TAXONOMIC STUDIES ON ISCHAEMINAE AND ANTHISTIRIINAE (POACEAE: PANICOIDEAE: ANDROPOGONEAE) OF SOUTHERN PENINSULAR INDIA

Thesis submitted to the
University of Calicut in partial fulfillment of the requirements for
the award of the degree of

DOCTOR OF PHILOSOPHY IN BOTANY

by

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CERTIFICATE

This is to certify that the thesis entitled **TAXONOMIC STUDIES ON ISCHAEMINAE AND ANTHISTIRIINAE (POACEAE: PANICOIDEAE: ANDROPOGONEAE) OF SOUTHERN PENINSULAR INDIA**, submitted to the University of Calicut by Ms. **Drisya V.**, in partial fulfillment of the award of the degree of Doctor of Philosophy in Botany is a bona fide record of the research work carried out by her under my supervision and guidance. No part of the present work has formed the basis for the award of any other degree or diploma previously.

I also certify that the corrections/suggestions from adjudicators have been incorporated in the revised thesis.

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Calicut University
Date: 30. 09. 2024

Dr. A.K. Pradeep
(Supervising Teacher)

DECLARATION

I hereby declare that the work presented in the thesis entitled **TAXONOMIC STUDIES ON ISCHAEMINAE AND ANTHISTIRIINAE (POACEAE: PANICOIDEAE: ANDROPOGONEAE) OF SOUTHERN PENINSULAR INDIA** is based on the original work done by me under the guidance of **Dr. A.K. Pradeep** and has not been included in any other thesis submitted previously for the award of any degree. The contents of the thesis are undergone plagiarism check using iThenticate software at C.H.M.K. Library, University of Calicut, and the similarity index found within the permissible limit. I also declare that the thesis is free from AI generated contents.

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Date: 30. 09. 2024

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Drisya V.

Abstract

A comprehensive taxonomic study on the subtribes Ischaeminae and Anthistiriinae of the tribe Andropogoneae of the family Poaceae in southern Peninsular India is presented here. The present work deals with a total of 10 genera with 6 from Anthistiriinae and 4 from Ischaeminae. The genera recognized under Anthistiriinae from southern Peninsular India are *Agenium* Nees, *Heteropogon* Pers., *Iseilema* Andersson, *Parahyparrhenia* A.Camus, *Pseudanthistiria* (Hack.) Hook.f. and *Themeda* Forssk. Whereas four genera namely *Apluda* L., *Ischaemum* L., *Sehima* Forssk. and *Thelepogon* Roth ex Roem. & Schult. are recognized under Ischaeminae of southern Peninsular India. Out of the 37 species reported, 36 were collected. Nomenclature of each taxon is updated with Shenzhen Code (Turland *et al*. 2018) using relevant taxonomic literature as well as by examining type specimens. A total of 20 new synonyms were recognized, 17 under *Ischaemum*, 2 in *Iseilema* and one in *Pseudanthistiria*. Among the 37 species, 10 species *viz.*, *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair, *I. kingii* Hook.f., *I. pushpangadanii* Ravi, N.Mohanan & Kiran Raj, *I. rangacharianum* C.E.C.Fisch., *I. travancorense* Stapf ex C.E.C.Fisch., *Iseilema anthephoroides* Hack., *Parahyparrhenia bellariensis* (Hack.) Clayton, *Themeda mooneyi* Bor, *T. palakkadensis* Chorghe, K.Prasad & Lakshmin. and *T. sabarimalayana* Sreek. & V.J.Nair. were assessed as endemic to India. However, 5 species were found strictly endemic to southern Peninsular India. Lectotype designation for 22 names were also done. The protologue of *Iseilema prostratum* (L.) Andersson was amended and a new combination *Agenium ritchiei* (Hook.f.) Drisya & Pradeep is proposed. A complete and updated taxonomic account on the subtribes Ischaeminae and Anthistiriinae of southern Peninsular India is provided along with illustrations, photoplates, distribution maps and taxonomic keys for identification.

Keywords: *Agenium, Apluda, Heteropogon, Ischaemum, Iseilema, Parahyparrhenia, Pseudanthistiria, Sehima, Thelepogon, Themeda*

സംഗ്രഹം

ദക്ഷിണേന്ത്യയിൽ കാണപ്പെടുന്ന ഇഷിമിനെ, ആന്തിസ്റ്റിറിനെ വിഭാഗത്തിൽപ്പെടുന്ന പുൽവർഗസസ്യങ്ങളുടെ ശേഖരണവും വർഗ്ഗീകരണവും നാമകരണവും ഉൾപ്പെടുന്ന ഒരു പഠനമാണിത്. ഇന്ത്യൻ ഉപദ്വീപിന്റെ ദക്ഷിണഭാഗത്തു സ്ഥിതിചെയ്യുന്ന കേരളം, തമിഴ് നാട്, കർണാടക, ആന്ധ്രപ്രദേശ്, തെലങ്കാന എന്നീ സംസ്ഥാനങ്ങളിലെ മേൽവിഭാഗത്തിൽപ്പെടുന്ന പുൽവർഗസസ്യങ്ങളെയാണ് പഠനത്തിനായ് തിരഞ്ഞെടുത്തിട്ടുള്ളത്. പശ്ചിമഘട്ടമലനിരകളുടെയും പൂർവ്വഘട്ടമലനിരകളുടെയും ഡെക്കാൻ പീഠഭൂമിയുടെയും സവിശേഷസ്വാധീനത്താൽ പുൽവർഗസസ്യങ്ങളിൽ പ്രകടമായിട്ടുള്ള ജൈവവൈവിധ്യമാണ് ഇത്തരമൊരു പഠനത്തിന്റെ അടിസ്ഥാനം.

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ഇഷിമിനെ, ആന്തിസ്റ്റിറിനെ വിഭാഗങ്ങളിലായി ഇരുപത് പുതിയ പര്യായങ്ങളും പ്രസ്തുത പഠനത്തിലൂടെ കണ്ടെത്താൻ സാധിച്ചു. അവയിൽ പതിനേഴ് എണ്ണം 'ഇഷിമം' എന്ന ജനുസിലും രണ്ടെണ്ണം 'ഐസിലീമ' ജനുസിലും ഒരെണ്ണം 'സ്യൂഡാൻന്തിസ്റ്റിരിയ' ജനുസിലും മറ്റൊരെണ്ണം 'തിമിഡ' ജനുസിലുമായി ഉൾപ്പെട്ടിരിക്കുന്നു.

ഇന്ത്യയിൽ ഇതുവരെ ഹെറ്റിറോപോഗോൺ ജനുസിൽ അറിയപ്പെട്ടിരുന്ന 'ഹെറ്റിറോപോഗോൺ റിറ്റ്ച്ചീ' എന്നയിനം യഥാർത്ഥത്തിൽ ദക്ഷിണ അമേരിക്കയിൽ മാത്രം അറിയപ്പെട്ടിരുന്ന 'അജീനിയം' എന്ന ജനുസിലേതാണെന്ന് ഈ പഠനഫലമായി മനസ്സിലായി. പഠന വിധേയമായ മുപ്പത്തിയേഴ് ഇനം പുൽചെടികളിൽ, പത്തെണ്ണം ഇന്ത്യയിൽ മാത്രം കാണപ്പെടുന്ന ദേശജാതികളാണെന്ന് തിരിച്ചറിഞ്ഞും ഈ പഠനത്തിന്റെ ഒരു പ്രധാന നേട്ടമാണ്.

സൂചക പദങ്ങൾ : അജീനിയം, ഇഷിമം, അപ്ലട, ഐസിലീമ, ഹെറ്റിറോപോഗോൺ, സ്യൂഡാൻന്തിസ്റ്റിരിയ, സെഹിമ, തെലിപോഗോൺ, തിമിഡ.

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Chapter 1 Introduction

Grasses are the economically as well as ecologically important group of plants among angiosperms. They occur in all parts of the globe, even adapted to extreme climatic conditions, and are seen from deserts to forests, sea level to high altitudes and near poles to the equator. Grasses being widespread and ecologically dominant, they form the world's one of the major ecosystems, the 'Grasslands' (Scribner & Southworth, 1896; Kellogg, 2015). Grasslands usually harbour a large number of species and are generally listed among the world's diversity hotspots. IUCN lists 234 centres of Plant Diversity of which 40 are grasslands (Kellogg, 2015). These grasslands can store about 34% of carbon worldwide, which is nearly equal to that done by forests (White *et al.*, 2000). Thus, grasses and grasslands have a major role in controlling increased atmospheric CO_2 levels. In fact, four of the top crops that feed the world are cereal crops: wheat, rice, corn and barley. Because of their economic and ecological importance, grasses have attracted considerable attention in the biological and agricultural sciences.

Poaceae comprises 789 genera with 11,783 species (Soreng *et al.*, 2022). Thus, based on the number of genera and species, Poaceae forms the fifth largest family after Asteraceae, Fabaceae, Orchidaceae and Rubiaceae. Grasses, with their adaptability to changeable environments, ability to coexist with grazing herbivores and with man, as well as their possession of a distinctive life form make it a successful family (Clayton & Renvoize, 1986).

The family Poaceae is subdivided into subfamilies. The subfamily Panicoideae is the more diverse group among them. Panicoideae includes 3316 species grouped in 212 genera (Kellogg, 2015). All members can be grouped on the basis of the presence of two-flowered spikelets with male or sterile lower florets (Clayton & Renvoize, 1986; Kellogg, 2000) and simple type starch grains in the endosperm (Tateoka, 1962). This subfamily is distributed worldwide, however, its members are dominant in tropical and sub-tropical areas. Andropogoneae is one of the two major tribes in Panicoideae. Based on morphology, this group of tropical

grasses is well defined containing more than 900 species with extensive morphological variation among its members (Clayton & Renvoize, 1986; GPWG I, 2001).

In India, Poaceae is represented by 266 genera with 1506 species and several infra-specific taxa (Kellogg *et al.*, 2020). According to Kellogg *et al.* (2020), 'India is the most poorly studied of all subcontinents for grasses' though the country represents about 1/3 of the total genera in the family.

Andropogoneae and Paniceae are the two dominant tribes in southern Peninsular India [while comparing the grass flora of Kerala state and India based on accounts by Sreekumar and Nair (1991) and Karthikeyan *et al*. (1989) respectively]. This advanced tribe Andropogoneae contains 85 genera with about 960 species worldwide and is distributed throughout the tropics, particularly the savanna zone, extending into warm temperate regions. Andropogoneae is characterised by the fragile racemes bearing paired spikelets (Clayton & Renvoize, 1986). According to Bews (1929), Andropogoneae include all the grasses that are usually dominant in the climax stages of the plant succession and their inflorescence characters show their advancement over Paniceae.

Economic importance of grasses

As a source of food for mankind

Major staple food of mankind belongs to the family Poaceae. Rice, Wheat, Corn, Barley, Rye, Oats and Sorghum are cultivated on a large scale to meet this purpose. They are commonly referred to as grains and millets. Another important food crop is sugar cane, *Saccharum officinarum* L. It is the main source of sugar in the world. Most of the human beings depend on rice than any other food source. Rice is a native of tropical Asia, Africa and possibly South America, but now all the warmer regions of the world is cultivating rice. Whereas the native place of wheat is Europe and presently grown throughout the cooler regions of the world. Corn, a New World plant crop with probable origin at Mexico, is now grown in all over the world. Bamboo is another important food source from grass family. In many regions

of the world especially tropical Asia, bamboo shoot is used as food. Bamboo grains [eg: grains of *Dendrocalamus strictus* (Roxb.) Nees] also constitutes one of the components of man's diet (Gould, 1968). According to Watt (1908), India alone constitutes 150 million culms as annual consumption of bamboo shoot for food.

Forage for domesticated animals

Many grasses are cultivated in large scale for feeding domesticated animals such as cattle and sheep. These forage grasses include species of *Pennisetum*, *Cenchrus*, *Sorghum* etc. Apart from this, the fodder (dried hay or straw) obtained from the food crops (rice, wheat, maize etc.) are also used as food for animals. In southern Peninsular India, almost all species of *Ischaemum* is found to be a best choice for cattles. Many countries such as United States maintain tame pastures or improved pastures for the purpose of grazing. An interesting grass, *Bouteloua dactyloides* (Nutt.) Columbus seen in semiarid plains and are usually grazed by livestock is commonly known as buffalo grass. Now a days cereal and millet based balanced diet are also given to dairy cattles for best quality milk and dairy products. Thus, dairy industry is also highly grass based.

Soil conservation and sand binders

Grass cover can control soil erosion or top soil loss caused by the action of wind and water. Apart from this, grasses with their elaborate fibrous root system act as soil binders as well as soil stabilizers by their contribution towards soil fertility and productivity. Species of *Themeda*, *Cymbopogon*, *Eulalia*, *Bothriochloa*, *Heteropogon* and *Dichanthium* are good soil binders.

In coastal areas, many grasses act as sand binders by producing thick mat of roots and aerial branches, thus they bind soil or sand together and protecting it from the action of waves and winds. Certain grasses have the capacity to prevent sand storms. Also, there are several other grasses [*Cynodon dactylon* (L.) Pers., *Elymus arenarius* L., *Psamma arenaria* Roem. ex Schult., *Spartina glabra* Muhl., *Stipa calamagrostis* Wahl. and *Ischaemum muticum* L.] growing in tidal muds performing great role in land reclamation (Arber, 1965; Gould, 1968).

Wildlife management

Most wild animals and birds depend on grass or grasslands for food or shelter. Forest grasslands or forest associated grasslands are the major source of food for many animals such as deer and bison. Several small mammals and birds like rabbit, prairie dog, fox, certain species of owls, sparrows etc are frequently associated with grasslands. Marsh or swamp grasses also have the similar role in supporting wildlife.

Turf or lawns

Grasses are one of the well known ground covering materials for aesthetic purposes or related to sports and recreation. Now a days many species of grasses are used to design lawns or to make green cover over parks, cementeries, playing fields and pathways. Species of *Zoysia*, *Cynodon* and *Stenotaphrum* are widely used for this purpose.

Other uses

Many grasses are used for various other purposes, it includes thatching [*Themeda* spp., *Pseudanthistiria heteroclita* (Roxb.) Hook.f.], broom making [*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda], matting and making handicraft products (certain species of bamboos), religious rituals (eg. *Desmostachya bipinnata* (L.) Stapf, the Dharba grass), biofuel (eg: maize as a source of ethanol), essential and aromatic oils (various species of the genera *Cymbopogon, Chrysopogon, Dichanthium, Bothriochloa* etc.), paper making [bamboos, *Eulaliopsis binata* (Retz.) C.E.Hubb., *Themeda arundinacea* (Roxb.) A.Camus etc.], medicinal uses [*Cymbopogon schoenanthus* (L.) Spreng., *Chrysopogon zizanioides* (L.) Roberty etc.] and making musical instruments. In North-West India, shepherd's pipes are prepared from hollow stems of *Arundo donax* L. and *Phragmites karka* (Retz.) Trin. ex Steud. (Bor, 1960; Dahlgren *et al.*, 1985; Jain, 1986).

Importance of the present study

Andropogoneae is one of the most diverse and taxonomically difficult tribes in Poaceae. Two important subtribes, Ischaeminae and Anthistiriinae of

Andropogoneae have been selected for this study. It follows the grass classification proposed by Clayton and Renvoize (1986). As per this classification, the southern Peninsular Indian genera of Ischaeminae are *Ischaemum* L., *Apluda* L., *Sehima* Forssk. and *Thelepogon* Roth ex Roem. & Schult. Whereas that of Anthistiriinae includes *Heteropogon* Pers., *Iseilema* Andersson, *Parahyparrhenia* A.Camus, *Pseudanthistiria* (Hack.) Hook.f. and *Themeda* Forssk. (Fischer, 1934; Bor, 1960; Singh *et al*., 1976; Sreekumar & Nair, 1991; Pullaiah, 1997; Kabeer & Nair, 2009)

Hooker (1897) in his *Flora of British India* reported 30 genera and 242 species under the tribe Andropogoneae. Since then, Bor (1960) has treated 64 genera and 385 species under Andropogoneae from India, Burma, Ceylon and Pakistan. After Bor, there was no detailed study on Ischaeminae and Anthistiriinae in India, except for some State Floras and a few taxonomic revisions on some genera. The available revisions include that of *Sehima* by Sur (1988), *Heteropogon* by Deshpande (1988), *Iseilema* by Chandramohan and Mahesh (2020) as well as *Ischaemum* by various authors (Sur, 2001; Singh & Rao, 2008; Srivastava & Nair, 2010). Apart from these revisions, a number of papers (Patil & D'Cruz, 1973; Ansari *et al*., 1984; Sreekumar *et al*., 1983, 1984, 1985a, 1985b, 1987; Nair & Sreekumar, 1984, 1985; Ravi *et al*., 1998, 2000a, 2000b, 2001; Sunil & Pradeep, 2005; Gad & Janarthanam, 2007; Raole *et al*., 2011; Dileep & Nair, 2015; Gorade *et al*., 2016; Sunil *et al*., 2017; Nawaz & Shinde, 2021, 2022; Jabeena *et al.*, 2022) were published describing new taxa in the genus during the last two decades. There is no unanimity of opinion on the occurrence and identity of several taxa included within these subtribes by different authors. Although a number of papers describing new species were available, there lack a comprehensive study on Ischaeminae and Anthistiriinae in southern Peninsular India. As it is a highly evolving group with chances of greater hybridization, polyploidy and apomixis, it is essential to have a study revisiting the status of the genera and species of these subtribes. Consequently, a comprehensive taxonomic treatment of these subtribes is attempted to understand the diversity, distribution and endemism in southern Peninsular India.

Objectives

- Exploration of southern Peninsular Indian states of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh and Telangana for studying the plants in the field and for collecting them for laboratory studies.
- To resolve taxonomic and nomenclatural problems using relevant taxonomic literature and type specimens.
- To describe new taxa, if any resulting from the present study.
- Intensive studies on the structural and biological characters of collected specimens leading to the reinterpretation of their interrelationships.
- To develop keys to identify genera and species of these subtribes.
- To assess the endemic species of the subtribes Ischaeminae and Anthistiriinae of the study area.
- To develop a complete and updated taxonomic account on the subtribes Ischaeminae and Anthistiriinae of the study area.

Area of study

Southern Peninsular India

India, one of the rich biodiversity countries, is unique in its diverse climate, ecology and vegetation patterns. The country lies between latitudes 8º4' and 37º6' North and between longitudes 68º7' and 97º25' East, and lies entirely to the north of the Equator having a major portion in the subtropical zone. Arabian sea on the west with a group of islands called Lakshadweep, and Bay of Bengal on the east with Andaman & Nicobar Islands forms the major southern natural boundaries of the country. Whereas the great Himalayas on the north, the mountain ranges lying in north-south direction on the eastern side and the stretch of Thar desert on north-west forms the remaining. Murthy *et al*. (1996a) divided India into three major physiographic divisions such as the Peninsula, the Extra Peninsula and the North

Indian Alluvial plains. The Peninsula, is the southern part of the country which narrows down towards south and ends in Indian Ocean. This more or less triangular plateau is boardered in the north by Vindhyan ranges. The Peninsula is peculiar with two mountain systems, the Western Ghats and the Eastern Ghats. The Western Ghats lies parallel to western coasts and are considered as continuous mountain range, though they have few gaps and passes. Palghat gap is such a gap seen in Kerala state of southern Peninsular India, which separates the Nilgiri ranges from the Anamalais. The Eastern Ghats runs parallel to eastern coast and composed of a series of disconnected ranges. It lies down from Odisha to the Nigiris. Apart from the Eastern Ghats, few isolated hills such as Biligirirangan Hills, the Shevaroy and the Javadi Hills seen near to southern end east to the Eastern Ghats. The Western Ghats and the Eastern Ghats have a great influence on the biodiversity of the Peninsula and southern Peninsular India. These two mountains are considered to be the remnants of Ancient Plateau."The Eastern and Western Ghats meet in south of Mysore and form the lofty plateau of the Nilgiri. The Nilgiri have in them two of the highest peaks, Dodabetta (2637 m) and Mukurthi (2554 m). To the south of the Nilgiri are the Anamalai, the highest peak in Peninsular India (2695 m). The Palghat Gap lies to the south of the Nilgiris and is about 24 km wide. The Cardamom Hills constitute the divide between the East and West Coasts. The Peninsular plateau is flanked by a narrow coastal strip on the west and by a much broader coastal area on the east" (Murthy *et al.*, 1996a). Peninsular Indian region has a high degree of endemism making it the second richest endemic centre after the Himalayas (Ahmedullah & Nayar, 1987).

The present study is restricted to southern states of Peninsula, *viz.*, Kerala, Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. It covers an area of 63,29,94 sq. km., and is bounded on the north by the states Goa, Maharashtra, Chhattisgarh and Odisha.

Phytogeographic zones

Among the 11 phytogeographic zones recognized in India by Balakrishnan (1996), major portions of the three zones covered by southern Peninsula includes; (i)

Southern Western Ghats, Southern West Coast & Lakshadweep, (ii) Deccan, (iii) Eastern Ghats & Coromandel Coast.

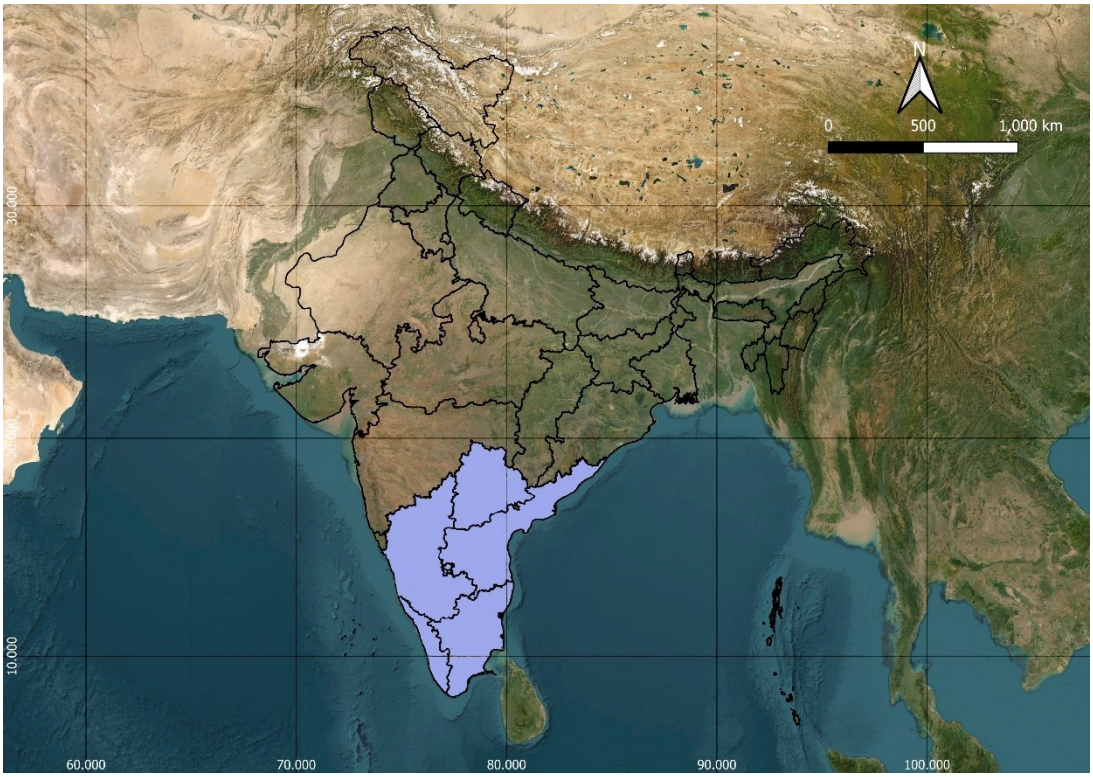

Fig. 1. Area of present study.

i. Southern Western Ghats, Southern West Coast and Lakshadweep

The Western Ghats or Sahyadri is one of the most important phytogeographical zones in India. The ecology and biogeography of the southern Peninsular India is greatly influenced by these mountain ranges. It lies along the western boarder of the Deccan, and extend from the mouth of Tapti River valley (21^{o} N) in Gujarat to Kanyakumari (Cape Comorin) (8^{o} N) in Tamil Nadu. These mountain ranges spread over about 1600 km length in north-south direction with about 5–10 km breadth. 'Topographically, the Western Ghats are characterised by both conical and flat-topped hills interspersed with valleys and spurs' (Vajravelu & Vivekananthan, 1996a).

As already mentioned, Peninsular India is characterised by two coastal systems, the West Coast and the East Coast and they are influenced by wave actions of the oceans. The West Coast line lies in a north-south direction between Kutch at

north and Kanyakumari at south and crosses the states Gujarat, Maharashtra, Karnataka, Kerala and Tamil Nadu. As compared to the East Coast, the West Coast is narrower and the gradient is rather steep. The two major types of shore ecosystem seen here are the 'Strand vegetation' and the 'Estaurine vegetation', lie between the coast line and adjacent plains. This coastal line along the southern states such as Tamil Nadu, Kerala, Karnataka and Maharashtra is usually referred to as the Southern West Coast. Plants which are physiologically specialized or ecologically adapted to saline habitats are usually found growing in this type of ecosystem. According to Vajravelu and Vivekananthan (1996b), there are five climatic groups based on moisture index; perhumid, humid, subhumid, semi and arid. Though the climate along the coastal area is relatively uniform, the humid climate is prevalent in south western shores of Kerala, Karnataka and Maharashtra.

ii. Deccan

Deccan region is bounded on the west by the Western Ghats, east by the Eastern Ghats, and forms a broad-based inverted triangle comprising a part of Madhya Pradesh, the plains and table lands of Maharashtra, Karnataka, Andhra Pradesh, Telangana and Dharmapuri district of Tamil Nadu. This region is comparatively dry elevated table land interspersed with numerous isolated hills, having low rain fall and dry climate. The major vegetation are moist deciduous, dry deciduous and thorn forests (Henry *et al.*, 1996).

iii. Eastern Ghats and Coromandel Coast

The Peninsula is bounded on the east by a series of discontinous hill ranges called the Eastern Ghats. It lies between latitude 11^{o} 30' to 20^{o} 0' North and between longitude 77^{0} 22' and 85^{0} 20' East. "The Eastern Ghats extend in a north-east south-west direction in the Indian Peninsula covering an area of about 75,000 sq. km with an average width of about 100 km in the south and about 1750 km in length, traversing the length of the Coromandel Coast, over parts of the states of Odisha, Andhra Pradesh, Tamil Nadu and a small part of Karnataka" (Swaminathan & Ellis, 1996). Mahanadi, Godavari, Krishna, Pennar and Kauvery are the major rivers which breaks the continuity of these hill ranges. Approximately fifty percent of the

forest area in Andhra Pradesh comes under Eastern Ghats, and Nallamalai Hills in Kurnool district and few strips in Cuddapah district are the only continuous ranges found in the Eastern Ghats. Biligirirangan Hills forms the highest elevation within Eastern Ghats, that is 1750 m.

The East Coast of Peninsular India is also known as Coromandel Coast. It is about 1500 km long with an average width of about 100 to 130 km, lying in wide curves and mostly covers the area between the Mahanadi River in Odisha to Kanyakumari in Tamil Nadu. The coast line is wider in East Coast than that of West Coast, and also deficient in rainfall. Hence, the plains of East Coast are wider and drier as compared to West Coast. It boarders major part of Bay of Bengal to Palk Strait and to Gulf of Mannar of Indian Ocean and consists of bays, gulfs, straits, channels, lagoons, estuaries, salt water lakes, back waters etc. (Swaminathan, 1996).

Rivers and Lakes

Rivers generally originates in highlands and flows down through the hilly tracts and plains and finally reaches in sea or lakes. Three major watersheds are known from India, they are the Himalayan in North India, Vindhyan and Satpura ranges in Central India and the Western Ghats in the West Coast. All the rivers originate from these watersheds. The rivers in India are broadly classified into two groups such as Extra Peninsular rivers or Himalayan rivers and Peninsular rivers. Nineteen rivers have their origin in Himalayas, among them the Indus, the Ganga and the Brahmaputra constitutes the largest and most important river systems. Out of the 19 Himalayan rivers, 6 belong to the Indus system; 9 belong to Ganges system and 4 belong to Brahmaputra system. The rivers of the Indus system flow towards north-west direction, Ganges and Brahmaputra system flow towards east. These Himalayan rivers are fed by the mountain springs or glaciers.

The Peninsular rivers are monsoon fed and are more or less dry in summer. They are broadly classified into two; rivers flowing towards west and enters Arabian Sea, and rivers flowing towards east and join to Bay of Bengal. The major Peninsular rivers flowing towards west includes, river Luni, Sabarmati, Mahi, Narmada, Tapti, Sharavati and more than 40 rivers with their tributaries originating

from the western slopes of Western Ghats and crossing Kerala plains to join the Arabian Sea. The river Barathapuzha, the first longest and the river Periyar, the second longest in Kerala have their origin in Anamalai Hills and Sabarimala Hills of the Western Ghats respectively. The Sharavati river in Karnataka is remarkable with Jog Falls in the Western Ghats.

The East flowing rivers include river Subarnarekha, Mahanadi, Godavari, Krishna, Kauvery and many smaller rivers along the East Coast. The Godavary, largest river of the Deccan and second largest river basin in India have origin in Trimbak in Nasik district of Maharashtra. It crosses the states Maharashtra, Telangana and the Eastern Ghats and finally reaches to Bay of Bengal. The third largest river in India and second largest in the Peninsula is the river Krishna. It has its source in Mahabaleshwar Hills in Maharashtra and flows south and south-east crossing Maharashtra, North Karnataka and Andhra Pradesh and ends in Bay of Bengal. The river Kauvery flows into Bay of Bengal through Karnataka and Tamil Nadu from its point of origin at Western Ghats near Mercara in Karnataka. The famous Shivasamudram Falls belongs to this river system. Apart from these major rivers, several small rivers are there along East Coast. The Ponnaiyar, Palar, Vaigai, Chittar and Tamraparini in Tamil Nadu are few among them. The Courtallum Falls belong to the river Chittar.

There are five major lakes in southern Peninsular India; Kolleru and Pulicat in Andhra Pradesh and Ashtamudi, Sasthamkotta and Vembanadu in Kerala. Kolleru lake and Sasthamkotta lake are fresh water lakes. Vembanadu lake is the largest and Ashtamudi lake is the deepest lake in Kerala (Murthy *et al.*, 1996a).

Soils

Venu *et al.* (1996) grouped soils in India under 8 categories, such as Laterite or Lateritic soils, Black cotton soils, Red soils, Alluvial soils, Alkali soils & Saline soils, Peaty and other organic soils, Desert soils and Scanty soils of mountains. Out of these, all soil types other than Desert soils and Scanty soils of mountains are found in southern Peninsular India.

i. Laterite or Lateritic soils

It is generally reddish or yellowish red in colour and black on exposure to sun, and occurs in Kerala, Karnataka, Tamil Nadu, the Eastern Ghats and the Western Ghats. Lateritic soils are mainly composed of hydrated oxides of Aluminium and Iron with minor quantities of Manganese and Titanium oxides. This type of soil is produced by the Aluminium rich rocks like gneisses, sand stone, basaltic rocks and granites. Laterites contain low levels of lime, magnesia, nitrogen and higher amount of humus. It is common in hill tops and usually forms where alternate wet and dry seasons exists. In Tamil Nadu, it occurs in different altitudes along West Coast and some area of the East Coast. In, Kerala, laterites are seen both at lower and higher elevation. But in Karnataka, the western parts of districts Shivamogga, Hassan, Chikkamagaluru and Mysuru are characterised by lateritic soils.

ii. Black cotton soils or Regur

Black soils occur in Ramanathapuram and Tirunelveli districts of Tamil Nadu, and parts of Karnataka and Andhra Pradesh. This soil is well known for cotton cultivation. Black soils are formed by the decomposition of trap rocks, and the iron in these rocks provides the characteristic black colour. It is characterised by small transparent or semitransparent grains which are bounded within dark coloured matrix of double hydrated ferrous and aluminium silicate. It is rich in nitrogen and organic matter and poor in phosphorus.

iii. Red soil including Red loam, and Yellow earth

Red soils occur mainly in Peninsular regions. It is formed by the weathering of ancient crystalline and metamorphic rocks. It found in Tamil Nadu, Karnataka and Andhra Pradesh. Red soils comprise silica and aluminium with free quartz or sands. As compared to Black soils, red soils have lower concentrations of lime, potash, iron oxide and phosphorus. In southern Peninsular India, many of the red soils does not have red colour, and some of them are of lateritic origin and quite different. According to Venu *et al.* (1996), the red soil forms about two-thirds of the

cultivated area in Tamil Nadu, and are characterised by shallow, open in texture and with a pH range of 6.6 to 8.0. The districts in Karnataka, such as Bengaluru, Kolar, Mysuru, Tumakuru and Mandya are rich in red soil, and their shade varies from red to yellow. Whereas districts covering the Western Ghats contain loamy red soils. Telangana predominates with both red and black soils.

iv. Alluvial soils

It forms the largest and most important soil group of India, with significant role in the agriculture of the country. Alluvial soils are derived from the silt laid by the numerous tributaries of the Indus, the Ganges and the Brahmaputra systems. In Peninsular states, this soils occurs in the valleys of Godavari, Krishna and Kauveri, and are very fertile. The deltaic soils formed by these three rivers in the Eastern Ghats are black, humid and sandy. The Coastal alluviums seen in Kerala are sandy with low water holding capacity and low nutrient status. While fertile alluviums are seen on banks of rivers.

v. Alkali and Saline soils

In southern Peninsular India, alkali and saline soils occur only in Tamil Nadu. If the soil is salty due to the presence of alkali salts, they are generally referred to as alkali soils. Whereas the soils contain salts other than alkali are known as saline soils.

vi. Peaty and Other organic soils

In southern Peninsular India, the peaty soils occur in coastal tracts of south-eastern Tamil Nadu and Kerala.

These soils are characterised by the presence of poorly decomposed organic matter in excessive amounts and are peculiar in colour due to the presence of free aluminium ferrous compounds. They are usually seen in low lying submerged areas.

Climate and Rainfall

Climate, the average state of weather over long period, have great effect on vegetation. The mountain ranges, the Western Ghats and the Eastern Ghats have a

great role in the climate of India. The two seasonal winds, the South-West Monsoon and the Noth-East Monsoon presides India's climate. The South-West Monsoon or Summer Monsoon blows from the sea to land after crossing the Indian Ocean. Whereas the North-East Monsoon or Winter Monsoon blows from land to sea. The climate of India is normally referred to as Tropical Monsoon type. The following are the four different seasons recognized by the Meteorological Department of India.

1. Summer (Pre-Monsoon) – March to May
2. Monsoon – June to September
3. Post-Monsoon – October to November
4. Winter – December to February

The two seasonal winds bring good rain into the country. During the South-West Monsoon (June to December), south-east of Peninsula gets comparatively less rain. But these area receives higher rainfall during North-East Monsoon in October to November.

Based on rainfall, four climatic regions are recognized in India. They are with

a) Heaviest annual rainfall over 200 cm

West Coast lying at the foot hills of Western Ghats, Bengal and Assam.

b) Annual rainfall between 100-200 cm

Maharashtra, Madhya Pradesh and Bihar along the Vindhyan mountains.

c) Annual rainfall between 50-100 cm

South coastal plains, North Western Deccan and Upper Gangetic plain.

d) Annual rainfall less than 50 cm

Rajasthan Desert extending to Kutch and the high Ladak Plateau in Kashmir constituting the arid zone (Murthy *et al.*, 1996b).

Fig. 2. Habitat diversity of Ischaeminae and Anthistiriinae: **a.** Agasthyamala; **b.** Anamudi Shola National Park; **c.** Vazhachal; **d.** Athirappilly Waterfalls; **e.** Maruthamalai; **f.** Bellary Fort; **g.** Gooty Fort; **h.** Gallikonda, Araku Valley.

Fig. 3. Habitat diversity of Ischaeminae and Anthistiriinae: **a & b.** Eravikulam National Park; **c & d.** Malabar Wildlife Sanctuary, Kakkayam; **e.** Calvary Mount; **f.** Lakkam; **g.** Belgaum; **h.** Bababudangiri.

Fig. 4. Habitat diversity of Ischaeminae and Anthistiriinae: **a.** Chembra Peak; **b.** Kakkadampoyil; **c.** Ethipothala Falls; **d.** Jogg Falls; **e.** Pathiramanal; **f.** Kodachadri; **g.** Padur wetland; **h.** Vembanadu Lake.

Fig. 5. Habitat diversity of Ischaeminae and Anthistiriinae: **a.** Kaniyamthodu, Kollam; **b.** Kolleru Lake; **c.** Nelliyampathi; **d.** Kurichiarmala; **e.** Madayippara; **f.** Pushpagiri, Kadapa; **g.** Kattur; **h.** Pokkunnumala.

Fig. 6. Habitat diversity of Ischaeminae and Anthistiriinae: **a.** Parunthupara; **b.** Sasthamkotta Lake; **c.** Mattuchola; **d.** Kondaveedu Fort; **e.** Meenuliyanpara; **f.** Vallanjanganam Falls; **g.** Olichuchattam; **h.** Macherla; **i.** Kuttanad, Alappuzha.

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Taxonomy

Ischaeminae and Anthistiriinae: A brief history

The family Gramineae was established by Jussieu (1789) in his *Genera Plantarum* with the description of 57 genera. The family Gramineae (as 'Gramina') was originally proposed by Adanson (1763) in his *Familles des Plantes*. Later in 1895, Barnhart formulated certain rules for the nomenclature of families, and listed family names of seed plants according to Engler and Prantl's system of classification. He omitted the family name 'Graminaceae' and used the name 'Poaceae', based on the genus *Poa*. The family name Poaceae was used by two other authors before Barnhart, Reichenbach (1828) and Caruel (1881) but their treatment happened to be illegitimate (Tropicos).

Tribe Andropogoneae ['Andropogineae'] was established by Dumortier (1823) characterised by jointed rachis and paired spikelets with a pair of dissimilar spikelets, one being sessile and the other pedicelled. Subtribes Ischaeminae ("Ischaemeae") and Anthistiriinae ("Anthistiriaceae") were established later by Presl (1830) in his *Reliquiae Haenkeanae*.

The most widely accepted morphology and anatomy based worldwide treatment on Poaceae were done by Clayton and Renvoize (1986). A three-level classification for grasses were adopted here, which includes subfamilies, tribes and subtribes. They recognized 6 subfamilies, 40 tribes and 34 subtribes. In this classification, Andropogoneae forms one of the major tribes with 11 subtribes such as Saccharinae, Germainiinae, Sorghinae, Ischaeminae, Dimeriinae, Andropogoninae, Anthistiriinae, Rottboelliinae, Tripsacinae, Chionachninae. According to Clayton and Renvoize, subtribe Ischaeminae includes genera *viz.*, *Ischaemum* L., *Thelepogon* Roth ex Roem. & Schult., *Apluda* L., *Kerriochloa* C.E.Hubb., *Triplopogon* Bor, *Pogonachne* Bor, *Sehima* Forssk. and *Andropterum* Stapf. While Anthistiriinae includes 12 genera *viz*., *Hyparrhenia* Andersson ex

E.Fourn., *Exotheca* Andersson, *Hyperthelia* Clayton, *Parahyparrhenia* A.Camus, *Elymandra* Stapf, *Anadelphia* Hack., *Monocymbium* Stapf, *Pseudanthistiria* (Hack.) Hook.f., *Agenium* Nees, *Heteropogon* Pers., *Themeda* Forssk. and *Iseilema* Andersson. The subtribe Anthistiriinae can be distinguished from other subtribes by its callus being pointed and attached obliquely to the internode tip, rather than blunt and sunk into it. In southern Peninsular India, the subtribe Ischaeminae is represented by *Ischaemum*, *Apluda*, *Sehima* and *Thelepogon*, whereas Anthistiriinae by *Heteropogon*, *Iseilema*, *Parahyparrhenia*, *Pseudanthistiria* and *Themeda*.

The genus *Ischaemum* was first established by Linnaeus (1753) to include two species *viz.*, *I. muticum* L. and *I. aristatum* L. Whereas *Thelepogon* was first published in *Systema Vegetabilium* (1817) with single species *Thelepogon elegans* Roth ex Roem. *et* Schult. It was Forsskal (1775), who described *Sehima* as a new genus with a single species *Sehima ischaemoides* Forssk. The genus *Apluda* was first described by Linnaeus (1753) with single species *Apluda mutica* L. from India. Subsequently he described yet another species *A. aristata* L. (1756), differing from the former species by possessing awned spikelets. Hackel adopted a new name for this taxon as *A. varia* Hack. and he recognized two subspecies, *A. varia* subsp. *mutica* (L.) Hack. and *A. varia* subsp. *aristata* (L.) Hack. with several varieties and subvarieties. Later Merrill (1912) treated a single species, *A. mutica* with two varieties, *A. mutica* var. *mutica* (awnless) and *A. mutica* var. *aristata* (L.) Rendle ex Merr. (awned). Pilger (1945) followed the treatment by Merrill and treated this genus with two varieties.

The genus *Heteropogon* Pers. was established by Persoon in 1807 (Syn.Pl. 2:533) as "*Spica simplex, monoica: flor. hine masculi, inde foeminei. M A S. Cal. 2-valvis. Cor. 2-valvis, mutica: valvula interior setacea. Nectarium 2-lobum, turgidum. F E M. Cal. 2-valvis. Cor. 2-valvis, altera crassiuscula aristata. Aristae longissimae, hirsutae".* He originally included two species in this genus, *H. glaber* Pers. and *H. hirtus* Pers. He also cited two names under *H. glaber*, *Andropogon allionii* Lam. ex DC. and *A. contortum sensu* All., *non* L. (1753) from "*Helvetia, Italia and Barbaria*". He also cited the Linnaean name *Andropogon contortus* under *Heteropogon hirtus*. However, Roemer & Schultes in their *Systema Vegetabilium* 2

(835: 1817) accepted the genus *Heteropogon* and treated *H. glaber* under *H. allionii* (DC.) Roem. & Schult., which is based on Lamarck & A.P.de Candolle's (1805) *Andropogon allionii* that was published two years earlier to Persoon's *H. glaber*. The name *Heteropogon hirtus* cannot be accepted, as an earlier name *Andropogon contortus* L. (Sp.Pl.1045: 1753) is available for the taxon. It was Roemer & Schultes (1817) who transferred *Andropogon contortus* to the genus *Heteropogon*, as *H. contortus* (L.) Beauv. ex Roem. & Schult.

The genus *Iseilema* was established by Andersson (1856) with four species, *viz.*, *I. prostratum* (L.) Andersson (as *'prostrata'*), *I. wightii* (Nees) Andersson, *I. argutum* (Nees ex Steud.) Andersson (as '*arguta*') and *I. mitchellii* Andersson. Whereas *Themeda* was established by Forsskal in his *Flora Aegyptiaco-Arabica* (1775). He described one species *Themeda triandra* Forssk. under this genus. The other genus *Parahyparrhenia* was first described by Camus in 1950, with a new species *Parahyparrhenia jaegeriana* A.Camus from Sudan (Soudan). In India, this genus is represented by two species, *P. bellariensis* (Hack.) Clayton and *P. khannae* A.P.Tiwari & Chorghe.

The genus *Pseudanthistiria* was established by Hooker (1897) by elevating *Andropogon* sect. *Pseudanthistiria* Hack. Hooker described 4 species which includes the two species originally included by Hackel [*Andropogon heteroclitus* (Roxb.) Nees as *Pseudanthistiria heteroclita* (Roxb.) Hook.f. and *Andropogon umbellatus* Hack. as *Pseudanthistiria umbellata* (Hack.) Hook.f.]. *Andropogon heteroclitus* was based on *Anthistiria heteroclita* Roxb. and the other species *Andropogon umbellatus* Hack. was based on *Anthistiria heteroclita* Thwaites *non* Roxb. [*Andropogon umbellatus* is a replaced name for *Anthistiria heteroclita* Thwaites, since it is a later homonym of *Anthistiria heteroclita* Roxb.]. Apart from these, Hooker (1897) described two more species, *P. hispida* Hook.f. and *P. burmanica* Hook.f.

Poaceae: Worldwide treatments and major classifications

Linneaus (1753) described few grass genera *viz.*, *Andropogon* L., *Holcus* L., *Ischaemum* L., *Cenchrus* L. and *Aegilops* L. with some species under the 'class' *Polygamia Monoecia*.

Roemer and Schultes in 1817 published a comprehensive treatment on grasses in *Systema Vegetabilium*. The authors placed grass genera under the classes *Triandria monogynia* and *Triandria Digynia*. They recognized the genera *Apluda* with 3 species *viz.*, *A. aristata*, *A. villosa* Schreb. and *A. digitata* L.f.; *Heteropogon* with 2 species, namely *H. allionii* and *H. contortus*; *Thelepogon* with single species *T. elegans*; *Ischaemum* with 10 species; *Themeda* and *Sehima* with single species in each. Again, Schultes and Roemer in 1824 published another piece of work on grasses, in *Mantissa*. They treated many grass genera under the classes *Triandria monogynia* and *Triandria digynia*. They recognized the genera such as *Ischaemum*, *Apluda*, *Andropogon*, *Anthistiria* L.f. and *Heteropogon*.

Nees von Esenbeck (1829) treated grass genera under 10 grass families such as Gramineae Paniceae with 18 genera, Gramineae Olyreae with 6 genera, Gramineae Saccharineae with 13 genera, Gramineae Stipeae with 2 genera, Gramineae Agrosteae with 7 genera, Gramineae Chlorideae with 11 genera, Gramineae Hordeaceae with 4 genera, Gramineae Festucaceae with 14 genera, Gramineae Oryzeae with 2 genera, Gramineae Bambuseae with 6 genera. The families Gramineae Festucaceae is divided into 3 sections such as *Avenaceae*, *Arundinaceae* and *Festuceae* and family Gramineae Bambuseae is subdivided into 2 sections such as *Triglossae* and *Bambuseae verae*. He described the genera *Andropogon*, *Heteropogon* and *Anthesteria* Trin. (annotated as '*Anthestheria*') under the family Gramineae Saccharineae. *Heteropogon* is represented by a single species, *H. villosus* Nees. He accepted the name *Anthesteria* over *Themeda* and treated the latter as a synonym under *Anthesteria*. Also he described one species, *Anthesteria humboldtii* (Spreng.) Nees, and the genus *Andropogon* is represented by 4 species.

Bentham and Hooker (1883) in *Genera Plantarum*, placed the family Gramineae under the order Glumaceae of Monocotyledones. He also recognized two series Panicaceae and Poaceae under this family. There are 6 tribes under Panicaceae, of which one tribe Zoysieae again divided into 2 subtribes. Another tribe Andropogoneae contain 26 genera, which includes *Thelepogon*, *Ischaemum*,

Heteropogon, *Apluda*, *Anthistiria* and *Andropogon*. The second series consists of 7 tribes, most of the tribes in this series are also subdivided into subtribes.

Hackel in 1889, made a comprehensive work on the tribe Andropogoneae and published it in de Candolle's *Monographiae Phanerogamarum*. He recognized 5 subtribes such as Dimerieae, Sacchareae, Ischaemeae, Rottboellieae and Euandropogoneae. Subtribe Ischaemeae includes the genera *Apluda*, *Ischaemum* and *Thelepogon*. *Apluda* is represented by a single species, *A. varia* with several subspecies, varieties and subvarieties. Hackel recognized 4 subgenera under the genus *Ischaemum*, *viz.*, *Ischaemum* subgen. *Euischaemum* Hack. with 35 species, *Ischaemum* subgen. *Sehima* (Forssk.) Hack. with 5 species, *Ischaemum* subgen. *Digastrium* Hack. and subgen. *Corrugaria* Hack. with single species each. Apart from these subgenera, he placed 3 species under '*Ischaemi species dubiae*' and 3 species under '*excludendae*'. Many species of *Ischaemum* are also described with several varieties. *Thelepogon* is represented by a single species. While the subtribe Euandropogoneae was established with 8 genera which includes *Themeda*, *Iseilema* and *Andropogon*. Though he recognized *Themeda* and *Iseilema* as distinct, he treated *Heteropogon* as a subgenus under the genus *Andropogon* with 6 species and *Pseudanthistiria* as one of the sections of subgenus *Hypogynium* under the genus *Andropogon* and described 5 species under this taxon. There are 5 species described the genus *Iseilema*. Hackel accepted the generic name *Themeda* over *Anthistiria* and described 8 species. Apart from this he placed one species under the category '*species dubia*' and two species under '*exclusa*'.

Then Stapf in the 9th volume of the *Flora of Tropical Africa* (1917, 1919), recognized two subfamilies under Gramineae, namely Panicoideae and Pooideae. There he recognized 3 tribes under Panicoideae such as Maydeae, Andropogoneae and Paniceae. Tribe Andropogoneae was again subdivided into 4 subtribes such as Ischaeminae, Rottboellinae, Saccharinae and Andropogoninae. One major difference of this work from the previously known systems was the subdivision of subtribes of Andropogoneae, into 'groups of genera'. Stapf recognized 16 such groups of genera. There are 2 such groups under Ischaeminae, Ischaemastrae which includes the

genera *Ischaemum*, *Thelepogon* and *Sehima*; the second one is Apludastrae which include *Apluda*. Similarly, the subtribe Andropogoninae is divided into 10 'groups of genera', in which Heteropogonastrae include *Heteropogon* and Themedastrae includes *Themeda*. In this treatment he also recognized 16 tribes under the subfamily Pooideae. It include *Ischaemum* with 5 species, *Sehima*, *Heteropogon* and *Themeda* with 2 species in each and single species of *Apluda* (*Apluda varia*) and *Thelepogon* (*T. elegans*) as occurring in Tropical Africa.

It was Bews (1929), one of the pioneer agrostologist who have provided a world level treatment on grasses. He recognized two subfamilies Pooideae with 11 tribes and Panicoideae with 4 tribes. The tribe Andropogoneae of Panicoideae marks the extreme specialization in the inflorescence with variations. Bews (*l.c.*) broadly divided the tribe Andropogoneae into two series based on the nature of rachis joint and pedicel. In the first series rachis joint and pedicel are slender, and are not fused together. Whereas in the second series the rachis joint and pedicel are more or less stout, and they fused together to form a receptacle for the attachment of sessile spikelet. According to Bews, first series is primitive than the other. Moreover, he recognized two subtribes each under the two series (subtribes Saccharinae and Andropogoninae under the first series and Ischaeminae and Rottboelliinae under the second series). In the subtribe Saccharinae, spikelets are usually all alike whereas in the larger and advanced subtribe Andropogoninae, spikelets of each pair are different in sex and form or both male, or neuter if they are alike. While in second series, the relatively primitive subtribe Ischaeminae, possess two flowered spikelets whereas Rottboelliinae, possess one or two flowered spikelets. Among the four subtribes, Saccharinae forms the most primitive and Andropogoninae are the much larger, more progressive and advanced subtribe within Andropogoneae. According to Bews (*l.c.*), *Themeda* forms one of the most advanced genera in the whole tribe Andropogoneae. In this treatment, he also provided keys to the tribes and genera and short note on distribution, ecology and economic importance of each genus.

Honda (1930) made a monographic study on Poaceae in Japan, excluding bambusoides. He recognized 5 sections under the genus *Ischaemum*. They are

Euischaemum, Aurea, Ciliaria, Fasciculata and *Aristata*. Among these sections, sect. *Euischaemum* was originally proposed by Hooker and all other sections were made by Honda. He treated and described 20 species and several varieties under these sections.

'Hooker's *Icones Plantarum* or Figures, with descriptive characters and remarks on new and rare plants selected from the Kew Herbarium' (in vol. 33 of the entire work or fifth series of third volume) was published in 1935, and was edited by Sir Arthur W. Hill. The book deals with a comprehensive treatment on the genus *Iseilema* from Australia. Three new species of *Iseilema* were described in this book. It treats 9 species, including the three new taxa and all of these are confined to Australia. Illustrations of newly described taxa and an identification key for the entire Australian species were also provided.

