminate, chartaceous, 7-nerved. Upper glume boat-shaped, lanceolate when spread, 3-3.5 x 1 mm, chartaceous, faintly 3-5-nerved, margins hyaline, apex puberulous. Lower floret empty. Upper floret bisexual. First lemma lanceolate, 1-2 x 0.5 mm, delicate, faintly 1-3-nerved, hyaline. Second lemma deeply notched, 1.5-2 mm long, awned, delicate, hyaline. Awns 5-10 mm long, column 3-4 mm. Stamens 2, anthers 0.5 mm long. Ovary oblong, c. 0.3 mm; styles c. 0.5 mm; stigmas c. 0.4 mm, cream coloured. Pedicelled spikelets reduced to glabrous points.

Often found along roadsides at higher altitudes, hill slopes, swampy places and barren fields forming thick carpets.

Fl. & Fr. : June-January.

Notes : This species shows a gradation of variation in size as well as shape especially in the case of the leaves.

It may be confused with *A. nudus*, but can be distinguished by the presence of 2 perfect stamens only and minute glabrous points of pedicels. The racemes are slender, and more in number, with villous joints and pedicels.

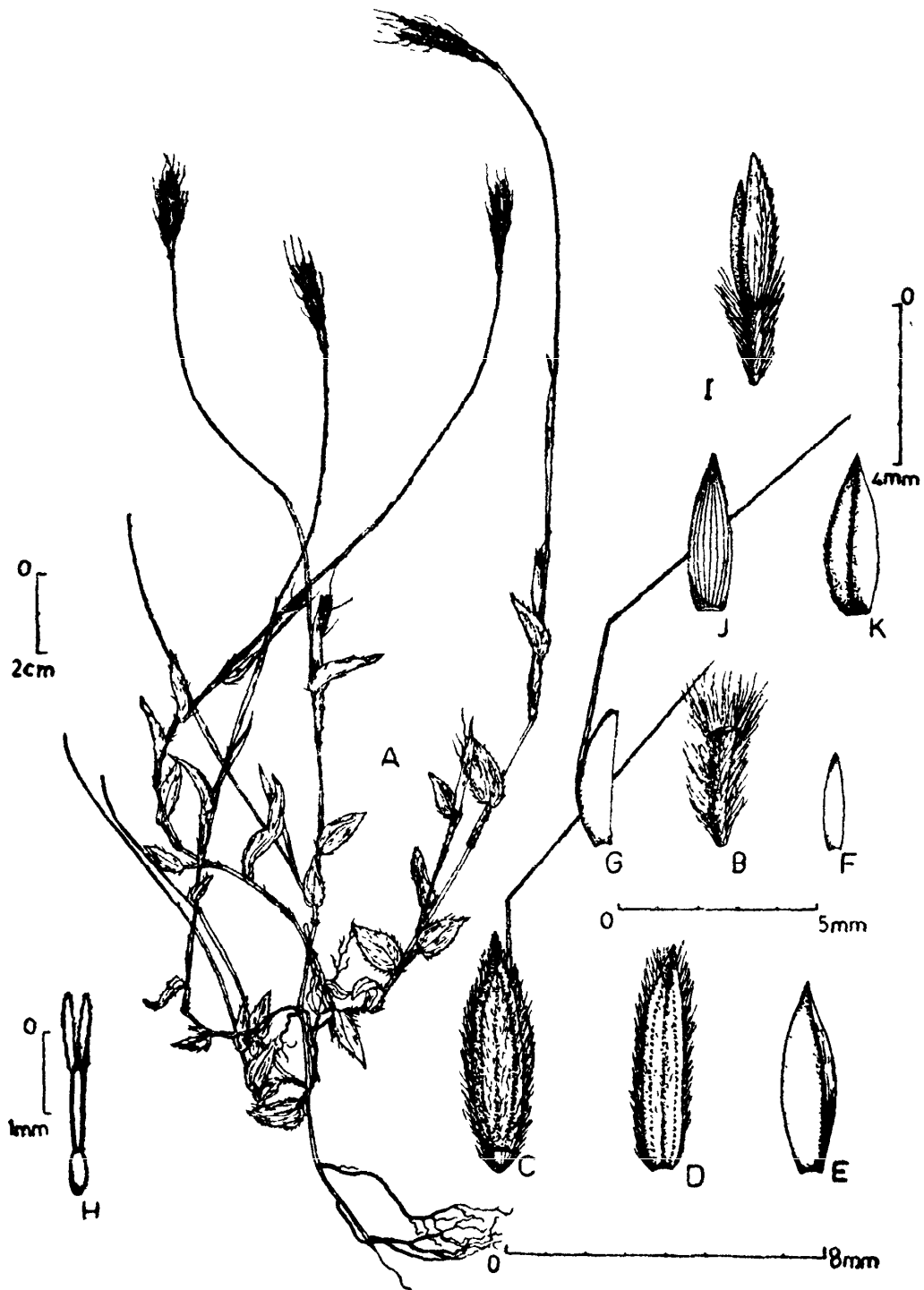


PLATE No. 4: *ARTHRAOXON VILLOSUS* C. E. C. Fischer

A. Habit; B. Joint of raceme; C. Sessile spikelet; D. Lower glume of sessile spikelet; E. Upper glume; F. First lemma; G. Second lemma; H. Pistil; I. Pedicelled spikelet; J. Lower glume of pedicelled spikelet; K. Upper glume.