Another important monographic work on Andropogoneae was done by Roberty (1960). Roberty followed a six level classification to describe species such as tribe, subtribe, cohors, genera, sections and finally species. In this classification system, the concept of his "cohors" is largely based on Stapf's (1917) "groups of genera". And he made various new combinations within many taxa, most of his combinations were rejected by later authors. He treated *Pseudanthistiria* as a section under the genus *Hypogynium* Nees [*Hypogynium* sect. *Pseudanthistiria* (Hack.) Roberty], of cohors Andropogonastreae, and recognized two taxa *Hypogynium heteroclitum* forma *heteroclitum* Roberty and *H. heteroclitum* forma *umbellatum* (Hack.) Roberty. He placed *Ischaemum*, *Sehima* and *Thelepogon* under the cohors Ischaemastreae. He proposed five sections under *Sehima* [sect. *Eremochloa* (Buse) Roberty, *Sehima* (Forssk.) Roberty, *Triplopogon* (Bor) Roberty, *Andropterum* (Stapf) Roberty and *Pogonachne* (Bor) Roberty]. All the presently accepted species of *Sehima* are included within the section *Sehima*. He recognized 8 sections under *Ischaemum*, sect. *Digastrum, Ischaemum, Corrugaria, Coelischaemum, Ischaemopogon, Kerriochloa, Polliniopsis* and sect. *Eulaliopsis*. He placed *Themeda* under the cohors Themedastreae, with four sections *viz*., section *Themeda, Iseilema, Germainia, Pleiadelphia*. All the currently known species of *Themeda* were in

section *Themeda*. He treated *Iseilema* as a section of *Themeda* and transferred all available species of previously known genus *Iseilema* into *Themeda*. He recognized the genera *Heteropogon* as well as *Apluda* under the same cohors, Themedastreae and described many sections under *Heteropogon*. These sections include many taxa that are later accepted as distinct genera. Stapf (1917) also recognized *Apluda* as a distinct monotypic genus and identified 7 subvarieties within the same species.

Clayton (1972, 1973) studied Poaceae in detail and published a series of articles on tropical and subtropical grasses. Skerman and Riveros (1990) published their work in the form of a book, *Tropical grasses*. It treats single species of *Heteropogon* (*H. contortus*), 2 species of *Ischaemum* [*I. indicum* (Houtt.) Merr. and *I. magnum* Rendle], 3 species of *Iseilema* [*I. laxum* Hack., *I. membranaceum* (Lindl.) Domin and *I. vaginiflora* Domin], single species of *Sehima* [*S. nervosum* (Rottler) Stapf], 3 species of *Themeda* [*T. australis* (R.Br.) Stapf, *T. quadrivalvis* (L.) Kuntze and *T. triandra* Forssk.]. Then Veldkamp (1991) published an article on the identity of *Ischaemum indicum*, *I. ciliare* Retz. and *Phleum indicum* Houtt. and reinstated the name *Ischaemum ciliare* Retz.

Watson and Dallwitz (1992) recognised 793 genera and followed a modified classification system which includes 5 subfamilies, *viz*., Pooideae, Bambusoideae, Arundinoideae, Chloridoideae and Panicoideae. These subfamilies are further subdivided into supertribes, tribes and subtribes. They recognized two supertribes Panicodae and Andropogonodae under subfamily Panicoideae. Four tribes Isachneae, Paniceae, Neurachneae and Arundinelleae under Panicodae supertribe and two tribes Andropogoneae and Maydeae under the supertribe Andropogonodae were recognized. But the one and only tribe which is again divided into subtribes is Andropogoneae, comprising nearly 967 species. Andropogoninae and Rottboelliinae are the two subtribes recognized under the tribe Andropogoneae. Andropogoninae forms the largest subtribe with 77 genera including *Apluda*, *Heteropogon*, *Ischaemum*, *Iseilema*, *Pseudanthistiria*, *Sehima*, *Thelepogon* and *Themeda*. While Rottboelliinae contains 25 genera. Each genus is provided with information on their general morphology, ecology and distribution, anatomy, cytology and economic

importance. According to Watson and Dallwitz, *Apluda* is represented by a single species, *Heteropogon* with 7 species, *Ischaemum* with 60 species, *Iseilema* with 20 species, *Pseudanthistiria* with 4 species, *Sehima* with 5 species, *Thelepogon* with one, and *Themeda* with 18 species. All of them are distributed throughout the world.

Grasses: Major treatments in India

Major pioneer work on plants in India includes Roxburgh's treatment in *Flora Indica or Descriptions of Indian Plants* (1820). He placed the grass members under *Triandria digynia* and recognized 27 genera namely *Perotis* Aiton, *Cenchrus* L., *Saccharum* L., *Anthistiria* L.f., *Andropogon* L., *Paspalum* L., *Lappago* Schreb., *Panicum* L., *Phleum* L., *Milium* L., *Agrostis* L., *Holcus* L., *Ischaemum* L., *Apluda* L., *Aira* L., *Melica* L., *Chloris* Sw., *Pommereulla* Naezén, *Poa* L., *Dactylis* L., *Eleusine* Gaertn., *Arundo* L., *Aristida* L., *Manisuris* L., *Rottboellia* Naezén, *Hordeum* L. and *Triticum* L. He reported 7 species under the genus *Anthistiria* and 36 species under *Andropogon*. He also proposed 4 sections under *Andropogon* based on the position and nature of spikes and panicles.

It was Duthie (1888) who worked on the grass genera occurring in the plains of North-Western India. He recognized two series Panicaceae and Poaceae under the family Gramineae. There are 6 tribes under Panicaceae. *Apluda*, *Iseilema*, *Anthistiria*, *Heteropogon* and *Ischaemum* are treated under the tribe Andropogoneae of Panicaceae. 7 tribes were recognized under the series Poaceae. He recognized 2 species of *Iseilema*, 4 species of *Ischaemum*, one species each in *Heteropogon* and *Apluda*, 6 species in *Anthistiria*.

Remarkable works on grasses in India include Hooker's (7: 1897) treatment in his *Flora of British India*. He recognized two series under the order Gramineae as Paniceae and Poaceae based on the nature of articulation and sessile and pedicelled spikelets. Later he subdivided these series into tribes, subtribes etc. He distinguished the tribe Andropogoneae in having paired spikelets, or the terminal spikelets in the inflorescence 3-nate, pairs homo-or heterogamous; upper lemma smaller than the lower, hyaline, often awned or reduced to an awn. He recognized 8 subtribes under Andropogoneae, namely Maydeae, Dimerieae, Sacchareae, Ischemeae, Apludeae,

Rottboellieae, Ratzeburgieae and Euandropogoneae. He treated *Ischaemum* and *Thelepogon* as distinct genera under the subtribe Ischemeae, and *Sehima* as a section under *Ischaemum*. The subtribe Apludeae was represented by the monotypic genus *Apluda* only. Hooker recognized 6 genera under the subtribe Euandropogoneae *viz.*, *Elionurus* Humb. & Bonpl. ex Willd., *Cleistachne* Benth., *Germainia* Balansa & Poitr., *Andropogon*, *Anthistiria* and *Iseilema*. *Heteropogon* was treated as a subgenus under the genus *Andropogon*. He described 7 species, *viz.*, *Andropogon contortus*, *A. melanocarpus* Elliott, *A. triticeus* R.Br., *A. bellariensis* Hack., *A. ritchiei* Hook.f., *A. oliganthus* Hochst. ex Steud. and *A. polystachyos* Roxb.

Hooker (1897) elevated *Andropogon* subgen. *Hypogynium* sect. *Pseudanthistiria* Hack. to the rank of a genus. Besides he recognized *Themeda* and *Iseilema* as distinct and placed them under the subtribe Euandropogoneae. He used the generic name *Anthistiria* L. instead of *Themeda* Forssk. due to its wide usage and described 11 species under *Anthistiria*. There are 4 species described under *Iseilema*. Hooker (1897) treated four species in *Pseudanthistiria* which include two new species.

Fischer (in Gamble, 1934) did not follow any of the infrafamilial classification in his treatment of grasses in the Flora of the Presidency of Madras. This treatment recognized 132 genera; *Apluda* with two species; *Ischaemum* with 14 species; *Iseilema* with 3 species; *Pseudanthistiria* with 3 species; *Sehima* with 2 species; *Thelepogon* with single species and *Themeda* with 5 species. Also he recognized 4 species of *Heteropogon* including a new combination, *Heteropogon bellariensis* (Hack.) C.E.C.Fisch. (1934) from Hackel's (1885) *Andropogon bellariensis*. It was Ranga Achariyar and Tadulinga Mudaliyar (1921) who had done major work on grasses in South India. They recognized two series under the family Gramineae; Panicaceae and Poaceae based on the articulation and position of the flower. Series Panicaceae was further divided into 4 tribes *viz.*, Paniceae, Oryzeae, Zoysieae and Andropogoneae and the series Poaceae into 4 tribes namely, Agrostideae, Chlorideae, Festucaceae and Hordeae. Some tribes are further divided into subtribes. They recognized 6 subtribes under Andropogoneae, which are

Maydeae, Sacchareae, Ischemeae, Apludeae, Rottboellieae and Eu-Andropogoneae. There are 5 species of *Ischaemum* placed under the subtribe Ischemeae. Subtribe Apludeae is represented by *Apluda* with a single species *A. varia* (=*A. mutica*). The genera *Iseilema* and *Themeda* comes under the subtribe Eu-Andropogoneae. Ranga Achariyar also used the generic name *Anthistiria* instead of *Themeda* due to its wide usage, and described one species *A. tremula* Nees ex Steud. They also recognized two species under the genus *Iseilema viz.*, *I. laxum* Hack. and *I. anthephoroides* Hack.

Haines (1922) published an account on indigenous plants and most commonly cultivated exotic plants in Bihar and Orissa. In this treatment, he made a remarkable note on the family Gramineae. Haines followed Stapf (1917) in many respects including the classification as well. He recognized the genera *Apluda*, *Heteropogon*, *Ischaemum*, *Iseilema*, *Sehima* and *Themeda*. *Apluda* is represented by a single species, *A. varia* with 2 subspecies, subsp. *mutica* and subsp. *aristata*. The genus *Heteropogon* is known by a single species, *H. contortus*. There are 3 species in *Ischaemum* (*I. rugosum* Salisb., *I. hirtum* Hack. and *I. ciliare* Retz.). *Sehima* is reported with a single species, *S. nervosum*. Haines worked well on *Themeda* and *Iseilema*. He reported 6 species of *Themeda* including the new combination *T. strigosa* (Buch.-Ham. ex Hook.f.) A.Camus. The other species were *T. imberbis* T.Cooke, *T. quadrivalvis* (L.) Kuntze, *T. laxa* A.Camus, *T. caudata* (Nees) A.Camus and *T. arundinacea* (Roxb.) Ridley. The author provided a good account on the genus *Iseilema* and recognized 4 species including a new species *I. holei* Haines. The remaining species were *I. anthephoroides*, *I. laxum* and *I. wightii* Andersson.

Blatter and McCann (1928) while revising the *Flora of the Bombay Presidency* recognized 5 species of *Heteropogon*, of which *H. oliganthus* Blatt. & McCann was a new combination made by them based on *Andropogon oliganthus* Hochst ex Steud. It was Bor (1954) who suggested that this taxon neither belongs to *Heteropogon* nor to *Dichanthium* P.Willemet as observed by Hackel (1889). Hackel even commented that the so called *H. oliganthus* (= *Andropogon oliganthus*) was intermediate between the subgenera *Dichanthium* and *Heteropogon*. Nevertheless,

he placed it in the subgenus *Heteropogon* of the genus *Andropogon*. Consequently, Bor erected a new genus *Indochloa* Bor to place so called *H. oliganthus* and made the new combination *Indochloa oligantha (*Hochst ex Steud.) Bor. Later, Cope (1980) and Almeida (2014) transferred this taxon into genera *Dichanthium* and *Euclasta* Franch. respectively.

In 1933, an anonymous author published an article 'New or little-known plants from South India: II' in Bullettin of Miscellaneous Information (Royal Botanic Gardens, Kew). This article includes the description of two new species of *Ischaemum* such as *I. rangacharianum* C.E.C.Fisch. and *I. travancorense* Stapf ex C.E.C.Fisch. and also mentioned another species *I. corollatum* (Steud.) Will.Watson. But *I. corollatum* was later found to be *Phacelurus speciosus* (Steud.) C.E.Hubb.

The major work on grasses available and well accepted in India is by Bor (1960). Indian agrostologists even today follows this exhaustive work. It includes detailed account on general grass morphology, dispersal methods, uses of grasses and also about obnoxious grasses. Bor recognized two groups, Panicoideae and Pooideae under the family Gramineae. These groups are further divided into tribes and then genera. There are 3 tribes such as Maydeae, Andropogoneae and Paniceae under Panicoideae and 36 tribes under Pooideae. The genera such as *Apluda*, *Heteropogon*, *Ischaemum*, *Iseilema*, *Pseudanthistiria*, *Sehima*, *Thelepogon* and *Themeda* are placed under the tribe Andropogoneae. *Apluda* and *Thelepogon* are monotypic genera with the species *A. mutica* and *T. elegans* respectively. *Heteropogon* represents 7 species. Thirty five species were described under *Ischaemum* (*I. zeylanicola* Bor is a new species described in this work), 5 species under *Iseilema*, 4 species under *Pseudanthistiria*, 4 species under *Sehima* and 4 species under *Themeda*.

Balapure (1971) prepared an account on the grasses of Lucknow district of Uttar Pradesh. He identified 65 genera and 130 species under 3 tribes of Panicoideae and 15 tribes of Pooideae. The study reported the taxa *Apluda mutica*, *Ischaemum rugosum*, *Heteropogon contortus*, *Themeda arundinacea*, *T. triandra*, *T.*

quadrivalvis and *Iseilema laxum* as occurring in Lucknow. Karthikeyan (1972, 1980) studied awned and unawned grasses of former Madras Presidency. Oke (1973) recognized various biotypes in many species of *Heteropogon*, *Ischaemum*, *Iseilema*, *sehima*, *Dichanthium* and *Chrysopogon* Trin. from the Western parts of India. Singh *et al*. (1976) studied Poaceae of the Karnataka state and identified 364 species and varieties under 114 genera. The authors recognized monotypic genera *Apluda* and *Thelepogon*, with the species *A*. *mutica* and *T*. *elegans* respectively. Apart from these, 16 species of *Ischaemum*, 4 species of *Themeda* and 3 species in each genera of *Hereopogon*, *Iseilema*, *Pseudanthistiria* and *Sehima* are also reported as occurring in Karnataka. Roy (1984) recognized single species of *Apluda*, *Heteropogon*, *Pseudanthistiria* and *Thelepogon*, 2 species of *Sehima* and 4 species of *Ischaemum*, *Iseilema* and *Themeda* from Madhya Pradesh. Karthikeyan (1984) studied grasses of Shevaroy hills in Salem district of Tamil Nadu. He made an account of 95 species belonging to 52 genera and recorded *Apluda mutica*, *Heteropogon contortus*, *Ischaemum commutatum* Hack., *I*. *indicum*, *Sehima nervosum*, *Themeda cymbaria* Hack. and *T*. *triandra* from Shevaroy hills.

Jain (1986) made a study on Grass Flora of India and presented a synoptic account on their uses and phytogeography. He listed the genera and number of species that occur in India. He also made a list of endemic grass genera as well as endemic and rare species in India. According to him single species each in *Apluda* and *Thelepogon*, 6 species of *Heteropogon*, 40 species of *Ischaemum*, 6 species of *Iseilema*, 4 species of *Pseudanthistiria*, 3 species of *Sehima* and 17 species of *Themeda* are distributed all over in India. Among these, many species are rare and endemic. Subsequently, Karthikeyan *et al*. (1989) made an enumeration of monocotyledons in India. It records single species in *Apluda* and *Thelepogon*, 6 species each in *Heteropogon* and *Iseilema*, 4 species in *Pseudanthistiria* and 17 species with 1 variety and 2 hybrids in *Themeda* as occurring in India. They also recognized the genus *Ischaemum* with 43 species, 2 varieties and 2 subvarieties from India.

Sreekumar and Nair (1991) in '*Flora of Kerala-Grasses*' treated 296 species distributed in 103 genera. Which include author's own 11 new species of *Ischaemum* and 1 new species of *Themeda*. There are 28 species, 3 varieties and 2 subvarieties of *Ischaemum*. Also they recognized 3 species of *Pseudanthistiria* and 4 species of *Themeda*. The genera *Apluda*, *Heteropogon* and *Sehima* are represented by a single species as occurring in Kerala. Sreekumar and Nair followed Bor's (1960) classification of grasses.

Moulik (1997) treated the genus *Pseudanthistiria* under Anadelphiastrae with four species *viz.*, *Pseudanthistiria heteroclita*, *P. hispida*, *P. umbellata* and *P. intermedia* Birari & D'cruz. *Themeda* and *Heteropogon* were treated under Themedastrae. He recognized five species of *Heteropogon* and 19 species of *Themeda*. *Iseilema* is placed under Iseilemastrae with 6 species. He recognized two groups under the subtribe Ischaeminae; Ischaemastrae and Apludastrae. *Ischaemum*, *Thelepogon* and *Sehima* are placed under Ischaemastrae and *Apluda* under Apludastrae. He recognized 35 species and a few varieties and subvarieties under *Ischaemum indicum*. Apart from this he also provided a list of 9 species newly published. He recognized a single species in *Apluda*, *A. mutica* with one variety var. *aristata*.

Augustine *et al*. (1998) published a checklist of grasses of Periyar Tiger Reserve. They reported one species each in *Apluda*, *Heteropogon* and *Pseudanthistiria*. The genera *Ischaemum* (6 species) and *Themeda* (3 species) were also recorded from the Tiger Reserve.

Kabeer and Nair (2009) recognized 19 tribes, 136 genera, 447 species and 19 infraspecific taxa in grasses from Tamil Nadu. It includes monotypic genus *Apluda* with *Apluda mutica*, *Heteropogon* with two species, *Ischaemum* with 12 species, and 2 varieties under *I. indicum* and *I. timorense* Kunth, *Iseilema* with 4 species, *Pseudanthistiria* with 3 species, *Sehima* with two species and *Themeda* with 6 species under the tribe Andropogoneae. Since then, Yadav (2010) published a pictorial database on grasses '*Know your grass genera through hand lens*'. This is

well illustrated book on the grass genera of Peninsular India with their diagnostic characters, geographical distribution, status and etymology for easy understanding.

Potdar *et al.* (2012) followed the former three level classification including family, subfamilies and tribes. They described about 415 species belonging to 125 genera as occurring in Maharashtra. They recognized *Apluda* with single species *A. mutica*, *Heteropogon* with 4 species, *Ischaemum* with 23 species and two subvarieties. Besides there are 4 species of *Iseilema*, 2 species of *Pseudanthistiria*, 4 species of *Sehima*, single species of *Thelepogon* and 7 species of *Themeda*.

Kunhikannan and Rao (2013) studied grasses and grasslands of Tadoba National Park in Maharashtra, with an ecological point of view. They identified 103 species belonging to 52 genera. It includes *Apluda mutica*, *Heteropogon contortus*, *Ischaemum indicum*, *I. indicum* var. *indicum* subvar. *villosum* (Nees) Bor, *I. pilosum* (J.G.Klein ex Willd.) Wight, *I. rugosum*, *Iseilema anthephoroides*, *I. laxum*, *I. prostratum*, *Sehima nervosum* and *Themeda quadrivalvis*. *H. contortus* found to be one of the dominant species in Tadoba National Park. The study also revealed the importance of biotic and edaphic factors in determining the composition of grasses. Ashwini *et al*. (2014) explored the grasses and sedges of Bababudangiri-Kemmannugundi montane of Karnataka. The authors identified 60 species of Poaceae, including *Heteropogon contortus*, *Ischaemum impressum* Hack., *I. indicum*, *I. semisagittatum* Roxb., *Themeda triandra*, *T. tremula* and *T. quadrivalvis*. Since then, Rao *et al*. (2017) published an account on the *Grasses of Arid zone of Peninsular India*. They recognized a single species of *Apluda*, two species of *Themeda* and genera *Heteropogon*, *Ischaemum*, *Iseilema* and *Sehima* with three species each. Later in 2020, Kellogg *et al.* published a checklist of the grasses of India. The list provided information regarding types, synonyms, distribution in India and habit of 1506 species of grasses plus infraspecific taxa available.

Subsequently, Chorghe and Prasanna (2021) documented and published the 'Grasses of Odisha'. In this treatment, authors recorded 104 genera with 271 species as occurring in Odisha state of India. Siddabathula and Prasanna (2023) recently

published an e-book named *Grasses of Telangana* with description of 273 species of grasses under 95 genera, from the state of Telangana in southern Peninsular India.

Regional Floristic treatments

There are many regional Floras available treating Poaceae by different authors. The major floristic treatments available from southern Peninsular India were done by Saldanha and Nicolson (1978), Matthew (1982, 1983, 1988, 1996, 1999), Sharma *et al.* (1984), Singh (1988), Pullaiah (1997) and Nayar *et al*. (2014).

Ramamoorthy (1978) published an account on Poaceae in Saldanha and Nicolson's *Flora of Hassan district, Karnataka, India*. He recognized 74 genera of grasses from the Hassan district of Karnataka. The genus *Apluda* is represented by *A*. *mutica* var. *aristata*. *Heteropogon* and *Sehima* were recorded with single species, *H*. *contortus* and *S*. *nervosum* respectively. *Ischaemum* is recognized with 3 species (*I*. *barbatum* Retz., *I*. *indicum* & *I*. *thomsonianum* Stapf ex C.E.C.Fisch.) and *Themeda* with 3 species (*T*. *tremula*, *T*. *triandra* and *T*. *quadrivalvis*).

Britto and Matthew (1983) have given an account on the grasses of Tamil Nadu in Matthew's *Flora of the Tamil Nadu Carnatic*. They followed the classification of Cope (1982) for the treatment of subfamilies and tribes. It deals with the genera *Apluda*, *Heteropogon*, *Sehima*, *Ischaemum*, *Iseilema* and *Themeda*. *Apluda*, *Heteropogon* and *Sehima* were recognized with single species each. The genus *Ischaemum* is represented by 3 species, *Iseilema* and *Themeda* were recorded with 2 species each. Besides, Matthew (1982, 1988, 1996) provided a series of good drawings of taxa belonging to genera such as *Apluda*, *Ischaemum*, *Heteropogon*, *Iseilema*, *Sehima* and *Themda*.

'Flora of Karnataka analysis' appeared as a part of *Flora India* series 2, by Sharma *et al.* (1984). It is a checklist of plants, and the authors recorded the genera *Apluda* with single species, *A*. *mutica*; *Heteropogon* with 3 species and *Ischaemum* with 17 species as occurring in Karnataka. The work also reports 4 species of *Themeda* as well as the genera *Pseudanthistiria*, *Sehima* and *Iseilema* with 3 species each. The monotypic genus *Thelepogon* is also reported. Since this publication,

Singh (1988) worked on the flora of Eastern Karnataka. This floristic work treats single species *Apluda*, *Ischaemum* and *Thelepogon*. They are *A. mutica*, *I. pilosum*, *T. elegans* respectively. Genera *Heteropogon* and *Themeda* counts for 2 species while *Iseilema* and *Sehima* are represented by 3 species from the eastern Karnataka.

Pullaiah (1997) in his *Flora of Andhra Pradesh* recorded single species each in *Apluda*, *Heteropogon*, *Parahyparrhenia*, *Pseudanthistiria* and *Thelepogon* and four species each in *Ischaemum* and *Iseilema*. He also recognized *Sehima* with 2 species *viz., S. nervosum* and *S. sulcatum*. The genus *Themeda* represented by 5 species, *T. arundinacea*, *T. laxa*, *T. quadrivalvis*, *T. tremula* and *T. triandra* as occurring in Andhra Pradesh state.

Matthew (1999) in the *Flora of Palni Hills* recognized three genera *Apluda*, *Ischaemum* and *Sehima* under the subtribe Ischaeminae likewise *Themeda* and *Heteropogon* under the subtribe Anthistiriinae. He described two species of *Ischaemum viz.*, *I. nilagiricum* Hack. and *I. indicum* and they are classified under two sections, section *Fasciculata* and section *Ischaemum* respectively. There are two species of *Heteropogon*, *H. contortus* and *H. fischerianus* Bor as well as four species of *Themeda viz*., *T. triandra*, *T. sabarimalayana* Sreek. & V.J.Nair, *T. tremula* and *T. cymbaria* in the Palni Hills. The genera *Apluda* and *Sehima* were recorded with single species, *A. mutica* and *S. nervosum* respectively.

Nayar *et al*. (2014) made a comprehensive work on the Flowering plants of the Western Ghats with a detailed reference to previous treatments. This work recognizes single species of *Apluda* ie, *A. mutica*, 5 species of *Heteropogon* and 31 species of *Ischaemum* with 2 subspecies and 8 varieties. It also treats the genera *Iseilema* with 4 species, *Pseudanthistiria* with 3 species, *Sehima* with 3 species, *Thelepogon* with single species and *Themeda* with 8 species as occurring in the Western Ghats.

Subsequent to the formation of Telangana state, Pullaiah published *Flora of Telangana* in three volumes. The family Poaceae was treated in the 3rd volume of *Flora of Telangana* (Pullaiah, 2015), and recognized single species each in *Apluda*, *Heteropogon* and *Thelepogon*; 4 species each in *Ischaemum* and *Iseilema*; 2 species in *Sehima* and 3 species in *Themeda* along with other grass genera.

Table 1. Ischaeminae and Anthistiriinae recorded in floras of southern peninsular India

Flora	**Year**	**Author(s)**	**Genus**	**Species**	**Current status/Accepted name**
Flora of Hassan district	1978	Ramamoorthy in Saldanha & Nicolson	*Apluda*	*mutica* var. *aristata*	*A. mutica*
			Heteropogon	*contortus*	*H. contortus*
			Ischaemum	*barbatum*	*I. barbatum*
				indicum	*I. ciliare*
				thomsonianum	*I. timorense*
			Sehima	*nervosum*	*S. nervosa*
			Themeda	*tremula*	*T. tremula*
				triandra	*T. triandra*
				quadrivalvis	*T. quadrivalvis*
Flora of the Tamil Nadu Carnatic	1983	Britto & Matthew in Matthew	*Apluda*	*mutica*	*A. mutica*
			Heteropogon	*contortus*	*H. contortus*
			Sehima	*nervosum*	*S. nervosa*
			Ischaemum	*commutatum*	*I. commutatum*
				indicum	*I. ciliare*
				rugosum	*I. rugosum*
			Iseilema	*anthephoroides*	*I. anthephoroides*
				laxum	*I. jainiana*
			Themeda	*cymbaria*	*T. cymbaria*
				triandra	*T. triandra*
Flora of Karnataka analysis	1884	Sharma B.D., Singh N.P., Raghavan R.S. & U.R. Deshpande	*Apluda*	*mutica*	*A. mutica*
			Heteropogon	*contortus*	*H. contortus*
				ritchiei	*Agenium ritchiei*
				triticeus	*H. triticeus*
			Ischaemum	*barbatum*	*I. barbatum*
				commutatum	*I. commutatum*
				dalzellii	*I. semisagittatum Roxb.*
				flumineum	*I. timorense*
				indicum	*I. ciliare*
				lisboae	*I. lisboae*
				mangaluricum	*I. barbatum*
				molle	*I. molle*
				muticum	*I. muticum*
				nilagiricum	*I. polystachyum*
				pilosum	*I. afrum* (J.F.Gmel.) Dandy
				ritchiei	*I. semisagittatum*
				rugosum	*I. rugosum*
				semisagittatum	*I. semisagittatum*
				thomsonianum	*I. timorense*
				timorense	*I. timorense*
				tumidum	*I. semisagittatum*

			Sehima	*ischaemoides*	*S. ischaemoides*
				nervosum	*S. nervosa*
				sulcatum	*S. sulcata*
			Iseilema	*anthephoroides*	*I. anthephoroides*
				laxum	*I. jainiana*
				prostratum	*I. prostratum*
			Pseudanthistiria	*heteroclita*	*P. heteroclita*
				hispida	*P. heteroclita*
				umbellata	*P. umbellata*
			Thelepogon	*elegans*	*T. elegans*
			Themeda	*cymbaria*	*T. cymbaria*
				laxa	*T. laxa*
				quadrivalvis	*T. quadrivalvis*
				tremula	*T. tremula*
				triandra	*T. triandra*
Flora of Eastern Karnataka	1988	Singh N.P.	*Apluda*	*mutica*	*A. mutica*
			Ischaemum	*pilosum*	*I. afrum*
			Thelepogon	*elegans*	*T. elegans*
			Heteropogon	*contortus*	*H. contortus*
				ritchiei	*Agenium ritchiei*
			Themeda	*quadrivalvis*	*T. quadrivalvis*
				triandra	*T. triandra*
			Iseilema	*anthephoroides*	*I. anthephoroides*
				laxum	*I. jainiana*
				prostratum	*I. prostratum*
			Sehima	*ischaemoides*	*S. ischaemoides*
				nervosus	*S. nervosa*
				sulcatum	*S. sulcata*
Flora of Andhra Pradesh	1997	T. Pullaiah	*Apluda*	*mutica*	*A. mutica*
			Heteropgon	*contortus*	*H. contortus*
			Ischaemum	*indicum*	*I. ciliare*
				nilagiricum	*I. polystachyum* J.Presl
				pilosum	*I. afrum*
				rugosum	*I. rugosum*
			Iseilema	*anthephoroides*	*I. anthephoroides*
				laxum	*I. jainiana*
				prostratum	*I. prostratum*
				venkateswarlui	*I. anthephoroides*
			Parahyparrhenia	*bellariensis*	*P. bellariensis*
			Pseudanthistiria	*umbellata*	*P. umbellata*
			Sehima	*nervosum*	*S. nervosa*
				sulcatum	*S. sulcata*
			Thelepogon	*elegans*	*T. elegans*
			Themeda	*arundinacea*	*T. arundinacea*
				laxa	*T. laxa*
				quadrivalvis	*T. quadrivalvis*
				tremula	*T. tremula*
				triandra	*T. triandra*

Flora of Palni Hills	1999	Matthew K.M.	*Apluda*	*mutica*	*A. mutica*
			Heteropgon	*contortus*	*H. contortus*
				fischerianus	*H. contortus*
			Ischaemum	*indicum*	*I. ciliare*
				nilagiricum	*I. polystachyum*
			Sehima	*nervosum*	*S. nervosa*
			Themeda	*cymbaria*	*T. cymbaria*
				sabarimalayana	*T. sabarimalayana*
				tremula	*T. tremula*
				triandra	*T. triandra*
Flowering plants of the Western Ghats, India 2.	2014	Nayar T.S., Sibi M. & A. Rasiya Beegam	*Apluda*	*mutica*	*A. mutica*
			Heteropgon	*contortus*	*H. contortus*
				fischerianus	*H. contortus*
				polystachyus	*H. contortus*
				ritchiei	*Agenium ritchiei*
				triticeus	*H. triticeus*
			Ischaemum	*afrum*	*I. afrum*
				barbatum	*I. barbatum*
				bombaiense	*I. bombaiense* Bor
				burmanicum	*I. burmanicum* Bor
				commutatum var. *commutatum*	*I. commutatum*
				commutatum var. *tadulingamii*	*I. commutatum*
				dalzelli	*I. semisagittatum*
				diplopogon	*I. diplopogon* Hook.f.
				fischeri	*I. rangacharianum*
				glabriglaucum	*I. pushpangadanii*
				huegelii	*I. huegelii* Hack.
				impressum	*I. impressum*
				indicum subsp. *indicum* var. *indicum*	*I. ciliare*
				indicum subsp. *indicum* var. *malacophyllum*	*I. ciliare*
				indicum subsp. *indicum* var. *scrobiculatum*	*I. ciliare*
				indicum subsp. *indicum* var. *villosum*	*I. ciliare*
				indicum subsp. *wallichii* var. *wallichii*	*I. ciliare*
				indicum subsp. *wallichii* var. *longipilum*	*I. ciliare*

				kingii var. *kingii*	*I. kingii*
				kingii var. *raizadae*	*I. kingii*
				lisboae	*I. lisboae*
				malabaricum	*I. semisagittatum*
				molle	*I. molle*
				muticum	*I. muticum*
				nairii	*I. molle*
				pappinisseriense	*I. rugosum*
				polystachyum	*I. polystachyum*
				quilonense	*I. barbatum*
				rangacharianum	*I. rangacharianum*
				raui	*I. semisagittatum*
				ritchiei	*I. semisagittatum*
				rugosum	*I. rugosum*
				santapaui	*I. santapaui*
				semisagittatum	*I. semisagittatum*
				timorense	*I. timorense*
				travancorense	*I. travancorense*
				tumidum	*I. semisagittatum*
				yadavii	*I. yadavii*
			Iseilema	*anthephoroides*	*I. anthephoroides*
				hackelii	*I. jainiana*
				jainiana	*I. jainiana*
				prostratum	*I. prostratum*
			Pseudanthistiria	*burmanica*	*P. umbellata*
				heteroclita	*P. heteroclita*
				umbellata	*P. umbellata*
			Sehima	*ischaemoides*	*S. ischaemoides*
				nervosum	*S. nervosa*
				sulcatum	*S. sulcata*
			Thelepogon	*elegans*	*T. elegans*
			Themeda	*cymbaria*	*T. cymbaria*
				laxa	*T. laxa*
				pseudotremula	*T. pseudotremula*
				quadrivalvis	*T. quadrivalvis*
				sabarimalayana	*T. sabarimalayana*
				strigosa	*T. strigosa*
				tremula	*T. tremula*
				triandra	*T. triandra*
Flora of Telangana vol.3	2015	T. Pullaiah	*Apluda*	*mutica*	*A. mutica*
			Heteropogon	*contortus*	*H. contortus*
			Ischaemum	*indicum*	*I. ciliare*
				pilosum	*I. afrum*
				rugosum	*I. rugosum*
				semisagittatum	*I. semisagittatum*
			Iseilema	*anthephoroides*	*I. anthephoroides*
				holei sensu Pullaiah *non*	*I. prostratum*

				Haines	
				laxum	*I. jainiana*
				prostratum	*I. prostratum*
			Sehima	*nervosum*	*S. nervosa*
				sulcatum	*S. sulcata*
			Thelepogon	*elegans*	*T. elegans*
			Themeda	*laxa*	*T. laxa*
				quadrivalvis	*T. quadrivalvis*
				triandra	*T. triandra*

Grasses: Major treatments in other areas

Several comprehensive works on Poaceae are available from different parts the globe. The *North American Flora* was published in parts by New York Botanical Garden. The family Poaceae was published in volume 17 and are appeared with 8 parts. George Valentine Nash, Albert Spear Hitchcock, Jason Richard Swallen and Agnes Chase were the authors who made contributions to the family Poaceae. Nash (1912) along with other genera, he recognized *Heteropogon* and *Themeda* with two species each from North America.

Ridley (1925), in the '*Flora of Malay Peninsula*' treated the family Gramineae with 83 genera under 18 tribes. He treated *Ischaemum* with 15 species, *Apluda* with a single species (*A. varia*), *Themeda* with 3 species, and *Heteropogon* with a single species (*H. contortus*) as occurring in Malay Peninsula.

Burcham (1948) studied the grass flora of few islands of the South and Western Pacific. A total of 72 species belonging to 45 genera under 9 tribes were identified from 7 islands such as Guadalcanal, Good-enough Island, New Britain, Pavuvu Island, Peleliu Island, Okinawa Shima and New Caledonia. One species of *Themeda*, *T. australis* is reported from the Island of Guadalcanal, the second largest of the British Solomon Islands. *Apluda mutica* is distributed in Good-enough Island, territory of Papua. The author also mentioned about one *Themeda* species as occurring in this Island. Grass flora of New Britain, the principal island of of the Bismarck Archipelago comprises one species of *Ischaemum*, that is *Ischaemum digitatum* Brongn. Another species, *Ischaemum intermedium* Brongn. is reported

from Peleliu Island. Author recognized *Apluda mutica*, *Ischaemum crassipes* Thell. and *I. murinum* G.Forst. from Okinawa Shima, part of Ryukyu Archipelago.

It was Jansen (1953) who published '*Notes on Malaysian Grasses-I*'. In this treatment along with other genera he recognized the genus *Ischaemum* and described 13 species and 4 varieties. Among these Malaysian taxa, two species *I. barbatum* and *I. timorense* are represented in India.

Grasses of Australia were studied by Burbidge (1970). She described grass species of the East coast from South-East Queensland to Victoria. Along with other taxa, she recognized *Heteropogon contortus* and two species of *Ischaemum* (*I. australe* R.Br. and *I. triticeum* R.Br.). The genus *Themeda* is represented by a single species *T. australis*, which is commonly known as Kangaroo grass. In this work, only representative species are described and illustrated instead of entire grass flora along the East coast. So this work cannot be considered as a comprehensive treatment on grasses from that area.

Bennet (1980) published '*Key to Zimbabwean grass species*'. In this treatment along with other grass genera he recognized 2 species of *Heteropogon viz.*, *H. contortus* and *H. melanocarpus* (Elliot) Benth.; 3 species of *Ischaemum viz.*, *I. afrum* (J.F.Gmel.) Dandy, *I. arcuatum* Stapf and *I. roseotomentosum* J.B.Phipps, *Sehima ischaemoides* Forssk., *Thelepogon elegans* and *Themeda triandra*.

Cope (1982) recognized 158 genera and 492 species in 26 tribes from Pakistan, of which 36 genera and 67 species comes under the tribe Andropogoneae. The genera *Heteropogon*, *Iseilema*, *Themeda*, *Apluda* and *Thelepogon* were represented by single species, they are *H. contortus*, *I. prostratum*, *T. anathera* (Nees ex Steud.) Hack., *Apluda mutica* and *Thelepogon elegans* respectively. Also there are two species of *Ischaemum* (*I. rugosum* and *I. molle* Hook.f.) and *Sehima* (*S. nervosum* and *S. ischaemoides*) reported from Pakistan.

Simon (1984) published notes on some grasses occurring in Australia. In this treatment, he proposed a new combination in the genus *Ischaemum* ie., *I. australe* var. *arundinaceum* (F.Muell ex Benth.) B.K.Simon.

Clayton *et al.* in Dassanayake (1994), in *A Revised Handbook to the Flora of Ceylon* provided detailed description and key to tribes, genera and species of the family Poaceae. Their treatment was largely based on the work '*Genera Graminum, Grasses of the World*' by Clayton and Renvoize (1986). There are 22 tribes recognized from Ceylon. Tribe Andropogoneae is represented by 85 genera. *Apluda* is treated as monotypic. Though they noticed awned and awnless forms, but treated them as a single species. The genus *Heteropogon* include two species, *H. contortus* and *H. triticeus* (R.Br.) Stapf ex Craib. There are 8 species of *Ischaemum* recorded from Ceylon, of which *I. indicum* and *I. muticum* have 2 varieties each. Two species of *Iseilema* (*I. laxum* and *I. prostratum*), one species of *Pseudanthistiria* (*P. umbellata*) and one species of *Sehima* (*S. nervosum*) are also recognized. *Themeda* is represented by four species namely *T. cymbaria*, *T. tremula*, *T. triandra* and *T. villosa* (Poir.) A.Camus.

The *Flora of China* published in 2006 deals with 226 genera (7 endemic) with 1795 species (809 endemic) of grasses as occurring in China. The authors, Chen *et al.* (2006) recognized 28 tribes under the family Poaceae. This work doesn't attempted to include subfamilies but accepted traditional tribes to classify grasses. This treatment relies largely upon morphological characters based on Clayton and Renvoize (1986), rather than recent molecular studies. But at the same time the authors used some molecular characters wherever it is necessary. Chen *et al*. (*l.c.*) described the tribe Andropogoneae and provided a key to the all available genera. They recognized 41 genera and 204 species under this tribe as occurring in China. Only one species of *Sehima* (*S. nervosum*) and *Apluda* (*A. mutica*) are reported from China. This treatment includes 12 species of *Ischaemum* (with 2 varieties under *I. aristatum*), 13 species of *Themeda*, 3 species of *Heteropogon* and one species of *Pseudanthistiria* (*P. heteroclita*) from China.

It was Gardner (2007) who reviewed the grasses of the central Pacific region. He treated 126 species of 57 grass genera as occurring in this region. The author treated *Heteropogon* with one species (*H. contortus*) and *Ischaemum* with 7 species *viz.*, *I. barbatum*, *I. byrone* (Trin.) Hitchc., *I. ciliare*, *I. murinum*, *I. rugosum*, *I.*

stokesii F.Br. and *I. timorense* from the study area. Two species of *Themeda*, *T. arguens* (L.) Hack. and *T. quadrivalvis* were also recorded from the Pacific region.

Hooker and Jackes (2009) published a small but very useful pictorial key of grass genera of North Queensland. The key in this book is mainly based on the type of inflorescence and nature of spikelets.

Agrostology is a growing area of interest in Madagascar. Recently a good number of research had happened in Madagascar in the field of grass taxonomy. Vorontsova and Rakotoarisoa (2014) made studies on endemic non-bambusoid genera of grasses. It is being a review work, the authors summarized all the endemic genera previously known from this region with all available data. This treatment provides information regarding the taxonomic placement of all grass genera previously said to be endemic to Madagascar. This work also includes the taxa present on islands in the Comoros and Mascarene Archipelagos. They recognized 9 species under 6 genera excluding bamboos, as endemic to Madagascar. Later in 2016, again Verontsova *et al*. made a good piece of work regarding origin of grasses and grasslands in Madagascar. This study revealed that 40% of grass species are endemic to Madagascar island and Madagascar has more endemic grass species in proportion to the total grass flora than other regions. They found out the formation of grasslands or grasses in Madagascar are natural and also support its separation from Africa. Subsequently Rabarivola *et al*. (2019) published '*Madagascar Grass Atlas*'. This database includes 522 species of grasses. Though some specimens are not identified upto species level, this work provide an insight to the grass diversity in that area. In this treatment, they recognized three species of *Heteropogon* (*H. contortus*, *H. melanocarpus* and one another species which is not identified), five species of *Ischaemum* (*I. heterotrichum* Hack., *I. koleostachys* (Steud.) Hack., *I. polystachyum* J.Presl, *I. rugosum* and one unknown species) and one species of *Themeda* (*T. quadrivalvis*) as occurring in Madagascar. It also include distribution map for each taxon.

A study by Ibrahim *et al*. on Aegyptian grasses was appeared in 2016. The authors identified 284 grasses and prepared descriptions, illustrations and a

vegetative key for identification of all taxa. The major highlight of this work is nothing but the construction of key using vegetative characters and also followed a modern classification system based on molecular DNA sequence studies (Soreng *et al.*, 2015). Here, authors recognized 7 subfamilies, 22 tribes and 37 subtribes from Aegypt. Along with other genera, *Themeda* with 2 species (*Themeda triandra* and *T. villosa*) were recorded from this study area.

Recently, Ibrahim *et al*. (2018) published '*Grasses of Mali*'. The authors followed the modern classification system based on molecular data (Peterson *et al.*, 2017; Soreng *et al.*, 2017) and constructed a vegetative key for the identification of taxa. Authors recognized 199 taxa and provided descriptions and illustrations. This study revealed the occurrence of *Ischaemum polystachyum*, *Sehima ischaemoides* and *Themeda triandra* in Mali.

Works on Ischaeminae and Anthistiriinae in India after Bor

Ischaemum

In Indian context, the only comprehensive work available on grasses is "The grasses of Burma, Ceylon, India and Pakistan (excluding Bambuseae)" by Bor (1960). Before the publication of this book, Bor (1949a, 1949b, 1950a, 1950b, 1951a, 1951b etc.) had published many articles related to the genera of the subtribes Ischaeminae and Anthistiriinae and most of them were related to *Ischaemum*.

The genus *Ischaemum* is represented by 68 species worldwide and are distributed throughout the tropics. This genus has been attracted the attention of many Indian botanists by its diversity and variation. After Bor, many authors described a large number of new species within the genus *Ischaemum* (Ansari *et al*., 1984; Nair & Sreekumar, 1984, 1985; Patil & D'Cruz, 1973; Ravi *et al*., 1998, 2000a, 2000b; Sreekumar *et al*., 1983, 1984, 1985a, 1985b, 1987) from India. Thus, the number of taxa within the genus, *Ischaemum* increased drastically. *Ischaemum* is perhaps the most difficult and complicated genus in the tribe with regard to variation in size, leaf base, ornamentation on glumes, pubescence, awns etc.

Sur (2001) revised the genus *Ischaemum* in India. He recognized 35 species, 2 varieties and one subvariety as occurring in India. Sur (*l.c.*) has mentioned about 13 species that are excluded from the treatment. Majority of which were newly described taxa prior to the publication of his revision. However, a number of species in *Ischaemum* were described (eg: Ravi *et al*., 2001; Sunil & Pradeep, 2005; Gad & Janarthanam, 2007) subsequent to Sur's revision.

It was Singh and Rao (2008), revised the genus *Ischaemum* in India, and treated 27 species, 1 subsp. and 8 varieties. However, at the time of his revision, the number of species in genus *Ischaemum* in India was 54 species, 3 varieties and 2 subvarieties [two new species by Sunil & Pradeep (2005) and Gad & Janarthanam (2007) were not included]. Singh and Rao (2008) synonymised many names that are recently published in the genus.

The third revision on *Ischaemum* in India is that by Srivastava and Nair (2010). They did not accept the previous treatment by Singh & Rao (*l.c.*) and recognized all the 56 species, 2 varieties and 3 subvarieties. According to this work, 43 species out of 56 are endemic to India. Ecological variations, affinities or interrelationships within the taxa were not taken into account by the authors.

Even after this revision, there came several scattered papers describing new species in the genus *Ischaemum* (Raole *et al*., 2011; Dileep & Nair, 2015; Gorade *et al*., 2016; Sunil *et al*., 2017; Nawaz & Shinde, 2021, 2022; Jabeena *et al.*, 2022). Majority of such papers were based on some morphological differences and did not address their ecological variations, hybridization and ploidy. Moreover, few papers on distribution and typification of names are also available (Gopal *et al*., 2004; Datar *et al*., 2014; Tiwari *et al*., 2016; Bokil *et al*., 2018). Recently Bokil *et al.* (2020, 2021) described two more new species in *Ischaemum* based on morphological and molecular data.

Heteropogon

The genus *Heteropogon* has shown a distribution range from South central Europe to tropical and subtropical regions with 3 species worldwide (modified from

POWO, 2022). It is common in India and grown in different habitats. It was Deshpande (1988) who revised the genus *Heteropogon* in India. She recognized 5 species and one variety. The variety, *H. contortus* var. *polystachyos* (Roxb.) Deshp. was a new combination proposed by her from the former species *H. polystachyos* (Roxb.) Schult. Recently Drisya and Pradeep (2020) reinstated the species *H. allionii* (Lam. ex DC.) Roem. & Schult. from the synonymy of *H. contortus*. A few papers regarding the nomenclature and typification of *H. fischerianus* and *H. contortus* var. *distichus* C.E.C.Fisch. have also been published recently (Kumar *et al.*, 2020; Siddabathula *et al.*, 2020; Tiwari, 2021).

Sehima

The genus *Sehima* shows a distribution range in tropical and subtropical Africa and Asia with 5 species worldwide (POWO, 2022). In India, Sur (1988) revised the genus *Sehima*. According to the author the genus comprises 4 species in India. Recently, Tiwari *et al*. (2018) lectotypified two names in this genus from India.

Apluda

Apluda is one of the monotypic genera showing high amount of variation. The distribution range of this genus is Mascarenes, Socotra and Asia to West Pacific (POWO, 2022). From India, Murty published a short note on the taxonomy of the genus *Apluda* in the year 1972. This paper explained the species delimitation in the genus, *Apluda* in a cytological point of view. His findings recommended to accept a single species, *Apluda mutica* with two varieties as adopted by Bor (1960), and also corroborates with Merrill (1912) and Pilger (1945). Another important work on *Apluda* from India was the publication of a new species, *Apluda blatteri* by Sur (1986). However, this species is not accepted by Govaerts (1995) and now it is treated only as a synonym of *A. mutica*.

Iseilema

Iseilema is distributed in Tropical Asia to Australia with 23 species worldwide (modified from POWO, 2022). When coming to the Indian context, in

1969, Uppuluri and Satyavathi published two new species of *Iseilema* (*I. hubbardii* Uppuluri & *I. venkateswarlui* Satyavathi) from India. Following this, Umamaheswari and Daniel (2001) published yet another new species, *I. jainiana* P.Umam. & P.Daniel from Coastal Tamil Nadu. Later Gandhi and Shrestha (2008) proposed a new name for *Iseilema laxum* and provided a detailed note on the identity and nomenclature of the species. Then, Drisya and Pradeep (2019) lectotypied three names in *Iseilema*. Soon after Chandra Mohan *et al*. (2020) published a new species *Iseilema kunhikannanii* K.C.Mohan, Y.Mahesh & K.Prasad from Rajasthan. In 2020, Chandramohan & Mahesh made a revision of Indian *Iseilema*. Following this revision, Chorghe and Tiwari (2021) lectotypified three names in *Iseilema*, *I. anthephoroides*, *I. hackelii* Shrestha & Gandhi and *I. holei*.

Parahyparrhenia

Parahyparrhenia is a small genus comprising 7 species worldwide and is distributed in India, Indo-China and West Tropical Africa to Sahara and Sudan (POWO, 2022). It was Clayton (1972) who made a new combination and published *Parahyparrhenia bellariensis* (Hack.) Clayton from India, based on *Andropogon bellariensis* Hack. The genus is represented by 2 species in India (Landge & Shinde, 2022). Later, Tiwari (2017) done a second step lectotypification for the name *A. bellariensis*. In the next year Tiwari *et al.* (2018) reported *P. bellariensis* from Madhya Pradesh. Then in 2020, Tiwari *et al.* discovered a new species, *P. khannae* A.P.Tiwari & Chorghe from India. Recently Nawaz and Shinde (2021) published a paper regarding rediscovery of *P. bellariensis* from Gandikota Fort Hill in Kadapa district of Andhra Pradesh.

Pseudanthistiria

The genus *Pseudanthistiria* is represented by two species worldwide and are distributed in Indian subcontinent to Indo-China (POWO, 2022). All the two species are available in India. Though, Hooker (1897) published two more new species in *Pseudanthistiria* (*P. burmanica* Hook.f. and *P. hispida* Hook.f.) as occurring in India, subsequent treatments recognized them as conspecific with already known species. Apart from this, Birari and D'Cruz (1976) again published yet another new

species *P. intermedia* Birari & D'cruz from India. But *P. intermedia* is not accepted by Clayton *et al*. (2006) and treated it as a synonym of *P. heteroclita*. Uniyal (1984) designated the species *P. heteroclita* as the lectotype for the generic name *Pseudanthistiria* and for its basionym. Recently Drisya and Pradeep (2021) published a conspectus on the genus *Pseudanthistiria* and recognized two species in *Pseudanthistiria* [*P. heteroclita* (Roxb.) Hook.f. & *P. umbellata* (Hack.) Hook.f.] by treating *P. burmanica* under the synonymy of *P. umbellata*.

Themeda

The genus has shown a distribution range from tropical and subtropical Old World to South West Pacific with 29 species worldwide (POWO, 2022). In India, many authors (Sreekumar & Nair, 1987; Potdar *et al*., 2003; Chorghe *et al*., 2016; Chorghe *et al*., 2019) described new taxa within this genus *Themeda*. In 2021 Chorghe *et al.* lectotypified four names in *Themeda*, *T. cymbaria*, *T. huttonensis* Bor, *T. laxa* and *T. tremula*. Recently, Chorghe and Kulloli (2022) rediscovered *T. saxicola* Bor from the Eastern Ghats of Odisha state.

Major works on Ischaeminae and Anthistiriinae in other areas

Simon (1993) identified a new species, *Thelepogon australiensis* B.K.Simon from Australia. It is characterised by inflorescence having 1–3 racemes, less rugose lower glumes, undeveloped lower palea and leaf margins with tubercle-based hairs as opposed to previously known species *T. elegans*. Later Thompson (2019), re-evaluated the taxonomic status of Australian species of *Thelepogon* and *Arthraxon* P.Beauv. and found that *T. australiensis* is nothing but a species of *Arthraxon* and made a new combination, *Arthraxon australiensis* (B.K.Simon) E.J.Thomps. Thompson followed a detailed comparison of above taxon with *T. elegans* and *A. castratus* (Griff.) V.Naray. ex Bor using gross morphology, micromorphology and anatomy. He also provided a key to the species of *Arthraxon* and *Thelepogon* for easy identification.

An exhaustive revisionary work on *Themeda* is available from Malesia by Veldkamp (2016a). He recognized 11 taxa which includes 10 species and one

variety. In this treatment the specific rank of *T. caudata* and *T. intermedia* (Hack.) Bor are reduced to varietal rank under the species *T. villosa*. Another important outcome of this study is the description of a new species, *T. polycephala* Veldkamp and a new distribution record of *T. hookeri* (Griseb.) A.Camus in Thailand. In the same year Veldkamp (2016b) revised another genus *Iseilema* in Malesia. He recognized 3 species (*Iseilema javanicum* Ohwi & Veldkamp, *I. maculatum* Jansen and *I. minutiflorum* Jansen) as occurring in Malesia, of which *I. javanicum* was described as new species. This work also provides notes on some Southeast Asian species such as *I. argutum* and *I. thorelii* A.Camus.

Apart from these comprehensive treatments few scattered papers describing new taxa in the genus *Ischaemum* in different areas at various times is available (Huiru, 1983; Renvoize, 1985; Lasut, 2006; Traiperm *et al*., 2012 etc.).

Anatomy and Micromorphology

Anatomy has great role in systematic studies of plants. The anatomical and micromorphological data can be used to support taxonomic studies in delimiting taxa and can provide information regarding affinities and interrelationships among the taxa to some extent.

Goossens and Theron (1934) studied the anatomy of *Themeda triandra*. They described the anatomical features in detail and attempted to classify the varieties based on the leaf anatomy with the support of morphological characters. Then Mes and Aymer-Ainslie (1935) studied water relations of *Themeda triandra*. The authors selected 3 varieties of *T. triandra* from South Africa for the experiment. Their study suggested that "the highest activity of the grasses normally takes place during November and December when the stomata are open nearly all day and the strongest carbon assimilation may be expected. A high soil water content and a high atmospheric humidity at that time resulting in a low transpiration combined with the active carbon assimilation would therefore be the most favourable condition for the most active growth of the grasses".

Tateoka *et al*. (1959) examined the bicellular microhairs in leaf epidermis. Several genera showed wide variation in characteristics of microhairs, which can be used in delimitation of taxa. Here, the author analyzed four relationships to establish characteristics of the hair. Based on the range of values of these characteristics, he grouped 238 species of 4 subfamilies into two types. These two types correspond to panicoid and chloridoid types established earlier by Prat (1936).

One of the major pioneer works in the area of grass anatomy was done by Metcalfe (1960). He provided an introductory remark on general morphology and diagnostic microscopical characters of grasses as well as the anatomy of each taxon in detail. He treated a total of 345 genera and 413 species (of which data of 206 genera was based on his own results and remaining was incorporated from already published data) and provided detailed anatomy of leaf and culm. "Genera under Andropogoneae and Paniceae have many characters in common. They are characterized by cross to dumb-bell shaped silica-bodies over the veins; by relatively long micro-hairs of which the distal cell tapers towards the apex; by conspicuously to inconspicuously radiate chlorenchyma; generally by single bundle-sheaths, double sheaths being uncommon, and when present, often restricted to the large vascular bundles" (Metcalfe, 1960). He recognized panicoid type of leaf structure in species of *Apluda*, *Heteropogon*, *Ischaemum*, *Iseilema*, *Pseudanthistiria* and *Themeda*. In 1968, Clifford reviewed the book of Metcalfe (1960) and made a brief account on microhairs seen in grasses (Metcalfe & Clifford, 1968).

Twiss *et al.* (1969) classified grass phytoliths under 4 classes such as Festucoid, Chloridoid, Panicoid and Elongate classes. The Festucoid class contains eight types *viz.*, circular, rectangular, elliptical or oblong forms. There are two types of saddle-shaped bodies in Chloridoid class and 11 types, which are the variations of crosses and dumbbells in Panicoid class. Five types are recognized under the Elongate class, that have no subfamily implications.

Ellis (1976, 1979) has done the standardization of comparative leaf anatomy in Poaceae. In 1976, he made an exhaustive work on describing the structures seen in transverse sections of leaf blade of Poaceae. Later in 1979, he worked on the

epidermis and described the characters that are seen in surface view. He provided descriptive keys with definitions and explanatory diagrams. These two works lead to the simplification of anatomical descriptions of grass leaf blades, both in transverse sections as well as in leaf epidermal features.

Renvoize (1982) surveyed the leaf blade anatomy of 85 genera of the tribe Andropogoneae with at least one species from each of the genera. The author did this work in support of a review by W.D. Clayton, of the classification of the whole grass family. The genera under Andropogoneae have the 'Kranz MS' type anatomy (Brown, 1977), characterized by a single bundle sheath, chlorenchyma cells arranged radially around the bundles, though not always clearly expressed and slender finger-like microhairs. This type of anatomy is generally associated with C_4 photosynthesis.

Watson and Dallwitz (1992) provided brief but remarkable accounts on the leaf anatomy of each genera that he had identified in '*The Grass genera of the World*'.

Piperno and Pearsall (1998) provided examples of phytolith discrimination at and below the subfamily level. According to them, bilobates with rounded or semirounded lobes and long, thin shafts, or with squared lobes and distinct, thin shafts are common in panicoid genera, but are absent in bamboos. Their study also suggested the possibility of silica bodies in tropical soil assemblages and their role in evolutionary studies. Eventhough the soil silica bodies are unclassifiable below the family level, they can perform as general indicators of grass presence. Moreover, Silica-body shapes reflects the phylogenetic relationships. The shape of phytolith changed according to the changes in anatomical and micromorphological characters due to diversification and selective pressures during grass evolution. The phytoliths seen in primitive taxa have the characteristics of saddles, bilobates and rondels or small, irregular bodies. Hence, conventional classification is difficult in primitive taxa. Moreover, the earliest grass phytoliths were often thick pieces of silica having only one saddle or bilobate type face and main stream genera in the Chloridoideae

and Panicoideae are characterised by planar, mirror-image saddles and bilobates due to leaf epidermal silicifications.

Krishnan *et al*. (2000) conducted studies on phytoliths in the grasses of Tamil Nadu. Authors determined the size and shape of phytoliths of about 100 species and provided identification key and drawings of silica cells for 80 species.

Lobate phytolith is one of the most important morphotypes of grass phytoliths (Lu & Liu, 2003). Lu and Liu studied the variability of 25 major phytolith shapes in 85 species of grasses. According to the observations, authors proposed a classification for lobate phytoliths based on two parameters such as the length of the lobate shank and the shape of the outer margin of the two lobes. The identification of tribe or even genus can be done in some cases based on these morphological parameters. There is only a limited range of lobate phytoliths produced by grasses and they often overlap from genus to genus. So the identification of taxa by using phytoliths is not possible in all cases. This study also revealed the influence of environmental factors especially moisture in the variations of lobate phytoliths. Lobate phytoliths with a very short shank is usually produced by hygrophytic grasses while lobate phytoliths with a very long shank is observed in xerophytic grasses.

The discussion on phytolith nomenclature arose during the 3rd International Meeting on Phytolith Research (IMPR) held at Bruxelles in 2000. Thus with the sponsorship of the Society for Phytolith Research (SPR), an International Working Group on Phytolith Nomenclature (IWGPN) was established for developing an International Code for Phytolith Nomenclature (ICPN). Subsequently, an International Code for Phytolith Nomenclature 1.0. was published (Madella *et al*., 2005). The Code proposes an internationally accepted protocol to describe and name phytoliths. This primary governing body for phytolith nomenclature in 2000, is now known as International Phytolith Society (IPS). IPS commissioned a new committee, the International Committee for Phytolith Taxonomy (ICPT) in 2014 for the purpose of revising, updating, expanding and improving the first code (ICPN 1.0). Later,

International Committee for Phytolith Taxonomy (ICPT): Neumann *et al*. (2019) published International Code for Phytolith Nomenclature (ICPN) 2.0.

Raole and Desai (2009) studied micromorphological characters such as epidermal cell size, epidermal frequency, stomatal frequency, stomatal index, presence of microhairs, papillae and its frequency and types of silica bodies of 5 taxa in the tribe Andropogoneae.

Ullah *et al*. (2011) selected 18 summer grasses of the tribe Andropogoneae from Hindukush-Himalayan ranges, to study foliar epidermal micromorphology. They observed considerable variation in micro-morphological characters between the genera and species. The characters such as shape and wall morphology of long cells, morphology of papillae, microhairs, stomatal size and shape of subsidiaries were found to be useful in the delimitation of the taxa studied.

Traiperm *et al*. (2011) studied the anatomy of subtribe Ischaeminae in Thailand. The study included 10 species representing 5 genera *viz.*, *Apluda*, *Ischaemum*, *Kerriochloa*, *Sehima* and *Thelepogon*. This study revealed the possession of nodular silica bodies in *Apluda* and cross-shaped or dumb-bell shaped or in between cross and dumb-bell shaped silica bodies in all other genera. Whereas, prickles are present in *Apluda*, *Sehima* and *Ischaemum rugosum*. But as compared to *Apluda* the prickles in *Sehima* and *Ischaemum rugosum* have distinctive ribs and furrows on both surfaces. Likely, prickles in *Ischaemum rugosum* is different from *Sehima* by the shape, varying degree of ribs and furrows as well as the masses of sclerenchymatous cells below the epidermis. Moreover, the ribs slides were rounded with a flat top as well as wide and open furrow in *Sehima* and triangular ribs with obtuse furrows in *I. rugosum*. Due to the presence of sclerenchymatous cell mass in between the lower and upper epidermis, the midrib of *Thelepogon* possess a conspicuous circular or semicircular keel along with vascular bundles. Also, there present one to a few rows of colourless parenchyma cells beneath the upper epidermis as well as the small vascular bundles are surrounded by chlorenchyma. Whereas in case of *Sehima* and *Kerriochloa* the vascular bundles of the midrib are arranged in a straight or somewhat uneven row, and large bundle is positioned at

center with few small bundles on both sides of it. Apart from this, the keel is inconspicuous here and are not associated with any parenchyma and sclerenchyma cells. Another important diagnostic character recognized by this study was the occurrence of papillae. The genera *Ischaemum* and *Kerriochloa* were characterised by the presence of papillae whereas it is absent in *Apluda*, *Sehima* and *Thelepogon*. The papillae in *Kerriochloa* was solitary while that in *Ischaemum* comprised of more than one papillus per cell. However, exceptions are there and some species fail to exhibit these general trends. Anatomical characters alone are insufficient for the delimitation of some taxa in general, but have an immense value in systematic studies in providing additional support.

Honaine and Osterrieth (2012) analyzed the effect of leaf section, leaf position and environmental conditions on the percentage of silicified epidermal cells of a panicoid grass from Argentina. Study was conducted in two environmental situations, a natural wetland and a quartzite quarry. The study revealed that 13–19% of total cells of the adaxial epidermis of leaf blades were silicified. Typical silica short cells form 53–98% and bulliform cells form 0–30%, out of total silicified cells. Silicified cells are more in superior leaves (younger leaves) than that of inferior (older leaves), but varies in sections. The plants growing in pond, where the silica content in the soil is higher, had the higher percentage of silicified cells. Among all types of cells, bulliform cells showed differences in the proportion of silicified cells between leaf position, leaf section and collection site. These results shows that cell silicification is influenced by soil silica content and thus transpiration.

Nazir *et al*. (2013) made studies on 13 species belonging to 10 genera of tribe Andropogoneae from Pakistan. This study revealed the role of different epidermal characters such as shape of subsidiary cells, silica bodies, presence or absence of microhairs, macrohairs and rounded papillae in specific or generic level identification of grasses.

Desai and Raole (2013) studied foliar micromorphology of subtribe Ischaeminae from Gujarat. Authors treated 16 taxa of 4 genera such as *Apluda*, *Ischaemum*, *Sehima* and *Triplopogon* and concluded that papillae and microhairs are

the most useful micromorphological characters to differentiate the species and genera in the subtribe Ischaeminae. Subsequently, Jattisha (2015) made a study on the phytoliths of few members of Poaceae in South India. She had choosen 173 species belonging to 83 genera of 7 subfamilies *viz.*, Ehrahrtoideae, Arundinoideae, Pooideae, Centothecoideae, Aristidoideae, Chloridoideae and Panicoideae for the study. This study observed considerable silicification in different type of cells and the ridged lobates, quadralobates and trapezoid short cell lobates in the costal regions were found to be the markers for the subfamily Panicoideae.

Naskar and Bera (2016) studied diversity of polylobate phytoliths of *Apluda mutica*, *Themeda arundinacea* and *Oplismenus compositus* (L.) P. Beauv. from deltaic West Bengal. They recognized and documented 27 subtypes of polylobates. This study also support the importance of polylobate phytoliths in paleoecological interpretations.

Khan *et al.* (2017) emphasized on the significance of foliar SEM and light epidermal microscopy in the field of grass systematics.

Cytology

It was Avdulov (1928), who is known for his pioneering chromosomal studies in the family Poaceae. Brown (1948) attempted to determine certain interrelationships of species, genera and tribes in Poaceae on the basis of cytological information. This study was mainly based on the tribe Paniceae of Southeastern United States. Celarier (1956a, 1956b, 1957, 1958, 1959) studied cytotaxonomy of many tribes of Andropogoneae. Celarier (1956b) proposed the basic chromosome number of tribe Andropogoneae as 5 and presented evidences to support this view. Later three basic chromosome numbers such as 5 (or 10), 7 and 9 were reported in subtribe Ischaeminae and found that polyploidy have much importance in the evolution of the subtribes and several species of the sutribe Ischaeminae. The study had been found the occurrence of two chromosome races within many species including *Apluda mutica*, *Ischaemum arcuatum* and *Sehima nervosum* (Celarier, 1957).

A number of authors (Pohl & Davidse, 1971; Davidse & Pohl, 1972a, 1972b, 1974, 1978; Faruqi *et al*., 1979) from various parts of the world studied the chromosome numbers of Poaceae.

Christopher (1978) studied the cytology and phylogeny of tribes Andropogoneae and Maydeae from South India, subsequent to similar studies on subfamilies Bambusoideae, Oryzoideae, Arundinoideae, Festucoideae and Eragrostoideae by Christopher and Abraham (1971, 1974).

Various cytological studies of *Heteropogon contortus* from different parts of the world, indicated that many of the populations of the species are characterized by irregular meiotic divisions (Gould, 1956; Mehra, 1954; Celarier & Harlan, 1953). Emery and Brown (1958) made a detailed study on apomixis of *H. contortus*. In 1976, Thothil and Hacker studied polyploidy, phenology and climatic adaptation in *H. contortus* with a cytological point of view. And this study showed "the tropical latitudes are almost exclusively occupied by tetraploids while the sub-tropical latitudes are characterized by a wide a range of ploidy levels from tetraploid to nonaploid". This study also concluded that populations from pantropical areas are almost exclusively composed of late flowering lines, and those from subtropical areas comprises mixed lines showing great diversity from early to late flowering types.

Birari in 1980 made an investigation on the cytology of various species of *Pseudanthistiria* from India. He studied the chromosome number, meiotic and reproductive behaviour in *P. heteroclita*, *P. hispida*, *P. intermedia* and *P. umbellata*, and found the somatic chromosome number of these species is 2n=20. This study also reported the occurrence of supernumerary chromosomes in *P. heteroclita*.

Many authors (Venkateswarlu & Murty, 1966, 1968; Murty, 1972, 1973a, 1973b; Murty & Satyavathi, 1978) from India have conducted extensive studies on the cytology of *Apluda mutica* and provided information regarding polyploidy, cytological races and apomixis in this species. Recently Singh and Singhal (2018) re-recorded the existence of B-chromosomes in *Apluda mutica* and studied its behaviour in meiocytes.

Molecular Phylogeny

Various authors have been worked to unravel phylogenetic relationships of selected taxa in Poaceae using nuclear ribosomal DNA (eg. Hamby & Zimmer, 1988), plastid *rbcL* gene (Doebley *et al.*, 1990), chloroplast DNA restriction site variation (Davis & Soreng, 1993) and plastid rps4 sequences (Nadot *et al.*, 1994). The major family level molecular phylogenetic studies were done by Clark *et al.* (1995), GPWG I (2001), Duvall *et al.* (2007), GPWG II (2012), Soreng *et al.* (2015), Kellogg (2015), Soreng *et al.* (2017) and Soreng *et al.* (2022).

In 1995, Clark *et al.* studied 45 grasses and 2 out groups using chloroplast gene *ndhF* to address phylogenetic relationships among the major lineages of the Poaceae. This study resurrected two subfamilies, Anomochlooideae and Pharoideae to accommodate the two basal lineages within the family. The remaining formed a monophyletic clade with two primary subdivisions such as weakly supported BOP (Bambusoids, Oryzoids and Pooids) and strongly supported PACC (Panicoids, Arundinoids, Chloridoids and Centothecoids) clade. In addition, this study also suggested the recognition of PACC clade at the subfamilial level.

The Grass Phylogeny Working Group was established in 1996 to produce a comprehensive phylogeny for the Poaceae. The GPWG published phylogeny of Poaceae in the year 2000, by the combined analysis of eight data sets (one morphological, four plastid and three nuclear) for 57 grasses and 4 outgroup taxa. The analysis supported *Anomochloa* + *Streptochaeta*, Phareae and *Puelia* + *Guaduella* as the early diverging lineages, with the rest of the family resolved as a clade in which there is a sister-group relationship between the PACC (Panicoideae, Arundinoideae, Chloridoideae + Centothecoideae) and BOP (Bambusoideae, Oryzoideae + Pooideae) clade. In 2001, GPWG I published a revised and updated version of the above analysis as '*Phylogeny and subfamilial classification of the grasses*'. This was also based on the analysis of the same data sets, such as six molecular sequence data sets (*ndh*F, *rbc*L, *rpo*C2, *PHY*B, ITS-2 and GBSSI or *waxy*), chloroplast restriction site data, and morphological data from a representative set of 62 grasses plus 4 out group taxa. This analysis resulted in a single most-

parsimonious tree and strongly supported relationships with the family Joinvilleaceae as sister to the monophyletic Poaceae; subfamilies Anomochlooideae, Pharoideae and Puelioideae are the earliest-diverging lineages; all remaining grasses formed a clade, consisting of two main clades, the BEP clade [Bambusoideae, Ehrhartoideae (=Oryzoideae) and Pooideae] and the PACCAD clade (Panicoideae, Aristidoideae, Centothecoideae, Chloridoideae, Arundinoideae and Danthonioideae). Based on the phylogeny, a classification with previously recognized 11 subfamilies plus one new subfamily, Danthonioideae was proposed. After the GPWG I, Sanchez-Ken *et al.* (2007) made some emendments and reinstated the subfamily Micrairoideae. Subsequently Duvall *et al.* (2007) revisited the phylogeny of grasses by analyzing 61 ingroup and 2 outgroup taxa using *ndh*F and *rbc*L. This study particularly focused on the taxa *Danthoniopsis* Stapf, *Eriachne* R.Br., *Micraira* F.Muell., and *Streptogyna* P.Beauv. and a representative of the outgroup Ecdeiocoleaceae. Meanwhile, Simon (2007) assessed the GPWG I phylogeny and subsequent phylogenetic treatments. Subsequent GPWG II (2012) also accepted the subfamily Micrairoideae instead of Centothecoideae, and updated the subfamilial classification of GPWG I. This comprehensive and robust molecular phylogeny for grasses were done by sampling 531 taxa emphasizing the C_4 rich PACMAD clade and the genetic markers used were rbcL, ndhF and the region encompassing the matK coding gene and the trnK (tRNA-Lys) introns (trnK/matK). This analysis identified several new C_4 lineages and, BEP and PACMAD clades were strongly supported.

In 2015, Soreng *et al.* presented a modern worldwide phylogenetic classification of the Poaceae based on molecular and morphological studies. They analysed 448 grass species using mat*K* and ndh*F* plastid DNA markers and recognized 12 subfamilies, 51 tribes, 80 subtribes, 771 genera with approximately 12074 species. The accepted subfamilies were Anomochlooideae, Aristidoideae, Arundinoideae, Bambusoideae, Chloridoideae, Danthonioideae, Micrairoideae, Panicoideae, Pharoideae, Puelioideae, Pooideae and Oryzoideae instead of Ehrhartoideae (Ehrhartoideae was accepted in earlier treatments but not Oryzoideae). Eventhough the subtribes Ischaeminae and Anthistiriinae were

available here within the tribe Andropogoneae, the genera *Apluda* and *Thelepogon* are placed under '*Incertae sedis*'. But placed the genera *Ischaemum* and *Sehima* under Ischaeminae, and *Heteropogon*, *Iseilema*, *Parahyparrhenia*, *Pseudanthistiria* and *Themeda* under Anthistiriinae as was done by Clayton and Renvoize (1986). In the same year Kellogg (2015) proposed another classification of the family Poaceae. She accepted the subfamilial classification of the GPWG II, and recognized 29 tribes, several classes and 53 subtribes. Here the genera *Apluda*, *Thelepogon* and *Sehima* are placed under '*Incertae sedis*', while *Ischaemum* is retained under Ischaeminae and the subtribe Dimeriinae is merged under Ischaeminae. Likewise, the subtribe Anthistiriinae is merged under the subtribe Andropogoninae and placed *Heteropogon*, *Iseilema*, *Parahyparrhenia*, *Pseudanthistiria* and *Themeda* under Andropogoninae as opposed to all other earlier treatments. Later Soreng *et al.* (2017) compared the two classifications (Soreng *et al.*, 2015; Kellogg, 2015) and again proposed a new worldwide phylogenetic classification based on the analysis of 11506 grass species. This treatment recognized 768 genera, 90 subtribes, 5 super subtribes, 52 tribes, 7 super tribes and 12 subfamilies. Soreng *et al.* (2017) also accepted the treatment of subtribe Anthistiriinae as the synonym of subtribe Andropogoninae as was done by Kellogg (2015), and revised the the classification of Soreng *et al.* (2015). Recently, Soreng *et al.* (2022) presented an updated worldwide phylogenetic classification of Poaceae with 11783 species in 12 subfamilies, 7 supertribes, 54 tribes, 5 super subtribes, 109 subtribes and 789 genera. This treatment recognized 2 new tribes and 22 new or resurrected subtribes. Besides, 24 previously accepted genera were placed in synonymy along with the acceptance of 45 new or resurrected genera.

At the same time, several phylogeneticists focused on specific groups or taxa within Poaceae for their phylogenetic studies. Some of the important work available on the subfamily Panicoideae, includes those by Sanchez-Ken and Clark (2010), Teerawatananon *et al.* (2011) and Burke *et al.* (2016). Sanchez-Ken and Clark (*l.c.*) proposed a phylogeny and a new tribal classification for Panicoideae based on plastid and nuclear sequence data and structural data. This study merged the subfamily Centothecoideae into the Panicoideae and recognized 12 tribes of

which Chasmanthieae and Zeugiteae were segregated from Centotheceae; Tristachyideae from Arundinelleae and a new tribe Cyperochloeae is proposed to include two isolated genera. Later Teerawatananon *et al.* (2011) evaluated the phylogenetic relationships among major subfamilies in Poaceae as well as among the major tribes in the subfamily Panicoideae. This study was based on the parsimony and Bayesian analyses of chloroplast *trn*L-F and *atp*β-*rbc*L DNA sequences and a nuclear ribosomal DNA sequence, ITS1-ITS2. It supported the separation of *Arundinella* Raddi and *Garnotia* Brongn. from the remaining Arundinelleae and their inclusion in the tribe Andropogoneae. Within Andropogoneae, the authors recognized 5 subtribes out of 11 (Chionachninae, Coicinae, Dimeriinae, Germainiinae and Tripsacinae) as monophyletic, as opposed to the view that 'none of the subtribes of Andropogoneae is monophyletic' by Spangler *et al.* (1999), Kellogg (2000), Spangler (2000), Mathews *et al.* (2002) and Skendzic *et al.* (2007). In 2016, Burke *et al.* studied evolutionary relationships in Panicoid grasses, and this study did not recognized any monophyletic subtribes within the tribe Andropogoneae. Even though this complete plastome based study largely supported previous studies, the five previously recognized monophyletic subtribes appeared here as non-monophyletic. Though there is no unanimity of opinion regarding the monophyly of subtribes within Andropogoneae, the monophyly of tribe Andropogoneae and subfamily Panicoideae are widely accepted. Besides, almost all molecular studies accepted *Arundinella* Raddi as sister to Andropogoneae (Spangler *et al.*, 1999; Kellogg, 2000; Mathews *et al.*, 2002; Sanchez-Ken & Clark, 2010; Teerawatananon *et al.*, 2011; GPWG II, 2012; Estep *et al.*, 2014). However, it is better to avoid subtribal classifications until there is a comprehensive and robust phylogeny for Andropogoneae (Kellogg, 2000).

In 2002, Mathews *et al.* made a phylogeny of Andropogoneae by the data inferred from phytochrome B, GBSSI and ndhF. This combined data rejected the monophyly of subtribes Andropogoninae and Anthistiriinae and suggested the inclusion of *Arundinella* within the expanded Andropogoneae. Later Skendzic *et al.* (2007) studied the phylogenetic relationships among the tribe Andropogoneae using maximum parsimony and Bayesian analyses of nuclear ITS and chloroplast trnL-F

DNA sequences. Estep *et al.* (2014) studied allopolyploidy and diversification in Andropogoneae using multiple nuclear genes and made a conclusion that the allopolyploidisation account for at least a third of all speciation events. It is remarkable that in Andropogoneae, the number of independent allopolyploidy events is unexpectedly high.

Recently, Arthan *et al.* (2017) analyzed whole chloroplast genomes of species of Andropogoneae in Mainland Southeast Asia along with two outgroup species of *Garnotia* using maximum likelihood and Bayesian inference. After this study, two more significant treatments on Andropogoneae are available (Welker *et al.*, 2020; Arthan e*t al.*, 2021). Welker *et al.* (2020) proposed a new subtribal classification of Andropogoneae by the analysis of whole plastome with the largest sample of genera to date (about 73%), including 65 newly assembled plastomes, together with a broad biogeographic analysis of the Andropogoneae. This new classification comprises 14 subtribes (including two new subtribes, Rhytachninae & Chrysopogoninae), 92 genera and approximately 1224 species. In contrary to Kellogg (2015) and Soreng *et al.* (2017), this treatment accepted and reinstated the subtribe Anthistiriinae of tribe Andropogoneae. Later, Arthan *et al.* (2021) also supported the distinctiveness of Anthistiriinae by the analysis of the plastome and nuclear genomes of *Themeda* and *Heteropogon* with comprehensive sampling. The other major result of this study is neither *Themeda* nor *Heteropogon* is monophyletic. Moreover, this study placed the species *Heteropogon melanocarpus* and *Heteropogon ritchiei* (Hook.f.) Blatt. & McCann under the genus *Themeda* and the genus *Heteropogon* is restricted to two species *H. contortus* (including *H. fischerianus*) as well as *H. triticeus*. It also suggested the diversification of *Themeda-Heteropogon* clade, in the strict sense occurred during the Miocene grassland expansion and spreading of the widespread *T. triandra* and *H. contortus* happened during the Pleistocene. Afterwards, Arthan *et al.* (2022) examined habitat preferences of the grassland/savanna and wetland species of *Themeda* - *Heteropogon* clade. They have analysed 31 species by describing bioclimatic niche characteristics, characterizing functional traits, and investigating the evolution of functional traits in relation to precipitation and temperature.

Literature required for the study were collected from different sources including various institutional libraries and some rare collections were received through personal or official communication with experts and librarians from foreign Universities or research institutes. Historic literature were collected from online information retrieval systems and digitized online libraries such as BHL (Biodiversity Heritage Library), Botanicus (by Missouri Botanical Garden), Harvard Library-online, JSTOR and Google Scholar. Electronic sources such as internet and INFO-NET facilities were also utilized. Indian Ph.D. theses were referred with the aid of Shodhganga (reservoir of Indian theses at INFLIBNET).

Plant specimens were collected by extensive field exploration in South India during the period 2015–2023. Some of the closely related taxa were collected from the nearby states (Gujarat, Madhya Pradesh and Maharashtra) as well. Multiple accessions of different species were collected to study variations. Some fields were continuously observed in two or three years and a few taxa were grown at Calicut University Botanical Garden to study their behaviour and variations. Field photographs including habit and habitat were taken using Canon EOS 1100D DSLR Camera. Field observations regarding the plants such as size, colour, odour if any, and other vegetative and floral characters were noted in the field book. Out of the 37 species known from this region, 36 were collected.

Identification of the collected specimens were done using taxonomic keys provided in the *Genera Graminum – Grasses of the World* (Clayton & Renvoize, 1986) and *The grasses of Burma, Ceylon, India and Pakistan (excluding Bambuseae)* [Bor, 1960]. The available State Grass Floras such as *Flora of Kerala – Grasses* (Sreekumar & Nair, 1991), *Flora of Tamil Nadu – Grasses* (Kabeer & Nair, 2009) and *Grasses of Maharashtra* (Potdar *et al.*, 2012) were also used. The online database, 'GrassBase – the online world grass flora' (Clayton *et al.*, 2006 onwards) were also utilized and further confirmation was done with the help of protologues and type specimens available at various herbaria. Apart from personal collections, specimens housed at Indian herbaria such as AHMA, BARO, BLAT, BSD, BSI, BSID, CAL, CALI, DD, FRC, LWG, MH, RHT, SUK and TBGT were also

examined for the better understanding of variations, and to collect data on distribution, flowering and fruiting. The digital images of specimens from virtual herbaria, K, W, P, E, LINN, MEL, BM and BR were also utilized for comparison, confirmation and for solving nomenclatural matters. Distribution map for each taxa were prepared with the help of QGIS version 3.24.3 (QGIS, 2022) and GeoCAT (Geospatial Conservation Assessment Tool by Royal Botanic Gardens, Kew).

Fig. 7. Photographs showing field exploration.

Morphological studies were made with the help of SMZ-168 stereomicroscope (Motic, Hong Kong, China) and M80 stereo microscope (Leica, Mannheim, Germany). Data sheets for each taxon were prepared and are used while describing the specimens to avoid character missing. Illustrations were made with the help of Camera lucida attached to the Leica microscope whereas photomicrographs were taken using digital camera fitted with the same microscope. Final drawings were made using standard gateway paper and, 0.1 and 0.2 microtip pens (rotring isograph).

Brummit and Powel (1992) were followed for author citations. Whereas citations of taxa were done according to IPNI and POWO (Royal Botanic Gardens,

Kew). The other online databases such as Tropicos (Missouri Botanical Garden), World Checklist of Poaceae (by the Royal Botanic Gardens, Kew) and The Plant List were also utilized. Acronyms of Herbaria were used in accordance with Index Herbariorum (Thiers, continuously updated) and the nomenclature were updated with the latest Shenzhen Code (Turland *et al.*, 2018). Description terminologies were adopted from Beentje (2016) and Simpson (2006). Taxonomic literature by Stafleu and Cowan (1976-1988) were used for obtaining relevant information about authors and Herbaria.

Herbarium specimens were prepared by the dry method following Vogel (1987) and, Bridson and Forman (1998). Handmade sheets of standard size (28 × 42 cm) were used to mount the dried specimens and the sheets were labeled properly with labels of standard size (14.5 × 11 cm). The duly filled and mounted voucher specimens were deposited at CALI.

Herbarium acronyms following Thiers (continuously updated) used here are provided in the Appendix II.

CHAPTER 4

General Morphology of the tribe Andropogoneae

Vegetative morphology

Vegetative morphology of all Poaceae members are somewhat similar. They are either annuals or perennials, or short-lived perennials. The root system are generally fibrous. The stem of grasses are known as culms which is characterised by solid nodes and hollow internodes except in few cases. The aerial portion may be tussock forming or stoloniferous or creeping or erect unbranched. The photosynthetic leaf is comprised of leaf sheath and leaf blade (or leaf lamina). Sheath is the basal portion of the leaf which usually encircles the culm. At the junction of leaf sheath and blade a ligule is present, it is represented by a membrane or by a line of hairs. Sometimes a ligule-like structure is seen at the base of the blade, which is known as the auricle.

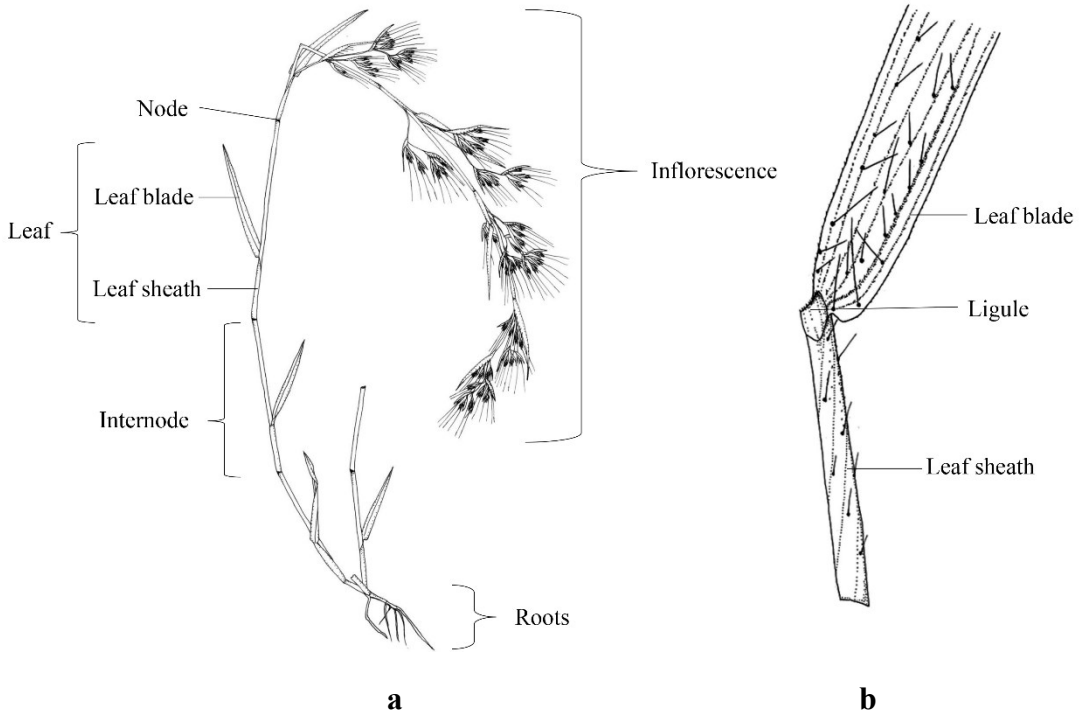

Fig. 8. Vegetative morphology of tribe Andropogoneae: **a.** Habit; **b.** Portion of leaf showing ligule.

Spikelet morphology

The spikelet is the basic reproductive unit of grasses. Here bracts are distichously arranged on a rachilla. A variety of spikelet have been observed in Poaceae due to the reduction of scales or bracts, or by the difference in shape or by the nature of awns etc, yet the overall structural pattern is consistent. In the spikelet, the two lowermost scales are known as lower glume and upper glume respectively, which is followed by lemmas and paleas.

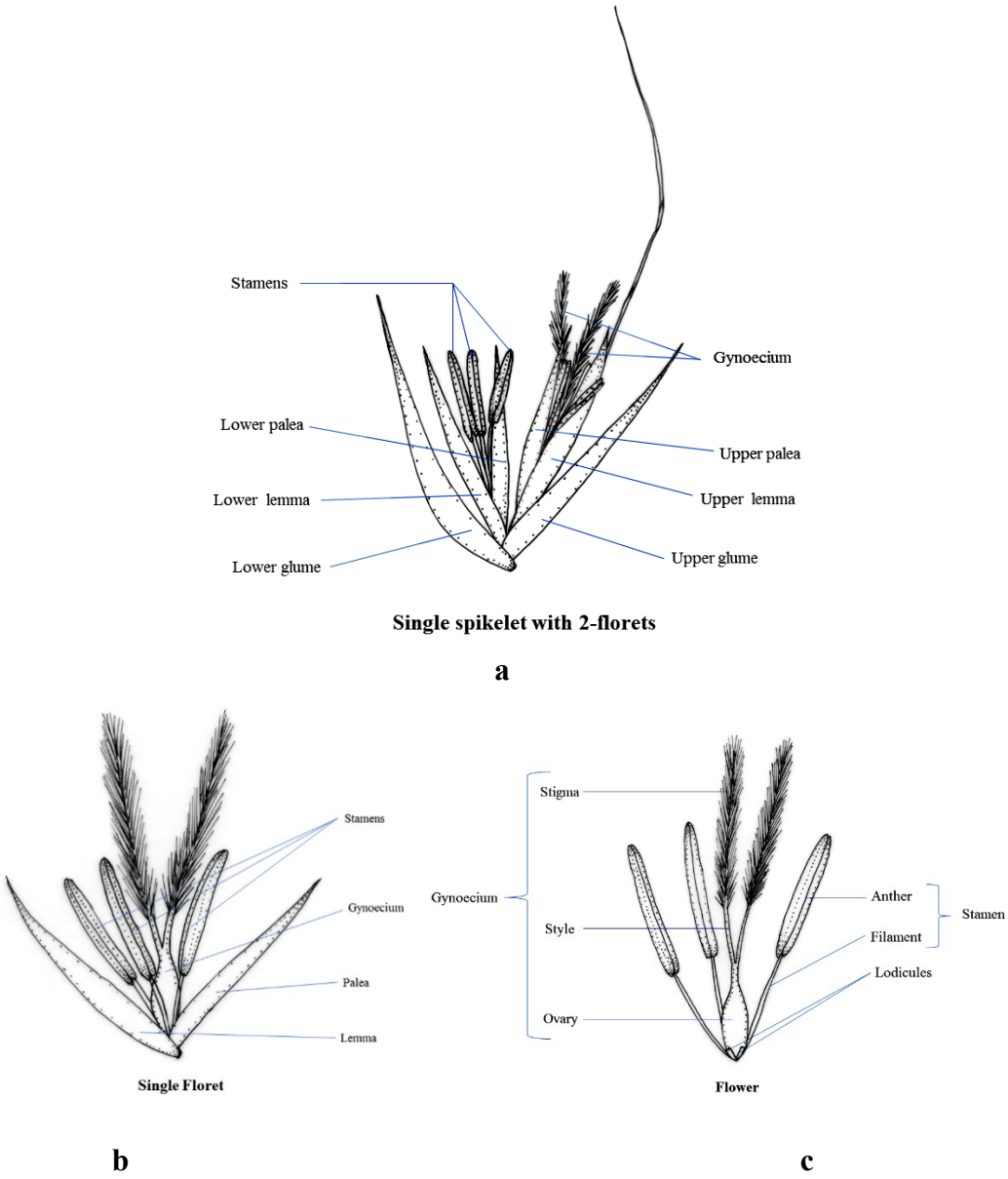

Fig. 9. Spikelet morphology of tribe Andropogoneae: **a.** Single spikelet with 2-florets; **b.** Floret; **c.** Flower.

Enclosed within the lemma and palea, two lodicules, 3 stamens and one gynoecium seen. This unit comprising lemma, palea, lodicule and their reproductive structures are generally termed as a floret .The glumes and lemmas are mainly derived from leaf sheaths. Whereas the palea is interpreted as the prophyll of a diminished axillary branch. The tiny lodicules are the vestigial perianth having role in anthesis. By the action of swelling, these lodicules helps the floret to open and thus helps the emergence of anthers. The main function of glumes, lemmas and paleas are the protection of reproductive structures and caryopses.

In Andropogoneae, spikelets usually contains two florets that means two lemmas and two paleas with their reproductive structures and lodicules. The floret may be either unisexual or bisexual or empty in different taxa. Also enormous range of variation in spikelets are seen within the members of the Andropogoneae by the reduction of glumes, lemmas and paleas. A diagrammatic representation showing the general type of spikelet in Andropogoneae is given in Fig. 9a. Whereas single floret and single flower are shown in Fig. 9b & 9c respectively.

Systematic Treatment

Subtribe Ischaeminae

Ischaeminae J.Presl, Reliq. Haenk. 1(4–5): 328. 1830 (as 'Ischaemeae'); Clayton & Renvoize, Gen. Gram., Grasses World: 345. 1986; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 301. 2015. Apludinae Hook.f., Fl. Brit. India 7: 4. 1897. *Type*: *Ischaemum* L.

Annuals or perennials. Inflorescence terminal, sometimes axillary, rarely spathate; paired, digitate or single racemes, rachis articulated; rachis internode linear to obovoid. Spikelets paired, dissimilar. Sessile spikelets usually bisexual, dorsally or laterally compressed; lower glume chartaceous to crustaceous, with or without median groove; lower floret male; upper lemma awned from the sinus; awn geniculate. Pedicelled spikelets male or bisexual or empty; sometimes reduced or absent and represented by barren pedicel.

Distribution: Throughout the tropics. The subtrib. Ischaeminae include 8 genera with 79 species in the world (Clayton & Renvoize, 1986; modified from POWO); 4 genera with 20 speceis are represented in southern Penisular India (Bor, 1960; Kellogg *et al*., 2020).

Key to the genera of Ischaeminae *s.l.* in southern Peninsular India

1. Ligule hairy; upper glume of sessile spikelet awned ..... 3. ***Sehima***
1. Ligule membranous; upper glume of sessile spikelet unawned **2**
2. Inflorescence a false panicle interrupted by spathes and spatheoles .....1. ***Apluda***
2. Inflorescence usually a binate or digitate raceme without spathe and spatheoles **3**
3. Pedicel barren ..... 4. ***Thelepogon***
3. Pedicel bearing a spikelet ..... 2. ***Ischaemum***

1. Apluda L.

Apluda L., Sp. Pl. 1: 82. 1753; Clayton & Renvoize, Gen. Gram., Grasses World: 346. 1986; Watson & Dallwitz, Grass Gen. World: 126. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 291. 2015. *Lectotype* (designated by Cope in Jarvis *et al.*, Regnum Veg. 127: 20.1993): *Apluda mutica* L.

Annuals or perennials. *Leaf blades* often petiolate. *Ligule* fringed membrane. *Inflorescence* false panicle interrupted by spathe and spatheoles. *Raceme* comprises two pedicelled and one sessile spikelet encircled by a boat shaped spatheole. *Sessile spikelet* bisexual, with bulbous callus; *upper lemma* muticous or awned from the sinus; *awn* geniculate. *Pedicelled spikelets* 2, one reduced to a scale and the other fertile and male.

Distribution: Monotypic genus distributed in Tropical Asia.

Habitat: Forest margins, open waste lands and hill slopes.

Apluda mutica L., Sp. Pl. ed. 1: 82. 1753; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1750. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 93. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 117. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1800. 1983; Karthik. *et al.,* Fl. Ind. Enum. Monocot. 183. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 32. 1991; S.Moulik, Grasses Bamboos India 2: 305. 1997; Pull., Fl. Andhra Pradesh 3: 1128. 1997; K.M.Matthew, Fl. Palni Hills 3: 1585. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 359. 2009; Potdar *et al*., Grasses Maharashtra 31. 2012; Pull., Fl. Telangana 3: 1064. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 35. 2017. *Lectotype* (designated by Cope in Jarvis *et al.*, 1993):— Herb. Linn. No. 1213.1 (LINN) digital image!.

Apluda aristata L., Cent. Pl. II: 7. 1756; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1750. 1934. *Lectotype* (designated by Renvoize in Cafferty *et al.*, 2000):— Herb. Linn. No. 1213.4 (LINN) digital image!.

Apluda geniculata Roxb., Fl. Ind. 1: 327. 1820. *Lectotype* (designated here): *Roxb.* no. 1939 (Icones Roxburghianae). *Apluda gigantea* (P.Beauv.) Spreng., Syst. Veg. [Sprengel.] 1: 290. 1825. *Calamina gigantea* P.Beauv., Ess. Agrostogr. 129, 151, t.23, f.1. 1812. *Type*:— Ess. Agrostogr. t.23, f.1. 1812.

Apluda varia Hack. *in* Engler & Prantl, Nat. Pflanzenfam. 2(2): 26. 1887, *nom. Illeg.*; Hook.f., Fl. Brit. India 7: 150. 1897. *Type*:— Non designatus.

Apluda blatteri Sur, Bull. Bot. Surv. India 28(1−4): 193. 1986. *Type*: INDIA, **Rajasthan**, Mount Abu, 13.10.1916, *Father E. Blatter* 2594 (holo: CAL [CAL0000002341!]).

Figs. 10–14

Erect annuals or perennials, upto 2 m tall, culm erect, yellowish or straw coloured–purplish; *nodes* bulbous, rooting from lower nodes, glabrous, greenish–purplish; *internode* terete–sub-terete, 5–22 cm long, glabrous, younger ones scabridulous, yellowish green–purplish. *Leaves* simple, petioled. *Petiole* 0.5–9 cm long, glabrous, greenish–purplish. *Leaf sheath* 2–12 cm long, striated–ribbed, glabrous, green with purple tinges. *Leaf blade* narrowly elliptic–lanceolate, 8–43 × *ca*. 2 cm, base acute–acuminate, margins scabrous, apex acuminate, chartaceous, dorsal and ventral surface scabridulous, young leaves sparsely tubercle-based hairy on dorsal surface, hairs hyaline, 2–3 mm long; greenish. *Ligule* 1–3 mm long, apex fimbriate, membranous, glabrous, hyaline or yellowish with purple tinge. *Inflorescence* axillary or terminal, false panicle interrupted by spathes and spatheoles. *Spathe* leafy, with sheath, blade and ligule, 1.5–3 cm long, chartaceous, greenish. *Peduncle* linear, 3–4 mm long, ventrally compressed, broad at apex, glabrous, scabridulous on margin at upper 1/3rd, hyaline–pale greenish, sometimes with purple tinge. *Raceme* with 3 spikelets, two pedicelled and one sessile spikelet encircled by a spatheole. *Spatheole* elliptic–narrowly elliptic, *ca*. 5.5 × 2.8–3 mm, cymbiform, ligulate, often blade reduced into arista, margins entire, scabridulous at upper half, chartaceous, dorsal surface

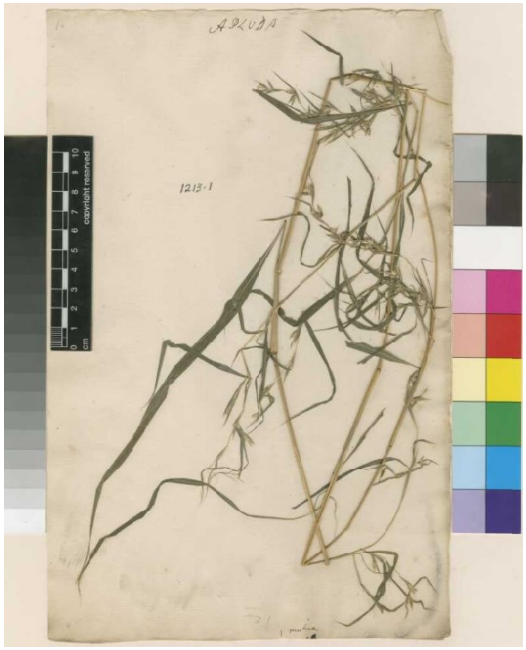

Fig. 10. Lectotype of *Apluda mutica* L. [Herb. Linn. No. 1213.1 (LINN)] © The Board of Trustees of Linnean Society, London. Reproduced with permission.

glabrous, scabridulous at upper 1/4th, hairs minute, ventral surface glabrous, greenish, hyaline towards margins, many nerved; *arista* 1–2 mm long, scabridulous, greenish. *Rachis internode* linear, 0.8–1 mm long, glabrous, greenish. *Callus* ellipsoid, *ca*. 0.8 × 0.5 mm, bulbous, hollow, glabrous, hyaline. *Sessile spikelet ca*. 4 × 1 mm, florets 2. *Lower glume* narrowly ovate, *ca*. 4 × 0.9–1 mm, base truncate, margins entire, scabridulous on upper half, narrowly inflexed in lower half, infolded and keeled at upper half, hyaline, keel narrowly winged and scabridulous, wing hyaline; apex notched–bifid, chartaceous, dorsal surface scabridulous, ventral surface glabrous, greenish, 11-nerved. *Upper glume* narrowly ovate–cymbiform, *ca*. 3.5 × 0.8–1 mm, base truncate, margins entire, infolded at upper half, apex notched–bifid, dorsally keeled at lower 3/4th, humped at middle, keel at lower half glabrous and upper half scabridulous, chartaceous, dorsal surface glabrous, scabridulous at upper half, ventral surface glabrous, 5–9-nerved. *Lower floret* male. *Lower lemma* narrowly ovate, *ca*. 3.3 × 1 mm, base truncate, margins infolded, ciliolate at upper 1/4th, apex mucronate–aristate, membranous, dorsal surface glabrous, scabridulous at upper 1/3rd, ventral surface glabrous, hyaline, 3-nerved; arista small, *ca*. 0.1 mm long, hyaline. *Lower palea* narrowly ovate or narrowly elliptic, *ca*. 3 × 0.5–0.7 mm, base truncate, margins infolded, scabridulous at upper half, laterally keeled, keel scabridulous, apex obtuse–muticous, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.3–0.4 × *ca*. 0.4 mm, hyaline. *Stamens* 3; filament hyaline; anthers *ca*. 1.8 mm long, yellowish. *Upper floret* bisexual. *Upper lemma* narrowly elliptic (when folded), 3–3.5 × 1.5–1.8 mm, folded, apex deeply clefted or bilobed, awned from the sinus, margins of lobes minutely scabridulous, membranous, glabrous, hyaline, 3-nerved; *awn* geniculate, 9–10 mm long, scabridulous, brownish; column *ca*. 4 mm long, glabrous, dark brownish; bristle *ca*. 5.5 mm long, scabridulous, pale brownish. *Upper palea* broadly ovate, *ca*. 1.5 × 0.8 mm, base truncate, margins inflexed, ciliolate at upper half, apex cuspidate, ciliolate, membranous, glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–0.6 × 0.3–0.4 mm, apex truncate–lobed, hyaline. *Stamens* 3; filament hyaline; anthers *ca*. 1.5 mm long, yellowish. *Gynoecium ca*. 5 mm long; ovary narrowly ovate–narrowly elliptic, 0.5–0.7 × 0.2–0.3 mm, glabrous, hyaline–yellowish; style 2, *ca.* 1.5 mm long, hyaline; stigma 2, feathery,

ca. 3 mm long, purple. *Pedicelled spikelets* 2, one sterile and the other fertile. *Sterile pedicelled spikelet* often reduced into a scale, *ca.* 4 × 0.5 mm long, apex bifid, chartaceous, glabrous, scabridulous on margins, hyaline, greenish towards apex. *Fertile pedicelled spikelet ca.* 4 × 0.8 mm, florets 2. Pedicel linear, *ca.* 2.5 × 0.6 mm, dorsiventrally compressed, glabrous, margins scabridulous, sparsely pilose at apex, hyaline–pale greenish. *Lower glume* narrowly ovate, *ca.* 4 × 1 mm, base truncate, margins hyaline, entire, scabridulous at upper half, narrowly keeled near apex, keel scabridulous; apex acuminate–aristate, chartaceous, dorsal surface scabridulous, ventral surface glabrous, greenish, 13-nerved. *Upper glume* narrowly ovate, *ca.* 3.8 × 1.3 mm, cymbiform, base truncate, margins hyaline, entire, inflexed at lower 1/4th, infolded at upper 3/4th, dorsally narrowly keeled at upper 1/4th, keel scabridulous; apex acuminate–aristate, chartaceous, dorsal surface scabridulous, ventral surface glabrous, greenish, 11-nerved. *Lower floret* male. *Lower lemma* narrowly ovate or narrowly elliptic, *ca.* 3 × 1 mm, cymbiform, base truncate, margins entire, scabridulous at upper half, infolded, keeled towards apex, keel scabridulous; apex acute–mucronate, membranous, dorsal surface scabridulous at upper 1/3rd, ventral surface glabrous, hyaline, 3-nerved. *Lower palea* narrowly ovate, *ca.* 2.8 × 0.5 mm, cymbiform, base truncate, margins infolded, keeled, entire, scabridulous at upper 1/4th, keel scabridulous; apex muticous, ciliolate; membranous, glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, *ca.* 0.2 × 0.3 mm, hyaline. *Stamens* 3, 1.8–5 mm long, yellowish; filament 0.5–4 mm long, hyaline; anthers 1.5–2 mm long, yellowish. *Upper floret* male. *Upper lemma* elliptic-narrowly elliptic, 2.5–3 × *ca.* 1 mm, cymbiform, base truncate, margins inflexed at lower 1/4–1/2, infolded at upper half, infolded margins ciliolate; apex aristate, membranous, glabrous, hyaline, 1-nerved; *arista* hyaline, 0.1–0.3 mm long. *Upper palea* broadly ovate–obovate, *ca.* 1 × 0.6 mm, base truncate, margins inflexed–infolded, entire, ciliolate at apex; apex mucronate, membranous, glabrous, hyaline, nerves absent. *Lodicules* 2, cuneate, *ca.* 0.4 × 0.3, hyaline. *Stamens* 3, upto 5 mm long, yellowish; filament 3–4 mm long, hyaline; anthers 1.5–2 mm long, yellowish. *Caryopsis* elliptic, 1.5–1.8 × 0.4–0.6 mm, glabrous, brownish, styles persistent.