This grass can be used as a good soil binder, especially for newly raised bunds and road cuttings.

IDUKKI: Munnar, Peermade; WYNAAD: Meppadi.

5. *Arthraxon villosus* C. E. C. Fischer in Kew Bull. 1933: 350. 1933. et in Gamble, Fl. Pres. Madr. 1728. 1934 (Repr. ed. 3: 1198. 1957); Bor, Grass. Bur. Cey. Ind. Pak. 103. 1960. Jain in J. Ind. Bot. Soc. 51: 182. 1972; Nair *et al.* in J. Econ. Tax. Bot. 3: 270. 1982. *A. lanceolatus* (Roxb.) Hochst. var. *villosus* (Fischer) van Welzen in Blumea 27(1): 288. 1981. PLATE No. 4

Annuals. Culms 5-40 cm long, creeping; nodes bearded. Leaves ovate, acute, 0.5-3 x 0.2-0.8 cm, rounded at base, densely villous, margins ciliate. Sheaths villous with tubercled hairs. Ligules ovate, membranous, fimbriate. Racemes 2-3 in number, 1-4 cm long. Joints c. 3 mm long, densely villous. Sessile spikelets lanceolate, c. 6 x 1 mm, densely villous. Lower glume lanceolate, 5-6 mm long, subcoriaceous, densely villous, keeled and echinulate along the margins. Upper glume boat-shaped, 4-5 x 1-1.5 mm, chartaceous, margins hyaline. Lower floret empty. Upper floret bisexual. First lemma oblong-lanceolate, 2-2.5 x 0.5 mm, delicate, hyaline, glabrous. Second lemma deeply notched, 3-3.5 x 1 mm, awned, delicate, hyaline. Awn 12-15 mm long, column 5-6 mm. Stamens 3, anthers c. 1 mm long. Ovary oblong, c. 0.5 mm; styles c. 1 mm; stigmas c. 1 mm, feathery. Pedicelled spikelets lanceolate c. 4 x 1 mm, usually empty. Pedicels linear-clavate, 2 mm long, densely villous. Lower glume elliptic-lanceolate, 3.5-4 x 1.25 mm, chartaceous, 7-nerved, scabrid towards apex. Upper glume ovate-lanceolate, 3-4 x 1.5 mm, chartaceous, 3-nerved.

Rare, along the moist shady hill slopes at higher elevations.

Fl. & Fr.: October-December.

Notes: Very rare grass. In MH, there is only an incomplete specimen collected from the type locality, on which no data are recorded. Jain (*l. c.*) gives its distribution as Mysore and Maharashtra in Peninsular India. The present collections of this endemic grass from a hilly area of Kerala widens its known range of distribution.

van Welzen (*l. c.*) has treated this grass as a variety of *A. lanceolatus*, in his revision of the genus. He says that this plant also shows a kind of evolutionary sequence in the pubescence and

scabrousness of the lower glumes of the sessile spikelets, like its allied forms. But the typical *A. lanceolatus* differs qualitatively and quantitatively very much from *A. villosus*. The south Indian materials available in MH were critically studied and it was found worth keeping them under separate species. Both of them can easily be distinguished as given in the Table.

<i>A. lanceolatus</i>	<i>A. villosus</i>
1. Leaves lanceolate, acuminate, glabrous	Leaves ovate-acute, villous.
2. Spikelets glabrous	Spikelets densely villous
3. Lower glumes of the sessile spikelets striate, distinctly nerved, margins spiculate	Glumes densely villous, nerves indistinct, margins ciliate.
4. Keels of the lower glume not winged	Keels of the lower glume winged

Few of our specimens were examined by van Welzen of Rijksherbarium, Leiden. He opined that (pers. comm.) 'in aberrant forms lower glumes show a gradation in the indumentum' Still it was thought to be better to maintain *Arthraxon villosus* as a separate species till a detailed biosystematic study is made.

IDUKKI : Munnar.

5. BHIDEA Stapf ex Bor

Stapf ex Bor in Kew Bull. 1948: 445. 1949 et in Grass. Bur. Cey. Ind. Pak. 103. 1960.

A genus of about 2 species distributed in India including Kerala, of which one is new to Science.

Key to the species

- 1a. Awns up to 20 mm long, slender; abscission of rhachis slightly oblique, 0.5 mm long; joints 2-3 mm long, stout; callus up to 1 mm long; spikelets 6-8 mm long

B. burnsiiana 1