Flowering & Fruiting: October to January.

Distribution: Mascarenes, Socotra, Asia to W. Pacific. In India, it is distributed in Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Karnataka, Kerala, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand and West Bengal.

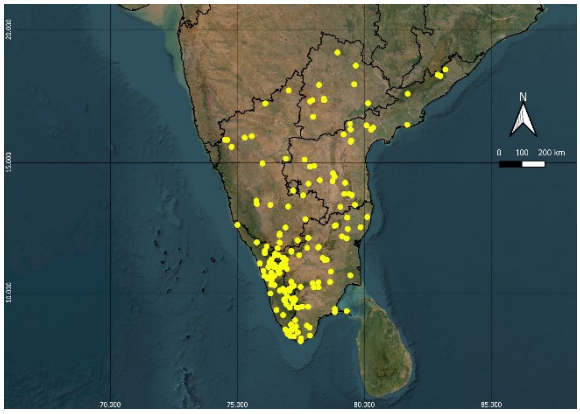

Fig. 11. Distribution of *Apluda mutica* L. in southern Peninsular India

Habitat: Grows in hill slopes, open waste lands, forest margins, bunds of paddy fields and road sides.

Specimens examined: INDIA, **Andhra Pradesh**, Anantapur district, Bukkapatnam, 18.10.1981, *N. Yesoda* 601 (MH); Gooty Fort Hill, 26.12.2021, *V. Drisya* 169590 (CALI); Gundumala R.F., 10.03.1983, *N. Yesoda* 1235 (MH); Katam, Chillavaripalli, 04.10.2016, *J. Swamy & S. Nagaraju* 007976 (BSID); Muchukota R.F., 09.01.1983, *T. Pullaiah & N. Yesoda* 971 (MH); Chittoor district, Balaparalla Gutta, 27.12.1975, *G.V. Subba Rao* 46792 (CAL & MH); Horsley Konda, 06.05. 1918, *s.coll.* 15484 (MH); Kailasanatha Kona, 21.10.2009, *B. Ravi Prasad Rao & P. Priyadarsini* 37134 (BSID); Thalacona Sacred Groove, 09.01.2016, *J. Swamy & S. Nagaraju* 007465 (BSID); East Godavari district, Chinthim, Maredumilli, 22.10.1994, *M. Mohanan* 102608 (MH); Guntur district, Dhulipalla, 11.10.2017, *V. Drisya* 157110 (CALI); Kondaveedu Fort, 17.11.1902, *s.coll*. 4736 (MH); *Ibid.*, 12.10.2017, *V. Drisya* 157119 [CALI184656, CALI184657, CALI184658 & CALI184659]; *Ibid.*, Valley near to Kondaveedu Fort, 12.10.2017, *V. Drisya* 157115 [CALI184660]; Pericherla, 10.10.2017, *V. Drisya* 157105; Rajupalem, 11.10.2017, *V. Drisya* 157108 (CALI); Kadapa district, Balapalle, 10.11.1962, *J.L. Ellis* 15004 (MH); *Ibid.*, 20.02.1963, *J.L. Ellis* 15704 (CAL & MH); Guvvalcheruvu-near road side, 08.10.1958, *K. Subramanyam* 6825 (MH); Kadapa, 00.02.1883, *J.S. Gamble* 10829; near Pushpagiri temple, 31.12.2019, *V. Drisya* 169508 (CALI); Kurnool district, Chelama-Nallamalais, 07.12.1963, *J.L. Ellis*

17946; *Ibid.*, 15.10.1964, *J.L. Ellis* 22002 (MH); Pulusumamella, 05.11.1986, *N. Rama Rao & V.B. Hosagoudar* 83719 (BSID & MH); Nellore district, Kakula Konda, 23.09.1937, *K.C. Jacob* 397 (MH); Palnadu district, Macherla, 11.10.2017, *V. Drisya* 157113 [CALI184661] (CALI); Prakasam district, Peddamantanala, 26.12.2006, *B. Sadasivaiah & S. Khadar Basha* 29397 (BSID); Srikakulam district, Salur forest, 10.09.1962, *N.P. Balakrishnan* 1121 (CAL); Tirupati district, Alipiri, Biosphere Reserve, 19.12.2012, *P.V. Prasanna & M. Sankara Rao* 002893 (BSID); Tirumala, 13.01.2016, *M. Sabu & V. Drisya* 176657; *Ibid.*, 11.10.2016, *Nikhil Krishna & V. Drisya* 176764 (CALI); TTD water sources dept near sannidhanam hill, Seshachalam Biosphere Reserve, 05.10.2013, *P.V. Prasanna & M. Sankara Rao* 003385 (BSID); Visakhapatnam district, Araku Valley, Getuvalasa, 15.10.2017, *V. Drisya* 157121; *Ibid.*, Galikonda, Ghat road side, 15.10.2017, *V. Drisya* 157123; *Ibid.*, 15.10.2017, *V. Drisya* 157126; *Ibid.*, Galikonda Hill, 16.10.2017, *V. Drisya* 157137; *Ibid.*, Sunkarametta, 15.10.2017, *V. Drisya* 157128 (CALI); forest near Anantagiri, 01.09.1960, *N.P. Balakrishnan* 10965 (MH). **Karnataka,** Belgaum district, Belgaum, *s.d.*, *Arun N. Chandore* 140 (SUK); Belgaum district, Belgaum Fort, 03.01.2020, *V. Drisya* 169518 (CALI); Hills near Sambra, 26.10.1978, *Cecil J. Saldanha & P. Prakash* 3571 (CAL); Kanbargi, 03.01.2020, *V. Drisya* 169521 (CALI); Bellary district, Bellary Fort, 01.01.2020, *V. Drisya* 169512 (CALI); Ramandrug, 07.10.1919, *s.coll.* 15896 (MH); Sogi R.F., Hadagalli, 04.11.1975, *N.P. Singh* 141353 (BSI); Sirivaram, 01.01.2020, *V. Drisya* 169510 (CALI); Bidar district, Pandargoa F.P., 18.11.1975, *N.P. Singh* 141814 (BSI); Bijapur district, Mustigiri RF, 12.11.1975, *N.P. Singh* 141643 (BSI); Chamarajanagar district, Gopalaswamy Hills, 30.09.2015, *V. Drisya* 144235; Chikmagalur district, Baba Budangiri, on the way to Manikyadhara, 03.03.2016, *V. Drisya* 176717; *Ibid.*, Kemmanagundi, 03.03.2016, *V. Drisya* 176722 (CALI); Dharwad district, Kottur near Kittur, 26.10.1978, *Cecil J. Saldanha & P. Prakash* 3407 (CAL); Hassan district, Nagpuri Hills, Arsikere, 24.11.1958, *B.M. Wadhwa* 44607 (CAL); *Ibid.* 24.11.1958, *B.M. Wadhwa* 44607 (BSI); *Ibid.*, on the way to Tumkur, 29.09.2015, *V. Drisya* 144226 (CALI); Kodagu district, Nagarhalli, 05.01.1959, *R.K. Arora* 46217 (CAL); Kolar district, Kamsandra S.F. III, 25.10.1975, *N.P. Singh* 140968

(BSI); Mandya district, Mandya, 31.12.2016. *P. Soumya & V. Drisya* 176670; Mysuru district, Chamundi Hills, 30.09.2015, *V. Drisya* 144229; *Ibid.*, 30.09.2015, *V. Drisya* 144231; Marase, 30.09.2015, *V. Drisya* 144232 (CALI). **Kerala,** Ernakulam district, Ernakulam, 05.11.1956, *P.C. Nanda* 863 (DD); Shoolamudi, 14.12.2016, *Shinoj & V. Drisya* 176685 (CALI); Vellarankuthu, Pooyankutty, 23.07.1988, *P. Bhargavan* 90061 (MH); Idukki district, Cheruthoni, 16.02.1982, *C.N. Mohanan* 73312 (CAL & MH); Eravikulam, 05.11.1956, *P.C. Nanda* 863 (CAL); Lakkam Kudimala, on the way to Lakkam Kudi, 06.02.2018, *V. Drisya* 157823 (CALI); Kattappana, 25.09.1981, *C.N. Mohanan* 72047 (CAL & MH); Kumily–Theni, 16.10.2015, *V. Drisya & A.K. Pradeep* 144254; Mattuchola, on the way to top, 04.01.2019, *V. Drisya* 170110 (CALI); Munnar, 13.11.1980, *P.V. Sreekumar* 68446 (BSID); Ozhuvathadam, way to Adimali, 13.11.1991, *P. Bhargavan* 98504 (BSID); Perumala, on the way to Nakkupetti kudi, 03.01.2019, *V. Drisya* 168780; Ramakkalmedu, 19.07.2016, *V. Drisya* 150733; *Ibid.*, 19.07.2016, *V. Drisya* 150739 (CALI); Thekkadi, 09.05.1958, *G.S. Puri* 36835 (BSI); Ullavayal Ghat side, on the way to Mattuchola, 04.01.2019, *V. Drisya* 168795; Vagamon, on the way to Pullikkanam, 15.10.2015, *V. Drisya & A.K. Pradeep* 144247 (CALI); Kannur district, Aralam farm, 26.02.1979, *V.S. Ramachandran* 61936 (CAL & MH); Begur R.F., 11.02.1978, *V.S. Ramachandran* 53858 (CAL & MH); Thadam, Elimalai, 20.10.1981, *P.V. Sreekumar* 71767 (BSID); Kasaragod district, Puthige, 23.01.2020, *V. Drisya* 169523 (CALI); Kottayam district, Pulluparai, 22.01.1965, *K. Vivekananthan* 22971 (MH); Pulluparai to Peruvanthanam, 24.11.1967, *K. Vivekananthan* 29348 (CAL); Vellikulam, Ghat road side, on the way to Vagamon, 26.10.2017, *V. Drisya* 157143 (CALI); Malappuram district, Calicut University Garden (introduced), 28.12.2020, *V. Drisya* 169539 [CALI184662 & CALI184663]; *Ibid.*, 28.01.2021, *V. Drisya* 169571; Manathumangalam, near Perinthalmanna, 03.12.2016, *V. Drisya* 144300; Nadukani, 12.02.2016, *Shinoj & V. Drisya* 150730 (CALI); Nedumgayam to Meenmutty, 13.03.1984, *N.C. Nair* 81217 (MH); *Ibid.* (CAL); Kuttippuram, 23.11.2017, *V. Drisya & A.K. Pradeep* 157748; *Ibid.*, 23.11.2017, *V. Drisya & A.K.*

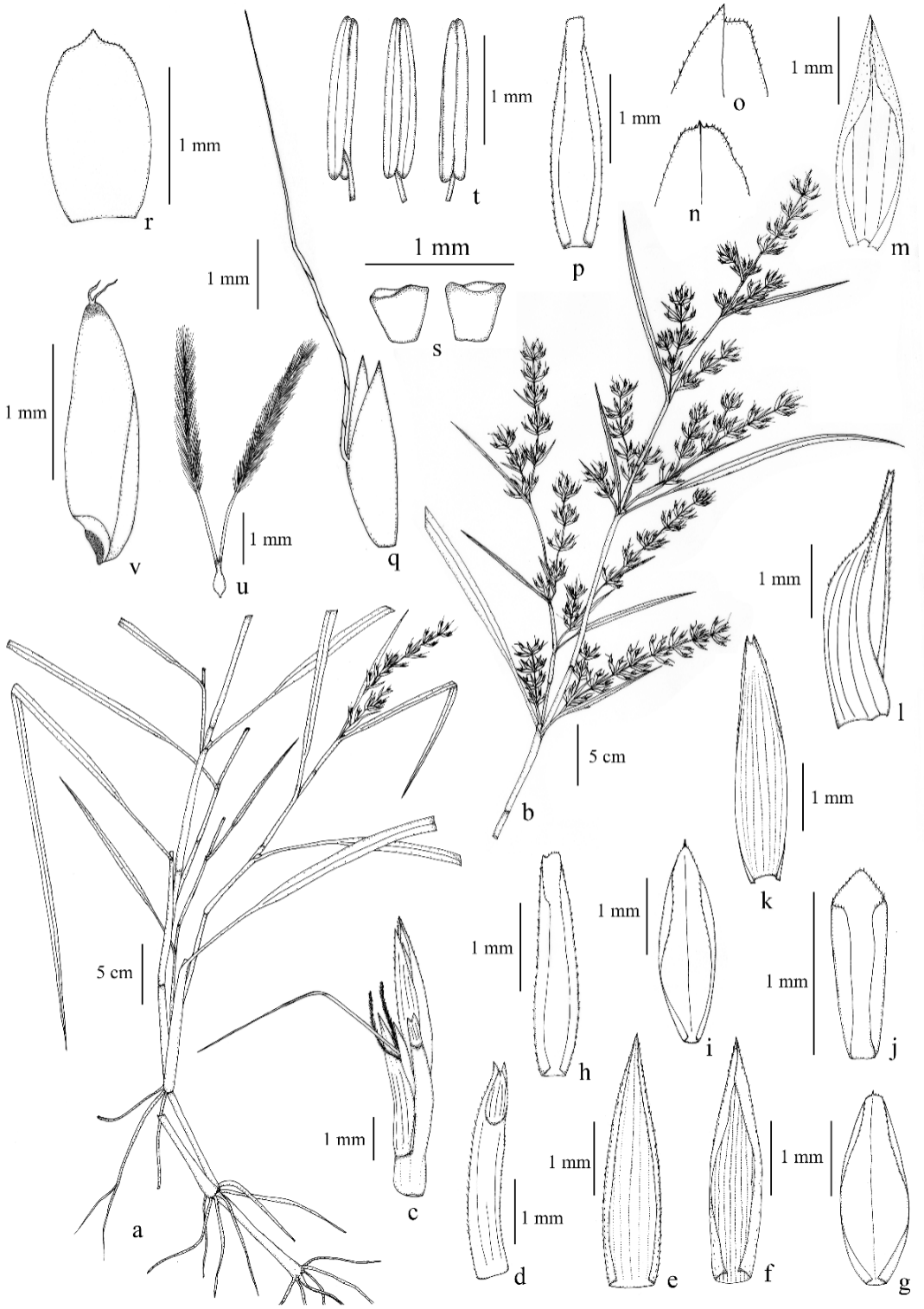

Fig. 12. *Apluda mutica* L.: **a & b.** Habit; **c.** Spikelet triad showing one sessile spikelet, one fertile and one reduced pedicelled spikelet; **d.** Reduced sterile pedicelled spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**e–j**: Pedicelled spikelet); **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma; **n & o.** Variation in apex of lower lemma; **p.** Lower palea; **q.** Upper lemma; **r.** Upper palea (**k–r**: Sessile spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium; **v.** Caryopsis (from *V. Drisya* 169539, drawn by V. Drisya).

Pradeep 157750 (CALI); Nilambur, 21.01.1953, *K.M. Vaid* 23443 (DD); Palakkad district, Aruvampara Estate, 04.05.1980, *V.J. Nair* 67518 (CAL & MH); Aruvampara grassy slopes, 10.10.1979, *N.C. Nair* 64472 (CAL & MH); Dhoni, 20.02.2011, *C.E.C. Fischer* 2577 (FRC); Kunthipuzha riverside, 23.04.1980, *V.J. Nair* 67277 (CAL & MH); Manappulli, 03.01.2016, *V. Drisya* 171478; Ottappalam, near Varikkassery Mana, 03.01.2016, *V. Drisya* 171485; *Ibid.*, 03.01.2016, *V. Drisya* 171486 (CALI); Parathode, 19.06.2008, *J. Remya* 63137 (TBGT); Padur, 05.12.2018, *V. Drisya* 157896; *Ibid.*, 05.12.2018, *V. Drisya* 157898; *Ibid.*, 05.12.2018, *V. Drisya* 176202; *Ibid.*, 05.12.2018, *V. Drisya* 176203; *Ibid.*, 05.12.2018, *V. Drisya* 176204; *Ibid.*, 05.12.2018, *V. Drisya* 176205; *Ibid.*, 05.12.2018, *V. Drisya* 176206; *Ibid.*, 05.12.2018, *V. Drisya* 176207; Palakkad, near Govt. Victoria College, 04.12.2015, *V. Drisya* 150785 (CALI); Silent Valley National Park, Sairandhri, 06.11.2012, *J. Remya* 74567; *Ibid.*, 06.11.2012, *J. Remya* 74585 (TBGT); Silent Valley, 26.12.1996, *S. Anil Kumar* 33620 (TBGT); Pathanamthitta district, Pamba range, Udumpara, near Ezhukuman, 18.11.2017, *V. Drisya* 157744 (CALI); Thiruvananthapuram district, Agasthyamala, on the way to Attayar, 20.12.2018, *V. Drisya* 168733 (CALI); Bonacaud, 21.12.1987, *N. Mohanan* 9107; *Ibid.*, 17.10.1988, *N. Mohanan* 4481; *Ibid.*, 22.10.1988, *N. Mohanan* 7911; *Ibid.*, 22.12.1988, *N. Mohanan* 7930 (TBGT); Kariavattom, 21.03.1980, *P.V. Sreekumar* 67127 (BSID & MH); *Ibid.*, 26.03.1980, *P.V. Sreekumar* 67148 (BSID & MH); Klamala R.F., Neyyar, 15.03.1980, *M. Mohanan* 66654 (MH); Kottur, 25.02.1979, *M. Mohanan* 59363 (MH); Kovalam, 28.02.1979, *M. Mohanan* 59418 (CAL & MH); Ponmudi, 26.11.1992, *Santhosh & Jabbar* 14754 (TBGT); Sreekariyam, 19.03.1980, *P.V. Sreekumar* 67118 (MH); Thrissur district, Chalakudy range, Thumbermozhy, 10.12.1965, *K.M. Sebastine* 26711; *Ibid.*, 10.12.1965, *K.M. Sebastine* 26713; Kombazha, 04.02.2018, *V. Drisya* 157820; Kunnamkulam, 20.01.2016, *V.S. Hareesh & V. Drisya* 176655; Mullamkunnathukavu, 20.01.2016, *V.S. Hareesh & V. Drisya* 176656 (CALI); near Peechi Dam, 09.04.1977, *K. Ramamurthy* 49276 (CAL & MH); near Shobha city, 12.11.2015, *Thoiba Kottekkattu & V. Drisya* 144281 (CALI); Velanimala, 21.10.1997, *T. Shaju & R. Rajesh* 36023 (TBGT); Wayanad district, Chembra, on the way to Lake, 30.12.2015,

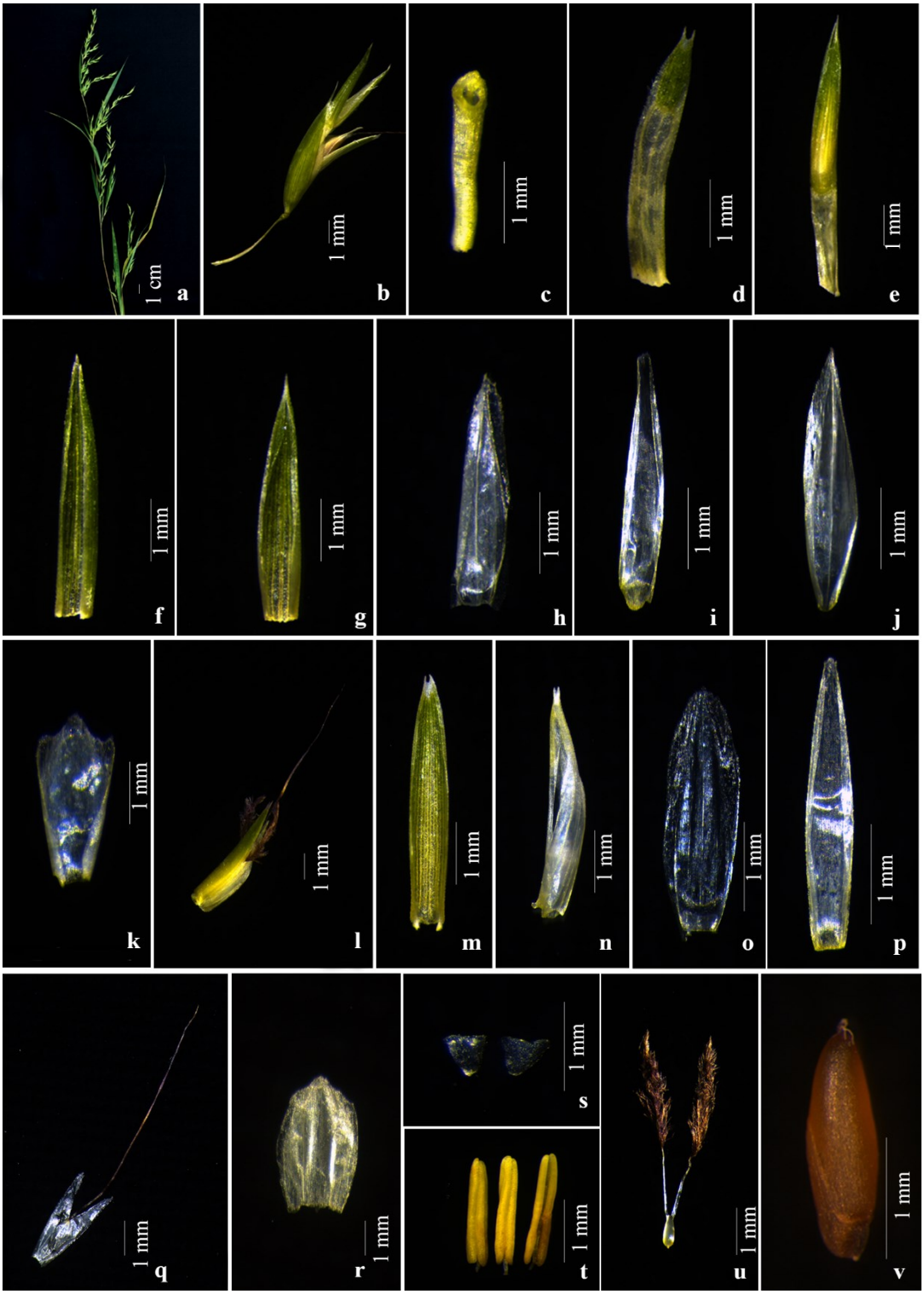

Fig. 13. *Apluda mutica* L.: **a.** Habit; **b.** Raceme; **c.** Rachis internode; **d.** Undeveloped pedicelled spikelet; **e.** Pedicelled spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea (**e–k:** Pedicelled spikelet); **l.** Sessile spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Lower palea; **q.** Upper lemma; **r.** Upper palea (**l–r:** Sessile spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium; **v.** Caryopsis.

V. Drisya 176704; Kalpetta, 31.12.2015, *V. Drisya* 176715; Pulppally, 16.10.2016, *Shimi Cherian & V. Drisya* 176659 (CALI). **Tamil Nadu**, Chengalpattu district, Bund side of Vedanthangal W.B. Sanctuary, 26.01.1976, *A.N. Henry* 47057 (CAL & MH); Madras Christian College Campus, Tambaram, 25.05.1985, *D. Narasimhan* 823 (MH); Coimbatore district, Anakkatti, 22.01.1931, *S.R. Raju & Naganathan* 4825; *Ibid.*, 22.01.1931, *S.R. Raju & Naganathan* 4843 (MH); Bolampatti Hills, 14.12.1910, *C.E.C. Fischer* 2424 (FRC); Boluvampatty Hills, near Vaidagi falls, 10.11.2002, *K.A.A. Kabeer* 114622; Gobichettipalayam, 28.11.1931, *S.R. Raju* 6231 (MH); Maruthamalai, 10.12.1956, *K.M. Sebastine* 1689 (CAL & MH); *Ibid.*, 03.12.1969, *M.V. Viswanathan* 264 (MH); *Ibid.*, 04.12.2017, *V. Drisya* 157755 (CALI); On the road to Siruvani, 21.11.1956, *K. Subramanyam* 1411 (CAL); Siruvani, 28.12.1956, *K. Subramanyam* 1840 (CAL); Slope of Konamalai, 15.11.1962, *C.P. Sreemadhavan* 252 (MH); Kurudimalai, 21.12.1956, *K. Subramanyam* 1814 (CAL & MH); *Ibid.*, 24.11.2002, *K.A.A. Kabeer* 114733; on the slopes of Kurudimalai, 30.07.1956, *K. Subramanyam* 408; Madukkarai Hills, 09.11.2002, *K.A.A. Kabeer* 114467; Nellimalai R.F., 22.03.1963, *K. Ramamurthy* 16056; Palamalai Hills, 13.12.2003, *K.A.A. Kabeer* 117191; Shiruvani, 28.12.1956, *K. Subramanyam* 1840 (MH); Topslip, 00.11.1937, *N.L. Bor s.n.*; *Ibid.*, 08.11.1956, *P.C. Nanda* 919; *Ibid.*, 08.11.1956, *B.D. Patil* 926 (DD); Velliangiri Hill, 30.09.2016, *A.K. Pradeep & V. Drisya* 150711 (CALI); Dindigul district, Anna, Palni Hills, Palani-Kodaikanal Ghat road, Kombaikkadu, 27.11.1985, *K.M. Matthew & N. Rajendran* 43340; Dindigul rock, 20.12.1969, *K.M. Matthew* 10645; Sirumalais, 16.12. 1959, *J. Pallithanam* 5408 (RHT); Erode district, Bannari to 1st hair pin bend, 03.01.1988, *N. Venkatasubramanian* 1113; *Ibid.*, 03.01.1988, *N. Venkatasubramanian* 1148; Dhimbam–Bannari Ghat road, 26.01.1987, *N. Venkatasubramanian* 231; Dhimbam–27th hair pin bend, 11.01.1987, *N. Venkatasubramanian* 141 (FRC); Kanyakumari district, Balamore Estate, 24.03.1960, *R.S. Rao* 61384 (BSI); Kulesekharam to Thakkalai, Marthandam, 19.08.2003, *K.A.A. Kabeer* 17153 (MH); Maruthwamalai, 30.10.2015, *V. Drisya* 144274; *Ibid.*, 30.10.2015, *V. Drisya* 144277; *Ibid.*, 30.10.2015, *V. Drisya* 144278; *Ibid.*, 30.10.2015, *V. Drisya* 144279; on the way to Maruthwamalai, 30.10.2015, *V.*

Drisya 144272 (CALI); Sengamal Estate, 27.07.1966, *B.V. Shetty* 28005 (CAL & MH); Madurai district, Beside Gudalur-Kumili road-Cumbum valley, 20.06.1959, *K. Subramanyam* 8063 (MH); Kambam, 00.05.1917, *s.coll. s.n.* (BLAT); Nilgiris district, Gudalur, Chinna Choondi, 'O' Valley, 25.02.2018, *V. Drisya* 157834 (CALI); Kateri-Coonoor, 05.03.2004, *K.A.A. Kabeer* 117784; Marappalam-Burliar, 04.12.1971, *N.C. Rathakrishnan* 39133 (MH); Mudumalai R.F., 18.11.1958, *K.M. Sebastine* 7343 (CAL & MH); North Arcot district, Tippukadu RF, 26.11.1963, *K. Ramamurthy* 17928 (CAL & MH); way to Komattiyur, 14.12.1958, *K. Subramanyam* 7472 (CAL & MH); Pudukkottai district, Kudumiyamalai, 05.02.1985, *C. Arulappan* 329 (MH); Ramanathapuram district, Ayyanarkoil, 24.02.1979, *N.C. Nair* 61402 (CAL & MH); Deviar Estate, Sethur Hills, 12.03.1980, *S.R. Srinivasan* 65919 (CAL & MH); Nagariar Estate to Sathaankoil, 13.06.1979, *S.R. Srinivasan* 63599 (CAL); Rameswaram, *V. Balasubramaniam* 1984 (MH); Samythoppu, Sundharamadayan, 20.02.1988, *V. Balasubramaniam* 1583; *Ibid.*, 20.02.1988, *V. Balasubramaniam* 1584; Sethukarai, 05.05.1987, *V. Balasubramaniam* 1319 (CAL); Ramnad district, Alagar koil forest, 25.07.1965, *E. Vajravelu* 24896 (MH); Salem district, Ghat road, Salem to Yercaud, 21.12.1958, *K. Subramanyam* 7588 (CAL & MH); Yercaud, 10.12.2017, *Nikhil Krishna & V. Drisya* 157764 (CALI); Hogainakkal forest, 24.11.1919, *E. Vajravelu* 21912 (CAL & MH); Kolli Hills, Ghat road, 15.01.1976, *K.M. Matthew & V. Alphonse* 900 (RHT); South Arcot district, Annamalai Nagar, 31.01.1958, *K.M. Sebastine* 5224 (CAL & MH); Gingee to Chettupattu, 19.02.1979, *K. Ramamurthy* 60307 (CAL & MH); Thanjavur district, Mannai, 05.03.1987, *S. Ragupathy* 296 (CAL & MH); Thiruvannamalai district, Hoganakkal–Dharmapuri National Highway, 18.01.2016, *K.M. Lamiya & V. Drisya* 176653 (CALI); Tiruchirappalli district, Sobanapuram, near rest house, 29.12.1975, *K.M. Matthew & C. Rjamani* 409; Tiruchi, 26.11.1975, *C. Rajamani* 122 (RHT); Puliyancholai, 22.03.1959, *K.M. Sebastine* 7937 (CAL & MH); Tirunelveli district, Manchola, 25.06.1957, *K.M. Sebastine* 3643; Mundanthurai, 11.07.1959, *K.M. Sebastine* 8466; Near Tiger Falls, 12.05.1958, *K.M. Sebastine* 5886; *Ibid.*, 04.03.1958, *K.M. Sebastine* 5513 (CAL); Pulikulam near Tisayanvilai, 21.01.2002, *K.A.A. Kabeer* 113113 (MH); Tiruvannamalai district, Javadi Hills, 26.01.2001,

K.M. Matthew 72452 (RHT); Tuticorin district, Karunkulam canal bed, Tamiraparani river, 27.01.2002, *K.A.A. Kabeer* 113167 (MH); Virudhu Nagar district, Iyanar Koil Hills, Rajapalayam, 25.01.2003, *K.A.A. Kabeer* 114855; Thiruthangal tank, Sivakasi, 28.01.2003, *K.A.A. Kabeer* 114895 (MH). **Telangana,** Hyderabad district, Hyderabad, 00.00.1941, *M.R. Saxena* 219; Upperpally, 13.07.1940, *M.R. Saxena* 308 (DD); Mahabubnagar district, Natural teak garden, 18.10.1996, *S.R. Srinivasan* 108626 (BSID); Mancherial district, Indhanpalli-Range, Narlapur-Beat, Kawal Tiger Reserve, 26.10.2013, *P.S. Annamma* 003910 (BSID); Medak district, Medak, 14.05.1995, *R. Gopalan* 104016 (BSID); Pegarikuttu East-Narsapur, 24.09.1958, *K.M. Sebastine* 6703 (MH); Karimnagar district, Manthani, 06.11.1987, *M.R. Rajendra Prasad* 601 (MH); Khammam district, Nellippakka forest, 21.11.1993, *R. Chandrasekaran* 98903 (MH); Warangal district, Kanapur R.F., 24.11.1960, *K.M. Sebastine* 11569 (MH).

Additional specimens examined (from other than study area): INDIA, **Gujarat**, Panchmahal district, Dhanpuri, 02.11.2018, *V. Drisya* 171465; Jambughoda Wildlife Sanctuary, 02.11.2018, *V. Drisya* 171466; Pavagadh, 02.11.2018, *V. Drisya* 171453; *Ibid.*, 02.11.2018, *V. Drisya* 171455; *Ibid.*, near second monument, 02.11.2018, *V. Drisya* 171460; *Ibid.*, Sath kamaan, 02.11.2018, *V. Drisya* 171461 (CALI). **Madhya Pradesh**, Ujjain district, Ujjain, Vikram University Campus, 06.11.2017, *V. Drisya* 157702 (CALI). **Maharashtra**, Kolhapur district, Shivaji University Campus, 14.01.2017, *V. Drisya* 171423; Tillari, 08.01.2017, *V. Drisya* 171405; Tillari Ghat, 08.01.2017, *V. Drisya* 171413 (CALI). **Uttar Pradesh,** Lucknow district, Lucknow, NBRI

Fig. 14. Lectotype of *Apluda geniculata* Roxb.: Drawing in Icones Roxburghianae no. 1939 (K) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

Botanical Garden, 10.11.2016, *V. Drisya* 176673 (CALI).

Notes on typification: The name *Apluda geniculata* was first appeared in Roxburgh's *Hortus Bengalensis* (1814), which was a *nomen nudum*. Later in 1820, Roxburgh validated the name in his *Flora Indica*. In 1820's treatment, Roxburgh provided a detailed note on characters as well as information regarding habitat as 'found on the banks of the Ganges in flower during the latter part of the rains and the cool season', but he did not cite any specimens. Authors also failed to trace any herbarium specimen seen or used by Roxburgh while describing *Apluda geniculata*. Hence, the only available element, the illustration of *A. geniculata* belonging to *Icones Roxburghianae* (collection of unpublished drawings by Roxburgh) with Roxb. no. 1939, is selected here to serve as the lectotype.

2. Ischaemum L.

Ischaemum L., Sp. Pl. 2: 1049. 1753; Clayton & Renvoize, Gen. Gram., Grasses World: 345. 1986; Watson & Dallwitz, Grass Gen. World: 498. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 302. 2015. *Lectotype* (designated by Nash, N. Amer. Fl. 17: 94. 1909; affirmed by M.L.Green, Prop. Brit. Bot. 193. 1929):— *Ischaemum muticum* L.

Annuals or perennials, caespitose, rhizomatous or stoloniferous. *Leaves* often cordate or linear–lanceolate, with or without pseudopetiole; sometimes possess auricles. *Ligule* usually membranous or a fringed membrane. *Inflorescence* terminal and axillary, usually paired or digitate racemes rarely solitary; in many cases the binary racemes generally one sided and interlocked back-to-back thus simulating a single spike; mostly exserted but sometimes embraced by a spatheole. *Rachis internodes* and *pedicels* stoutly linear–obovoid, chartaceous–crustaceous, exposed on the back of the raceme and together forming a U-shaped or V-shaped segment, hairy or glabrous. *Spikelets* usually have 2-florets, rarely with 1-floret by reducing the other; often paired with one sessile and one pedicelled spikelet. *Pedicelled spikelets* bisexual, male or empty. *Sessile spikelets* usually possess bisexual upper floret and staminate lower floret; *lower glume* dorsiventrally compressed, winged or not, rugose or not, sometimes side-noduled, usually unawned, sometimes awned;

upper glume awned or not; *lemmas* and *paleas* membranous; *upper lemma* usually awned, sometimes awn absent or reduced, *awn* usually geniculate, very rarely straight (mostly when it is reduced). *Caryopsis* narrowly elliptic or oblong, usually with persistent style base.

Distribution: Throughout the tropics, but mainly in Asia. About 68 species in the world (modified from POWO); 27 in India (modified from Kellogg *et al.*, 2020) and 16 in southern Peninsular India (Kellogg in Kubitzki, 2015; Kellogg *et al.*, 2020).

Habitat: Damp or shady places. Seen in grasslands both in high altitude and lowlands; waste lands; lateritic plateaus, marshy or aquatic and in rice fields.

Key to the species of *Ischaemum* in southern Peninsular India

1. Racemes 3–12; hairy **2**

1. Racemes usually 2, rarely 3 or solitary; hairy or glabrous **3**

2. Lower glume of both sessile and pedicelled spikelets with a shallow depression; upper lemma of sessile spikelet deeply clefted upto the base of awn ….1. ***I. afrum***

2. Lower glume of both sessile and pedicelled spikelets without depression; upper lemma of sessile spikelet bifid but not deeply clefted upto the base of awn .... 10. ***I. polystachyum***

3. Spikelets strictly awnless, not even with rudimentary or reduced awn in upper lemma ..... 9. ***I. muticum***

3. Spikelets prominently awned, or sometimes with rudimentary or reduced awn in upper lemma which may or maynot be seen out of the spikelets **4**

4. Margins of the lower glume of the sessile spikelet expanded in the lower half **5**

4. Margins of the lower glume of sessile spikelet narrowly or evenly inturned or inflexed from base to apex **6**

5. Lower glume of sessile spikelet broadly or narrowly winged on both sides towards apex; wing often auriculate ..... 4. ***I. ciliare***

5. Lower glume of sessile spikelet not winged towards apex ….. 15. ***I. timorense***

6. Racemes binate or separate; rarely solitary, then leaf base cordate or sagittate **7**

6. Racemes adpressed together and looks like solitary 8

7. Culms erect to diffuse with or without stilt rooted lower nodes; racemes constantly binate ..... 11. ***I. pushpangadanii***

7. Culms geniculately ascending to creeping; racemes binate or solitary, if binate then leaves less than 8 cm long ..... 14. ***I. semisagittatum***

8. Lower glume of sessile spikelet wrinkled or not with side nodules deeply or shallowly interconnected, but without deep ridges and furrows ..... 8. ***I. molle***

8. Lower glume of sessile spikelet usually with side nodules joined by sharp or shallow ridges and furrows or rugose; rarely smooth but then winged on one-side towards apex **9**

9. Lower glume of pedicelled spikelet winged on one margin **10**

9. Lower glume of pedicelled spikelet unwinged **11**

10. Leaf margins entire, undulate or sinuate; rachis internode always long pilose along dorsal margin; lower glume wing in pedicelled spikelet with purplish shade ..... 12. ***I. rangacharianum***

10. Leaf margins scabridulous, not undulate or sinuate; rachis internode glabrous or very minutely puberulent; lower glume wing in pedicelled spikelet without a purplish shade **12**

11. Annuals; lower glume of sessile spikelet two aristate or two awned; upper glume of sessile spikelet with a tuft of hairs dorsally at middle ..... 7. ***I. kingii***

11. Annuals or perennials; lower glume of sessile spikelet not aristate or not awned; upper glume of sessile spikelet without a tuft of hairs **13**

12. Lower glume of sessile spikelet broadly winged and wing auriculate towards apex ..... 2. ***I. barbatum***

12. Lower glume of sessile spikelet either narrowly winged or unwinged towards apex, if winged, then wing auriculate .....16. ***I. travancorense***

13. Lower glume of sessile spikelet rugose, or side nodules interconnected by sharp or shallow ridges ..... 13. ***I. rugosum***

13. Lower glume of sessile spikelet smooth or wrinkled, side nodules absent or if present then not interconnected by ridges **14**

14. Plants annuals; upper glume of sessile spikelet with a dorsal hump in the middle **15**

14. Plants annuals or perennials; upper glume of sessile spikelet without a dorsal hump ..... 5. ***I. commutatum***

15. Upper lemma of pedicelled spikelet aristate; lower glume of sessile spikelet with 2- semilunar depressions; leaf margins scabridulous ..... 6. ***I. impressum***

15. Upper lemma of pedicelled spikelet acuminate; lower glume of sessile spikelet without any semilunar depressions; leaf margins entire .....3. ***I. cannanorensis***

1. Ischaemum afrum (J.F.Gmel.) Dandy in F.W.Andrews, Fl. Pl. Sudan 3. 476. 1956; B.R.P.Rao *et al*., Grasses Arid Zone Penins. India 131. 2017. *Andropogon afer* J.F.Gmel., Syst. Nat., ed. 13[bis]. 2(1): 166. 1791. *Lectotype*:—— dessins in Bruce, Travels 5: 47 (1790). Sheet not traceable.

Ischaemum pilosum (J.G.Klein ex Willd.) Wight, Madras J. Lit. Sci. 3: 138. 1835; Hook.f., Fl. Brit. India 7: 130. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1723. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 183. 1960; N.P.Singh *et al*., Bull. Bot. Surv. India 18(1−4): 122. 1976; Karthik. *et al.,* Fl. Ind. Enum. Monocot.

232. 1989; S.Moulik, Grasses Bamboos India 2: 295. 1997; Pull., Fl. Andhra Pradesh 3: 1211. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 426. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 819. 2008; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 440. 2009; Srivastava & V.J.Nair, Nelumbo 52: 84. 2010; Potdar *et al.,* Grasses Maharashtra 193. 2012; Pull. Fl. Telangana 3: 1138. 2015. *Andropogon pilosus* J.G.Klein ex Willd., Sp. Pl., ed. 4 [Willdenow] 4(2): 920. 1806. *Lectotype* (designated here):— INDIA, **Karnataka**, Mysore, 29.09.1800, *Heyne s.n.* (lecto: K [K000245689 digital image!]; isolecto: B [B-W 18649-010 digital image!]).

Figs. 15–18

Tufted perennials, rhizomatous, erect, 50–200 cm tall; *nodes* glabrous; *internodes* terete, 10–20 cm long, glabrous, greenish. *Leaves* sessile; *leaf sheath* 10–15 cm long, rounded, margins entire, chartaceous, both dorsal and ventral surfaces glabrous, greenish; *leaf blade* linear–lanceolate, 35–40 × 0.5–0.8 cm, base obtuse or rounded, margins scabridulous, apex acuminate, chartaceous, both abaxial and adaxial surfaces scabridulous–puberulent, greenish. *Ligule* ovate, 4–5 mm long, membranous, dorsally sparsely pilose, pale brownish–brownish. *Spathe* leafy with reduced lamina. *Peduncle* terete, 15–18 cm long, glabrous, greenish. *Racemes* 2–7, usually more than 2, densely hairy, digitate or subdigitate, 10–20 cm long. *Rachis internode* clavate, 3.8–4 × 1–1.2 mm, hollow, 3-angled, coriaceous, ventral surface membranous–chartaceous, dorsally scabridulous–sparsely scabridulous, dorsal margin glabrous, the two lateral margins densely pilose, hairs hyaline, yellowish green. *Sessile spikelet* bisexual, awned, narrowly elliptic, *ca.* 7 × 1.5–2 mm, yellowish green, hairy; callus densely long pilose, hairs hyaline. *Lower glume* narrowly ovate, 6–6.5 × 1.8–2 mm, cymbiform, margins entire, inflexed or infolded, laterally keeled, keel densely pilose throughout and scabridulous near apex, apex acute–acuminate, chartaceous, dorsal surface densely pilose and scabridulous, ventral surface scabridulous or puberulent, dorsally depressed, yellowish green with a small brown tinge at apex, 6–8-nerved. *Upper glume* narrowly ovate, 6.5–7 × *ca.* 2 mm, cymbiform, dorsally keeled, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, apex acute–acuminate, subcoriaceous, dorsal surface glabrous with scabridulous and densely pilose dorsal keel, ventral surface glabrous–very

sparsely puberulent, hairs seen along midvein towards upper half, yellowish green, 8–9-nerved. *Lower lemma* narrowly elliptic or oblong, 6–6.5 × 1–1.3 mm, margins inflexed or infolded at lower half, infolded and ciliate at upper half, apex acute, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 2-nerved. *Lower palea* narrowly elliptic, 5.5–6 × 1.2–1.5 mm, cymbiform, margins inflexed or infolded, ciliolate at upper 1/3rd, apex acute, subcoriaceous–membranous, dorsal surface glabrous, ventral surface puberulent, hyaline or pale greenish, 2-nerved. *Upper lemma* narrowly ovate or narrowly elliptic, *ca*. 5.5 × 1.8–2 mm, cymbiform, margins inflexed at lower 1/3rd, inflexed or infolded and ciliate at upper 2/3rd, apex bilobed, awned from the sinus, lobes deep upto the base of awn, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 3-nerved, nerves jointed at the base of the awn; *awn* geniculate but not well developed, 6.5–8 mm long, pale brownish; column minutely twisted, 4 mm long, sparsely scabridulous; bristle 2.5–4 mm long, scabridulous. *Upper palea* narrowly elliptic, *ca*. 4 × 1–1.2 mm, margins ciliate–ciliolate, inflexed or infolded, apex acute, membranous, glabrous or minutely puberulent, hyaline, 2-nerved. *Lodicules* 2, cuneate, *ca*. 0.6 × 0.4–0.6 mm, hyaline. *Stamens* 3; anthers 2.5–3 mm long, yellowish. *Ovary* oblong–elliptic, *ca*. 0.8 × 0.2–0.3 mm, brownish; *style* 2, *ca*. 2 mm long, hyaline; *stigma* 2, plumose, *ca*. 3 mm long, purplish. *Pedicelled spikelet* bisexual, awned, narrowly ovate, 5–6 × 1–1.5 mm, densely hairy, greenish; callus densely long pilose, hairs hyaline. *Pedicel* clavate, *ca*. 4 × 0.8–1 mm, hollow, dorsiventrally compressed or dorsiventrally flattened, the two lateral margins densely pilose, hairs hyaline, coriaceous, ventral

Fig. 15. Lectotype of *Andropogon pilosus* J.G.Klein ex Willd. [*Heyne s.n.* (K000245689)] © The Board of Trustees for The Royal Botanic Gardens, Kew.

surface membranous, both dorsal and ventral surfaces scabridulous–sparsely scabridulous. *Lower glume* narrowly ovate, *ca*. 6 × 1.8–2 mm, cymbiform, dorsally shallowly depressed, margins entire, inflexed or infolded, laterally keeled, apex acuminate, chartaceous, keel and dorsal surface scabrous–scabridulous and densely long pilose, ventral surface glabrous and scabridulous near apex, greenish with brown tinge at apex, 9–10-nerved. *Upper glume* narrowly ovate, 6–6.5 × 1.8–2 mm, cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, apex acuminate, chartaceous, dorsally keeled, dorsal surface long pilose along keel, ventral surface puberulent towards apex, greenish, 8-nerved. *Lower lemma* narrowly elliptic or narrowly ovate, *ca*. 5.5 × 1–1.2 mm, margins inflexed at lower 1/3rd or lower half, infolded and ciliate at upper 2/3rd or at upper half, apex acute–obtuse, membranous, dorsal surface glabrous, ventral surface glabrous–puberulent, hyaline–pale greenish, 2-nerved. *Lower palea* narrowly ovate, *ca*. 5 × 1 mm, cymbiform, margins inflexed at lower 1/3rd or at lower half, infolded at upper 2/3rd or at upper half, infolded margins ciliate, apex acute and ciliate–ciliolate, chartaceous, both dorsal and ventral surfaces puberulent–glabrous, hyaline–pale greenish, 2-nerved. *Upper lemma* similar to that of sessile spikelet, narrowly ovate, 4.5–5 × 1.5–1.8 mm, cymbiform or folded, margins inflexed at lower 1/3rd, inflexed or infolded and ciliate at upper 2/3rd, apex bilobed, awned from the sinus, lobes deep upto the base of the awn, lobe margins ciliolate, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 3-nerved, nerves jointed at the base of the awn; *awn* geniculate, not well developed, 4–5.5 mm long, pale brownish; column 2.5–3 mm long, glabrous or very sparsely scabridulous; bristle 2–2.5 mm long, scabridulous. *Upper palea* narrowly ovate, *ca*. 3.5 × 0.6–0.8 mm, margins inflexed or infolded and scabrous–scabridulous, apex acute or shortly lobed, membranous, both dorsal and ventral surfaces glabrous–puberulent, hyaline, 2-nerved. *Caryopsis* not seen.

Flowering & Fruiting: September to January.

Distribution: India, Tropical and South Africa. In India, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Telangana.

Habitat: Bunds of fields, open waste lands and usually found growing in black cotton soil.

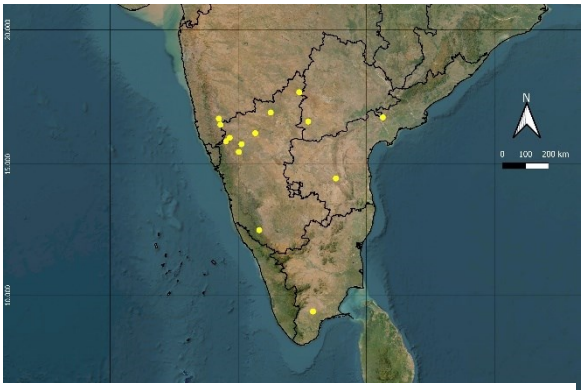

Fig. 16. Distribution of *Ischaemum afrum* (J.F.Gmel.) Dandy in southern Peninsular India.

Notes: Very similar to *Ischaemum polystachyum* J.Presl but can be differentiated from it in having glabrous nodes, lower glume of sessile and pedicelled spikelets dorsally with a shallow depression and the upper lemma being deeply bilobed upto the base of the awn.

In many of the Indian Floras (eg. Bor, 1960; Karthikeyan *et al.*, 1989; Kabeer & Nair, 2009), the name *Ischaemum pilosum* was accepted as the correct name of the taxon. However, the earliest legitimate epithet available for the taxon is 'afer' (*Andropogon afer* J.F.Gmel., 1971). Hence the combination based on this earliest legitimate name, *I. afrum* is accepted in the present treatment.

Specimens examined: INDIA, **Andhra Pradesh**, Kadapa [Cuddapah] district, Kadapa, 20.10.1938, *DFO s.n.* (DD); NTR district, Mylavaram, 02.08.1907, *C.A. Barber* 8143 (FRC). **Karnataka**, Bagalkote district, Bagalkote, 16.01.1976, *N.P. Singh* 142536 (BSI); Belgaum [Belgavi] district, Appachiwadi, 15.09.2008, *Arun N. Chandore* 833 (SUK); Belgaum, *s.d.*, *W.M. Munro* 792 (CAL); Hudli, 03.01.2020, *V. Drisya* 169522 (CALI); Saundatti [Savadatti], 17.09.1979, *B.R. Ramesh & S.R. Ramesh* 9397 (CAL); Bidar district, Bidar–Chincholi road, 10th mile, 09.02.1975, *N.P. Singh* 128601 (BSI); Dharwad district, 26.12.1889, *W.A. Talbot* 2185 (BSI); Kalaburagi district, Sindagi–Jevargi road, 19.01.1976, *N.P. Singh* 142640 (BSI); Kodagu district, Coorg, near Sangam of Harangi and Madapur rivers, *s.d.*, *s.coll.* 86667 (CAL). **Tamil Nadu**, Virudhunagar district, Etturvattam, Sathur, 30.01.2003, *K. Althaf Ahamed Kabeer* 116143 (MH). **Telangana**, Mahbubnagar district, Marikal, 14.11.2014, *J. Swamy & L. Rasingam* 002943 (BSID).

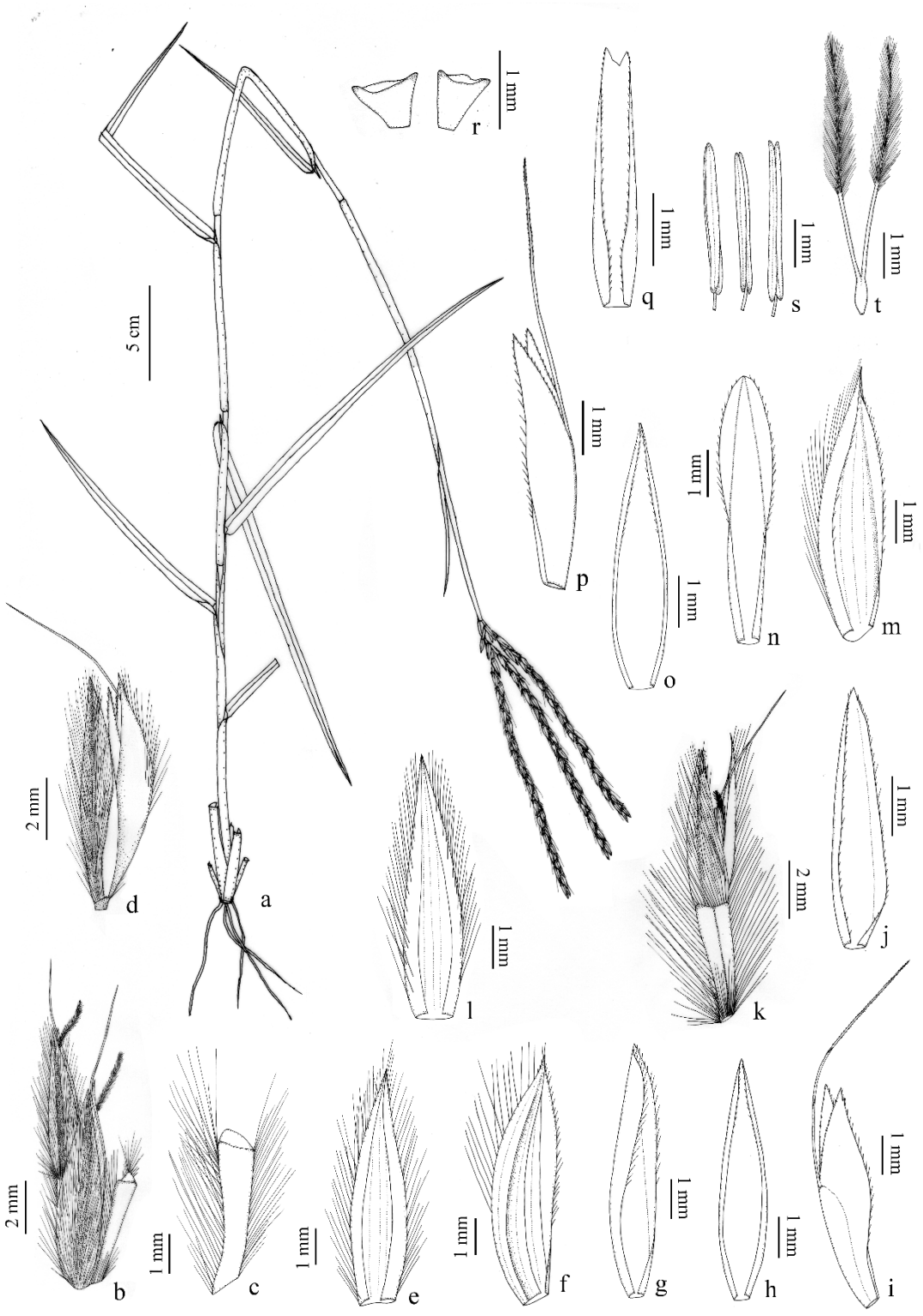

Fig. 17. *Ischaemum afrum* (J.F.Gmel.) Dandy: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium (from *V. Drisya* 169522, drawn by V. Drisya).

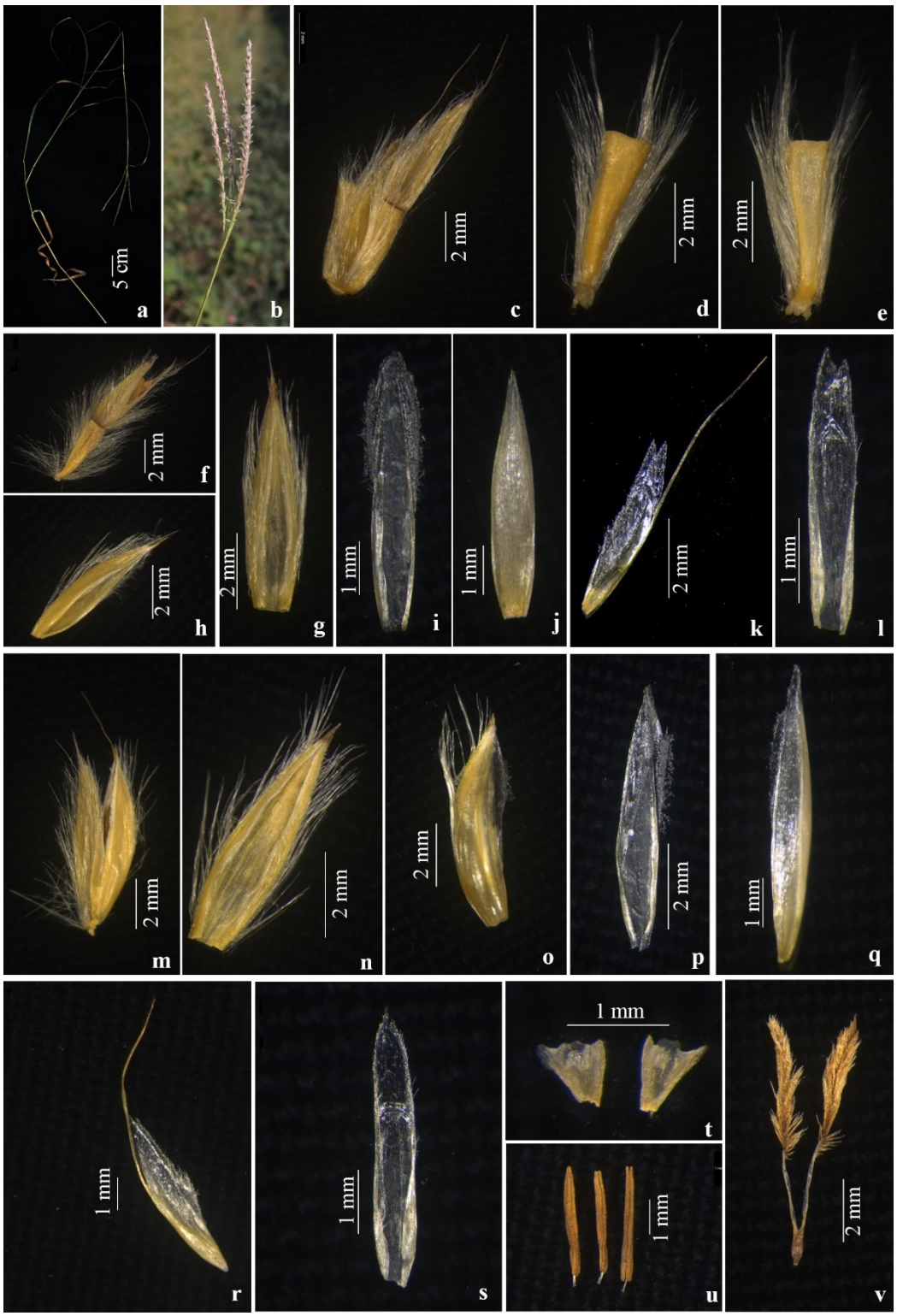

Fig. 18. *Ischaemum afrum* (J.F.Gmel.) Dandy: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode-dorsal view; **e.** Rachis internode-ventral view; **f.** Pedicelled spikelet; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**f–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume; **o.** Upper glume; **p.** Lower lemma; **q.** Lower palea; **r.** Upper lemma; **s.** Upper palea (**m–s:** Sessile spikelet); **t.** Lodicules; **u.** Stamens; **v.** Gynoecium.

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Kolhapur district, Kolhapur, 08.01.2017, *V. Drisya* 171412; Shivaji University Campus, 14.01.2017, *V. Drisya* 171422 [CALI184698, CALI184699, CALI184700, CALI184701 & CALI184702] (CALI).

Notes on typification: In the protologue of *Andropogon pilosus*, the author mentioned only "Habitat in India Orientali Mysore". While searching the original specimens, authors could trace two sheets of *A. pilosus* collected from Mysore by B. Heyne. One sheet from herbarium K and one specimen from Herbarium B. The sheet from K, being a well preserved specimen perfectly agreeing with the protologue is taken here to serve as the lectotype.

2. Ischaemum barbatum Retz., Observ. Bot. 6: 35. 1791; N.P.Singh *et al*., Bull. Bot. Surv. India 18(1−4): 122. 1976, *p.p.*; Karthik. *et al*., Fl. Ind. Enum. Monocot. 231. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 123. 1991, *p.p.*; S.Moulik, Grasses Bamboos India 2: 290. 1997, *p.p.*; Sur, J. Econ. Taxon. Bot. 25(2): 410. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 803. 2008, *p.p.*; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 433. 2009, *p.p.*; Srivastava & V.J.Nair, Nelumbo 52: 67. 2010, *p.p.*; Potdar *et al*., Grasses Maharashtra 175. 2012, *p.p. Ischaemum aristatum sensu* Hack. *non* L. subsp. *barbatum* (Retz.) Hack. in A.L.P.P.de Candolle & A.C.P. de Candolle, Monogr. Phan. 6: 204. 1889; Hook.f., Fl. Brit. India 7: 127. 1897. *Lectotype* (designated by Davidse, 1994):—— INDONESIA, **Java**, *D. Wennerberg s.n.* (LD [LD1229226 digital image!]).

Ischaemum mangaluricum (Hack.) Stapf ex C.E.C.Fisch. in Gamble, Fl. Madras 3: 1723. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 182. 1960; N.P.Singh *et al*., Bull. Bot. Surv. India 18(1−4): 122. 1976; Sreek. & V.J.Nair, Fl. Kerala - Grasses 147. 1991; S.Moulik, Grasses Bamboos India 2: 294. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 422. 2001; Srivastava & V.J.Nair, Nelumbo 52: 81. 2010, *p.p.*; Potdar *et al*., Grasses Maharashtra 191. 2012. *Ischaemum aristatum sensu* Hack. *non* L. subsp. *imberbe* Hack. var. *mangaluricum* Hack. in A.L.P.P. de Candolle & A.C.P. de Candolle, Monogr. Phan. 6: 204. 1889. *Lectotype* (designated by Bor, 1960):——

INDIA, **Karnataka**, Mangaluru [Mangalor], 00.00.1847, *Hohenacker* 184 (lecto: K [K000245680 digital image!]).

Ischaemum jayachandranii R.Ansari, V.S.Ramach. & Sreek., Curr. Sci. 53(3):151. 1984, s*yn. nov. Type*:—— INDIA, **Kerala**, Kasaragod district, Nileswar, 29.01.1979, *V.J. Nair* 59981 (holo: CAL [CAL0000002272!]; iso: K [*n.v.*], MH [MH00001588!]).

Ischaemum quilonense Ravi & Shaju, Rheedea 8: 152. 1998 (as '*quilonensis*'), *syn. nov. Type*:—— INDIA, **Kerala**, Kollam district, Perumkulam Ela, 27.10.1996, *Ravi* 24098 (holo: TBGT!; iso: CAL [CAL0000007136!], K [*n.v.*], KFRI [*n.v.*], MH [MH00001586!]).

Ischaemum wayanadense Ravi, N.Mohanan & Shaju, Bot. Bull. Acad. Sin. 42(3): 223. 2001. *Type*:—— INDIA, **Kerala**, Wayanad district, Kelloor, Thekkumpara, 14.12.1996, *Ravi* 33779 (holo: TBGT!; CAL [*n.v.*], iso: K [K001057516 digital image!], KFRI [*n.v.*], MH [*n.v.*]).

Ischaemum kasaragodensis Dileep & G.G.Nair, Ann. Pl. Sci. 4(10): 1199. 2015, *syn. nov. Type*:—— INDIA, **Kerala**, Kasaragod district, Badiyadukka, on the way to Mangalore, 23. 09.2013, *P. Dileep* 9313 (holo: CALI [*n.v.*]; iso: CMPR [*n.v.*], KFRI [*n.v.*]).

Fig. 19–22

Tufted perennials or annuals, 30–120 cm tall, or decumbent with roots from lower nodes; *nodes* glabrous, or ciliate, sometimes glaucous; *internode* terete–subterete, 10–15 cm long, glabrous, greenish or reddish-brown. *Leaves* sessile or sub-sessile; *leaf sheath* 4–12 cm long, dorsally slightly keeled, margins entire, chartaceous, dorsal surface glabrous or sparsely puberulent near apex, ventral surface glabrous, greenish; *leaf blade* narrowly elliptic or linear–lanceolate, 4–20 × 0.3–1.2 cm, base rounded or narrowed, margins scabridulous, apex acuminate, chartaceous, abaxial surface minutely puberulent or punctate, adaxial surface scabridulous–puberulent, greenish. *Ligule* ovate, 2–6 mm long, membranous. *Lower leaves* narrowed at base or pseudopetiolate. *Spathe* leafy with or without reduced lamina. *Peduncle* terete, 10–30 cm long, glabrous, yellowish green. *Racemes* 2, adpressed together and looks like solitary, 4–13 cm long, more or less glabrous. *Rachis internode* turbinate, 2.5–6 × 1.75–2.2 mm, coriaceous, ventral surface membranous, 3-angled, swollen, hollow,

glabrous or very sparsely puberulent, dorsal margin scabridulous–puberulent, lateral margins glabrous, greenish. *Sessile spikelet* bisexual, narrowly ovate or narrowly elliptic, 5–8 × 1.8–2.2 mm, usually awned, rarely unawned, usually one margin broadly winged at upper 1/4th, wing margin auriculate, greenish with yellowish towards base; callus glabrous. *Lower glume* narrowly ovate, 4.5–7 × 1.5–2 mm, margins entire, inflexed or infolded, laterally keeled, one margin shallowly 2–3-side noduled at lower half and broadly winged at upper 1/3rd, wing auriculate, or sometimes wing narrow and not auriculate, the other margin very shallowly side noduled or not and narrowly winged at upper 1/3rd with narrowly auriculate wing, wing margins scabridulous, rarely side nodules totally absent, apex obtuse, chartaceous at upper 1/3rd, subcoriaceous–coriaceous at lower 2/3rd, dorsal surface puberulent or punctate with scabrous–scabridulous hairs on infolded or inflexed marginal portion at lower 1/3rd, hairs seen oriented towards down or base, ventral surface scabridulous, greenish at upper 1/3rd, yellowish green at lower 2/3rd, 9–16-nerved. *Upper glume* narrowly ovate, 4–6.5 × 1.5–3 mm, cymbiform, dorsally keeled, shallowly folded, margins entire or sparsely ciliolate at upper half, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex acute–acuminate, chartaceous, dorsal surface hispid–hispidulous, ventral surface scabrous–scabridulous at upper half, yellowish green, greenish at apex, 3–7-nerved; dorsal keel scabridulous or hispidulous, winged near apex, wing auriculate. *Lower lemma* narrowly ovate, 3.5–6 × 1–2 mm, cymbiform, margins entire, inflexed at lower half or at lower 1/3rd, infolded at upper half or at upper 2/3rd, apex acute–acuminate, chartaceous–membranous, dorsal surface scabridulous–puberulent at upper half, ventral surface

Fig. 19. Lectotype of *Ischaemum barbatum* Retz. [*D. Wennerberg s.n.* (LD1229226)] © The Board of Trustees for Lund University Botanical Museum, Sweden.

scabridulous–puberulent at upper 1/3rd, hyaline–pale greenish, prominently 3–5-nerved. *Lower palea* narrowly ovate, 3.5–5.5 × 1–1.5 mm, cymbiform, margins entire, inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, laterally keeled, keel narrowly winged near apex, apex truncate or notched, membranous, dorsal surface and keel scabridulous–puberulent at upper half or at upper 2/3rd, glabrous or sparsely hairy towards base, ventral surface glabrous, hyaline–pale greenish, 2-nerved; keel little broad near apex and base, narrowly winged near apex, wing margin entire. *Upper lemma* narrowly ovate, 3–5.5 × 1–2 mm, cymbiform or shallowly folded, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex usually deeply bilobed and awned from the sinus, or apex entire without an awn or apex notched with a rudimentary awn, membranous, both dorsal and ventral surface scabridulous–puberulent, hyaline, 3–5-nerved; *awn* geniculate, 10–15 mm long; column twisted, 5–8 mm long, sparsely scabridulous or glabrous, dark brownish; bristle 5–7 mm long, scabridulous along margins, pale brownish–hyaline. *Upper palea* narrowly ovate, 2.5–5 × 0.75–1.5 mm, cymbiform, margins entire otherwise scabridulous at lower half, inflexed or infolded, laterally keeled at lower half or at lower 1/3rd, apex acute–obtuse or notched, membranous, dorsal surface and keel scabridulous at upper half or at upper 3/4th, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–1 × 0.3–0.4 mm, hyaline. *Stamens* 3; anthers 1–3 mm long, yellowish. *Pedicelled spikelet* bisexual, not awned, narrowly ovate or narrowly elliptic, 4.5–6 × 2–3.2 mm, yellowish green with greenish tinge (nerves greenish); callus glabrous. *Pedicel* 1–2 × 0.8–1.5 mm, glabrous or sparsely puberulent, all the 3 margins glabrous, similar to rachis internode. *Lower glume* narrowly ovate, 4.5–6 × 1.5–3 mm, margins entire, inflexed or infolded, laterally keeled, keel usually broadly winged on one margin but rarely narrowly winged, the other margin very narrowly winged or not, wing margin scabridulous, apex obtuse or rounded, subcoriaceous, dorsal surface sparsely scabridulous–puberulent, hairs seen mainly on wings and infolded or inflexed portions, ventral surface scabridulous, 2–3-side noduled or not, yellowish green with greenish nerves, 11–16-nerved. *Upper glume* narrowly ovate, 4.3–5.5 × 1–2 mm, cymbiform, dorsally keeled, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins membranous, entire or very sparsely ciliolate at infolded margins, apex acute–acuminate, chartaceous–subcoriaceous, dorsal surface scabridulous, ventral surface scabridulous at upper 2/3rd, yellowish green with greenish nerves, 5–20-nerved,

nerves hard to count. *Lower lemma* narrowly ovate, 3.8–5.5 × 1.5–1.8 mm, cymbiform, margins entire, inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or at upper half, apex acute, membranous–chartaceous, dorsal surface scabridulous–puberulent, ventral surface scabridulous near apex, hyaline–pale greenish, 3–4-nerved. *Lower palea* narrowly ovate, 3.5–5 × 1.5–1.8 mm, cymbiform, margins entire, inflexed or infolded, laterally keeled, apex acute, membranous, dorsal surface scabridulous at upper half or at upper 2/3rd, ventral surface scabridulous–puberulent near apex, hyaline, 2 lateral nerves seen; keel little broad at base, broadly winged at upper half or at upper 2/3rd on one margin, the other margin very narrowly winged or not near apex, keel and wing margins entire or glabrous. *Upper lemma* narrowly ovate, 3–5.2 × 0.7–2 mm, cymbiform, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex acute or mucronate–aristate or shortly awned; *awn* imperfect, upto 4 mm long, membranous, dorsal surface scabridulous at upper 2/3rd or at upper half, ventral surface scabridulous at upper half, hyaline, dorsally shallowly keeled, keel glabrous, 3–5-nerved. *Upper palea* narrowly ovate, 3–5 × 1–1.5 mm, cymbiform, margins infolded, entire or ciliate–ciliolate, laterally keeled, apex obtuse, membranous, dorsal surface scabridulous at upper half or at upper 2/3rd, ventral surface glabrous, hyaline, 2-nerved; keel scabridulous, glabrous near base. *Ovary* narrowly elliptic, 0.5–0.8 × 0.2–0.4 mm, brownish; *style* 2, 1.5–2.5 mm long, hyaline; *stigma* 2, plumose, 2–3 mm long, purplish. *Caryopsis* ellipsoid, 2–3.2 × 0.6–1.2 mm, brownish, style base persistent.

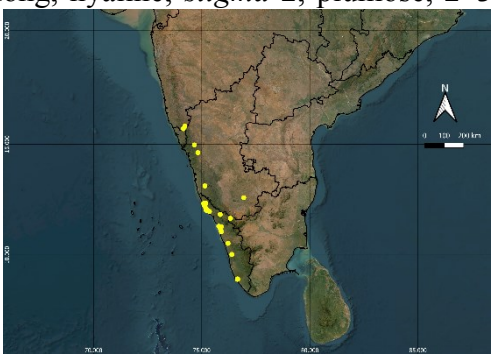

Fig. 20. Distribution of *Ischaemum barbatum* Retz. in southern Peninsular India

Flowering & Fruiting: September to January.

Distribution: Tropical & Subtropical Asia to W. Pacific. In India, it is distributed in Goa, Karnataka, Kerala, Maharashtra, Odisha, Sikkim, Tamil Nadu and West Bengal.

Habitat: Seen in wet habitats like marshy areas, wetlands, bunds of paddy fields and rarely aquatic.

Notes: Caryopsis of pedicelled spikelet smaller than that of sessile spikelet.

Ischaemum barbatum is a highly variable species. It shows considerable variation with respect to size of floral parts, ornamentation of lower glumes, wings on lower glumes, and length of awns of the sessile spikelets. The awns may be highly reduced and often concealed in the spikelets, and at times very prominent and protrude out from the spikelets. Different forms can be seen in one and the same population.

Ischaemum jayachandranii was described from Nileshwaram by Ansari *et al.* (1984). It is distinguished mainly by the presence of unawned sessile spikelets. In, 2016, we could only collect plants with awned sessile spikelets from Nileshwaram. However, we could find another population of plants growing in a wetland near to Pilicode (a place 9–10 km away from Nileshwaram) comprising plants with awned sessile spikelets as well as plants with unawned or very minutely awned sessile spiklets. The awn length showed variation within the spikelets of same plants as well as that of different plants of the same population. All other characters of *I. jayachandranii* falls within the range of *I. barbatum*. Moreover, Ansari *et al.* (1984) compared their new taxon with a distant species *I. commutatum* Hack. Hence, *Ischaemum jayachandranii* is treated here as the synonym of *I. barbatum.*

The characters of recently described taxa *Ischaemum quilonense*, *Ischaemum wayanadense* and *Ischaemum kasaragodensis* are overlapping with *I.barbatum*. Also, the authors of *I. kasaragodensis* compared it with *I. fischeri*, a morphologically distant species. Hence, *I. quilonense*, *I. wayanadense* and *I. kasaragodensis* primarily distinguished based on variable characters such as creeping culms with rooting nodes, leaf size, shape and base, variation in the lower leaf bases, nature of wing on lower glume of sessile spikelets (whether narrow or broad) and differences in the apex of upper lemma of sessile spikelets. Hence, all these names are reduced herein under the synonymy of *I. barbatum.*

Specimens examined: INDIA, **Karnataka**, Belgaum district, Sada, 04.11.2006, *Arun N. Chandore* 112 (SUK); Dakshina Kannada district, near Naravi, 08.09.2015, *V. Drisya* 144206 (CALI); Uttara Kannada district, Sirsi, near Karwar, 12.11.1997, *P.V. Prasanna* 176712 (BSI); Yellapura, 15.10.1884, *W.A. Talbot* 1037 (CAL);

Mandya district, Keelara, 29.09.1961, *A.S. Rao* 74796 (BSI). **Kerala**, Kannur district, Ezhimala (Elimala), 20.10.1981, *P.V. Sreekumar* 71764 (BSID); *Ibid.*, 28.07.1999, *N. Mohanan & N. Ravi* 41491 (TBGT); Kalyassery, 07.12.2018, *V. Drisya* 176211 (CALI); Madayippara, 08.10.2002, *N. Mohanan & N. Ravi* 44998; *Ibid.*, 08.10.2002, *N. Mohanan & N. Ravi* 44999; *Ibid.*, 08.10.2002, *N. Mohanan & N. Ravi* 45000 (TBGT); *Ibid.*, 18.11.2015, *Rinku J. Desai* 1710 (BARO); *Ibid.*, 14.11.2018, *V. Drisya* 157868; *Ibid.*, 16.12.2019, *V. Drisya* 169543; *Ibid.*, in a pond near Co-Operative college, 14.11.2018, *V. Drisya* 157867 (CALI); Payyanur, 12.12.1997, *N. Mohanan & N. Ravi* 37092; Payyanur railway station, 28.07.1999, *N. Mohanan & N. Ravi* 41484; Theyyanoor, 07.10.2002, *N. Mohanan & N. Ravi* 44986; *Ibid.*, 07.10.2002, *N. Mohanan & N. Ravi* 44987 (TBGT); Kasaragod district, Kanhangad–Mavungal road, 07.10.2002, *N. Mohanan & N. Ravi* 44993 (TBGT); Mugu road, 17.10.1981, *P.V. Sreekumar* 71742 (BSID); Nileshwaram, 11.05.1982, *V.J. Nair* 73822 (MH); *Ibid.*, 24.12.2016, *V. Drisya* 176616 (CALI); Palathara Palace, 07.10.2002, *N. Mohanan* 44990; Pallikkara, 12.12.1996, *N. Mohanan* 33728 (TBGT); Periya, near cashew project, 18.10.1981, *P.V. Sreekumar* 71757 (BSID); Periya, 02.10.1982, *R. Ansari* 74460 (CAL); Thottam–Padne road, near Ganeshmukku, Pilicode, 24.12.2016, *V. Drisya* 176603; *Ibid.*, 24.12.2016, *V. Drisya* 176611 (CALI); Kollam district, Mukhathala, Murarimukku, 15.11.2017, *V. Drisya* 157731; Kaniyamthodu, near Mukhathala, 15.11.2017, *V. Drisya* 157733 (CALI); Kozhikode district, Pariyangad, Marumayil padam, 15.11.2015, *V. Drisya* 144293; *Ibid.*, 18.12.2016, *V. Drisya* 176758 (CALI); Ramanattukara, 11.12.1996, *N. Mohanan* 31876 (TBGT); Vengeri, 27.10.1981, *P.V. Sreekumar* 71780 (BSID); Malappuram district, Venchalippadam, 03.11.2019, *P.P. Jincy & V. Drisya* 176283; Villunniyal, near Kuroor Ayyappan Kaavu, 14.03.2016, *V. Drisya* 150713; *Ibid.*, 10.12.2016, *V. Drisya* 176691; *Ibid.*, 27.11.2017, *V. Drisya* 157752 [CALI184993, CALI184994, CALI184995, CALI184996, CALI184997 & CALI184998]; *Ibid.*, 19.02.2021, *V. Drisya* 169574 (CALI); Thrissur district, Thrissur, 09.12.1997, *N. Ravi & N. Mohanan* 37028 (TBGT); Wayanad district, Sulthan Bathery, Kallor, 05.12.2016, *V. Drisya* 176728; *Ibid.*, 05.12.2016, *V. Drisya* 176729; *Ibid.*, 05.12.2016, *V. Drisya* 176731 (CALI).

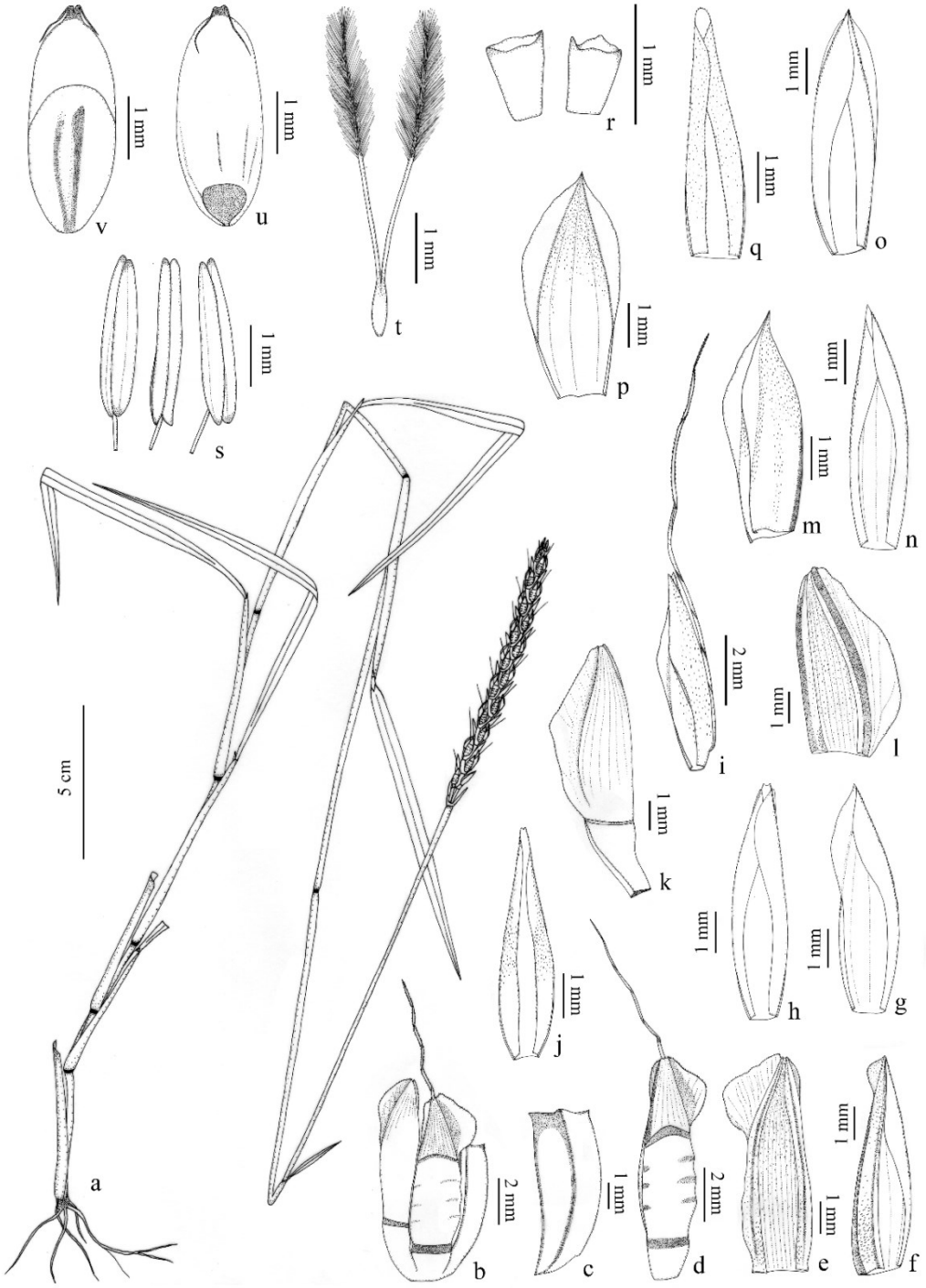

Fig. 21. *Ischaemum barbatum* Retz.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium; **u.** Caryopsis-dorsal view; **v.** Caryopsis-ventral view (from *V. Drisya* 157752, drawn by V. Drisya).

Fig. 22. *Ischaemum barbatum* Retz.: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet-dorsal view; **f.** Pedicelled spikelet-ventral view; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**e–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume; **o.** Upper glume; **p.** Lower lemma; **q.** Lower palea; **r.** Upper lemma; **s.** Upper palea (**m–s:** Sessile spikelet); **t.** Lodicules; **u.** Stamens; **v.** Gynoecium; **w & x.** Caryopsis-dorsal view (**w:** from sessile spikelet; **x:** from pedicelled spikelet); **y & z.** Caryopsis-ventral view (**y:** from sessile spikelet; **z:** from pedicelled spikelet).

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Kolhapur district, Tillari, 08.01.2017, *V. Drisya* 171403 (CALI).

3. Ischaemum cannanorensis Sreek., V.J.Nair & N.C.Nair, J. Econ. Taxon. Bot. 4(3): 1009. 1983; Karthik. *et al.,* Fl. Ind. Enum. Monocot. 231. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 127. 1991; Srivastava & V.J.Nair, Nelumbo 52: 69. 2010 (as 'cannanorense'). *Type*:—— INDIA, **Kerala**, Kasaragod district, Paramba, on the way to Bendudka, 16.10.1981, *P.V. Sreekumar* 71713 (holo: CAL [*n.v.*]; iso: K [K000245751 digital image!], MH [MH00001628!]).
Ischaemum commutatum sensu Singh & Rao, J. Econ. Taxon. Bot. 32(4): 806. 2008 *non* Hack., 1889, *p.p.*

Figs. 23–27

Tufted erect annuals, 50–80 cm tall, sometimes rooting at lower nodes; *nodes* glabrous, purplish or brownish, younger node at the base of peduncle densely villous, hairs hyaline; *internode* terete–subterete, 5–3 cm long, glabrous, greenish. *Lower leaves* petiolate, *upper leaves* sessile–subsessile, base of the petiole or the junction of leaf blade and sheath densely scabridulous–scabrous, hairs hyaline; *leaf sheath* rounded or dorsally keeled, 4–6 cm long, margins entire, chartaceous, both dorsal and ventral surface glabrous, greenish; *leaf blade* narrowly ovate, 6–10 × 0.6–0.8 mm, base usually cordate, sometimes base of lower leaves narrowed or attenuate, margins entire, apex acuminate, chartaceous, both abaxial and adaxial surface tubercle-based hairy, greenish. *Ligule* ovate, *ca.* 2.5 mm long, membranous, dorsal surface scabridulous, pale brownish. *Petiole* 0.2–1.4 cm long, sparsely or densely scabridulous–puberulent on both surface and ventrally scabrous near base. *Racemes* 2, usually adpressed together and looks as solitary, 3.5–5 cm long, more or less hairy. *Spathe* leafy with reduced lamina. *Peduncle* terete–subterete, 7–10 cm long, hollow, glabrous, greenish. *Rachis internode* clavate, 3–3.5 × 0.4–0.6 mm, 3-angled, hollow, base and apex oblique, ventrally compressed, crustaceous, ventral side membranous, usually densely pilose along dorsal margin and at base, or rarely densely pilose throughout the dorsal surface, hairs hyaline. *Sessile spikelet* bisexual, awned, narrowly elliptic or oblong, 5–5.5 × 0.6–0.8 mm, glabrous, rarely densely

pilose, greenish; callus oblique, pilose, hairs hyaline–pale yellowish. *Lower glume* narrowly ovate, 4–5 × 1.8–2 mm, cymbiform, smooth, rarely wrinkled, margins entire, inflexed at lower half or at lower 2/3rd, infolded at upper 1/3rd, laterally keeled at upper 1/4th, keel scabrous–scabridulous, apex obtuse, coriaceous, subcoriaceous towards apex and membranous at apex, dorsal surface usually glabrous, rarely densely pilose throughout, ventral surface puberulent, greenish, 12-nerved. *Upper glume* narrowly ovate, 4–4.5 × *ca.* 1 mm, cymbiform, margins inflexed at lower 1/3rd or at lower half, infolded at upper 2/3rd or at upper half, ciliate at upper 1/3rd or at upper half, apex acute, coriaceous–subcoriaceous, dorsally keeled, keel scabridulous at upper 1/3rd, dorsal surface scabridulous–puberulent, rarely pilose, ventral surface scabridulous–puberulent, greenish, 7-nerved, central 3 prominent nerves fused into one at the lower 1/3rd, dorsal keel humped at the fusing point of the 3 central nerves. *Lower lemma* narrowly ovate, 4–4.2 × 1–1.2 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate and keeled, keel scabridulous, apex acute, membranous, both dorsal and ventral surface puberulent–glabrous, hyaline, 2-nerved. *Lower palea* narrowly elliptic, 3.5–4 × 1–1.5 mm, margins ciliate at upper half or at upper 2/3rd, inflexed at lower 1/3rd, infolded at upper 2/3rd, laterally keeled, keel scabridulous at upper 2/3rd, apex obtuse, membranous, dorsal surface puberulent–scabridulous, ventral surface puberulent–glabrous, hairs seen towards apex, hyaline, 2-nerved. *Upper lemma* narrowly ovate, 3.5–4 × 0.8–1 mm, folded or cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, apex bilobed, awned from the

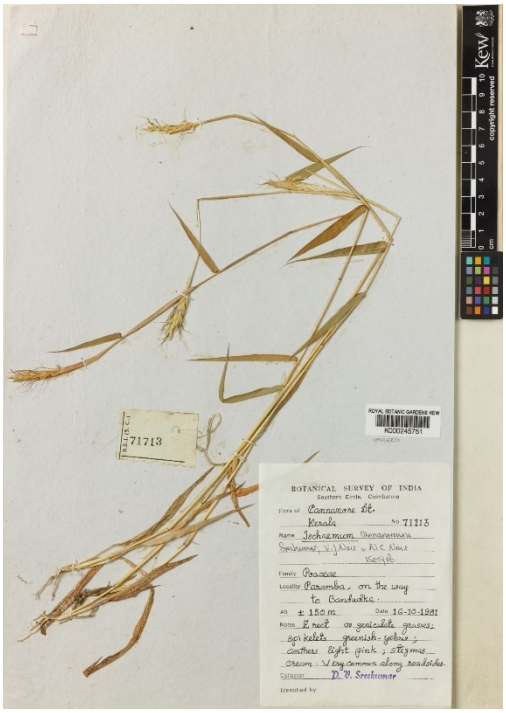

Fig. 23. Isotype of *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair (*P.V. Sreekumar* 71713 [K000245751]) © The Board of Trustees for The Royal Botanic Gardens, Kew.

sinus, membranous, both dorsal and ventral surface puberulent, hyaline, 3-nerved, nerves jointed at the base of awn. *Awn* geniculate, 24.5–25.5 mm long; column 11.5–12 mm long, twisted, scabrous–scabridulous on margins or spirals, dark brownish; bristle 13–13.5 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 2.5–3 × 0.5–0.8 mm, margins scabridulous, inflexed or infolded at lower 1/3rd, narrowly infolded at upper 2/3rd, apex obtuse, membranous, dorsal surface scabridulous–puberulent, hairs seen more towards upper half and towards margins, ventral surface puberulent, hyaline, nerves not seen. *Lodicules* 2, cuneate, 0.3–0.4 × 0.2–0.3 mm, hyaline. *Stamens* 3; anthers 1.5–2.2 mm long, yellowish. *Ovary* elliptic, 0.6–0.8 × 0.2–0.3 mm, brownish; *style* 2, 1.5–2 mm long, hyaline; *stigma* 2, plumose, *ca.* 1.5 mm long, purplish. *Pedicelled spikelet* male, unawned, elliptic–narrowly elliptic, 5 × 1.5 mm, glabrous, rarely densely pilose, greenish; callus pilose, hairs hyaline. *Pedicel* 2–2.2 mm long, similar to rachis internode. *Lower glume* narrowly ovate, 4–4.2 × 1.5–1.8 mm, cymbiform, margins entire, inflexed or infolded, one margin broadly winged throughout, other margin narrowly winged or keeled at upper 1/3rd, wing margins or keel scabridulous, apex acute–obtuse, chartaceous, membranous at apex, dorsal surface puberulent–sparsely puberulent, hairs seen mainly at upper half and infolded or inflexed portions, rarely densely pilose throughout, ventral surface puberulent–scabridulous, greenish, 12–14-nerved. *Upper glume* narrowly ovate, *ca.* 4.5 × 1.5–1.8 mm, cymbiform, margins inflexed at lower half, infolded and ciliate at upper half, apex acute, chartaceous, dorsally keeled towards upper half, keel scabridulous, dorsal surface puberulent, rarely densely pilose, ventral surface puberulent towards upper half, greenish, 3-nerved, midvein prominent. *Lower lemma* narrowly ovate, 4–4.2 × 0.8–1.2 mm, cymbiform, margins inflexed at lower half, infolded and ciliate at upper half, infolded margins keeled, keel scabridulous, apex acute–obtuse, membranous, dorsal surface puberulent–scabridulous, hairs mainly seen towards margins and apex, ventral surface glabrous, pale greenish–hyaline, 2-nerved. *Lower palea* elliptic–narrowly elliptic, 4–4.2 × 1.8–2 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, laterally keeled, keel narrowly winged at lower 1/3rd, wing margins entire, keel scabridulous–puberulent, apex obtuse, membranous,

dorsal surface puberulent–glabrous, ventral surface puberulent–glabrous, hyaline, 2-nerved. *Upper lemma* elliptic, 3. 8–4.2 × 1–1.5 mm, margins inflexed at lower 1/3rd, infolded and ciliolate at upper 2/3rd, apex acuminate, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 3-nerved. *Upper palea* narrowly ovate, 3.2–3.5 × 0.6 mm, margins entire, inflexed or infolded, apex acute, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 2-nerved, nerves faint. *Caryopsis* oblong or elliptic, 1.8–2 × 0.5–0.7 mm, brownish, style base persistent or not.

Flowering & Fruiting: October to December.

Distribution: Endemic to southern Peninsular India. Distributed in Kasaragod and Kannur districts of Kerala.

Habitat: Lateritic plateaus and lateritic soils seen in northern Kerala.

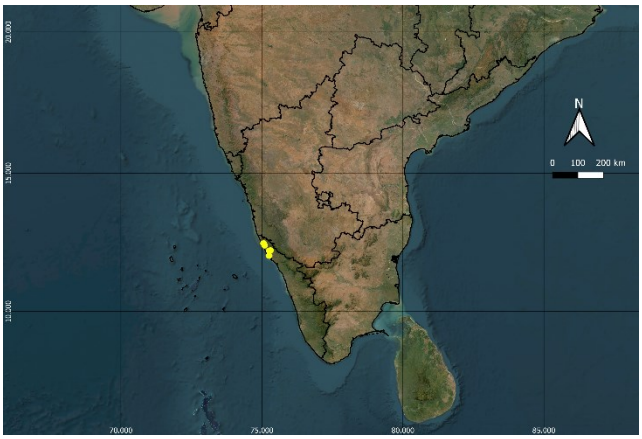

Fig. 24. Distribution of *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair

Notes: *Ischaemum cannanorensis* is commonly seen with sessile spikelets having smooth lower glumes, glabrous sessile and pedicelled spikelets (excluding callus) as well as with rachis internode and pedicel that are pilose only along dorsal margin and at the base. But interestingly, plants with sessile spikelets having wrinkled lower glume, densely pilose sessile and pedicelled spikelets as well as with rachis internode and pedicel that are densely pilose throughout the dorsal surface were also observed in the same population of plants (**Fig. 27**).

Specimens examined: INDIA, **Kerala**, Kannur district, Chooral, 17.10.2019, *V. Drisya* 170163; Madayippara, 14.11.2018, *V. Drisya* 157869; Peringome, 14.11.2018, *V. Drisya* 157862 [CALI184729, CALI184730, CALI184731 & CALI184732]; Kasaragod district, Chattanchal, 25.12.2016, *V. Drisya* 176624; *Ibid.*, 25.12.2016, *V. Drisya* 176630; *Ibid.*, 02.11.2017, *V. Drisya* 157187; *Ibid.*, 11.11.2018, *V. Drisya* 157845; Periya, 20.09.2015, *V. Drisya* 144214; *Ibid.*, 25.12.2016, *V. Drisya* 176635; *Ibid.*, 02.11.2017, *V. Drisya* 157193 (CALI).

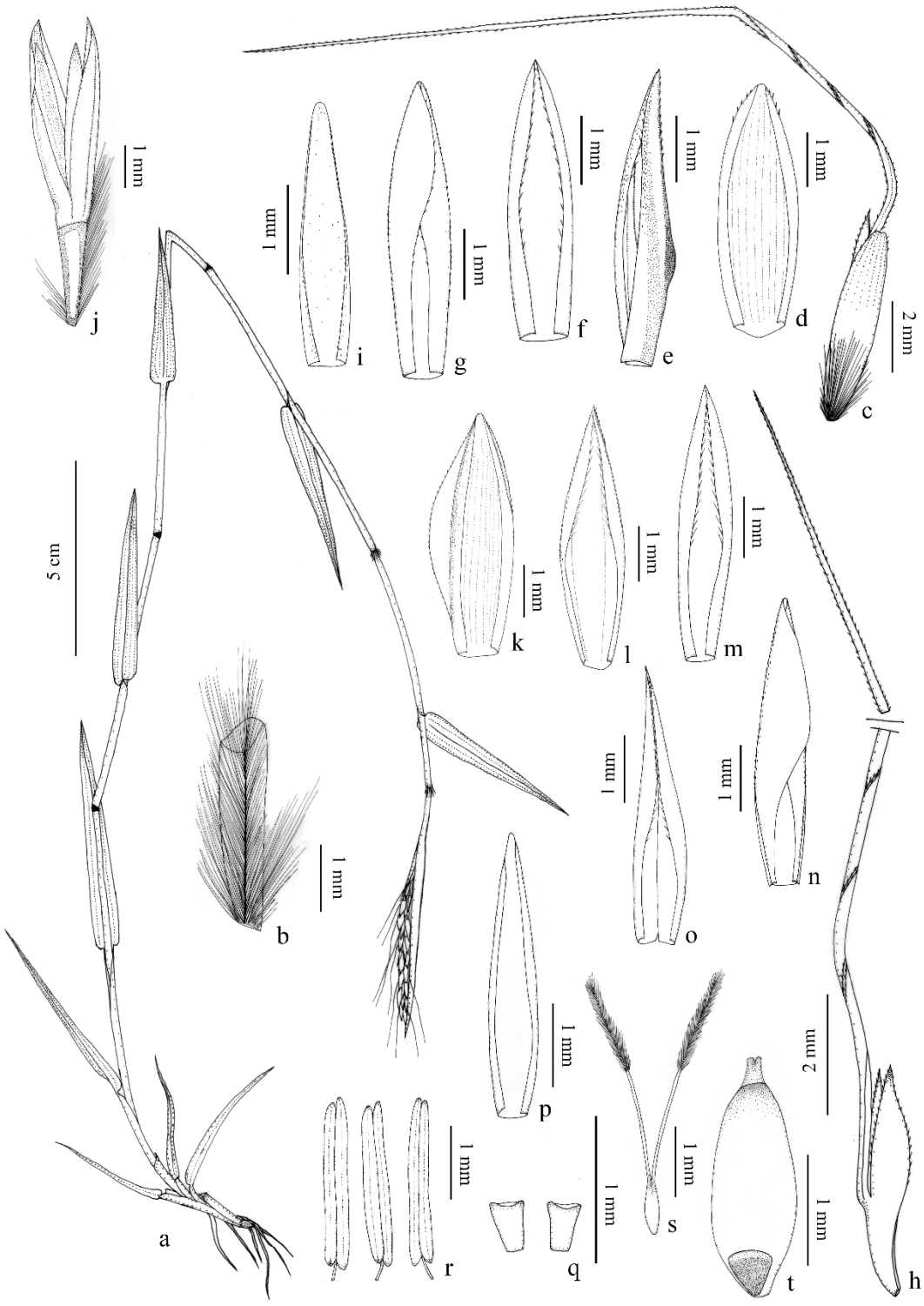

Fig. 25. *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**c–i:** Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma; **n.** Lower palea; **o.** Upper lemma; **p.** Upper palea (**j–p:** Pedicelled spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis (from *V. Drisya* 157862, drawn by V. Drisya).

Fig. 26. *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea (**e–k:** Pedicelled spikelet); **l.** Lower glume-dorsal view; **m.** Lower glume-ventral view; **n.** Upper glume; **o.** Lower lemma; **p.** Lower palea; **q.** Upper lemma; **r.** Upper palea (**l–r:** Sessile spikelet); **s.** Stamens; **t.** Gynoecium; **u.** Caryopsis-dorsal view; **v.** Caryopsis-ventral view.

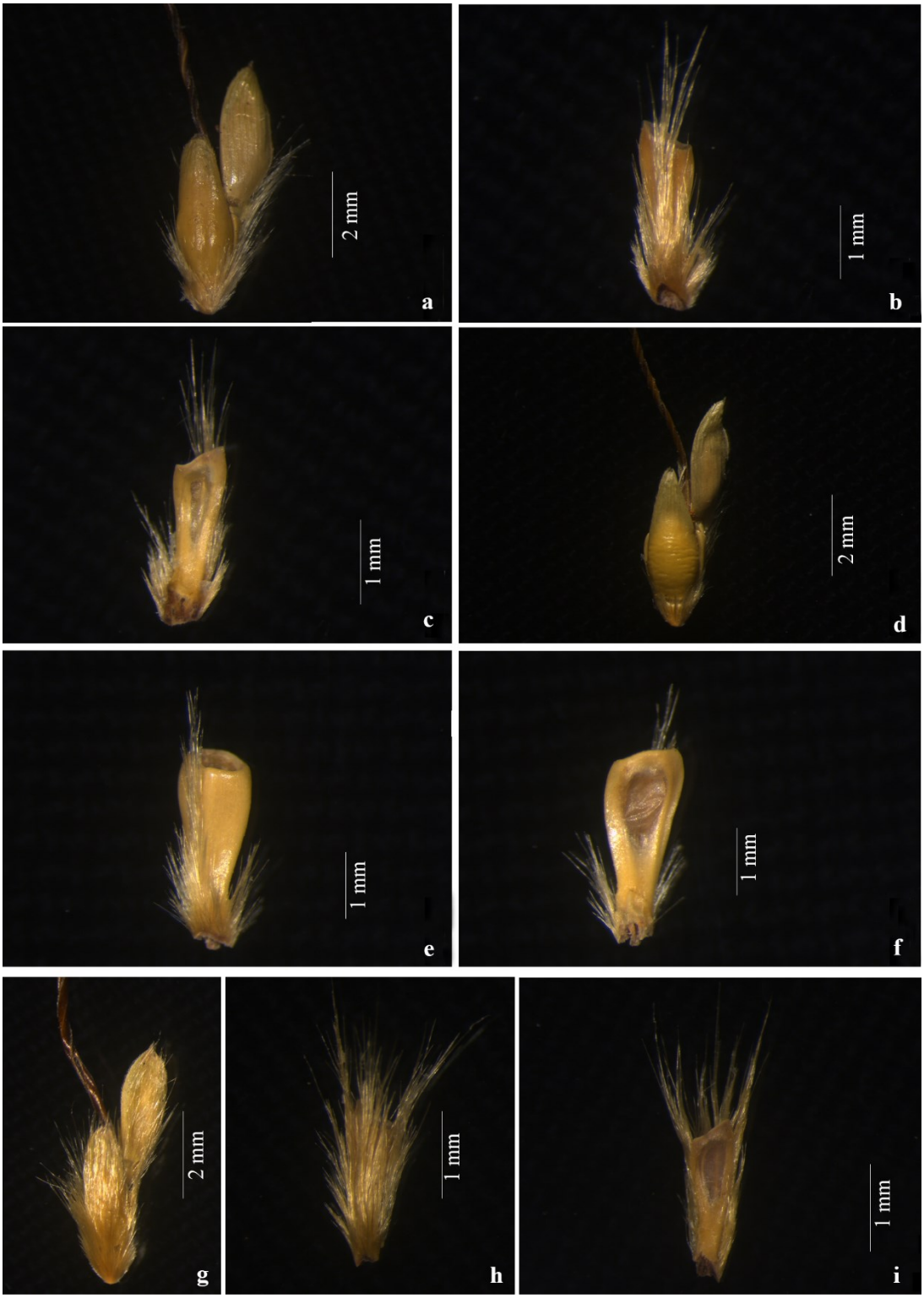

Fig. 27. *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair showing variation in indumentum and lower glume ornamentation in sessile spikelet: **a.** Spikelet pair with smooth and less hairy lower glume in sessile spikelet; **b.** Rachis internode-dorsal view; **c.** Rachis internode-ventral view; **d.** Spikelet pair with wrinkled and less hairy lower glume in sessile spikelet; **e.** Rachis internode-dorsal view; **f.** Rachis internode-ventral view; **g.** Spikelet pair with densely hairy lower glume in sessile spikelet; **h.** Rachis internode-dorsal view; **i.** Rachis internode-ventral view.

4. Ischaemum ciliare Retz., Observ. Bot. 6: 36. 1791; Hook.f., Fl. Brit. India 7: 133. 1897. *Type* (verified by Blake S.T., 1965):—— CHINA, *s.d.*, *Tranchell s.n.* (LD [LD1228219 digital image!]).

Spodiopogon villosus Nees in Hook. & Arn., Bot. Beech. Voy. 242. 1838. *Ischaemum ciliare* var. *villosum* (Nees) Hack., Monogr. Phan. 6: 227. 1889. *Ischaemum indicum* var. *indicum* subvar. *villosum* (Nees) Bor, Grasses Burma, Ceylon, India & Pakistan 180. 1960; Sreek. & V.J.Nair, Fl. Kerala - Grasses 138. 1991; S.Moulik, Grasses Bamboos India 2: 294. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 419. 2001; Potdar *et al*., Grasses Maharashtra 187. 2012; Srivastava & V.J.Nair, Nelumbo 52: 77. 2010. *Ischaemum indicum* subsp. *indicum* var. *villosum* (Nees) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 813. 2008. *Type*:—— CHINA, **Macao** [*n.v.*].

Andropogon bifidus Steud., Syn. Pl. Glumac. 1: 373. 1854. *Type*: —— India Or. [*n.v.*].

Andropogon malacophyllus Hochst. ex Steud., Syn. Pl. Glumac. 1: 372. 1854. *Ischaemum ciliare* subvar. *malacophyllum* (Hochst. ex Steud.) Hack., Monogr. Phan. 6: 226. 1889. *Ischaemum indicum* var. *indicum* subvar. *malacophyllum* (Hochst.) Bor, Grasses Burma, Ceylon, India & Pakistan 180. 1960; S.Moulik, Grasses Bamboos India 2: 293. 1997; Srivastava & V.J.Nair, Nelumbo 52: 76. 2010. *Ischaemum indicum* var. *malacophyllum* (Hochst. ex Steud.) P. Sur, J. Econ. Taxon. Bot. 25(2): 420. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 812. 2008. *Lectotype* (designated here):—— Montes Nilagiri, 00.00.1851, *Hohenacker* 917 (lecto: K [K00245698 digital image!]; isolecto: K [K000245699 digital image!], JE [JE00007320 digital image!, JE00007321 digital image!, JE00007322 digital image!], FI [FI012286 digital image!], W [W0028800 digital image!, W18890017013 digital image!, W19160035823 digital image!], US [US00406422 digital image!], MPU [MPU024305 digital image!, MPU024306 digital image!], CANB [CANB442387 digital image!], CORD [CORD00001449 digital image!], TUB [TUB-010076 digital image!], S [S-G-400 digital image!]).

Ischaemum ciliare subvar. *scrobiculatum* Hack., Monogr. Phan. 6: 226. 1889. *Ischaemum indicum* var. *indicum* subvar. *scrobiculatum* (Hack.) Bor, Grasses

Burma, Ceylon, India & Pakistan 180. 1960; Sreek. & V.J.Nair, Fl. Kerala - Grasses 138. 1991; S.Moulik, Grasses Bamboos India 2: 293. 1997; Srivastava & V.J.Nair, Nelumbo 52: 77. 2010. *Ischaemum indicum* subsp. *indicum* var. *scrobiculatum* (Hack.) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 813. 2008. *Lectotype* (designated here):—— INDIA, Peninsular India, *s.d.*, *Wight* 2322 (lecto: E [E00393556 digital image!]; isolecto: K [K0001057490 digital image!]).

Ischaemum ciliare var. *longipilum* Hack., Monogr. Phan. 6: 227. 1889. *Ischaemum indicum* var. *longipilum* (Hack.) Bor, Grasses Burma, Ceylon, India & Pakistan 181. 1960; Sreek. & V.J.Nair, Fl. Kerala - Grasses 140. 1991; S.Moulik, Grasses Bamboos India 2: 294. 1997; Srivastava & V.J.Nair, Nelumbo 52: 77. 2010. *Ischaemum indicum* subsp. *wallichii* ((Hack.) R.Kr.Singh & P.S.N.Rao var. *longipilum* (Hack.) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 813. 2008. *Type*:—— SRI LANKA [CEYLON], *Thwaites* 3167 (W [W18890064964 digital image!]).

Ischaemum ciliare var. *wallichii* Hack., Monogr. Phan. 6: 227. 1889. *Ischaemum indicum* var. *wallichii* (Hack.) Bor, Grasses Burma, Ceylon, India & Pakistan 180. 1960; Sreek. & V.J.Nair, Fl. Kerala - Grasses 139. 1991; S.Moulik, Grasses Bamboos India 2: 294. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 420. 2001; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 437. 2009; Srivastava & V.J.Nair, Nelumbo 52: 77. 2010. *Ischaemum indicum* subsp. *wallichii* (Hack.) R.Kr.Singh & P.S.N.Rao var. *wallichii* (Hack.) Bor, J. Econ. Taxon. Bot. 32(4): 813. 2008. *Type*:—— BANGLADESH, **Sylhet** ('Silhet'), *Wallich* 8860 B (K [K001057486 digital image!]).

Spodiopogon scrobiculatus Nees ex Steud., Syn. Pl. Glumac. 1: 373. 1854. *pro syn., nom. inval.*

Ischaemum scrobiculatum Wight & Arn. ex Steud., Syn. Pl. Glum. 1: 373. 1854. *pro syn., nom. inval.*

Ischaemum aristatum sensu C.E.C.Fisch. in Gamble, Fl. Madras 3: 1721. 1934, *non* L., 1753, *p.p.*

Ischaemum indicum auct. mult. N.P.Singh *et al.,* Bull. Bot. Surv. India 18(1−4): 122. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1869. 1983; Karthik. *et*

al., Fl. Ind. Enum. Monocot. 231. 1989; Pull., Fl. Andhra Pradesh 3: 1210. 1997; K.M.Matthew, Fl. Palni Hills 3: 1586. 1999; Pull. Fl. Telangana 3: 1138. 2015, *non* (Houtt.) Merr. 1938 (all in part).

Ischaemum indicum var. *indicum auct. mult.* Bor, Grasses Burma, Ceylon, India Pakistan 180. 1960; S.Moulik, Grasses Bamboos India 2: 293. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 419. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 812. 2008; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 436. 2009, *non* (Houtt.) Merr. 1938 (all in part).

Ischaemum indicum var. *indicum* subvar. *indicum auct. mult.* Sreek. & V.J.Nair, Fl. Kerala - Grasses 137. 1991; Srivastava & V.J.Nair, Nelumbo 52: 76. 2010; Potdar *et al*., Grasses Maharashtra 187. 2012, *non* (Houtt.) Merr. 1938 (all in part).

Figs. 28–33

Annuals, creeping; *nodes* hairy, purplish; *internode* subterete, 1–15 cm long, glabrous, greenish with or without purple shade. *Leaves* sessile; *leaf sheath* 1.5–7 cm long, dorsally keeled, margins entire, chartaceous, dorsal surface tubercle-based hairy, hairs more along submargins and at upper half, ventral surface glabrous, greenish; *leaf blade* narrowly ovate, 4–12 × 0.3–0.6 cm, base rounded or sometimes narrowed or attenuate, margins scabridulous, undulate, apex acuminate, chartaceous, both adaxial and abaxial surfaces densely tubercle-based hairy, greenish. *Ligule* ovate, 1.5–2 mm long, membranous, glabrous, hyaline or pale brownish. *Racemes* 2, separate, 4–6 cm long, pores distinct on ventral side of racemes, more or less hairy. *Spathe* leafy often with reduced lamina. *Peduncle* subterete or corrugated, 11–12 cm long, glabrous or puberulent towards apex, greenish with or without purple tinge. *Rachis internode* clavate, 2.5–3 × 0.4–0.6 mm, 3-angled, coriaceous, ventral surface membranous, dorsal margin densely long pilose, lateral margins toothed, hairs hyaline, greenish. *Sessile spikelet* bisexual, awned, elliptic or oblong, *ca.* 5 × 0.8–1 mm, greenish with purplish tinge; callus pilose, hairs hyaline. *Lower glume* narrowly ovate, *ca.* 3.5 × 1.5–1.8 mm, cymbiform, broad at lower half, scrobiculate or not towards apex, margins entire, scabridulous towards apex, inflexed or infolded, winged at upper 1/3rd or at upper half, wing purplish, wing margins scabrous–scabridulous, apex bifid, coriaceous below (at lower half) and chartaceous–

subcoriaceous above (at upper half), dorsal surface scabridulous–puberulent, hairs seen at upper half, ventral surface scabridulous–puberulent, greenish with purple shade on wings and at apex, 10–12-nerved. *Upper glume* narrowly ovate, 4.5–5 × 1–1.5 mm, cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, dorsally keeled, keel narrowly winged at upper half, wing margins scabridulous, apex oblique or truncate or shortly bifid and awned, chartaceous, dorsal surface scabridulous at upper upper half or at upper 2/3rd, ventral surface scabridulous, greenish, 5-nerved, midnerve continues as awn; *awn* straight, 2–2.5 mm long, scabridulous, greenish. *Lower lemma* elliptic–narrowly elliptic, 3.2–3.5 × 1–1.2 mm, cymbiform, margins inflexed, infolded near apex, ciliate at upper half or at upper 1/3rd, apex acute, chartaceous, dorsal surface puberulent towards apex, ventral surface glabrous or puberulent, hairs very minute, pale greenish, 3-nerved. *Lower palea* narrowly elliptic or oblong, 2.8–3 × 0.8–1 mm, margins inflexed at lower 1/4th or at base, infolded at upper 3/4th, ciliate at upper 1/3rd, laterally keeled at upper 2/3rd or at upper 3/4th, apex rounded or notched, chartaceous, membranous at infolded margins, keel and dorsal surface at upper 1/4th scabridulous, ventral surface glabrous, pale greenish, 2-nerved. *Upper lemma* narrowly ovate, 2.8–3 × 0.6–0.8 mm, cymbiform, margins inflexed at lower 1/3rd or at lower half, infolded at upper 2/3rd or at upper half, infolded margins ciliate, apex bilobed, awned from the sinus, membranous, dorsal surface puberulent—sparsely scabridulous, ventral surface

Fig. 28. Type of *Ischaemum ciliare* Retz. (*Tranchell s.n.* [LD1228219]) © The Board of Trustees for Lund University Botanical Museum, Sweden.

glabrous, hyaline, 3-nerved, nerves jointed at the base of awn; *awn* geniculate, 12–12.5 mm long; column *ca.* 5 mm long, scabridulous along margins and spirals, dark brownish; bristle 7–7.5 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 2.8–3 × 0.6–0.8 mm, margins entire, laterally shallowly keeled at upper 2/3rd, keel scabridulous, apex obtuse or notched, membranous, dorsal surface scabridulous at upper 1/4th or near apex and on lateral keels, ventral surface glabrous–puberulent, hairs very minute, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.4–0.6 × 0.4–0.5 mm, hyaline. *Stamens* 3; anthers *ca.* 2 mm long, yellowish. *Ovary* oblong–elliptic, 0.6–0.8 × 0.3–0.4 mm, brownish; *style* 2, 1.5–2 mm long, hyaline; *stigma* 2, plumose, 1.2–2 mm long, purplish. *Pedicelled spikelet* bisexual, 3-awned (1 geniculate & 2 straight), elliptic, 3.5–4.5 × 1.2–1.5 mm, greenish with purplish tinge; callus glabrous. *Pedicel* clavate, 2.5–3 × 0.3–0.4 mm, hollow, chartaceous, ventral surface membranous, dorsally pilose with scabridulous near apex, lateral margins toothed, greenish. *Lower glume* narrowly ovate, *ca.* 3.5 × 1.5–1.8 mm, cymbiform, broad at lower half, margins entire, narrowly inflexed or not at upper 2/3rd or at upper half, apex aristate or awned, coriaceous at lower half, subcoriaceous–chartaceous at upper half, dorsally keeled, keel winged at upper half or at upper 2/3rd, wing purplish, wing margin scabridulous, dorsal surface scabridulous at upper half, glabrous or very sparsely scabridulous at lower half, greenish with purplish wing and arista, 8–13-nerved; arista/awn 0.8–1 mm long, straight, scabridulous, purplish. *Upper glume* narrowly ovate, *ca.* 3.5 × 1.5 mm, cymbiform, dorsally keeled, keel scabridulous, margins inflexed at lower half, infolded and ciliate at upper half, apex acute–acuminate or obtuse and ends as an awn or arista, chartaceous–subcoriaceous, dorsal surface scabridulous with a tuft of long pilose hairs along dorsal keel at its middle portion, scabridulous hairs seen at upper 2/3rd, ventral surface scabridulous–puberulent, greenish, 5-nerved; *awn* straight, 1–1.2 mm long, scabridulous, greenish with or without purplish tinge. *Lower lemma* oblong–elliptic, 3–3.2 × *ca.* 0.8 mm, cymbiform, margins inflexed at lower half or lower 2/3rd, infolded and ciliate at upper half or at upper 1/3rd, apex acute, membranous–chartaceous, dorsal surface glabrous or puberulent near apex, ventral surface glabrous or puberulent, hyaline–pale greenish, 3-nerved. *Lower*

palea elliptic, 2.5–2.8 × 0.6–0.8 mm, cymbiform, margins inflexed at lower 1/4th, infolded at upper 3/4th, ciliate at upper 1/3rd, laterally keeled, keel scabridulous at upper 3/4th, apex rounded with or without a minute notch, chartaceous, dorsal surface scabridulous near apex and on keels, ventral surface puberulent, hairs seen towards apex, hyaline–pale greenish, 2-nerved. *Upper lemma* elliptic, 2.8–3 × 0.8–1 mm, cymbiform, margins inflexed at lower half, infolded and ciliate at upper half, apex bilobed, dorsally awned from the sinus, membranous, dorsal surface glabrous, ventral surface puberulent, hairs very minute, hyaline, 3-nerved, nerves jointed at the base of awn; *awn* geniculate, 9–9.5 mm long; column twisted, *ca.* 3.5 mm long, scabridulous along spirals, dark brownish; bristle 5.5–6 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 2.5–2.8 × 0.6–0.8 mm, margins sparsely ciliolate, inflexed at lower 1/3rd or at lower half, infolded at upper 2/3rd or at upper half, infolded margins keeled, keel scabridulous, apex obtuse or notched, membranous, dorsal surface scabridulous at upper half, ventral surface puberulent, hyaline, 2-nerved. *Caryopsis* not seen.

Flowering & Fruiting: September to February.

Distribution: Indian Subcontinent to S. China and W. Malesia. In, India it is distributed in Andhra Pradesh, Assam, Bihar, Dadra and Nagar Haveli, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Telangana, Tripura, Uttar Pradesh and West Bengal. Common in southern Peninsular India.

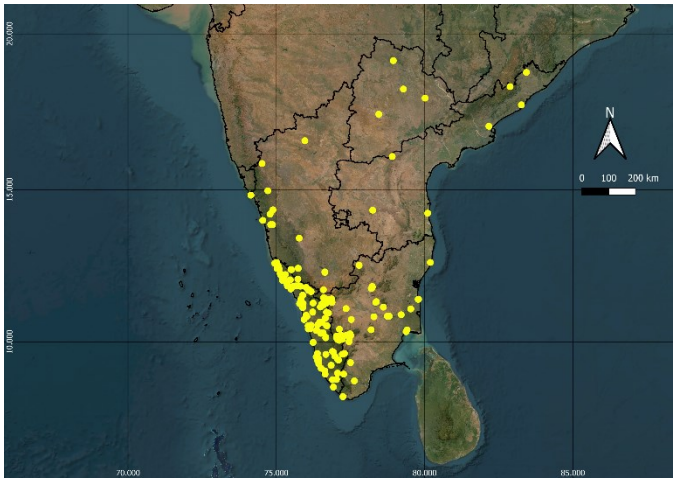

Fig. 29. Distribution of *Ischaemum ciliare* Retz. in southern Peninsular India

Habitat: Very common grass, frequently seen along road sides, waste lands, bunds of paddy fields, sea shores, hill slopes, shola grasslands.

Notes: All the previously known varieties are synonymized here under one variable species *Ischaemum ciliare* following Kellogg *et al.* (2020). A number of species and infraspecific taxa recognized under this taxon is reduced into the synonymy. The indumentum pattern of the lower glume of the sessile spikelets (pilose versus non-pilose) rachis internodes and pedicels (densely pilose on dorsal margin with the two lateral margins toothed with shorter hairs versus densely pilose on all the three margins or atleast on two margins), habits (creeping versus stoloniferous or tufted), nature of lower glumes (scrobiculate versus non scrobiculate) and visibility or nature of pores seen on the ventral side of racemes (distinct versus indistinct) traditionally used for the segregation of taxa cannot be considered as a reliable character as the variations are continuous making the distinctions always difficult. Hence, there is no value in maintaining such infraspecific taxa under this taxon.

Specimens examined: INDIA, **Andhra Pradesh**, East Godavari district, Samalkota, 17.01.1916, *s.coll.* 12489; *Ibid.*, 12.01.1917, *s.coll.* 14176; *Ibid.*, 19.01.1918, *s.coll.* 15459 (BSID); Krishna district, Leelanagar, 26.11.1984, *P. Venkanna* 5412 (BSID); Kurnool district, Sunnipenta, 24.02.2009, *B. Sadasivaiah & S. Khadar Basha* 32982 (BSID); Nellore district [Sri Potti Sriramulu Nellore district], Thamminapatnam, 00.02.1889, *J.S. Gamble* 20392 (DD); Parvathipuram Manyam district, Balugam near Parvatipuram, 11.10.1930, *V. Narayanaswami* 4551 (BSID); Tirupati district, Kakulakonda, Seshachalam Biosphere Reserve, 15.02.2014, *P.V. Prasanna & M. Sankara Rao* 003847 (BSID); Visakhapatnam district, Adativalasa, 12.10.1964, *G.V. Subbarao* 21609 (MH & CAL); Araku Valley, 16.09.1961, *N.P. Balakrishnan* 619 (CAL). **Karnataka**, Belgaum district, Sada, 04.11.2006, *Arun N. Chandore* 88 (SUK); Chamarajanagar district, Gopalaswamy Hills, 30.09.2015, *V. Drisya* 144233 (CALI); Chikmagalur district, Bababudangiri range, 18.11.1978, *A.L. Takhtajan, Cecil J. Saldanha & K.R. Keshava Murthy* 4616 (CAL); Kodagu district, Brahmagiri Hill, 30.10.1976, *B.C. Banarjee* 11663; Bhagamandala to Talakaveri, 02.02.1976, *B.C. Banarjee* 11462 (CAL); Coorg, 21.11.1958, *G.S. Puri* 45806; *Ibid.*, 21.11.1958, *G.S. Puri* 45836; *Ibid.*, 21.11.1958, *G.S. Puri* 45838; Mercara [Madikeri], 10 miles from Mercara on way to Sampaje, 26.10.1963, *A.S. Rao* 95112 (BSI); *Ibid.*, Kudgi farm, 19.11.1956, *B.D. Patil* 991; Makutta, 00.08.1939, *I.F.C.*

s.n. (DD); Mysore district, Marnhalli, 00.11.1908, *A. Meebold* 16580 (CAL); Mysore & Carnatic, *s.d.*, *G. Thomson* 9 (CAL); Shivamogga district, Kodachadri, 08.10.2022, *V. Drisya* 176294; *Ibid.*, 08.10.2022, *V. Drisya* 176295; Udupi district, Kollur, on the way to Souparnikatheertham, 08.10.2022, *V. Drisya* 176296 (CALI); Uttara Kannada district, Bhatkal, 23.01.1947, *M.B. Raizada* 21074; Jog, 01.05.1939, *N.L. Bor* 11339; Jog falls, 28.04.1939, *N.L. Bor* 11393; *Ibid.*, 28.04.1939, *N.L. Bor* 11394 (DD); Karwar, 00.11.1891, *Talbot* 9736; Sirsi-Siddapur, 00.10.1919, *McCann* 9937; Yellapura, 00.11.1880, W.A. *Talbot* 9730 (BLAT); *Ibid.*, 00.11.1880, *W.A. Talbot* 1526 (DD). **Kerala**, Alappuzha district, Alleppey, 21.03.1980, *P.V. Sreekumar* 66775 (MH180132 & MH180133) (MH); Karumadi, Karumadikkutan road, 16.12.2017, *V. Drisya* 157778; Mahadevikadu, Pullikeezhu, 15.12.2017, *V. Drisya* 157775 (CALI); Mankombu, 14.06.1980, *P.V. Sreekumar* 67189 (BSID); Pathiramanal Island, 17.12.2017, *V. Drisya* 157791; Thakazhi, road side, 16.12.2017, *V. Drisya* 157784; *Ibid.*, 16.12.2017, *V. Drisya* 157785; *Ibid.*, Thakazhi Sivasangarappilla Memorial U.P. School ground, 16.12.2017, *V. Drisya* 157783; Thrikkunnapuzha, 15.12.2017, *V. Drisya* 157773; Variamkadu, near Mahadevikadu, 15.12.2017, *V. Drisya* 157776; Ernakulam district, Bhoothathankettu Dam catchment area, 13.12.2018, *V. Drisya* 168707; Thundathil Forest range, Thundam kandam, near forest station, 14.12.2018, *V. Drisya* 168713; *Ibid.*, 14.12.2018, *V. Drisya* 168714 (CALI); Vettilapara forest, 07.12.1952, *J. Fernandez* 13 (BLAT); Idukki district, Anamudi Shola, on the way to Idlimotta, 02.01.2019, *V. Drisya* 168758 (CALI); Munnar, 01.06.1944, *K.C. Jacob* 20506; *Ibid.*, 27.08.1980, *P.V. Sreekumar* 67798 (BSID); *Ibid.*, 23.11.2015, *Rinku J. Desai* 1792 (BARO); western slopes, Eravikulam hut, 05.12.1987, *P. Bhargavan* 87344 (BSID & CAL); Eravikulam National Park, Lakkam, near Lakkam Kudi, 06.02.2018, *V. Drisya* 157832; *Ibid.*, 01.01.2019, *V. Drisya* 168735; *Ibid.*, Lakkam kurisumala, 01.01.2019, *V. Drisya* 168741; *Ibid.*, 01.01.2019, *V. Drisya* 168743; *Ibid.*, near Eravikulam hut, on the way to Turner's Valley, 05.01.2019, *V. Drisya* 170122; *Ibid.*, near Eravikulam pool, 05.01.2019, *V. Drisya* 170117; *Ibid.*, on the way to Lakkam kudi 01.01.2019, *V. Drisya* 168747 (CALI); *Ibid.*, Rajamalai, 26.12.1983, *A.G. Pandurangan* 62546 (BSID); *Ibid.*, Turner's Valley, 05.01.2019, *V. Drisya* 170118;

Fig. 30. *Ischaemum ciliare* Retz.: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**c–i:** Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma; **n.** Lower palea; **o.** Upper lemma; **p.** Upper palea (**j–p:** Pedicelled spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium (from *V. Drisya* 169558, drawn by V. Drisya).

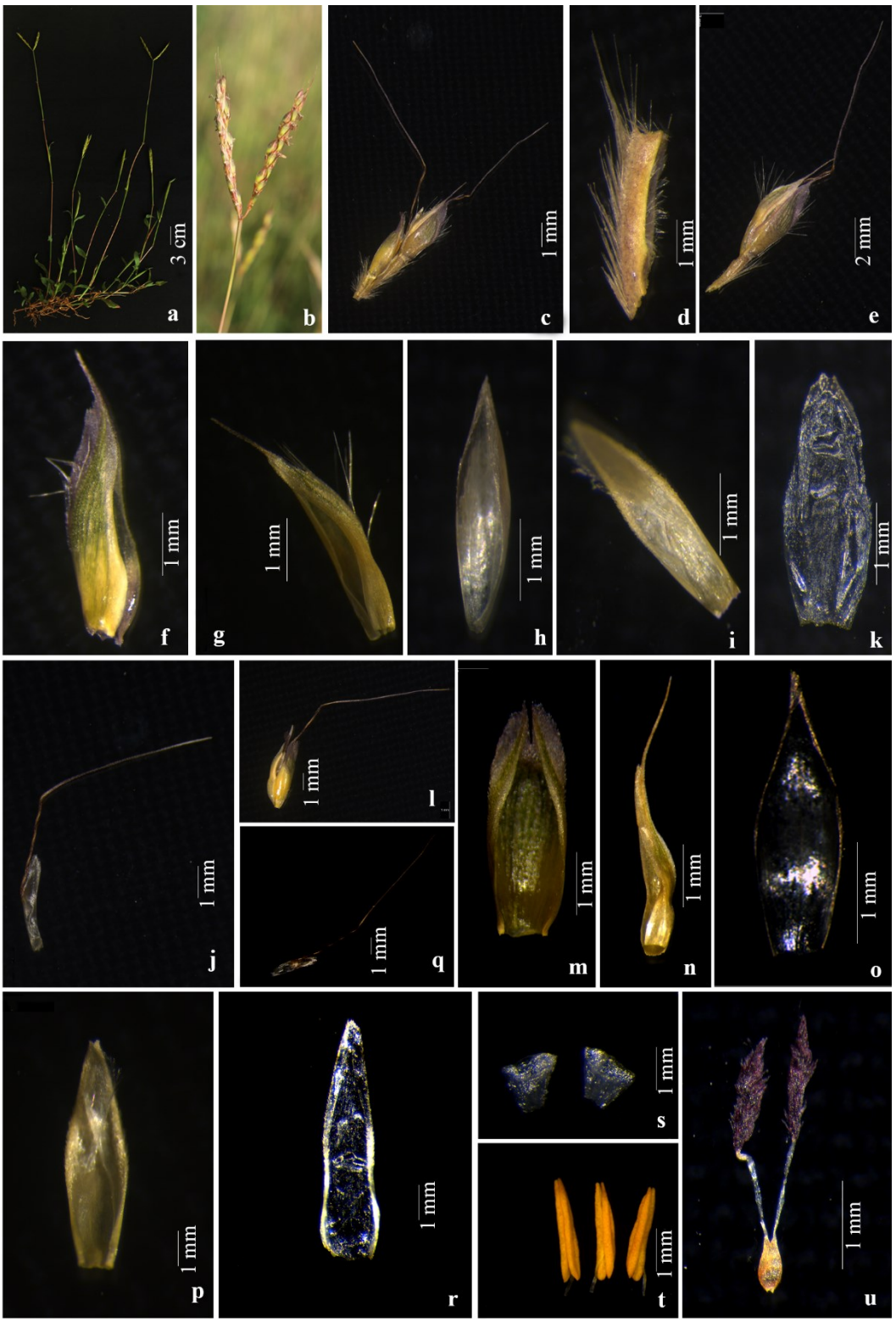

Fig. 31. *Ischaemum ciliare* Retz.: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea (**e–k:** Pedicelled spikelet); **l.** Sessile spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Lower palea; **q.** Upper lemma; **r.** Upper palea (**l–r:** Sessile spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium.

Ibid., 05.01.2019, *V. Drisya* 170119; K. Chappath, 17.10.2015, *V. Drisya & A.K. Pradeep* 144258; Kollukkumala, 13.12.2021, *Alan Thomas & V. Drisya* 169582; Mattuchola, 04.01.2019, *V. Drisya* 170101; *Ibid.*, 04.01.2019, *V. Drisya* 170102; *Ibid.*, 04.01.2019, *V. Drisya* 170102; Mattuchola top, 04.01.2019, *V. Drisya* 168797; on the way to Mattuchola top, 04.01.2019, *V. Drisya* 168790; *Ibid.*, 04.01.2019, *V. Drisya* 168794; *Ibid.*, 04.01.2019, *V. Drisya* 170103; Panjalimedu, 17.10.2015, *V. Drisya & A.K. Pradeep* 144260; Perumala, Bramaram view point, near Kulachivayalkudi, 03.01.2019, *V. Drisya* 168782; *Ibid.*, on the way to Nakkupettikudi, 03.01.2019, *V. Drisya* 168783; *Ibid.*, 03.01.2019, *V. Drisya* 168786; *Ibid.*, 03.01.2019, *V. Drisya* 168787 (CALI); Umaiya malai, Devikolam, 20.11.1965, *B.V. Shetty* 26566 (BSID & CAL); way to Mangala Devi temple, 10.10.1976, *K. Vivekananthan* 48654 (CAL); Vagamon, 05.12.2019, *A.K. Pradeep & V. Drisya* 176265; Vagamon Kurisumala, 26.10.2017, *V. Drisya* 157144; *Ibid.*, 26.10.2017, *V. Drisya* 157145; *Ibid.*, 01.12.2019, *V. Drisya* 170182; *Ibid.*, 01.12.2019, *V. Drisya* 170184; *Ibid.*, 01.12.2019, *V. Drisya* 170191; Vagamon meadows, 26.10.2017, *V. Drisya* 157151; *Ibid.*, 01.12.2019, *V. Drisya* 170179 (CALI); Kannur district, Chooral, 17.10.2019, *V. Drisya* 170166; Eenthodu, near Pappinissery, 30.12.2016, *V. Drisya* 176641; *Ibid.*, 30.12.2016, *V. Drisya* 176642; Ezhimala, 28.11.2016, *Shinoj & V. Drisya* 176749; Ezhimala Kurisumala, 12.11.2017, *V. Drisya* 157710; *Ibid.*, near Hanuman temple, 12.11.2017, *V. Drisya* 157711 (CALI); Kannoth R.F., 28.02.1979, *V.S. Ramachandran* 61988 (CAL); Keecheri, 07.12.2018, *V. Drisya* 176210 (CALI); Kunnaru, near Ezhimala, 12.11.2017, *V. Drisya* 157714; *Ibid.*, 12.11.2017, *V. Drisya* 157722 (CALI); Kuthuparamba, 23.01.1979, *V.S. Ramachandran* 59179 (CAL); Madayippara, 14.11.2018, *V. Drisya* 157865; *Ibid.*, 14.11.2018, *V. Drisya* 157876; *Ibid.*, near Madayi Kavu, 31.10.2017, *V. Drisya* 157177; *Ibid.*, near College, 31.10.2017, *V. Drisya* 157171; *Ibid.*, on the way to Fort, 16.12.2019, *V. Drisya* 169544 (CALI); Nedumpoil, 21.02.1978, *V.S. Ramachandran* 54133 (BSID & CAL); Pappinisseri, 07.12.2018, *V. Drisya* 176209; Pazhayangadi, 16.12.2019, *V. Drisya* 169542; Peringome, 30.11.2018, *V. Drisya* 157860 (CALI); St. Angelo Fort [Angel Fort], 08.10.2002, *N. Mohanan* 44853 (TBGT); Thalassery [Tellicherry] forests,

00.01.1951, *S.K. Jain & R.C. Bharadwaja s.n.* (DD); Vallapatanam River bank, 07.12.2018, *V. Drisya* 176208 (CALI); Kasaragod district, Aarangadi, road side, 05.10.2002, *Kiran Raj* 44946 (TBGT); Bekal, 28.09.1982, *R. Ansari* 74364 (CAL); Chattanchal, 02.11.2017, *V. Drisya* 157188; Cherkala, 25.12.2016, *V. Drisya* 176626; *Ibid.*, 25.12.2016, *V. Drisya* 176628; *Ibid.*, 02.11.2017, *V. Drisya* 157200 (CALI); Kumbla, 25.01.1979, *V.S. Ramachandran* 59243 (BSID & CAL); Koipady, near Kumbla, 11.11.2018, *V. Drisya* 157853; *Ibid.*, 11.11.2018, *V. Drisya* 157854 (CALI); Kumbla, 25.01.1979, *V.J. Nair* 59909 (BSID & CAL); Nileshwaram, 24.12.2016, *V. Drisya* 176617 (CALI); Periya, 02.10.1982, *R. Ansari* 74459 (CAL); *Ibid.*, 02.10.1982, *R. Ansari* 74461 (BSID & CAL); *Ibid*, 02.10.1982, *R. Ansari* 74465 (BSID & CAL); *Ibid.*, 25.12.2016, *V. Drisya* 176621; *Ibid.*, 25.12.2016, *V. Drisya* 176631; *Ibid.*, 02.11.2017, *V. Drisya* 157191; *Ibid.*, 02.11.2017, *V. Drisya* 157192; *Ibid.*, 11.11.2018, *V. Drisya* 157849; Puthige, 23.01.2020, *V. Drisya* 169525; Thottam–Padne road, near Pilicode, 24.12.2016, *V. Drisya* 176605; *Ibid.*, 24.12.2016, *V. Drisya* 176606; *Ibid.*, 24.12.2016, *V. Drisya* 176607; *Ibid.*, 24.12.2016, *V. Drisya* 176609; Veethukunnu, Pilicode, 24.12.2016, *V. Drisya* 176615 (CALI); Kollam district, near Sasthamkotta Lake, 15.11.2017, *V. Drisya* 157737; Oochira, near Manjadimukku, 08.12.2019, *V. Drisya* 176268 (CALI); Tenmalai [Thenmala] 'Edaman', 24.03.1915, *C.C. Calder & M.S. Ramaswami* 1473 (CAL); Kozhikode district, Kakkayam, Ambalappara Grassland, 30.11.2018, *V. Drisya* 157880; *Ibid.*, 30.11.2018, *V. Drisya* 157882; *Ibid.*, on the way to Search, 28.12.2017, *V. Drisya* 157800; *Ibid.*, 30.11.2018, *V. Drisya* 157889 (CALI); Kanjeerakkadavu, 26.11.1981, *P.V. Sreekumar* 71844; Kozhikode [Calicut], 11.12.1931, *G.V. Narayana* 6285 (BSID); Pariyangad, Marumayil padam, 20.03.2015, *V. Drisya* 144201; *Ibid.*, 08.10.2015, *V. Drisya* 144291; *Ibid.*, 15.11.2015, *V. Drisya* 144294; *Ibid.*, 18.12.2016, *V. Drisya* 176757; *Ibid.*, 23.12.2019, *V. Drisya* 169565; *Ibid.*, 25.12.2020, *V. Drisya* 169548; *Ibid.*, 25.12.2020, *V. Drisya* 169550; *Ibid.*, 25.12.2020, *V. Drisya* 169551; *Ibid.*, 25.12T.2020, *V. Drisya* 169552; *Ibid.*, 25.12.2020, *V. Drisya* 169553; *Ibid.*, 15.01.2022, *V. Drisya* 169577; Pokkunnumala, near Nanminda, 26.10.2016, *V. Drisya* 150765; *Ibid.*, 26.10.2016, *V. Drisya* 150767; *Ibid.*, 26.10.2016, *V. Drisya*

150771; *Ibid.*, 26.10.2016, *V. Drisya* 150774; *Ibid.*, 23.11.2019, *V. Drisya* 170173; *Ibid.*, 23.11.2019, *V. Drisya* 176239 (CALI); Ramanattukara, 15.12.1996, *N. Mohanan* 36979 (TBGT); Malappuram district, Calicut University Campus, 16.03.2014, *Rinku J. Desai* 1058 (CAL); *Ibid.*, 03.07.2015, *V. Drisya* 144286; *Ibid.*, 05.07.2015, *V. Drisya* 144287; *Ibid.*, 14.07.2015, *V. Drisya* 144285; *Ibid.*, 29.10.2016, *V. Drisya* 176776; *Ibid.*, 19.11.2019, *V. Drisya* 176218; *Ibid.*, infront of IAAT, 05.09.2015, *V. Drisya* 144290; *Ibid.*, 11.12.2020, *V. Drisya* 169558; *Ibid.*, Ladies hostel, 05.09.2015, *V. Drisya* 144282; Kuttippuram, 23.11.2017, *V. Drisya & A.K. Pradeep* 157749 (CALI); Manathumangalam, 15.12.1996, *N. Ravi & N. Mohanan* 33029; *Ibid.*, *N. Ravi & N. Mohanan* 33031 (TBGT); *Ibid.*, 03.12.2016, *V. Drisya* 144296; *Ibid.*, 03.12.2016, *V. Drisya* 144297; *Ibid.*, 03.12.2016, *V. Drisya* 144298; *Ibid.*, Ooty road, 03.12.2016, *V. Drisya* 150704 (CALI); Nilambur, 30.11.1937, *N.L. Bor s.n.* (DD); Puthuponnani to Kuttippuram roadside, 23.11.2017, *V. Drisya & A.K. Pradeep* 157745 (CALI); Palakkad district, Alathur, Gurukula Junction, 05.12.2018, *V. Drisya* 157894; Manappulli, 03.01.2016, *V. Drisya* 171474; *Ibid.*, 03.01.2016, *V. Drisya* 171476; *Ibid.*, 03.01.2016, *V. Drisya* 171478; *Ibid.*, 03.01.2016, *V. Drisya* 171480; Nelliyampathy, 05.12.2015, *V. Drisya* 150788; *Ibid.*, 05.12.2015, *V. Drisya* 150791; *Ibid.*, 05.12.2015, *V. Drisya* 150792; *Ibid.*, 05.12.2015, *V. Drisya* 150793; *Ibid.*, Valiya Govindamala, 10.12.2022, *V. Drisya* 169595; Padur, 05.12.2018, *V. Drisya* 157895; *Ibid.*, 176201; Palakkad, Govt. Victoria College ground, 04.12.2015, *V. Drisya* 150787 (CALI); Pathanamthitta district, Konni R.F., Thavazhappara, 18.11.1976, *M. Chandrabose* 49104 (CAL & MH); Konni, 21.11.1928, *s.coll.* 1751 (CAL); Udumpara, near Ezhukuman, Pamba forest range, 18.11.2017, *V. Drisya* 157741 (CALI); Villoonipara, Poojapara, 27.11.1996, *N. Ravi & N. Mohanan* 24747 (TBGT); Thiruvananthapuram district, Palode, TBGRI Medicinal Garden, 02.02.2017, *V. Drisya* 176648 (CALI); Pulimath, 25.05.1979, *M. Mohanan* 59393 (CAL & MH); 75 miles from Thiruvananthapuram, 03.11.1956, *S.C. Agrawal* 788 (CAL); Veli, 03.02.2017, *V. Drisya* 176651; *Ibid.*, 03.02.2017, *V. Drisya* 176652 (CALI); Thrissur district, Avittappilly, 15.01.2018, *V. Drisya* 157818; Chazhur, 14.01.2018, *V. Drisya* 157814; Chembuchira, 10.02.2019, *V. Drisya* 170160; Kodali, 10.02.2019, *V. Drisya* 170154; Kombazha, 04.02.2018,

V. Drisya 157819; Mandhirappilly, 10.02.2019, *V. Drisya* 170151; *Ibid.*, 10.02.2019, *V. Drisya* 170152; Muthuvara, Puzhakkal Padam, 13.01.2018, *V. Drisya* 157812; near Charpa Falls, in between Athirappilly & Vazhachal, 12.12.2019, *V. Drisya* 176275; Snehatheeram Beach, 23.11.2017, *V. Drisya* & *A.K. Pradeep* 171489; *Ibid.*, 23.11.2017, *V. Drisya* & *A.K. Pradeep* 171490; *Ibid.*, 23.11.2017, *V. Drisya* & *A.K. Pradeep* 171491; *Ibid.*, 23.11.2017, *V. Drisya* & *A.K. Pradeep* 171493; *Ibid.*, 23.11.2017, *V. Drisya* & *A.K. Pradeep* 171494 (CALI); Wayanad district, Chandanathode, 04.01.1942, *Indian Forest College Student* 90902; *Ibid.*, near Thalassery, 06.01.1942, *G.S. Dhillon s.n.* (DD); Kurichiar mala, 31.12.2015, *V. Drisya* 176713 (CALI); Mananthavady [Manantoddy], 11.02.1978, *V.S. Ramachandran* 53887 (CAL); Meenangadi, 27.12.2015, *K.K. Jeomol & V. Drisya* 144295 (CALI); Theethundamalai top, Chandanathode, 04.12.1967, *J.L. Ellis* 29460 (CAL); Wayanad, 00.11.1939, *IFC s.n.* (DD). **Tamil Nadu**, Coimbatore district, Topslip, 21.11.1937, *N.L. Bor* 8634 (DD); Velliangiri Hills, 11.01.2004, *K. Althaf Ahamed Kabeer* 117245; *Ibid.*, 11.01.2004, *K. Althaf Ahamed Kabeer* 117220 (MH183876); *Ibid.*, 30.09.2016, *A.K. Pradeep & V. Drisya* 150707; *Ibid.*, 30.09.2016, *A.K. Pradeep & V. Drisya* 150709; *Ibid.*, 30.09.2016, *A.K. Pradeep & V. Drisya* 150776 (CALI); Velliangiri 7th Hills, 21.01.2004, *K. Althaf Ahamed Kabeer* 117284 (MH183980); *Ibid.*, 21.01.2004, *K. Althaf Ahamed Kabeer* 117705 (MH183980) (MH); Cuddalore district, Pichavaram, North Pichavaram from lands, 04.04.1978, *K.M. Matthew* 12750 (CAL & RHT); Pichavaram, off T.S. Pettai, 23.02.2001, *K.M. Matthew* 72661 (RHT); Dindigul district, CIMAP surrounding areas, Attuvampatti, Kodaikanal, 01.03.2002, *K. Althaf Ahamed Kabeer* 113291 (MH); Kodaikanal, 00.09.1941, *V.M.L. Sharma s.n.* (DD); *Ibid.*, 16.09.1956, *J. Pallithanam* 2202; *Ibid.*, 00.00.1956, *K.M. Matthew* 730 (RHT); On way to Kodaikanal, 28.10.1956, *P.C. Nanda* 667 (DD); Palni Hills, Kodaikanal–Berijam road, 06.12.1986, *K.M. Matthew & M. Charles* 47748; Palni Hills, Vadakavunchi–Perumal peak path, 12.12.1986, *K.M. Matthew* 47879 (RHT); Pulneys, Kodaikanal lake side, 17.07.1898, *Bourne* 1929; head of Bear Shola, 20.05.1907, *Bourne* 1348; Kodaikanal, *s.d.*, *Van Maideren* 1228 (CAL); Kodaikanal, Blackburne marsh, 10.08.1987, *K.M. Matthew & K.T. Mathew* 50018; *Ibid.*, Blackburne shola,

10.08.1987, *K.M. Matthew & K.T. Mathew* 50022; *Ibid.*, Mannavanur Lake exit, 30.08.1987, *K.M. Matthew & K.T. Mathew* 50623; *Ibid.*, Vandaravu–Marian shola, Levinge path, Vandaravu, 18.12.1989, *K.M. Matthew & K.T. Mathew* 54040 (RHT); Kanchipuram district, Mamallapuram, 07.02.2003, *K.M. Matthew* 74547; Kanchipuram, East Coast road, 06.01.2000, *K.T. Augustine* 61763 (RHT); Kanyakumari district, Colachal, 26.01.1978, *A.N. Henry* 53297 (CAL & MH); Valayathu vayal, 26.11.2005, *K. Althaf Ahamed Kabeer* 118575 (MH); Krishnagiri district, Denkanikottai, 16.12.1939, *N.L. Bor s.n.* (DD); Namakkal district, Kolli Hills, 24.01.1968, *K.M Matthew* 8426; *Ibid.*, Semmedu, Nachiar Koil Shola, 12.11.1976, *K.M. Matthew* 4759; *Ibid.*, Pooduballi village, 16.04.1977, *D.I. Arockiasamy* 7651; *Ibid.*, Madal shola slopes, 12.01.1982, *K.M. Matthew, S.J. Britto & N. Rani* 28899; *Ibid.*, Solakkadu, 11.01.1982, *K.M. Matthew* 28838; *Ibid.*, Sothupparai stream, 25.11.1987, *S.J. Britto* 30663; *Ibid.*, 25.11.1987, *S.J. Britto* 30674; *Ibid.*, Periakada Aar upwards, 13.01.1976, *K.M. Matthew & V. Alphonse* 825 (RHT); Nilgiris district, Avalanche, 14.10.1972, *K. Vivekananthan* 42947 (MH); Coonoor, *s.d.*, *J.S. Gamble* 12613 (CAL); Coonoor, Simps park, 19.10.2003, *K. Althaf Ahamed Kabeer* 117184 (MH); forest office, Naduvattom, 22.07.2003, *K. Althaf Ahamed Kabeer* 116251; Hulical Droog R.F., 27.08.1957, *K.M. Sebastine* 4120; *Ibid.*, 27.08.1957, *K.M. Sebastine* 4152 (MH); Kotagiri, 00.05.1915, *s.coll.* 9495 (BLAT); Mudumalai R.F., 18.11.1958, *K.M. Sebastine* 7373 (CAL & MH); *Ibid.*, 7342 (CAL & MH); Mukurthy National Park, Avalanche Guest house to Bhavani temple, 12.09.2008, *K. Althaf Ahamed Kabeer* 121736; *Ibid.*, Korakundah, 11.01.2002, *K. Althaf Ahamed Kabeer* 113094; *Ibid.*, Upper Bhavani, 18.09.2008, *K. Althaf Ahamed Kabeer* 121928 (MH); *Ibid.*, 26.07.2012, *J. Remya & R. Prasanna* 73793; *Ibid.*, 09.11.2012, *J. Remya* 75492 (TBGT); *Ibid.*, Upper Bhavani to No-1 dam, 19.09.2008, *K. Althaf Ahamed Kabeer* 122002 (MH); Nilgiris, *s.d.*, *Perrottet* 1310; *Ibid.*, *s.d.*, *Perrottet* 1330 (DD); Pykara, 12.09.1930, *V. Narayana Swami* 4181 (MH); *Ibid.*, 12.10.2016, *P. Soumya & V. Drisya* 176767 (CALI); Pykara river banks, 15.07.1970, *J.L. Ellis* 34706; Thala Kuntha, 27.08.1970, *B.D. Sharma* 35838 (MH); Tiger Hill, Ooty, 00.11.1883, *J.S. Gamble* 13157 (CAL); Udhagamandalam [Ootacamund or Ooty], 15.11.1937, *N.L. Bor* 7648 (DD); Salem district, Yercaud,

Balmadies to Kaka-Sholai, 20.12.1958, *K. Subramanyam* 7564 (CAL & MH); Yercaud, Graigmore Estate, 29.07.1976, *K.M. Matthew & D.I. Arockiasamy* 2842 (RHT); *Ibid.*, Ladies sheet view point, 10.12.2017, *Nikhil Krishna & V. Drisya* 157766 (CALI); Yercaud Manjakottai, 11.01.1980, *K.M. Matthew* 25700; Servarayan Hills, Kaka Shola up Mines Hill, 19.12.2000, *K.M. Matthew & N. Baskaran* 62491 (RHT); Thanjavur district, Adiramapatanam, along the sides of cultivated fields, 22.05.1978, *V.J. Nair* 57045 (CAL & MH); Thamarankkotai, 07.03.1989, *S. Ragupathy* 1025 (MH); Theni district, Maharajamettu, *s.d.*, *V. Lakshmanan* 91113 (BSID); Thiruchirappalli district, Srirangam Isl, Thiruvalar solai, 21.02.1978, *Perianayagam* 12030; Top Sengattupatty, Puthur path, Thuraiyur taluk, 16.03.1978, *K.M. Matthew* 12321; Tollgate to Edaiyathumangalam, Lalgudi taluk, 19.02.1980, *Perianayagam & Diraviadoss* 26547; Mullakkudi road, bypass road junction, 03.03.1984, *K.M. Matthew & S.J. Britto* 29612 (RHT); Thiruvannamalai district, Javadi Hills (Thenmalai), Melpet–pond, 07.01.2002, *K.M. Matthew* 73821 (RHT); Tirunelveli district, Main Falls, Courtallam, 16.12.1957, *K. Subramanyam* 4953; Suthamalli tank, 29.01.2002, *K. Althaf Ahamed Kabeer* 113198 (MH); Tiruppur district, Dharapuram, 17.01.1914, *C.E.C. Fischer* 3681 (FRC); *s.loc.* [Madras state], 00.01.1951, *S.K. Jain & R.C. Bharadwaja* 22724 (DD). **Telangana**, Karimnagar district, Aklaspur, 30.12.1964, *G.V. Subbarao* 22489 (CAL & MH); Mancherial district, Indhanpalli-Range, Narlapur-Beat Kawal Tiger Reserve, 26.10.2013, *P.S. Annamma* 003917 (BSID); Warangal district, Pakhal R.F., 28.11.1960, *K.M. Sebastine* 11661 (CAL & MH). *s.loc.*, *s.d.*, *C.A. Barber* 7239 (MH00062775).

Additional specimens examined (from other than study area): INDIA, **Gujarat**, Panchmahal district, 02.11.2018, *V. Drisya* 171456 (CALI).

Notes on typification: *Ischaemum ciliare* subvar. *scrobiculatum* Hack. was described by Hackel in 1889 and cited two elements as "In ins. Ceylon (Macrae; *Wight* 2322)". Moreover, he also cited *Ischaemum scrobiculatum* Wight & Arn. ex Steud., *Spodiopogon scrobiculatus* Nees ex Steud., *Spodiopogon zeylanicus* Nees, *Andropogon bifidus* Steud., *Andropogon simillimus* Steud. and *Andropogon Macraei*

Steud. as synonyms. The two names having the same specific epithet 'scrobiculatum' or 'scrobiculatus' are prosynonyms because they were not validly published and were cited just as synonyms under *Andropogon bifidus* by Steudel (1854); no previous records of their publication is available. Steudel cited *Ischaemum scrobiculatum* under two names *Andropogon bifidus* and *Andropogon simillimus* with locality as 'Ind. Or.' under *Andropogon bifidus* and as 'Penin. Ind. Or.' under *Andropogon simillimus*. Moreover, Steudel treated *Spodiopogon zeylanicus* under *Andropogon macraei* with locality as "Macrae legit in Zeylon". Thus, Steudel's treatment supports the greater probability of the two names *Ischaemum scrobiculatum* and *Spodiopogon scrobiculatus* as being of Indian origin. But Steudel in his treatment, did not cite any material under these names. Moreover, authors failed to trace any herbarium specimen belongs to Steudel from India. Later it was Hackel (1889) who validly published the name *Ischaemum ciliare* subvar. *scrobiculatum* and cited a specimen as "In ins. Ceylon (Macrae; *Wight* 2322)". By searching various herbaria, authors could trace two sheets by Robert Wight with collection number as 2322. One sheet is housed at herbarium E [barcode E00393556 digital image!] and the other one at K [barcode K0001057490 digital image!]. According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), one out of the two available syntypes has to be selected to

Fig. 32. Lectotype of *Spodiopogon scrobiculatus* Nees ex Steud. (*Wight* 2322 [E00393556]) ©The Board of Trustees of Royal Botanic Garden Edinburgh.

serve as the lectotype for the name *Ischaemum ciliare* subvar. *scrobiculatum*. Hence, the sheet at E (E00393556) being a well preserved specimen agreeing with the protologue is selected here as the lectotype, the sheet at K (K0001057490) is an isolectotype.

Hackel (1889) described another subvariety *malacophyllum* under *Ischaemum ciliare* based on *Andropogon malacophyllus* Hochst. ex Steud. While validly publishing *A. malacophyllus*, Steudel (1855) cited the original material or gathering as "in Hohnkr. Hrbr. Ind. nr. 917" and the locality as "Montes Nilagiri". But there are 16 sheets of Hohenacker with collection number 917 available at various herbaria. Out of these 16 sheets, two sheets available at K [barcode K00245698 & K000245699 digital image!]; three at JE [barcode JE00007320, JE00007321 & JE00007322 digital image!]; one at FI [barcode FI012286 digital image!]; three at W [barcode W0028800, W18890017013 & W19160035823 digital image!]; one at US [barcode US00406422 digital image!]; two at MPU [barcode MPU024305 & MPU024306 digital image!]; one at CANB [barcode CANB442387 digital image!]; one at CORD [barcode CORD00001449 digital image!]; one at TUB [barcode TUB-010076 digital image!] & one at S [barcode S-G-400 digital image!]). According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), one out of these 16 syntypes has to be selected as the lectotype. Hence, one of the well preserved specimen with barcode K00245698, is selected here as the lectotype with all other sheets as isolectotypes.

Fig. 33. Lectotype of *Andropogon malacophyllus* Hochst. ex Steud. (*Hohenacker* 917 [K00245698]) © The Board of Trustees for The Royal Botanic Gardens, Kew.

Whereas in case of *Ischaemum ciliare* var. *longipilum* Hack., only one sheet is traced from the syntypes. In the protologue, Hackel cited two elements under *Ischaemum ciliare* var. *longipilum* as "Ceylon (Thwait. 3167); Birma pr. Maulmein (Kuntze)". Besides, Davidse in Dassanayake (1994) cited two sheets (*Thwaites* C.P. 3167) one each at herbaria K and PDA as well as reference to Kuntze's specimen as syntypes. Authors could trace one specimen belongs to *Thwaites* 3167 at herbarium W, but failed to trace it in K and PDA. Hence the sheet *Thwaites* 3167 available at W [barcode W18890064964] is cited here as the syntype.

5. Ischaemum commutatum Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 209. 1889; Hook.f., Fl. Brit. India 7: 131. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 178. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 122. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1868. 1983; Karthik. *et al*., Fl. Ind. Enum. Monocot. 231. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 129. 1991; S.Moulik, Grasses Bamboos India 2: 291. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 412. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 806. 2008, *p.p.*; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 433. 2009; Srivastava & V.J.Nair, Nelumbo 52: 70. 2010; Potdar *et al*., Grasses Maharashtra 178. 2012. *Lectotype* (designated by Davidse in Dassanayake, 1994):—— SRI LANKA (CEYLON), *s.d.*, *Thwaites* C.P. 2625 (lecto: PDA [*n.v.*]; isolecto: CAL [CAL0000033982 digital image!], G [G00176012 digital image!], W [W1889-0065084 digital image!]).

Ischaemum tadulingamii N.C.Nair & Sreek., Blumea 30(2): 385. 1985, *syn. nov.* *Ischaemum commutatum* var. *tadulingamii* (N.C.Nair & Sreek.) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 807. 2008. *Type*:—— INDIA, **Kerala**, Idukki district, near subsidiary Turner's Valley, Eravikulam National Park, 07.04.1980, *P.V. Sreekumar* 71863 (holo: CAL [CAL0000002274!]; iso: K [*n.v.*], MH [MH00001583!]).

Figs. 34–37

Tufted annuals or perennials, 15–50 cm tall; *node* glabrous, purplish or brownish; *internode* terete–subterete, 1–8 cm long, glabrous, greenish. *Leaves* shortly petiolate; *leaf sheath* dorsally keeled, 2.5–6 cm long, margins entire, dorsal surface

bulbous based hairy, ventral surface glabrous, greenish; *leaf blade* narrowly ovate, 3–10 × 0.5–1.2 cm, base cordate, margins scabridulous, apex acute–acuminate, both abaxial and adaxial surfaces densely bulbous based hairy, greenish. *Ligule* ovate, 1.5–2 mm long, membranous, dorsally sparsely bulbous based hairy. *Petiole* 0.2–0.5 cm long, both dorsal and ventral surfaces more or less bulbous based hairy. *Lower leaves* pseudopetiolate or narrowed at base. *Racemes* 2, adpressed together and looks like solitary, 4–6 cm long, more or less hairy. *Spathe* leafy with reduced lamina. *Peduncle* terete–subterete, 8–26 cm long, slender, shallowly striated or not, glabrous, greenish. *Rachis internode* triangular or clavate, *ca.* 5 × 0.8–1 mm, one side membranous, 2 sides coriaceous, dorsal margin densely pilose, one lateral margin sparsely pilose and the other glabrous. *Sessile spikelet* bisexual, awned, narrowly elliptic, 6.5–7 × 1–1.2 mm, crustaceous; callus pilose, hairs hyaline. *Lower glume* narrowly ovate, 5.5–6 × 1.5–1.8 mm, margins entire, inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or at upper half, infolded margins keeled and winged, sometimes wing very narrow or absent, wing margins scabridulous, apex acute–obtuse, chartaceous, dorsal surface scabridulous towards margins and infolded portions, ventral surface scabridulous, hairs mainly seen towards apex, laterally side-noduled (with obscure side nodules) or not towards base, greenish, 7–13-nerved. *Upper glume* narrowly ovate, *ca.* 5.5 × 1.6–2 mm, cymbiform, margins inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or at upper half, infolded margins ciliate, apex acute, chartaceous, dorsal surface scabridulous or puberulent, ventral surface scabridulous–puberulent, dorsally keeled towards apex, keel winged at apex, wing scabridulous, greenish, midvein prominent. *Lower lemma* narrowly ovate, 5.2–5.5 × 0.8–1 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate and keeled, keel scabridulous, apex acute, membranous, dorsal surface glabrous except lateral keels, ventral surface puberulent, hyaline with pale green tinge, 2-nerved. *Lower palea* narrowly elliptic, *ca.* 5 × 1–1.2 mm, margins ciliate at upper 2/3rd, infolded, keeled, keel winged, wing margin entire, or scabridulous near apex, apex obtuse or muticous, sometimes minutely incised, membranous, dorsal surface glabrous, ventral surface puberulent, hyaline with a green tinge, 2-nerved. *Upper lemma* elliptic, 4.5–5 × 1.5–2 mm,

cymbiform, margins ciliate, inflexed or infolded, apex bilobed, awned from the sinus, membranous, glabrous, hyaline, 3-nerved, nerves jointed at the base of awn; *awn* geniculate, 13–13.5 mm long, scabridulous; column twisted, *ca.* 6.5 mm long, scabridulous along margins, dark brownish; bristle 6.5–7 mm long, margins scabridulous, pale brownish. *Upper palea* narrowly ovate, *ca.* 4 × 0.8–1 mm, margins inflexed or infolded, keeled, ciliate at upper half or at upper 2/3rd, apex obtuse, membranous, dorsal surface glabrous, ventral surface scabridulous–sparsely scabridulous, keel scabridulous, hyaline, 2-nerved. *Lodicules* 2, cuneate, *ca.* 0.5 × 0.2–0.4 mm, hyaline. *Stamens* 3; anthers 1.5–2.2 mm long, yellowish. *Ovary* elliptic or narrowly ovate, 0.5–0.7 × 0.3–0.4 mm, brownish; *style* 2, 1.8–2 mm long, hyaline–pale brownish; *stigma* 2, plumose, *ca.* 2 mm long, purplish. *Pedicelled spikelet* usually well developed, rarely reduced, male, unawned, elliptic–narrowly elliptic, 5–5.5 × 2–2.2 mm, greenish; callus scabrous–sparsely pilose, hairs hyaline. *Pedicel* triangular or clavate, 4.5–5 cm long, all the 3 margins pilose (one margin less hairy as compared to the other two), similar to rachis internode. *Lower glume* narrowly ovate, 5–5.5 × *ca.* 2 mm, margins ciliate at upper 1/3rd or at upper half, inflexed or infolded, keeled throughout, one margin broadly winged throughout, the other narrowly winged and broad towards upper half, wing margins scabridulous, apex acute, chartaceous, dorsal surface puberulent with scabridulous hairs at infolded marginal portion towards apex, ventral surface puberulent, hairs seen towards upper half, greenish, 10–12-nerved. *Upper glume* narrowly ovate, *ca.* 4.5 ×

Fig. 34. Lectotype of *Ischaemum commutatum* Hack. (*Thwaites* 2625 [CAL0000033982]) © The Director, Botanical Survey of India.

1.5–1.8 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, apex acute, chartaceous, dorsal surface scabridulous, hairs seen towards upper half, ventral surface glabrous, greenish, 5-nerved. *Lower lemma* narrowly ovate, 3.8–4 × 0.8–1.2 mm, margins inflexed at lower 1/3rd or at lower 1/4th, infolded at upper 2/3rd or at 3/4th, infolded margins ciliate, laterally keeled at upper half, keel scabridulous, apex obtuse, membranous, dorsal surface glabrous, ventral surface puberulent, hairs very minute, hyaline, 3-nerved. *Lower palea* narrowly elliptic or oblong, *ca.* 2.8 × 0.6–0.8 mm, margins inflexed or infolded, ciliate towards upper half, apex obtuse, membranous, hyaline, 2-nerved. *Upper lemma* narrowly ovate, *ca.* 3.5 × 1–1.2 mm, margins inflexed or infolded, ciliate at upper half or at upper 2/3rd, apex shortly bifid, membranous, glabrous or puberulent, hyaline, nerves not seen. *Upper palea* narrowly ovate, 3.2–3.5 × *ca.* 0.8 mm, margins ciliate, apex acute–obtuse or notched, membranous, glabrous or puberulent, hyaline, nerves not seen. *Caryopsis* oblong–elliptic, *ca.* 2.8 × 1.8–2 mm, brownish, with persistent style.

Flowering & Fruiting: September to March.

Distribution: India and Sri Lanka only. In India, it is restricted to Peninsular Indian states of Karnataka, Kerala, Maharashtra and Tamil Nadu.

Habitat: Common in high altitude grasslands, sometimes in fringes of shola forests.

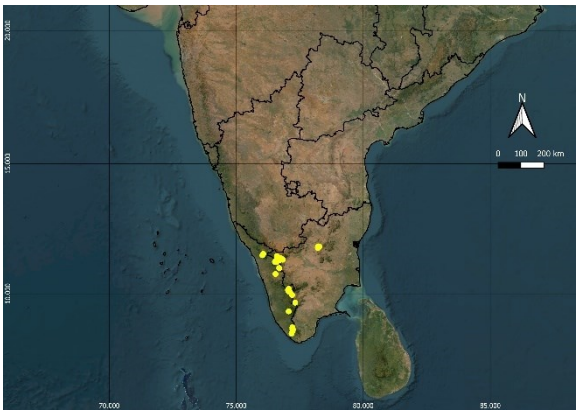

Fig. 35. Distribution of *Ischaemum commutatum* Hack. in southern Peninsular India

Specimens examined: INDIA, **Kerala**, Idukki district, Anamudi Shola National Park, on the way to Idlimotta, 02.01.2019, *V. Drisya* 168754; Eravikulam National Park, near Bheemanoda, 05.01.2019, *V. Drisya* 170123; Mathikettan Shola National Park, 18.12.2016, *Shinoj & V. Drisya* 176759; Munnar, on the way to Range Forest Office, 21.07.2016, *V. Drisya* 150746; on the way to Devikulam, near KFRI nursery, 08.04.2016, *Shinoj & V. Drisya* 176661 (CALI); on the way to Eravikulam,

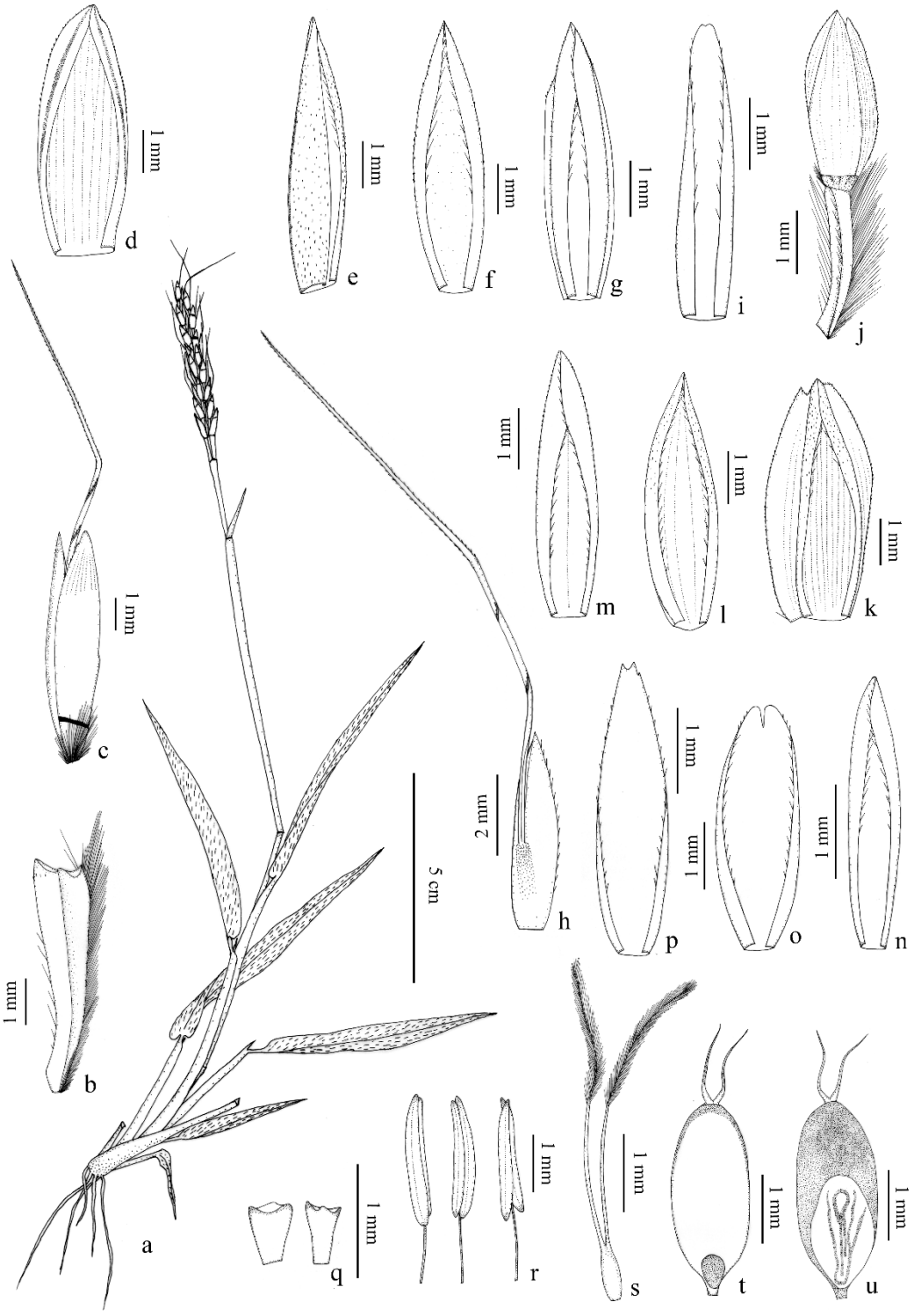

Fig. 36. *Ischaemum commutatum* Hack.: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**c–i:** Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma; **n.** Lower palea; **o.** Upper lemma; **p.** Upper palea (**j–p:** Pedicelled spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis-dorsal view; **u.** Caryopsis-ventral view (from *V. Drisya* 168722, drawn by V. Drisya).

28.08.1980, *P.V. Sreekumar* 68413; *Ibid.*, 28.08.1980, *P.V. Sreekumar* 68420 (BSID & MH); Kollam district, Moozhiyar, near power house, 07.07.1981, *P.V. Sreekumar* 70448 (BSID); Palakkad district, below Ayyappan Kovil area, 27.10.1976, *E. Vajravelu* 48712 (CAL); Thiruvananthapuram district, Agasthyamala, Athirumala, 14.03.2016, *Shinoj & V. Drisya* 176668; *Ibid.,* in between Pongalappara and Agastyarkoodam peak, 20.12.2018, *V. Drisya* 168721; *Ibid.*, 20.12.2018, *V. Drisya* 168722; *Ibid.*, 20.12.2018, *V. Drisya* 168725; near Agastyarkoodam, 20.12.2018, *V. Drisya* 168719; Pongalappara, 15.03.2016, *Shinoj & V. Drisya* 176669; *Ibid.*, 20.12.2018, *V. Drisya* 168723 (CALI); Chemmunjii, 15.10.2009, *J. Remya* 65439; Chemmunjii Hills, 27.02.2004, *N. Mohanan* 53441; *Ibid.*, 17.10.2007, *N. Mohanan* 45190; *Ibid.*, 07.11.2002, *N. Mohanan* 44867 (TBGT); Wayanad district, Chembra, 12.10.2012, *J. Remya* 74518 (TBGT); Chembra top, 30.12.2015, *V. Drisya* 176708 (CALI). **Tamil Nadu**, Coimbatore district, Velliangiri peak, 21.02.1932, *S.R. Raju & Ratnavelu* 227; Velliangiri Hills, 7th hill, 21.01.2004, *K. Althaf Ahamed Kabeer* 117713 (MH); Velliangiri, 7th hill top, 27.04.1969, *S. Karthikeyan & M. Chandrabose* 31814 (CAL); Velliangiri Hill, 30.09.2016, *V. Drisya & A.K. Pradeep* 150708 (CALI); Kanyakumari district, Muthukuzhi, 15.03.1979, *A.N. Henry* 60717 (CAL); Nilgiris district, Avalanche, 24.06.1987, *M.K. Janarthanam* 83047 (BSID); Avalanche Power House, Mukurthy National Park, 15.09.2008, *K. Althaf Ahamed Kabeer* 121900; back water area, upper Bhavani Dam, 02.02.2008, *K. Althaf Ahamed Kabeer* 121667; Avalanche Guest House to Bhavani temple, 12.09.2008, *K. Althaf Ahamed Kabeer* 121749 (MH); Emerald, 09.11.2012, *J. Remya* 75482 (TBGT); Hulical Droog, 27.08.1957, *K.M. Sebastine* 4144; Coonoor, 21.01.1957, *K.M. Sebastine* 2157 (CAL); Meenamalai, near Arahatti, Coonoor, 03.03.2004, *K. Althaf Ahamed Kabeer* 117746 (MH); Ketti Hills, 31.03.1958, *K.M. Sebastine* 5712 (CAL); Korakundah, Dairy farm, 26.07.2012, *Remya J. & R. Prasanna* 73794 (TBGT); Pykara, Ooty, 24.02.2018, *V. Drisya* 157837 (CALI); Upper Bhavani, 26.07.2012, *J. Remya & R. Prasanna* 73799 (TBGT); Salem district, Shervarayan Hills, Yercaud, Marappalam (Nagalur), 15.12.1980, *K.M. Matthew, J.B. Britto & N. Rani* 28021; Shevaroys, foot of the temple hill, Omallur, 10.01.1980, *K.M. Matthew* 25642; Shevaroys, below temple, Omallur, 10.01.1980, *K.M. Matthew* 25644;

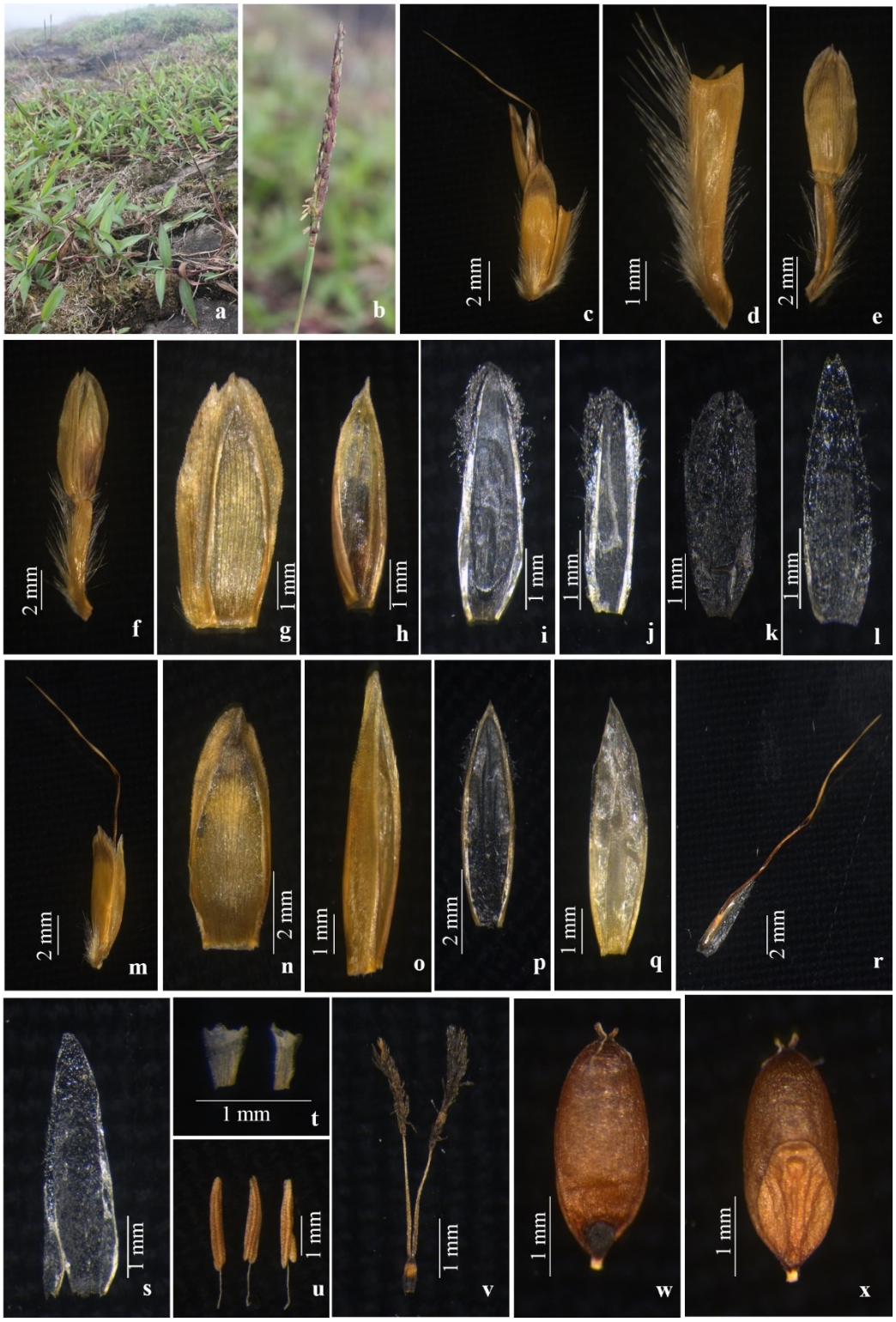

Fig. 37. *Ischaemum commutatum* Hack.: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet-dorsal view; **f.** Pedicelled spikelet-ventral view; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**e–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume; **o.** Upper glume; **p.** Lower lemma; **q.** Lower palea; **r.** Upper lemma; **s.** Upper palea (**m–s:** Sessile spikelet); **t.** Lodicules; **u.** Stamens; **v.** Gynoecium; **w.** Caryopsis-dorsal view; **x.** Caryopsis-ventral view.

Yercaud, way to mines, 15.12.1977, *D.I. Arockiasamy* 10158; Yercaud, way to Shevaroy's temple from Kadukkamaram near water tank, 29.04.1977, *D.I. Arockiasamy* 7796; Yercaud, Marappalam, 24.11.1976, *K.M. Matthew & Arockiasamy* 4991 (RHT); Yercaud, Manjakuttai, 15.02.1969, *D.B. Deb* 31406 (CAL); Theni district, High Wavy Mountain [Meghamalai], 00.05.1917, *Blatter & Hallberg* 86; *Ibid.*, 00.05.1917, *Blatter & Hallberg* 679 (CAL).

Notes on synonymisation: It was Singh and Rao (2008), who treated *Ischaemum tadulingamii* as a variety of *I. commutatum*, but all others (Sur, 2001; Srivastava & Nair, 2010 & Kellogg *et al.*, 2020) kept it as a distinct species. Singh & Rao observed that *I. tadulingamii* is morphologically similar to *I. commutatum* and differs only by few marginal characters which is not enough to treat as distinct species.

The characters of *I. tadulingamii* overlaps with *I. commutatum*, and it is observed the presence of reduced pedicelled spikelets in many south Indian species of *Ischaemum* which normally possess well developed pedicelled spikelets. Also, Lower leaves with pseudopetioles and without pseudopetioles are common in case of *Ischaemum*. Hence, the characters used to distinguish *I. tadulingamii* from *I. commutatum* (eg: nature of pedicelled spikelet whether they are developed or reduced as well as lower leaves whether they are pseudopetioled or not) are not good enough to segregate species within the genus *Ischaemum*. Moreover, authors visited the type locality of *I. tadulingamii* and failed to collect such a specimen. So, there is greater probability in the occurrence of *I. tadulingamii* as a short-lived intermediate form or an ecological variant of *I. commutatum*. With all these observations *I.tadulingamii* is treated here as the synonym of *I. commutatum*.

6. Ischaemum impressum Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 210. 1889; Hook.f., Fl. Brit. India 7: 132. 1897; Bor, Grasses Burma, Ceylon, India & Pakistan 180. 1960; Karthik. *et al*., Fl. Ind. Enum. Monocot. 231. 1989; S.Moulik, Grasses Bamboos India 2: 292. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 418. 2001; S.G.Gopal *et al*., J. Econ. Taxon. Bot. 28(3): 549. 2004; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 811. 2008; Srivastava & V.J.Nair,

Nelumbo 52: 75. 2010; Potdar *et al*., Grasses Maharashtra 184. 2012. *Type*:—— ASIA, *s.d.*, *Hugel* 4018 (W [W0028785 digital image!]).

Figs. 38–41

Annual herbs, 30–50 cm tall; *internodes* terete, 3–7 cm long, glabrous, greenish; *nodes* glabrous, purplish. *Leaves* petiolate, *petiole* linear, 2–5 mm long, flat, glabrous, hairy at base; *leaf sheath* 7–9 cm long, dorsally keeled, glabrous, margins bulbous-based hairy, greenish; *leaf blade* narrowly elliptic–lanceolate, 10–16 × 0.9–1.2 cm, base attenuate, margins scabridulous, apex acuminate, chartaceous, both abaxial and adaxial surface tubercle-based hairy, greenish. *Ligule* ovate, 3–5 mm long, membranous, tubercle-based hairy. *Racemes* 2, adpressed together, 4–6 cm long, more or less hairy. *Spathe* leafy, with or without reduced lamina, 4–6 mm long. *Rachis internode* triangular, 4–4.5 × *ca.* 1.5 mm, swollen, one side membranous, other two sides crustaceous, dorsal margin densely pilose, pale greenish. *Sessile spikelet* bisexual, awned, narrowly elliptic–oblong, 7–8 × 1–1.5 mm, crustaceous, greenish; callus pilose, hairs hyaline. *Lower glume* narrowly ovate, 5.5–6 × 1.5–1.8 mm, margins entire, inflexed at lower half, infolded at upper half, infolded margins keeled, winged at upper 1/3rd, wing margin scabridulous, apex acute, crustaceous, chartaceous near apex, with 2 semilunar depression on dorsal surface, both dorsal and ventral surfaces puberulent, 12–14-nerved, nerves inconspicuous. *Upper glume* narrowly ovate, *ca.* 6.5 × 1.5–2 mm, cymbiform, dorsally keeled, dorsal keel humped at middle and winged at upper 1/4th, margins entire, inflexed or infolded at lower half, infolded and keeled at upper half, keel scabrous, apex acuminate, chartaceous, dorsal surface scabridulous, ventral surface puberulent or glabrous towards base, greenish, 6-nerved, midnerve prominent. *Lower lemma* narrowly ovate, 4.8–5 × 0.8–1 mm, margins ciliate at upper half or upper 1/3rd, inflexed at lower half, infolded at upper half, infolded margins keeled, keel scabrous, apex acute, membranous, dorsal surface scabridulous, hairs seen on infolded portions, ventral surface glabrous, pale greenish–hyaline, 3-nerved. *Lower palea* narrowly ovate, *ca.* 4.5 × 0.8–1 mm, margins entire, infolded and keeled, keel scabridulous and sparsely scabrous, apex acute–obtuse, membranous, both dorsal and ventral surfaces glabrous, hyaline with pale green tinge, 4-nerved. *Upper lemma*

narrowly ovate, *ca.* 4 × 1–1.2 mm, folded, margins sparsely ciliate, apex bilobed, awned from the sinus, membranous, glabrous, hyaline. *Awn* geniculate, *ca.* 9.5 mm long; column twisted, *ca.* 3.5 mm long, scabridulous or sparsely scabridulous, dark brownish; bristle *ca.* 6 mm long, scabridulous, hyaline. *Upper palea* narrowly ovate, 3.2–3.5 × 1–1.2 mm, margins entire, inflexed or infolded at lower half, apex acute–muticous or notched, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline. *Pedicelled spikelet* male or empty, unawned, narrowly ovate, 4.5–5 × 1–2 mm, greenish; callus glabrous. Pedicel clavate or triangular, 4–4.5 × 0.8–1 mm, similar to rachis internode. *Lower glume* narrowly ovate, 4.5–5 × 1.8–2 mm, margins entire, keeled, inflexed at lower half or lower 1/3rd, infolded at upper half or upper 2/3rd, one margin broadly winged throughout, the other margin narrowly winged towards apex, wing margin serrulate, apex acute or bifid, chartaceous, dorsal surface glabrous, ventral surface scabridulous, greenish, *ca.* 20-nerved. *Upper glume* narrowly ovate, 4–4.5 × 1.2–1.5 mm, cymbiform, margins ciliate, inflexed or infolded, apex acute–acuminate, chartaceous, dorsal surface scabridulous, ventral surface scabridulous–sparsely scabridulous, pale greenish, 5-nerved. *Lower lemma* narrowly ovate, *ca.* 4 × 1 mm, margins inflexed at lower half or lower 1/3rd, infolded at upper half or upper 2/3rd, infolded margins ciliate, apex acute, membranous, dorsal surface sparsely scabridulous, ventral surface glabrous, hyaline, 3-nerved. *Lower palea* narrowly ovate or narrowly

Fig. 38. Type of *Ischaemum impressum* Hack. (*Hugel* 4018 [W0028785]) © The Board of Trustees of Natural History Museum, Vienna.

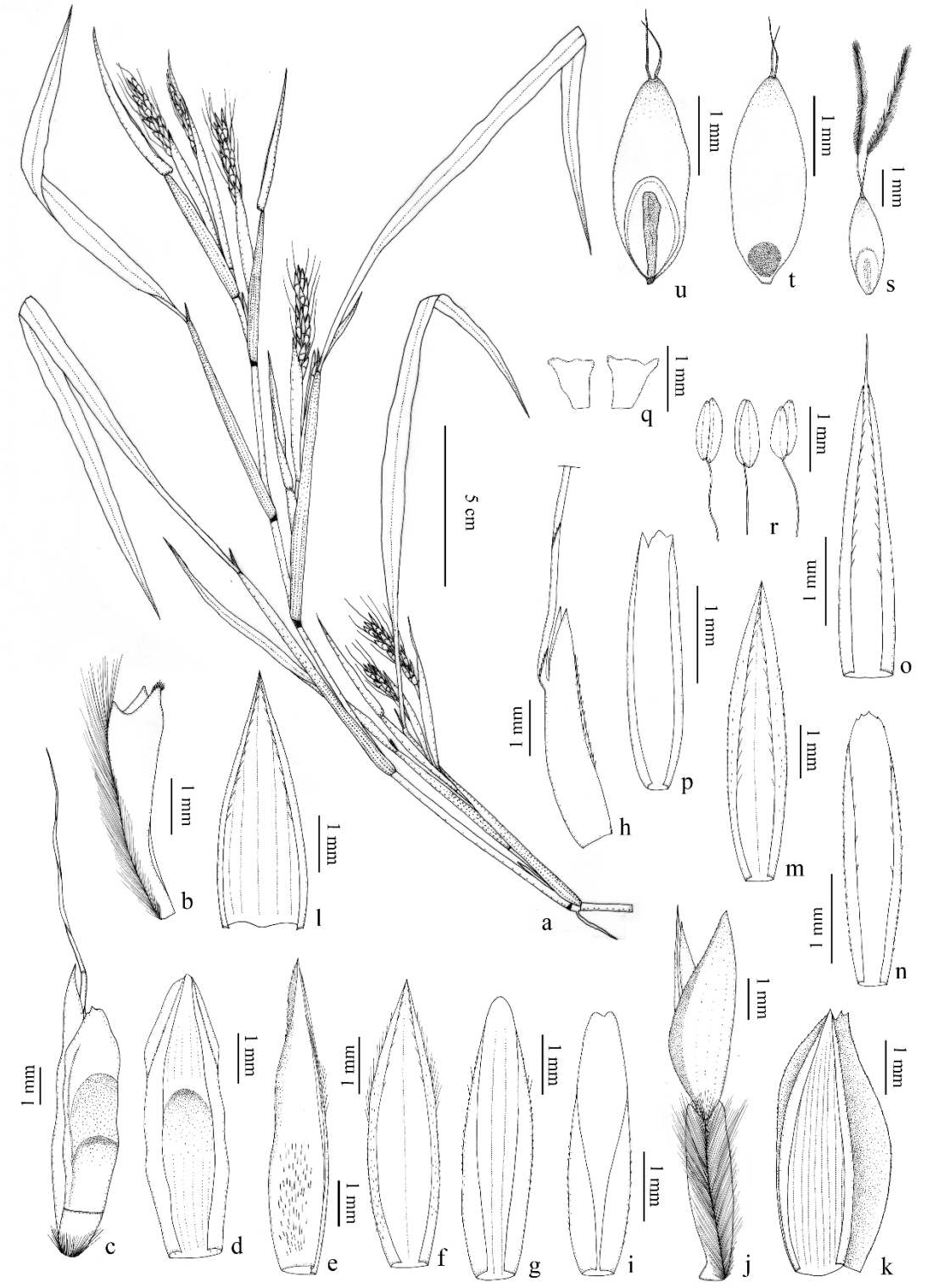

Fig. 39. *Ischaemum impressum* Hack.: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**c–i:** Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma; **n.** Lower palea; **o.** Upper lemma; **p.** Upper palea (**j–p:** Pedicelled spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis-dorsal view; **u.** Caryopsis-ventral view (from *V. Drisya* 169568, drawn by V. Drisya).

Fig. 40. *Ischaemum impressum* Hack.: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet-dorsal view; **f.** Pedicelled spikelet-ventral view; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**e–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume-dorsal view; **o.** Lower glume-ventral view; **p.** Upper glume; **q.** Lower lemma; **r.** Lower palea; **s.** Upper lemma; **t.** Upper palea (**m–t:** Sessile spikelet); **u.** Lodicules; **v.** Caryopsis.

elliptic, *ca.* 3 × 0.6–0.8 mm, margins sparsely ciliate, inflexed or infolded, keeled, keel scabridulous, apex obtuse, membranous, glabrous, hyaline. *Upper lemma* narrowly ovate, 3–3.5 × 1–1.2 mm, margins sparsely ciliate, inflexed or infolded, apex aristate, membranous, glabrous, hyaline, 1-nerved; arista *ca.* 0.5 mm long. *Upper palea* oblong, 2.5–2.8 × 0.6–0.8 mm, margins entire, inflexed or infolded, apex obtuse or minutely lobed, membranous, glabrous, hyaline, nerves not seen. *Lodicules* 2, cuneate, *ca.* 0.8 × 0.3–0.4 mm. *Stamens* 3; anther *ca.* 0.8 × 0.3–0.4 mm, yellowish. *Ovary* narrowly elliptic–oblong, 1.8–2.2 × 0.6–0.8 mm; style 2, 1.2–1.5 mm long, hyaline; stigma 2, plumose, 2.5–3 mm long, purplish. *Caryopsis* elliptic, 2.5–2.8 × 0.6–0.8 mm, style persistant, brownish.

Flowering & Fruiting: September to December.

Distribution: India, Pakistan and Socotra. In India, it is distributed in Delhi, Karnataka, Kerala, Maharashtra and Rajasthan.

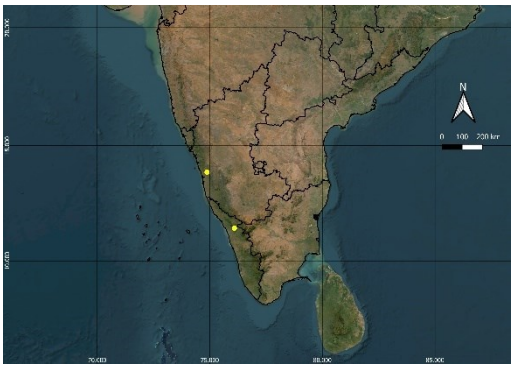

Fig. 41. Distribution of *Ischaemum impressum* Hack. in southern Peninsular India

Habitat: Hill slopes and lateritic plateaus of higher elevations.

Specimens examined: INDIA, **Karnataka**, Shivamogga district, Kodachadri, 08.10.2022, *V. Drisya* 176292. **Kerala**, Kozhikode district, Olichuchattam, 09.12.2018, *Nikhil Krishna & V. Drisya* 170144; *Ibid.*, 24.12.2019, *V. Drisya* 169568 (CALI).

7. Ischaemum kingii Hook.f., Fl. Brit. India 7: 129. 1897; Bor, Grasses Burma, Ceylon, India & Pakistan 182. 1960; Karthik. *et al*., Fl. Ind. Enum. Monocot. 232. 1989; S.Moulik, Grasses Bamboos India 2: 294. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 421. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 815. 2008; Srivastava & V.J.Nair, Nelumbo 52: 78. 2010; Potdar *et al*., Grasses Maharashtra 189. 2012; Abhijit & Y.L.Krishnam., Zoo's Print 34(4): 19–21. 2019. *Lectotype* (designated by Bor, 1960):—— INDIA, **Rajasthan**, Sirohi district, Mount Abu, 00.09.1808, *G. King*

s.n. (lecto: K [K000245688 digital image!]; isolecto: CAL [CAL0000002290!, CAL0000002291!]).

Ischaemum raizadae Hemadri & Billore, Indian Forester 96: 318. 1970, *syn. nov.* *Ischaemum kingii* var. *raizadae* (Hemadri & Billore) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 815. 2008. *Type*:—— INDIA, **Maharashtra**, Thana district, Sadrya Ghat, near Harischandra garh, Tokavada forest range, 16.11.1968, *K.V. Billore* 115450 A (holo: CAL[CAL0000002294!]; iso: CAL [CAL0000002295!]).

Figs. 42–45

Plant annual, 25–40 cm high, culm erect or geniculate; *node* glabrous; *internode* terete–subterete, 3–7 cm long, glabrous or punctate, greenish. *Leaves* mostly with a pseudopetiole, uppermost leaves may sessile or subsessile; *leaf sheath* 3.5–5 cm long, dorsally keeled, margins entire, chartaceous, dorsal and ventral surface glabrous, greenish; *leaf blade* narrowly ovate or narrowly elliptic, 5–12 × 0.6–1.5 cm, base attenuate or narrowed, margins scabridulous, apex acute–acuminate, chartaceous, both abaxial and adaxial surfaces glabrous, greenish. *Ligule* ovate, 1–1.3 mm long, apex minutely lobed or crenate, membranous. *Racemes* 2, adpressed together, 3–5 cm long, more or less hairy. *Spathe* leafy with or without reduced lamina. *Peduncle* terete–subterete, 6–8 cm long, glabrous, greenish. *Rachis internode* clavate, 2–3 × 0.4–0.6 mm, coriaceous, ventral surface membranous, laterally compressed, glabrous except margins, dorsal margin densely long pilose, one lateral margin pilose and hairs shorter than dorsal margin,

Fig. 42. Lectotype of *Ischaemum kingii* Hook.f. (*G. King s.n.* [K000245688]) © The Board of Trustees for The Royal Botanic Gardens, Kew.

one margin glabrous, greenish. *Sessile spikelet* bisexual, awned, narrowly elliptic or oblong, 6–7 × 0.8–1 mm, greenish; callus hairy, hairs hyaline. *Lower glume* narrowly ovate or oblong, 4.5–5 × 0.8–1 mm, margins entire, inflexed at lower 1/4th or 1/3rd, infolded at upper 3/4th or 2/3rd, laterally keeled, keel scabridulous near apex (at upper 1/4th or 1/3rd), keel continues into arista, apex bifid with two long arista, coriaceous, shallowly side noduled towards margins near base (one nodule on each side seen), dorsal surface punctate throughout and scabridulous near apex, ventral surface scabridulous–puberulent at upper 1/3rd or at upper half and with or without a tuft of long pilose hairs on infolded margins near to middle, 10–12-nerved; aristas unequal, 2.5–4 mm long, greenish, scabridulous. *Upper glume* narrowly ovate–oblong, 6–7 × 1–1.2 mm, cymbiform, margins entire, inflexed or infolded, apex long aristate, chartaceous–subcoriaceous, dorsal surface glandular–punctate and scabridulous throughout with a tuft of small glandular hairs or with a tuft of long pilose hairs seen at middle, ventral surface scabridulous–puberulent towards apex, dorsally keeled above middle, keel scabridulous, greenish, 3-nerved; arista 5–6 mm long, scabridulous, greenish. *Lower lemma* narrowly ovate, 3.8–4 × 0.4–0.6 mm, cymbiform, margins entire, inflexed or infolded, apex acute, chartaceous, dorsal surface scabridulous towards margins, ventral surface glabrous, pale greenish, 3-nerved. *Lower palea* narrowly elliptic or oblong, 2–2.2 × 0.2–0.4 mm, margins entire, apex obtuse, membranous, glabrous, hyaline, nerves not seen. *Upper lemma* narrowly ovate, 3–3.2 × 0.8–1.2 mm, cymbiform, margins entire, inflexed or infolded, apex bilobed, awned from the sinus, membranous, dorsal surface puberulent–glabrous, ventral surface glabrous, hyaline, 3-nerved; *awn* geniculate, 30–40 mm long; column twisted, 7–12 mm long, scabridulous–sparsely scabridulous along spirals, dark brownish; bristle 23–28 mm long, scabridulous on margins, pale brownish–hyaline. *Upper palea* linear–lanceolate, 1.8–2 × 0.1–0.2 mm, margins entire, apex acute–acuminate or obtuse, membranous, glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.4–0.6 × 0.2–0.3 mm, hyaline. *Stamens* 3; anthers 1.2–1.5 mm long, yellowish. *Ovary* ovoid, 0.4–0.6 × 0.3–0.4 mm; *style* 2, 1–1.2 mm long; *stigma* 2, plumose, 1–1.2 mm long, purple. *Pedicelled spikelet* male or empty, aristate and not awned, narrowly elliptic or narrowly ovate, 4.5–5 × 0.6–0.8 mm,

greenish; callus somewhat prominent, 0.2–0.4 mm long, glabrous or very sparsely scabrous–scabridulous. *Pedicel* 2–3 × 0.3–0.4 mm, similar to rachis internode. *Lower glume* narrowly ovate or oblong, 4.5–5 × 0.8–1 mm, margins entire, inflexed at lower 1/3rd or lower 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins keeled and winged, wing margins scabridulous, apex notched with 2 unequal aristas, chartaceous, dorsal and ventral surface glabrous, greenish, 6–9-nerved; arista 0.5–1.2 mm long. *Upper glume* narrowly ovate, 3.2–3.5 × 0.6–0.8 mm, cymbiform or folded, margins entire or very sparsely ciliate, inflexed or infolded, apex aristate, chartaceous, dorsally keeled, keel scabridulous, dorsal surface scabridulous–sparsely scabridulous, hairs seen more towards base and margins at apex, ventral surface glabrous, pale greenish, 3-nerved; arista 0.8–1 mm long. *Lower lemma* narrowly ovate or narrowly elliptic, 1.5–2.5 × 0.2–0.5 mm, margins entire, inflexed or not, apex acute or obtuse, membranous, glabrous or puberulent, hyaline. *Paleas* and *upper lemma* reduced or absent, not seen. *Caryopsis* narrowly elliptic with or without persistent style base, 2–2.2 × 0.3–0.4 mm, brownish.

Flowering & Fruiting: October to November.

Distribution: Endemic to India. Distributed in Karnataka, Maharashtra and Rajasthan. In southern Peninsular India, it is reported only from Karnataka.

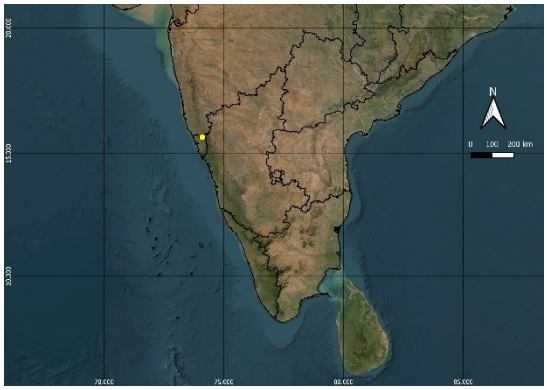

Fig. 43. Distribution of *Ischaemum kingii* Hook.f. in southern Peninsular India

Habitat: Grassy hill slopes and on rocks near waterfalls.

Specimens examined: INDIA, **Karnataka**, Sada, 23.10.2008, *Arun N. Chandore* 939 (SUK).

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Pune district, B.S.I. Experimental Garden, Pune, 10.10.1969, *K.V. Billore* 115984 (CAL [CAL0000002292! & CAL0000002293!); Sindhudurg district, Amboli, 12.11.2016, *Shinoj & V. Drisya* 176676 (CALI).

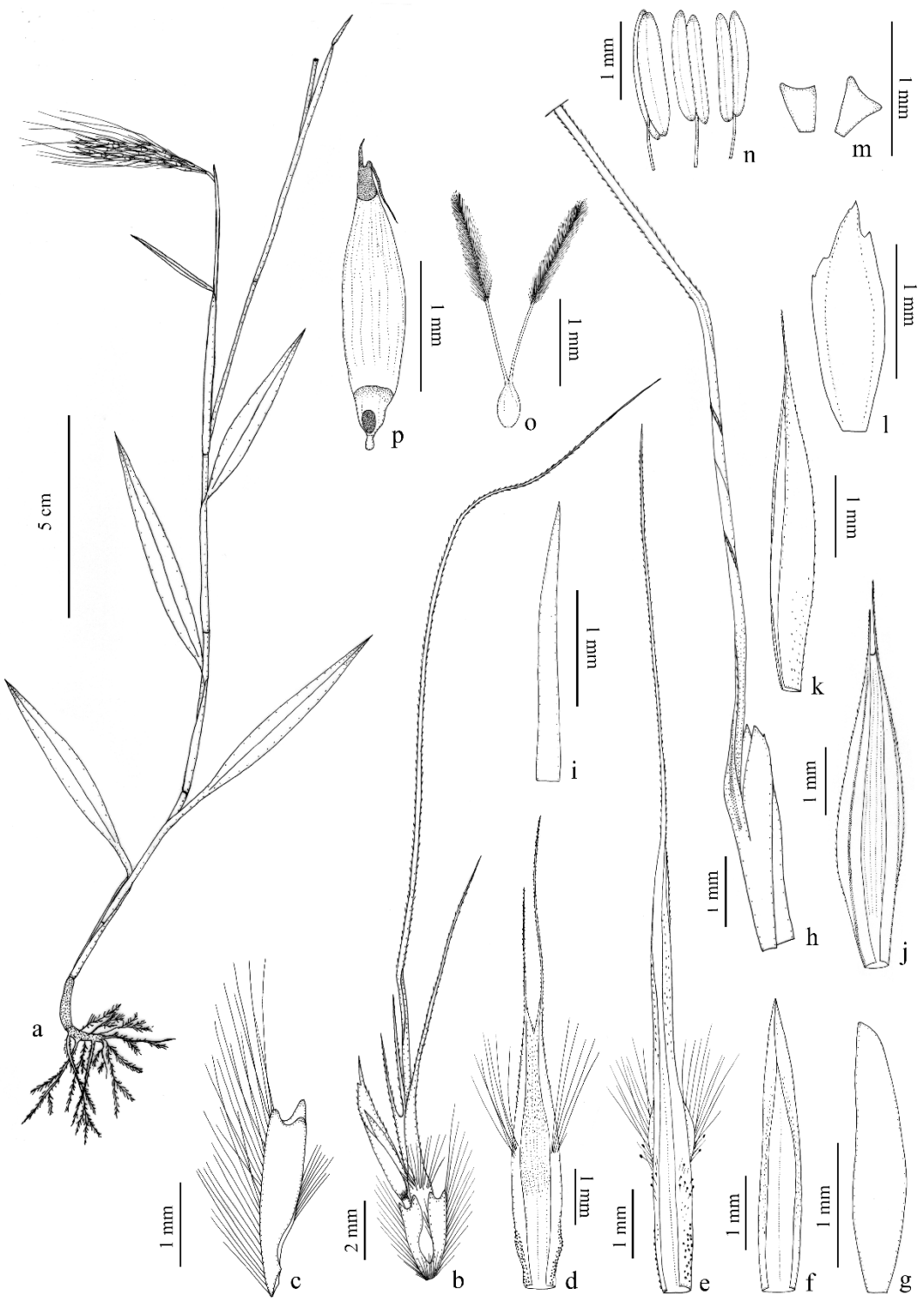

Fig. 44. *Ischaemum kingii* Hook.f.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**d–i:** Sessile spikelet); **j.** Lower glume; **k.** Upper glume; **l.** Lower lemma (**j–l:** Pedicelled spikelet); **m.** Lodicules; **n.** Stamens; **o.** Gynoecium; **p.** Caryopsis (from *Shinoj & V. Drisya* 176676, drawn by V. Drisya).

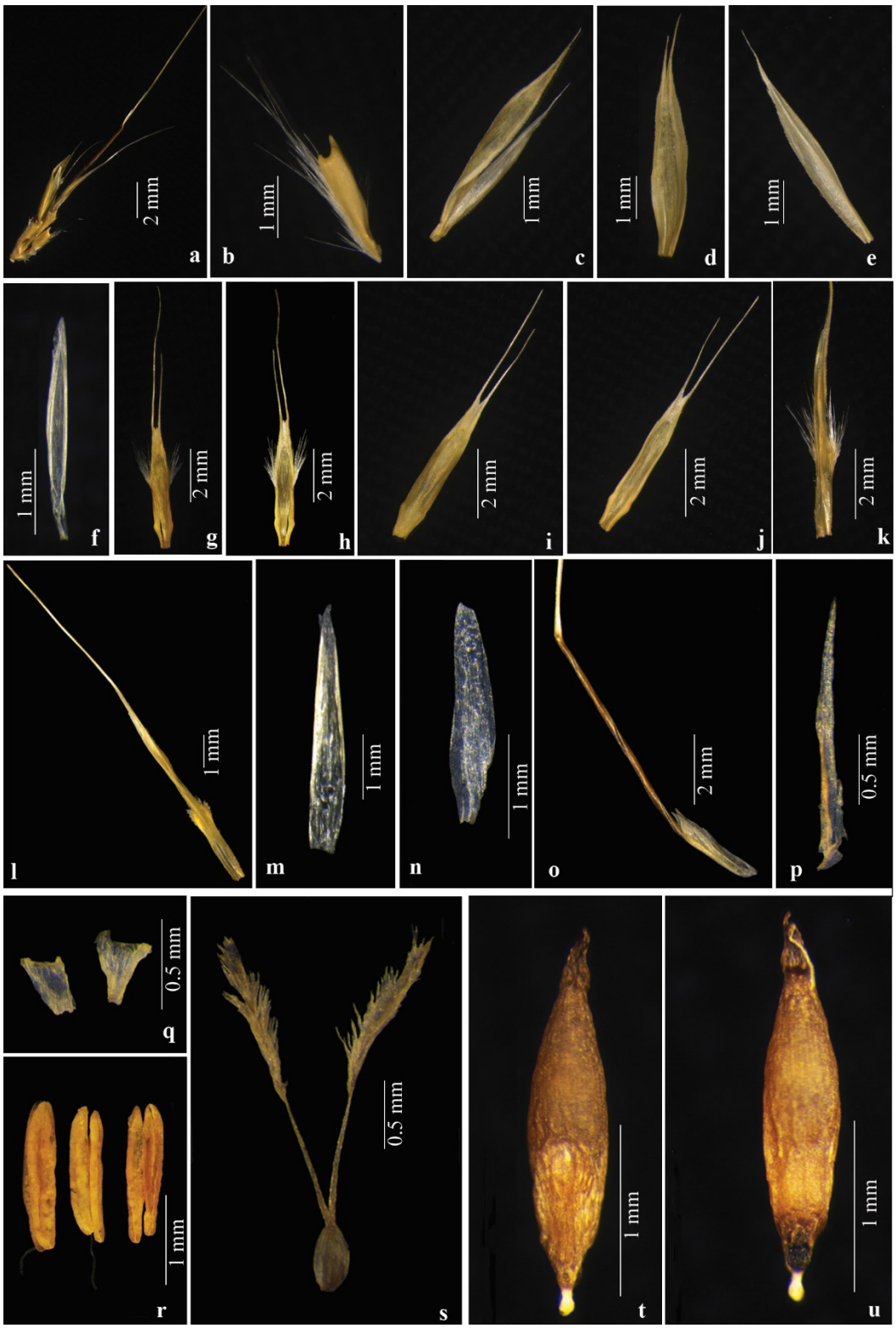

Fig. 45. *Ischaemum kingii* Hook.f.: **a.** Spikelet pair; **b.** Rachis internode; **c.** Pedicelled spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma (**c–f**: Pedicelled spikelet); **g.** Lower glume-dorsal view; **h.** Lower glume-ventral view; **i & j.** Lower glume showing variation in indumentum (**i.** dorsal view; **j.** ventral view); **k.** Upper glume; **l.** Upper glume showing variation in indumentum; **m.** Lower lemma; **n.** Lower palea; **o.** Upper lemma; **p.** Upper palea (**g–p:** Sessile spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis-dorsal view; **u.** Caryopsis-ventral view.

Notes: *Ischaemum kingii* shows variation in the 'tuft of hairs' seen on the lower glume of sessile spikelet. This variation is noticed within the spikelets of same plant as well as plants of the same population. The characters of *I. raizadae* overlap with that of *I. kingii*. Moreover, the type specimens of *I. raizadae* shows minute difference in awn length of upper lemma of sessile spikelet as well as in rachis internode and pedicel with that of *I. kingii*. But these characters are not enough to treat *I. raizadae* as distinct since these characters falls within the variation range of *I. kingii*. Hence, *I. raizadae* is treated here as the synonym of *I. kingii*.

The present description is based on author's own collection from Maharashtra as well as herbarium specimens available at CAL and SUK. The occurrence of this species in southern Peninsular India is very rare. The entry to the reported locality was restricted due to natural calamity, hence the author could not collect the specimen from Chitramoola in Kodachadri Hills of Mookambika Wildlife Sanctuary in Karnataka.

8. Ischaemum molle Hook.f., Fl. Brit. India 7: 128. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 183. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 122. 1976; Karthik. *et al*., Fl. Ind. Enum. Monocot. 232. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 148. 1991; S.Moulik, Grasses Bamboos India 2: 295. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 423. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 817. 2008; Srivastava & V.J.Nair, Nelumbo 52: 82. 2010; Potdar *et al*., Grasses Maharashtra. 191. 2012. B.R.P.Rao *et al*., Grasses Arid Zone Penins. India 131. 2017. *Lectotype* (designated by Tiwari *et al*., 2016):—— INDIA, Concan, *s.d.*, *N.A. Dalzell*, *s.n.* (K000245684 digital image!).

Ischaemum nairii V.J.Nair & Sreek., J. Econ. Taxon. Bot. 5(5): 1205. 1984, *syn. nov. Type*:—— INDIA, **Kerala**, Kozhikode district, Kanjeerakkadavu, near Kakkayam, 26.11.1981, *P.V. Sreekumar* 71843 (holo: CAL [CAL0000007131!]; iso: K [*n.v.*], MH [MH00001579!]).

Ischaemum elimalayanum Sreek., V.J.Nair & N.C.Nair *in* P.V. Sreekumar & V.J.Nair, Fl. Kerala – Grasses 459, 134. 1991. *Type*:—— INDIA, **Kerala**, Kannur

[Cannanore] District, Elimala, 20.10.1981, *P.V. Sreekumar* 71773 (holo: CAL [*n.v.*]; iso: K [K002383650 digital image!], MH [*n.v.*]).

Ischaemum kumarakodiense Ravi, N.Mohanan & Kiran Raj, Rheedea 8(2): 149. 1998 (as '*kumarakodiensis*'). *Type*—— INDIA, **Kerala**, Alappuzha district, Pallana, 29.12.1996, *N. Ravi* 33084 (holo: TBGT!; iso: K [K000308181 digital image!], KFRI [*n.v.*], MH [*n.v.*]).

Ischaemum abrahamii Ravi, N.Mohanan & R.Rajesh, Bot. Bull. Acad. Sin. 42(3): 225. 2001. *Type*:—— INDIA, **Kerala**, Malappuram district, Manathumangalam, 15.12.1996, *N. Ravi* 33027 (holo: TBGT!; iso: CAL [*n.v.*], KFRI [*n.v.*], MH [*n.v.*]).

Ischaemum sreenarayanii Sunil, Nithya & Remya Kr., Bangladesh J. Pl. Taxon. 24(1): 33. 2017, *syn. nov. Type*:—— INDIA, **Kerala**, Thrissur district, Kombazha, 8.12.2015, *Sunil* & *Nithya* 9007 (holo: MH [*n.v.*]; iso: CALI [*n.v.*], SNMH [*n.v.*]).

Figs. 46–51

Plant perennial, tufted, robust or short, erect or geniculately ascending, 50–200 cm high; *nodes* densely or sparsely hairy, lower nodes sometimes glabrous, stilt rooted or not; *internode* terete–subterete, 5–20 cm long, greenish, glabrous. *Leaves* sessile or subsessile; *Lower leaves* mostly narrowed towards base. *leaf sheath* 7–80 cm long, dorsally keeled, margins entire, dorsal surface glabrous or tubercle-based hairy, chartaceous, membranous towards margins, greenish; *leaf blade* narrowly ovate or lanceolate, 8–60 × 0.5–2.7 cm, base obtuse–rounded or shallowly cordate with or without a short densely pilose petiole (of younger leaves) or narrowed (of lower leaves), margins scabridulous, hairs caducous and thus mostly seen as glabrous or sparsely scabridulous, apex acuminate, chartaceous, abaxial surface tubercle-based hairy–glabrous, adaxial

Fig. 46. Lectotype of *Ischaemum molle* Hook.f. (*N.A. Dalzell*, *s.n.* [K000245684]) © The Board of Trustees for The Royal Botanic Gardens, Kew.

surface tubercle-based hairy, greenish; petiole of upper leaves 0.1–3 mm long. *Ligule* ovate, 2–6 mm long, membranous, pale brownish, dorsal surface and apex densely pilose, hairs hyaline, ventral surface glabrous. *Racemes* 2, adpressed together, 4–14 cm long, densely or sparsely hairy, raceme base at the joining point with peduncle hairy with a rim of short pilose hairs, hairs hyaline. *Spathe* leafy with or without reduced lamina, 9–12 cm long, dorsally shallowly keeled or rounded. *Peduncle* corrugated or terete–subterete, 10–20 cm long, slender, glabrous, greenish. *Rachis internode* clavate, 2.5–4 × 0.6–0.8 mm, 3-angled (or with 3-margins), hollow, swollen, coriaceous, ventral surface membranous, long pilose along all the three margins or sometimes along the dorsal margin only, greenish. *Sessile spikelet* bisexual, awned, narrowly elliptic, 5–6.5 × 1.2–1.5 mm, densely pilose throughout or at lower half, greenish; callus pilose, hairs hyaline. *Lower glume* narrowly ovate, 4.5–6 × 1.6–2 mm, margins entire, inflexed or incurved at lower half or at lower 2/3rd, infolded at upper 1/3rd or at upper half, infolded margins keeled, keel scabridulous and winged or not along one margin, apex usually acute–acuminate, or rarely notched, coriaceous–subcrustaceous, chartaceous or herbaceous at upper 1/3rd, dorsal surface puberulent–sparsely puberulent at upper 1/3rd and puberulent–scabridulous on infolded and inflexed portions throughout, dorsally wrinkled at lower 2/3rd or lower half with few side nodules (4–7-side nodule), side-nodules deeply or shallowly interconnected or not, a tuft of long pilose hairs near base at lower 1/3rd or densely pilose throughout or pilose throughout on lower half of dorsal surface, hairs hyaline, ventral surface puberulent at upper 1/3rd, greenish, 9–14-nerved. *Upper glume* narrowly ovate, 4.5–5.5 × 1–1.2 mm (when folded), folded, dorsally keeled, humped below middle, dorsal keel winged at upper 1/3rd or at upper 1/4th, margins entire, inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, infolded portion scabrous or pilose at submargins, apex acute or very minutely mucronulate, chartaceous–subcoriaceous, dorsal surface scabrous–scabridulous, ventral surface scabridulous–puberulent at upper half, greenish with purple shade on keel at lower half, 5–9-nerved. *Lower lemma* narrowly ovate, 4–5 × 1.2–1.5 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins shallowly keeled, ciliate at middle 1/3rd, apex acute, membranous–chartaceous, dorsal surface scabridulous–puberulent at upper 1/3rd and on keel (upper 2/3rd on keel), ventral surface scabridulous–puberulent near apex (*ca.* at upper 1/4th), pale greenish, 3-nerved. *Lower palea* narrowly ovate or oblong, 3–5.5 ×

1–1.2 mm, margins infolded and keeled, keel broad near base (lower 1/4th or 1/3rd), ciliate at middle, apex obtuse, chartaceous, keel and infolded submargins scabridulous–puberulent at upper 2/3rd, dorsal surface scabridulous–puberulent at upper 1/3rd, ventral surface scabridulous–puberulent near apex (at upper 1/4th), pale greenish, 2-nerved or nerves inconspicuous. *Upper lemma* narrowly ovate, 3–4.5 × 1–1.2 mm, folded, margins ciliate, inflexed or infolded, dorsally keeled, apex bilobed, dorsally awned from the sinus, membranous, dorsal surface scabridulous–puberulent, hairs mainly seen at upper half, ventral surface glabrous, hyaline, 3-nerved; *awn* geniculate, 12–24 mm long, scabridulous; column 5–10 mm long, twisted, scabridulous on margins, dark brownish; bristle 7–14 mm long, scabridulous on margins, pale brownish or yellowish brown. *Upper palea* narrowly ovate, 2.5–4 × 1–1.2 mm, margins inflexed or infolded, scabridulous on lower half or lower 2/3rd, apex notched or muticous, membranous, dorsal surface scabridulous–puberulent at upper half or at upper 1/3rd, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.4–0.6 × 0.2–0.3 mm, hyaline. *Stamens* 3; anthers 1.5–3 mm long, yellowish. *Pedicelled spikelet* bisexual, unawned or if minutely awned then not seen outside, elliptic–narrowly elliptic, 4–5.5 × 1.8–2 mm, glabrous or hairy, greenish. *Pedicel* clavate, 1–3.5 × 0.2–0.4 mm, ventrally compressed, hollow, swollen, coriaceous, ventral surface membranous, base and 3 margins densely long pilose, hairs hyaline, similar to rachis internode. *Lower glume* narrowly ovate, 4–5.5 × 1.5–2.5 mm, margins entire, one margin inflexed at lower 1/3rd or 1/4th and infolded at upper 2/3rd or 3/4th, keeled throughout and keel broadly or narrowly winged, the other margin inflexed at lower half or at lower 2/3rd, infolded at upper 1/3rd or at upper half, keeled at upper 1/3rd, keel scabridulous and minutely winged or not, with or without side nodules on both margins (2–4-side nodules, if present), apex acute or notched, chartaceous, dorsal surface scabridulous–puberulent and with or without long pilose hairs, scabridulous hairs sparse towards lower half, sparsely or densely long pilose on lower half, ventral surface scabridulous, hairs seen at upper 2/3rd or at upper half, greenish, 07–13-nerved. *Upper glume* narrowly ovate, 3.5–5.5 × 1–2 mm, cymbiform, margins shallowly keeled at upper 2/3rd, keel scabridulous, margins ciliate on middle portion, apex acute, chartaceous–subcoriaceous, dorsal surface scabridulous–puberulent, ventral surface scabridulous at upper 2/3rd or at upper half, pale greenish with purple or brown shade on midnerve on ventral side at lower half, 5–7-nerved. *Lower lemma* narrowly ovate,

3.5–5 × 1–1.5 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, margins ciliate at middle, laterally keeled at upper half or at upper 2/3rd, keel scabridulous–puberulent at upper half, apex acute, membranous, dorsal surface scabridulous–puberulent at upper 1/3rd and on keels and infolded submargins at upper half or upto 2/3rd, ventral surface glabrous, hyaline with pale greenish tinge, 2–3-nerved. *Lower palea* narrowly ovate or oblong, 3.5–4.8 × 1–1.3 mm, margins infolded, infolded or inflexed near base, laterally keeled, keel scabridulous at upper 2/3rd, apex obtuse, chartaceous–subcoriaceous, dorsal surface scabridulous at upper 1/3rd or upto upper half, keel and infolded submargins scabridulous at upper 2/3rd, ventral surface sparsely scabridulous–puberulent near apex, pale greenish, 2-nerved. *Upper lemma* narrowly ovate, 3–4.2 × 1–2 mm, cymbiform, margins inflexed or infolded, ciliate at middle, dorsally folded or shallowly keeled, apex shortly bifid and minutely aristate or minutely awned from the sinus, sometimes apex minutely trifid, membranous, dorsal surface scabridulous–puberulent, scabridulous hairs seen at upper 1/3rd or at upper half, ventral surface glabrous, hyaline, 3–5-nerved, midnerve prominent, 2–4-lateral nerves faint towards apex; arista or imperfect awn 0.1–4 mm long. *Upper palea* narrowly ovate, 2.5–3.8 × 0.5–1 mm, margins inflexed or infolded, scabridulous at lower half or lower 2/3rd, laterally shallowly keeled, keel scabridulous at upper half or upper 1/3rd, apex obtuse, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, 2-nerved. *Ovary* oblong or narrowly elliptic, 0.6–0.8 × 0.2–0.4 mm, pale yellowish or pale brownish; *style* 2, 1.5–2 mm long, hyaline; *stigma* 2, plumose, 1–2.2 mm long, purple. *Caryopsis* not seen.

Flowering & Fruiting: October to January.

Distribution: India, Myanmar and Pakistan. In India, it is distributed in Gujarat, Karnataka, Kerala, Maharashtra, Rajasthan and Tamil Nadu. Whereas, Karnataka, Kerala and Tamil Nadu in southern Peninsular India.

Habitat: Wetlands and hill slopes.

Fig. 47. Distribution of *Ischaemum molle* Hook.f. in southern Peninsular India

Notes: *Ischaemum molle* is found growing in different habitats from wetlands (either marshy or aquatic or bunds of paddy fields) to hill slopes and the indumentum pattern, size of floral parts, occurrence of stilt roots etc varies according to the varying habitats. The indumentum on lower glume of sessile as well as pedicelled spikelet shows variation from glabrous to sparsely hairy or to densely hairy. The pedicel length of pedicelled spikelet also varies (*ie*, more than or less than or equal to 1/3rd the length of sessile spikelet) in different pedicelled spikelets of single raceme as well as in racemes of different plants of same population. Lower glume of sessile spikelet may be wrinkled, side-noduled, shallowly or deeply interconnected or not and lower glume of pedicelled spikelet may be side noduled or not. The upper lemma of pedicelled spikelet also varies from minutely aristate (0.1 mm long) to minutely awned (2–4 mm long imperfect awn) with or without minute lobes at apex. This awned and unawned pedicelled spikelets are observed within same population of plants. The rachis internode sometimes be long pilose throughout on all the three margins or sometimes long pilose throughout along the two margins with the third margin pilose at lower half only or sometimes pliose along only one margin (*ie*, dorsal). Pedicel of pedicelled spikelet also seen long pilose on all the 3 margins or along the dorsal margin only with or without sparse hairs near base of the other two margins. Moreover, it is generally observed that many species of *Ischaemum* growing near to water or marsh produces stilt roots from lower nodes and the presence of green shaded as well as red shaded spikelets were also observed in the same plant or in different plants of the same population. Another problem when considering number nerves is that, some nerves may be faint when some are prominent. This may be due to the colour or texture or sometimes by the indumentum and ornamentation of floral bracts, and in most cases these characters show variation within plants of same population as well as with respect to habitat changes. Moreover, in some species the nerves show branching also (mostly seen in lower and upper glumes). So, these may lead to various range in nerve number by different authors apart from the normal variation in the number of nerves. Also, the present study showed the wing character on glumes is a variable character.

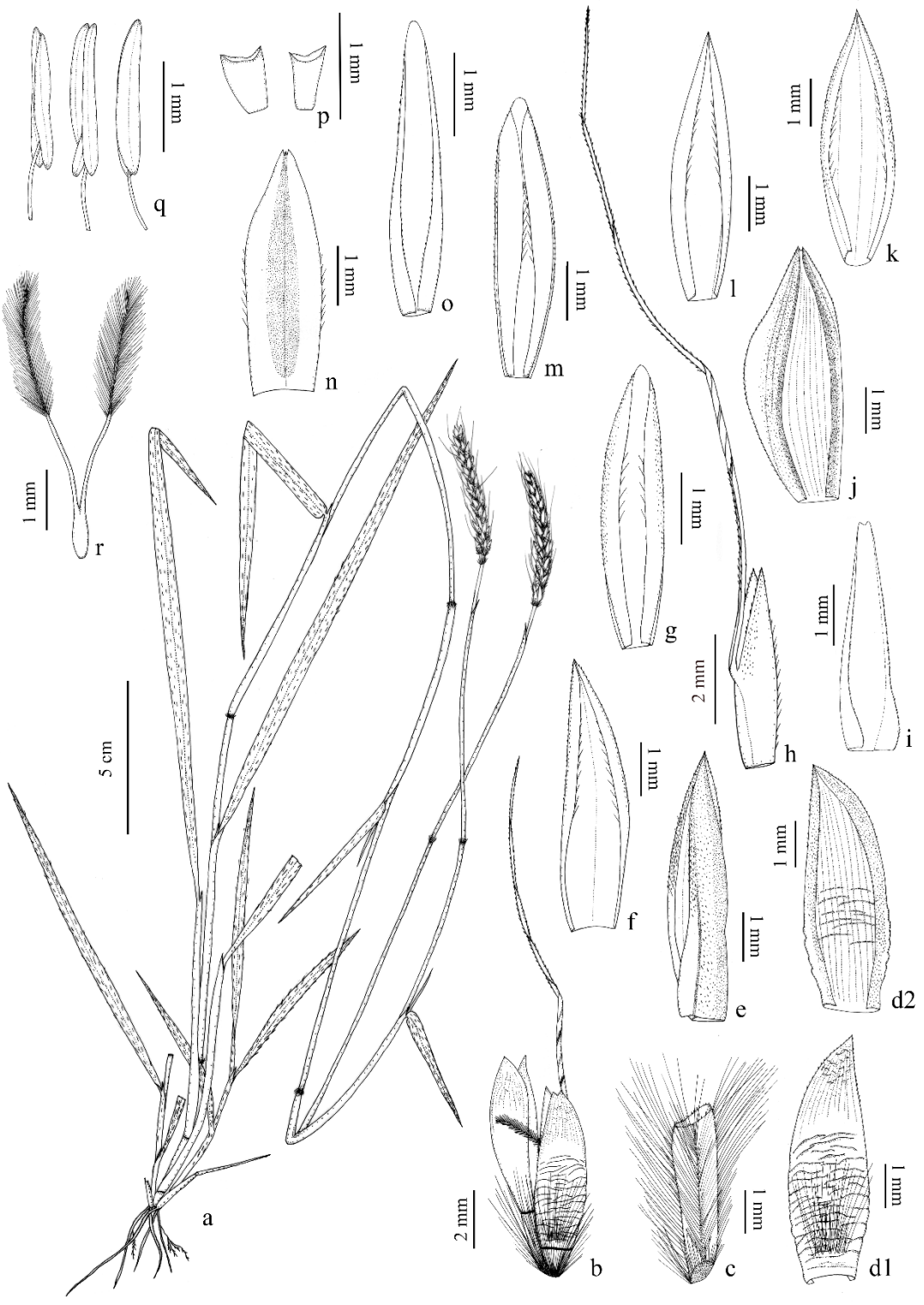

Fig. 48. *Ischaemum molle* Hook.f.: **a.** Habit; **b.** Spikelet pair; **c.** Rachis internode; **d1.** Lower glume-dorsal view; **d2.** Lower glume-ventral view; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**d1–i:** Sessile spikelet); **j.** Lower glume; **k.** Upper glume; **l.** Lower lemma; **m.** Lower palea; **n.** Upper lemma; **o.** Upper palea (**j–o:** Pedicelled spikelet); **p.** Lodicules; **q.** Stamens; **r.** Gynoecium (from *V. Drisya* 170158, drawn by V. Drisya).

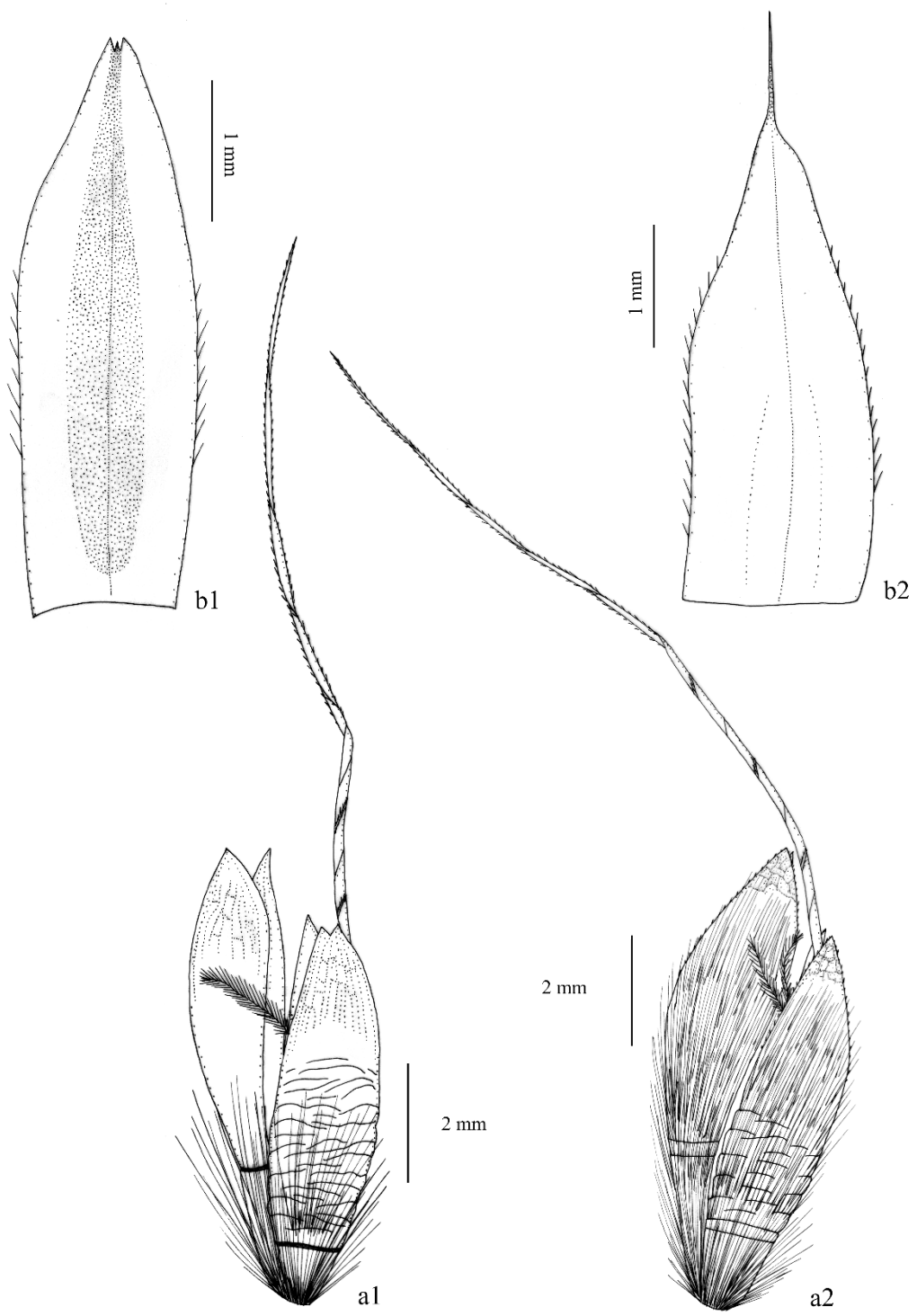

Fig. 49. *Ischaemum molle* Hook.f.: **a1 & a2.** Spikelet pair showing variation in indumentum and ornamentation; **b1 & b2.** Upper lemma of pedicelled spikelet showing variation in apex (**a1, a2** & **b1** from *V. Drisya* 170158; **b2** from *V. Drisya* 171439, drawn by V. Drisya).

Ischaemum elimalayanum was described from hilly habitat whereas the remaining *I. abrahamii, I. sreenarayanii, I. nairii* and *I. kumarakodiense* were from the wetland habitats in the plains. These five species come under the variation range of *I. molle* since they were distinguished mainly based on above discussed variable characters. Hence, *I. elimalayanum*, *I. abrahamii, I. sreenarayanii, I. nairii* and *I. kumarakodiense* are trated here as the synonyms of *I. molle*.

Specimens examined: INDIA, **Karnataka**, Udupi district, Kollur forest, Mookambika WLS, 17.10.2007, *P.G. Diwakar & R.Kr. Singh* 193262; Meghan Valley, Mookambika WLS, 20.12.2007, *P.G. Diwakar & R.Kr. Singh* 193740 (BSI); Shivamogga district, Emkalkare, Agumbe, 02.11.1960, *R.S. Raghavan* 68075 (BSI); **Kerala**, Alappuzha district, Kumarakodi, Pallana, 01.12.1997, *N. Ravi* 32518 (TBGT); *Ibid.*, 01.12.1997, *N. Ravi* 32519 (CAL & TBGT); Ernakulam district, Mayiladumkunnu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168705; Thundathil Forest Range, Cherukadu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168704; *Ibid.*, Thottapalam, on the way to Karimpani, 14.12.2018, *V. Drisya* 168706 (CALI); Kannur district, Madayippara, 18.11.2015, *Rinku J. Desai* 1708 (BARO); Malappuram district, Cherakode, 12.11.2017, *V. Drisya* 171439; Manathumangalam, near Perinthalmanna, 03.12.2016, *V. Drisya* 150701 (CALI); Palakkad district, Alathur, Gurukula Junction, 05.12.2018, *V. Drisya* 157893 [CALI185274, CALI185275, CALI185276 & CALI185277]; Padur, 05.12.2018, *V. Drisya* 157900 [CALI185267, CALI185268, CALI185269, CALI185270, CALI185271, CALI185272 & CALI185273] (CALI); Thiruvananthapuram district, Agasthyamala, Athirumala, 27.08.1997, *M.S. Kiran Raj* 34765; Attayar, 22.12.1989, *N. Mohanan* 9177 (TBGT); grassland in between Attayar and Athirumala, 20.12.2018, *V. Drisya* 168730; on the way to Attayar, 20.12.2018, *V. Drisya* 168734 (CALI); Thrissur district, Avittappilly, 15.01.2018, *V. Drisya* 157817; Chazhur, 14.01.2018, *V. Drisya* 157815; Chembuchira, 10.02.2019, *V. Drisya* 170162; Kattor, Thekkupadam, 09.02.2019, *V. Drisya* 170146; *Ibid.*, 09.02.2019, *V. Drisya* 170147; Kodali, 10.02.2019, *V. Drisya* 170158; Puzhakkal Padam, 13.01.2018, *V. Drisya* 157809; *Ibid.*, 13.01.2018, *V. Drisya* 157811 (CALI); '**Madras**', 00.00.1937, *N.L. Bor s.n.* (DD).

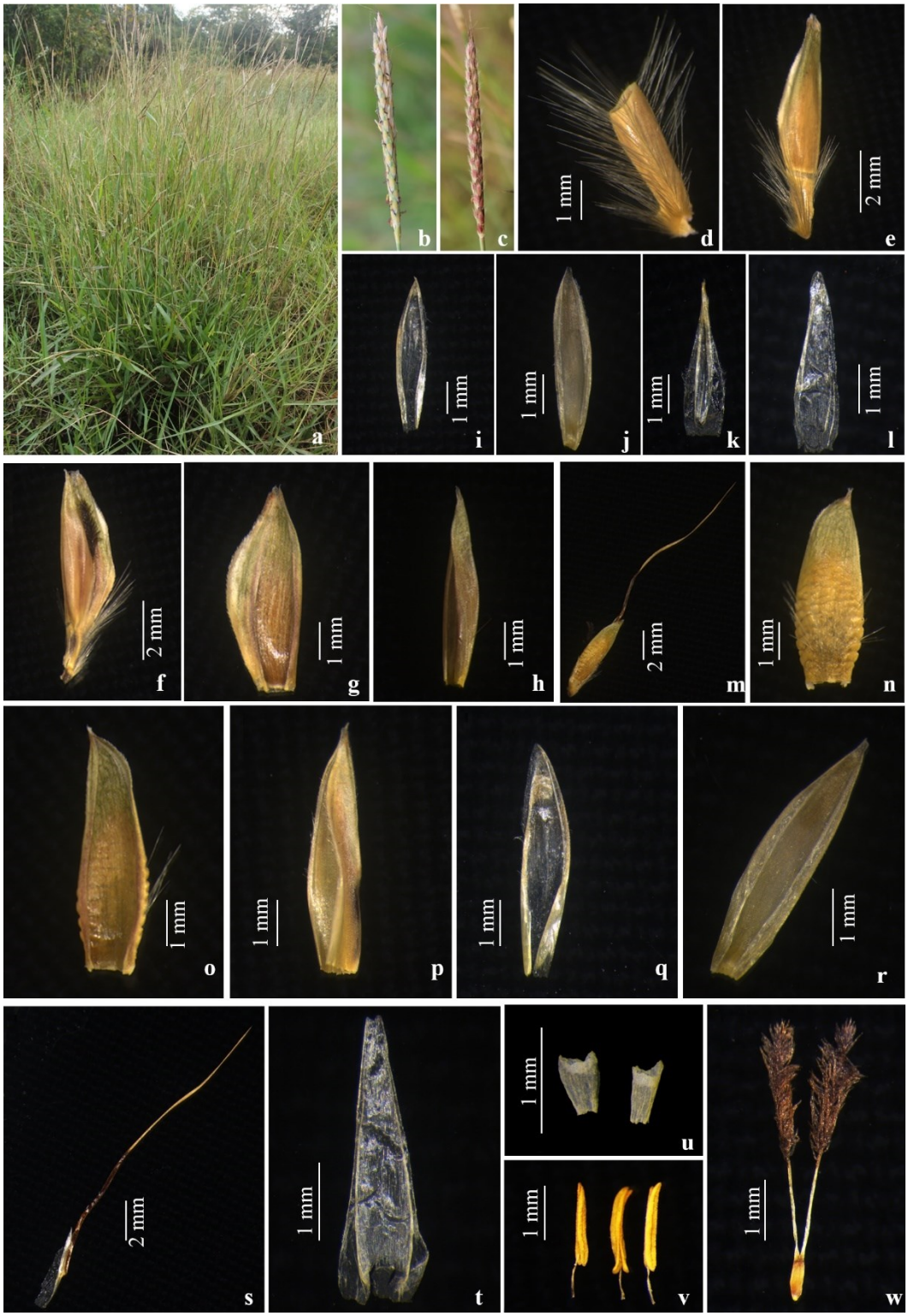

Fig. 50. *Ischaemum molle* Hook.f.: **a.** Habit; **b & c.** Raceme showing colour variation; **d.** Rachis internode; **e.** Pedicelled spikelet-dorsal view; **f.** Pedicelled spikelet-ventral view; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**e–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume-dorsal view; **o.** Lower glume-ventral view; **p.** Upper glume; **q.** Lower lemma; **r.** Lower palea; **s.** Upper lemma; **t.** Upper palea (**m–t:** Sessile spikelet); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium.

Fig. 51. *Ischaemum molle* Hook.f.: **a–c.** Racemes showing variation in colour & indumentum; **d & e.** Spikelet pair showing variation in indumentum; **f & g.** Spikelet pair showing variation in relative length of pedicel in pedicelled spikelet; **h–j.** Rachis internode showing variation in indumentum; **k–n.** Upper lemma of pedicelled spikelet showing variation.

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Chanda [Chandrapur] district, 28.11.1989, *J.F. Duthie* 9962 (CAL).

9. Ischaemum muticum L., Sp. Pl. 2: 1049. 1753; Hook.f., Fl. Brit. India 7: 132. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1723. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 183. 1960; N.P.Singh *et al*., Bull. Bot. Surv. India 18(1−4): 122. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 232. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 149. 1991; S.Moulik, Grasses Bamboos India 2: 295. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 423. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 818, 2008, excl. syn. *I. jayachandranii*; Srivastava & V.J.Nair, Nelumbo 52: 82. 2010. *Lectotype* (designated by Renvoize in Jarvis *et al*., 1993):—— LINN-1214.1 digital image!.

Figs. 52–55

Perennial, creeping or stoloniferous, 20–40 cm high, wiry, lower nodes rooting or not; *nodes* glabrous, younger nodes glabrous or sparsely hairy; *internode* terete–subterete, 2–4.5 cm long, glabrous, greenish. *Leaves* sessile; *leaf sheath* 2–4 cm long, rounded or shallowly keeled, margins entire, chartaceous, dorsal surface with soft tubercle-based hairs, ventral surface glabrous, greenish; *leaf blade* narrowly ovate, 3–8 × 0.4–0.7 cm, base cordate–subcordate, margins entire or scabridulous towards apex, apex acuminate, chartaceous, both abaxial and adaxial surfaces tubercle-based hairy and sparsely puberulent, hairs deciduous thus looks like glabrous with few tubercle-based hairs near base when dry, greenish. *Ligule* short or reduced, membranous with fringe of hairs at apex, 0.1–0.2 mm long, hyaline. *Racemes* 2, adpressed together and looks like solitary, 2.5–3.5 cm long, hardly exserted from the spathe. *Spathe* leafy with reduced lamina and ligule, much broader than normal leaf sheath. *Peduncle* terete–subterete, 2–3 cm long, greenish, glabrous. *Rachis internode* turbinate, 4.2–4.5 × 0.8–1.2 mm, 3-angled, convex, all surface coriaceous or ventral surface subcoriaceous, greenish, hollow, not swollen, glabrous or sparsely puberulent, ventral surface concave (or compressed towards in), dorsal angle or margin scabridulous, lateral margins (or angles) scabrous. *Sessile spikelet* bisexual, unawned, narrowly ovate, *ca.* 6 × 1.6–2 mm, greenish; callus glabrous.

Lower glume narrowly ovate, *ca.* 6 × 1.8–2 mm, cymbiform, margins entire, inflexed or infolded, keeled and winged at upper half, sometimes wing on one margin narrow, wing margin scabridulous, apex muticous or notched, coriaceous, dorsal surface and infolded margins sparsely scabridulous, hairs seen at upper half, ventral surface scabridulous, hairs seen towards apex, greenish with or without brownish tinge, 8-nerved. *Upper glume* narrowly ovate, 6–6.5 × 3–3.8 mm, cymbiform, margins inflexed at lower half, infolded and ciliate at upper half, apex acute–acuminate or mucronate, coriaceous, dorsally keeled, keel narrowly winged at upper 1/3rd, wing margin scabridulous, both dorsal and ventral surfaces scabridulous–puberulent towards apex (*ca.* at upper 1/3rd), greenish with brownish tinge, 3-nerved. *Lower lemma* narrowly ovate, 5.5–6 × *ca.* 2 mm, cymbiform, margins inflexed at lower half or lower 1/3rd, infolded and ciliate at upper half or upper 2/3rd, apex acute–acuminate, coriaceous–subcoriaceous, dorsal surface scabridulous at upper half mainly on infolded portions and near apex, ventral surface glabrous, pale greenish with or without brown tinge, midnerve prominent. *Lower palea* narrowly ovate, 5.5–6 × 1.8–2 mm, cymbiform, margins inflexed at lower half or lower 1/3rd, infolded at upper half or upper 2/3rd, ciliate at upper 1/3rd, infolded margins keeled, keel scabridulous, apex notched and scabridulous, chartaceous–subcoriaceous, dorsal surface scabridulous at upper half, hairs seen mainly on keels and infolded portions, ventral surface glabrous, greenish, 2–4-nerved. *Upper lemma* narrowly ovate, 5–5.5 × 1.5–1.8 mm, cymbiform, margins inflexed or infolded, ciliate at upper half, apex aristate or shortly awned, membranous, dorsal surface scabridulous at upper half, ventral surface glabrous,

Fig. 52. Lectotype of *Ischaemum muticum* L. (LINN-1214.1) © The Board of Trustees of Linnean Society, London.

hyaline with pale greenish or pale brownish tinge, 3-nerved; arista or awn 1.2–1.5 mm long. *Upper palea* narrowly ovate, 5.5–6 × 1.2–1.5 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, ciliate at upper 1/3rd, infolded margins keeled, apex acuminate, membranous, dorsal surface scabridulous towards apex and on keels, ventral surface glabrous, 2-nerved. *Stamens* 3; anthers 1.8–2 mm long, yellowish. *Pedicelled spikelet* bisexual, unawned, sometimes reduced, narrowly elliptic, 4–4.5 × 1–1.5 mm, greenish; callus glabrous. *Pedicel* turbinate or narrowly elliptic or cymbiform, 4–4.5 × 1.5–1.8 mm, similar to rachis internode, lateral margins scabrous as in rachis internode but dorsal margin glabrous or scabridulous. *Lower glume* narrowly ovate, *ca.* 5 × 1–1.3 mm (when folded), folded, dorsally keeled, keel winged at upper 1/4th or 1/3rd, wing margin scabridulous, margins entire, narrowly inflexed, apex acute–acuminate, coriaceous, dorsal surface puberulent–sparsely scabridulous on upper half and on wings, ventral surface scabridulous–puberulent on upper half, greenish with brownish tinge, 12-nerved. *Upper glume* narrowly ovate, 5–5.2 × 1–1.2 mm (when folded), folded, dorsally keeled, margins inflexed at lower half or lower 1/3rd, infolded and ciliate at upper half or upper 2/3rd, apex acute, coriaceous, membranous on margins, dorsal surface scabridulous–puberulent at upper half mainly on keel wing and infolded portion of margins, ventral surface scabridulous at upper half, keel winged at upper half, wing margin scabridulous, greenish with brownish tinge, 3-nerved. *Lower lemma* narrowly ovate, *ca.* 5 × 1.6–1.8 mm, cymbiform, margins infolded, ciliate at upper half, apex acute, chartaceous–subcoriaceous, membranous at margins, dorsally keeled, dorsal surface scabridulous–puberulent near apex and on infolded margins at upper half or at upper 2/3rd, ventral surface glabrous, pale greenish, midnerve prominent. *Lower palea* narrowly ovate, 4.5–4.7 × *ca.* 1.2 mm, cymbiform, margins keeled, inflexed at lower 1/3rd, infolded at upper 2/3rd, ciliate at upper 1/3rd or upper half, apex muticous or notched, chartaceous–subcoriaceous, keel scabridulous at upper 2/3rd or 3/4th, dorsal surface scabridulous near apex and on keels and infolded margins at upper 2/3rd, ventral surface glabrous, pale greenish, 2-nerved. *Upper lemma* narrowly ovate, 4.5–4.7 × *ca.* 1.5 mm, cymbiform, margins inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, ciliate at upper half, apex acuminate

or mucronate, chartaceous–membranous, dorsal surface densely or sparsely scabridulous or puberulent, hairs seen near apex and on infolded margins at upper half or at upper 2/3rd, ventral surface glabrous or puberulent, pale greenish–hyaline, 5–7-nerved. *Upper palea* narrowly ovate, 4.3–4.5 × 0.8–1 mm, cymbiform, margins laterally keeled, inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, ciliate–ciliolate at upper half or at upper 1/3rd, apex muticous, membranous, keel scabridulous at upper half or at upper 2/3rd, dorsal surface scabridulous–puberulent, ventral surface glabrous, pale greenish–hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–0.7 × 0.4–0.6 mm. *Ovary* narrowly elliptic, 1–1.2 × 0.2–0.4 mm, brownish; *style* 2, *ca.* 3 mm long, hyaline; *stigma* 2, plumose, 2.8–3 mm long, yellowish. *Caryopsis* not seen.

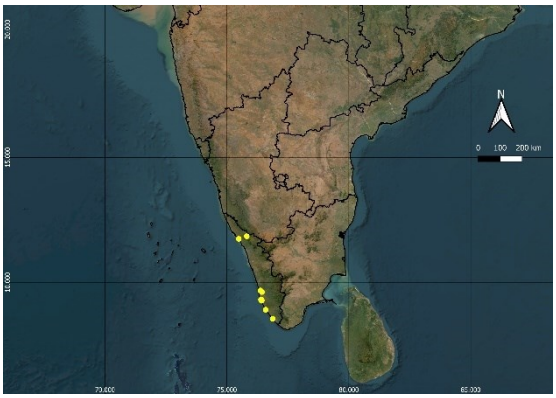

Fig. 53. Distribution of *Ischaemum muticum* L. in southern Peninsular India

Flowering & Fruiting: September to January.

Distribution: Tropical Asia to Nansei-shoto and W. Pacific. In India, it is distributed in Andaman and Nicobar, Karnataka, Kerala, Lakshadweep, Maharashtra and Tamil Nadu.

Habitat: Found growing along banks of back waters, coastal sands, sometimes in water.

Specimens examined: INDIA, **Kerala**, Alappuzha district, Kumarakodi, Pallana, 29.12.1996, *N. Ravi* 33087; *Ibid.*, 29.12.1996, *N. Ravi* 33088 (TBGT); *Ibid.*, banks of Pallana river, 15.12.2017, *V. Drisya* 157769; Mahadevikadu, Pullikeezhu, 15.12.2017, *V. Drisya* 157774; Pathiramanal Island, 17.12.2017, *V. Drisya* 157792 (CALI); R Block, Vembanadu Lake, 19.04.1988, *M.S. Swaminathan* 88260 (CAL & MH); Kannur district, Thalassery shore, 16.11.1972, *T.A. Rao* 9920 (CAL); Kollam district, Residency Ward, 17.03.1980, *P.V. Sreekumar* 67107 (BSID); Sea beach, 30.09.1913, *M. Rama Rao* 1819 (CAL); *s.loc.*, 08.12.1893. *M.A. Lawson* 129 (CAL & DD); *Ibid.*, 08.11.1893, *M.A. Lawson s.n.* (DD); Kottayam district, Kumarakom, 21.03.1980, *P.V. Sreekumar* 67062 (BSID & MH); Thiruvananthapuram district,

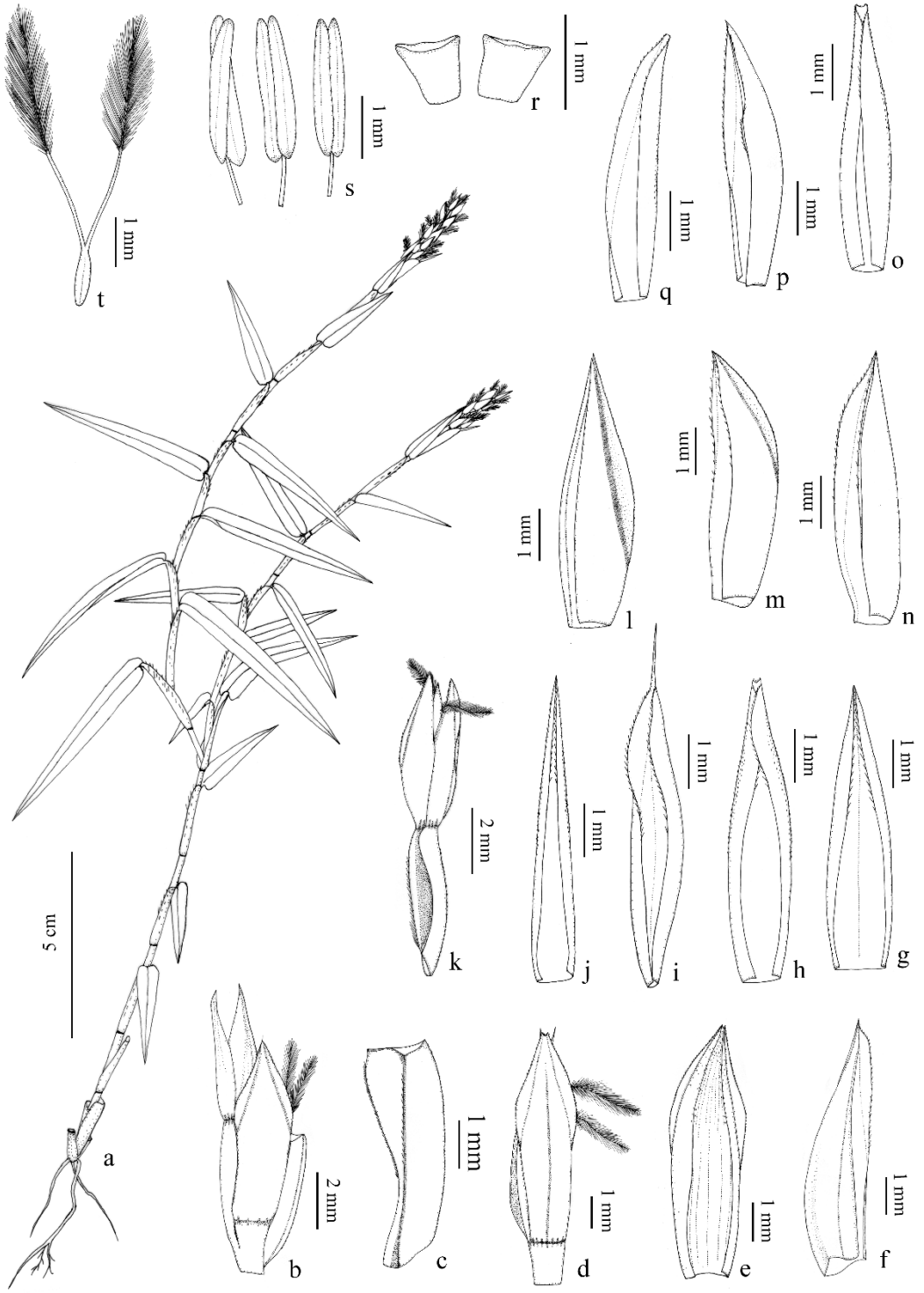

Fig. 54. *Ischaemum muticum* L.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium (from *V. Drisya* 157769, drawn by V. Drisya).

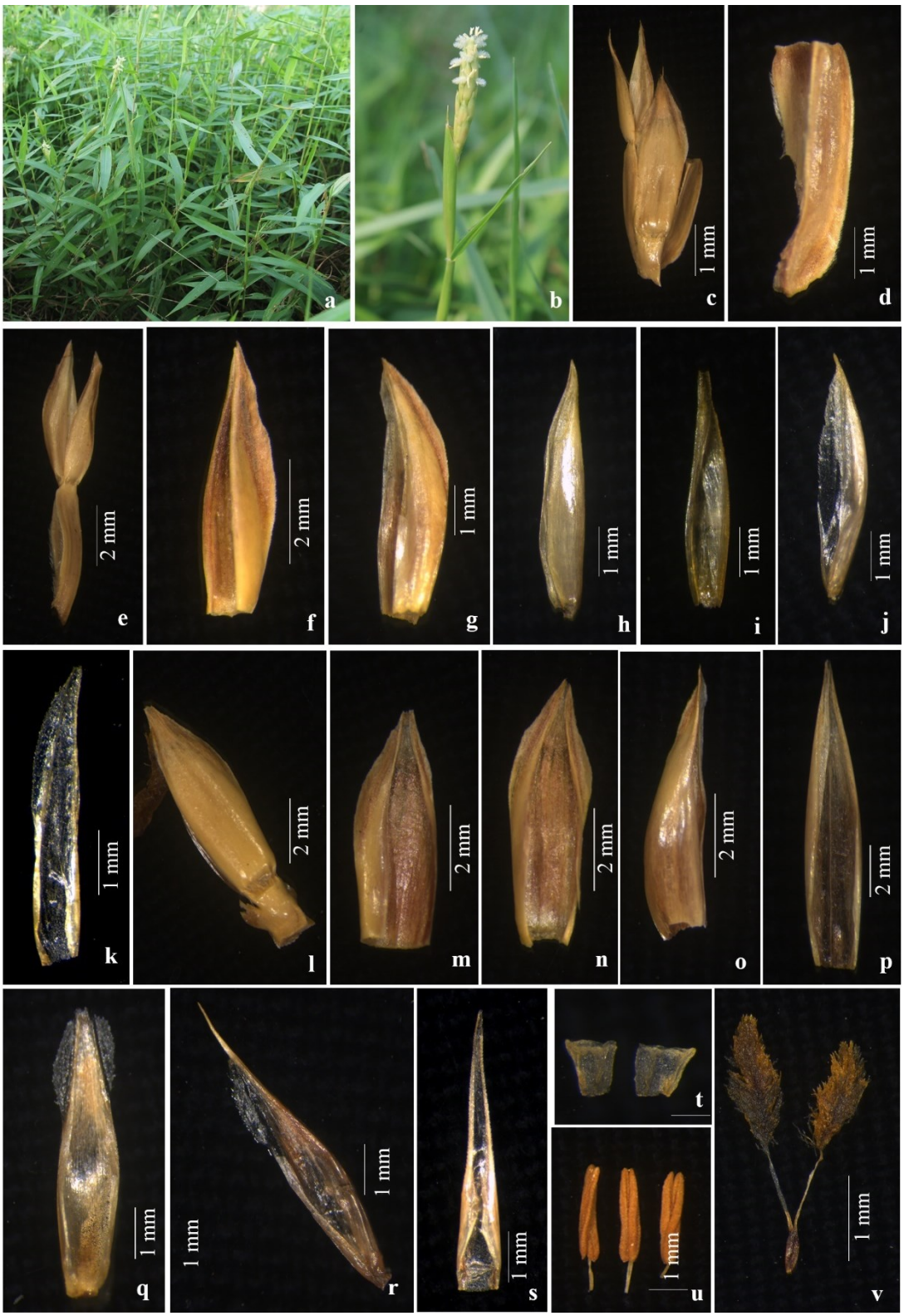

Fig. 55. *Ischaemum muticum* L.: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea (**e–k:** Pedicelled spikelet); **l.** Sessile spikelet; **m & n.** Lower glume; **o.** Upper glume; **p.** Lower lemma; **q.** Lower palea; **r.** Upper lemma; **s.** Upper palea (**l–s:** Sessile spikelet); **t.** Lodicules; **u.** Stamens; **v.** Gynoecium.

Veli, 04.08.1978, *M. Mohanan* 58562 (CAL); *Ibid.*, 30.07.1979, *M. Mohanan* 63339 (MH); Wayanad district, Chandanathode, 15.02.1978, *V.S. Ramachandran* 53991 (CAL).

Additional specimens examined (from other than study area): INDIA, Peninsular India, *s.loc.*, *Wight* 3078 (CAL); *s.loc.*, *s.d.*, *Wight* 3282; *s.loc.*, *s.d.*, *Wight s.n.* (DD).

10. Ischaemum polystachyum J.Presl, Reliq. Haenk. 1(4-5): 328. 1830. *Type*:—— MARIANA ISLANDS, *s.d.*, *Haenke s.n.* (MO [MO-2114731 digital image!]).
Ischaemum hirtum Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 228. 1889, *p.p.*; Hook.f., Fl. Brit. India 7: 135. 1897. *p.p.*; Bor, Grasses Burma, Ceylon, India & Pakistan 179. 1960; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 231. 1989; S.Moulik, Grasses Bamboos India 2: 292. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 417. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 809. 2008; Srivastava & V.J.Nair, Nelumbo 52: 74. 2010. *Type*:—— INDIA, **Meghalaya**, Khasia, *s.d.*, *J.D. Hooker & J.J. Thomson* "*Spodiopogon* no. 13" (CAL [CAL0000002281!]).
Ischaemum nilagiricum Hack., Oesterr. Bot. Z. 51: 150. 1901; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Sreek. & V.J.Nair, Fl. Kerala - Grasses 153. 1991; Pull., Fl. Andhra Pradesh 3: 1211. 1997; K.M.Matthew, Fl. Palni Hills 3: 1586. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 438. 2009. *Lectotype* (designated here):—— INDIA, **Tamil Nadu**, Nilgiris district, Coonoor, 13.03.1870, *C.B. Clarke* 10791 (lecto: CAL [CAL0000002282!]; isolecto: W [W19160035730 digital image!]).

Figs. 56–60

Perennials, 30–100 cm high, tufted, robust, erect; *nodes* dark coloured, lower nodes glabrous, younger ones hairy; *internodes* terete–subterete or ventrally compressed, 7–10 cm long, glabrous, greenish. *Leaves* sessile; *leaf sheath* rounded of keeled, 5–12 cm long, margins entire, chartaceous, dorsal surface densely scabrous, ventral surface glabrous, greenish; *leaf blade* narrowly ovate or lanceolate, 10–18 × 0.5–1 cm, base rounded or obtuse or narrowed, margins scabridulous, apex acuminate,

chartaceous, abaxial surface densely tubercle-based hairy, adaxial surface sparsely tubercle-based hairy, greenish. *Ligule* ovate, 1–1.3 mm long, membranous, apex and dorsal surface densely scabrous, ventral surface glabrous, brownish. *Inflorescence* with 3–8-racemes; *racemes* 6–9 cm long, densely hairy. *Spathe* leafy with or without reduced lamina. *Peduncle* terete–subterete, 10–30 cm long, glabrous, greenish. *Rachis internode* clavate, 4–4.5 × 0.5–0.8 mm, 3-angled, more or less hollow, ventral side concave, coriaceous, all the 3 margins densely pilose, hairs on dorsal margin longer than that of 2 lateral margins, greenish. *Sessile spikelet* bisexual, awned, narrowly ovate or narrowly elliptic, *ca.* 5 × 1–1.5 mm, greenish; callus elongate, 0.2–0.8 mm long, more or less hairy. *Lower glume* ovate, 4–5 × *ca*. 2 mm, cymbiform, margins inflexed and entire at lower half, inflexed or infolded and ciliate at upper half, laterally keeled at upper half or upper 1/3rd, keel scabridulous, apex bifid, subcoriaceous towards lower half and chartaceous towards upper half, dorsal surface scabrous–scabridulous and densely long pilose at lower 2/3rd, ventral surface scabridulous–puberulent, hairs seen towards upper half, greenish, 12–13-nerved. *Upper glume* narrowly ovate, 5–5.5 × *ca.* 2 mm, cymbiform, margins inflexed or infolded, ciliate at upper half, apex acuminate, subcoriaceous towards lower half and chartaceous towards upper half, dorsally keeled at upper 1/3rd or at upper half, keel scabridulous, dorsal surface scabridulous at upper half with a tuft of pilose hairs at middle near keel, ventral surface scabridulous at upper half, greenish, 5-nerved. *Lower lemma* narrowly ovate, 4–4.5 × 1–1.2 mm, cymbiform, margins

Fig. 56. Type of *Ischaemum polystachyum* J.Presl (*Haenke s.n.* [MO-2114731]) © The Board of Trustees of Missouri Botanical Garden.

inflexed or incurved at lower half, infolded and ciliate at upper half, apex acute, chartaceous, dorsal surface scabridulous at upper half, hairs seen towards apex and submargins, ventral surface scabridulous towards apex, hyaline, 3-nerved. *Lower palea* elliptic–narrowly elliptic, 3.5–4 × 1.8–2 mm, margins infolded, ciliate at upper 1/3rd or at upper half, apex obtuse, membranous, laterally keeled, keel scabrous–scabridulous at upper 2/3rd, dorsal surface scabridulous–puberulent towards apex (*ca.* at upper 1/3rd) and infolded portions at upper half or upper 2/3rd, ventral surface glabrous, hyaline with pale greenish tinge, 2-nerved. *Upper lemma* narrowly ovate, 4–4.5 × 1.5–1.8 mm, cymbiform, margins inflexed or infolded, ciliate at upper 2/3rd, apex bifid not deeply lobed upto the base of awn, awned from the sinus, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, 3–4-nerved, nerves jointed at the base of awn; *awn* geniculate, 11.5–12 mm long; column twisted, 4–4.5 mm long, scabridulous, dark brownish; bristle 7.5–8 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 4–4.2 × 1–1.2 mm, margins inflexed or infolded, ciliate–ciliolate at upper half or upper 1/3rd, apex acuminate and ciliate–ciliolate, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, 4-nerved. *Ovary* ellipsoid, 1.2–1.5 × 0.4–0.6 mm, brownish; *style* 2, 1–1.4 mm long, hyaline; *stigma* 2, plumose, 3–4 mm long, purplish. *Pedicelled spikelet* bisexual, awned, elliptic–narrowly elliptic, 6–7 × 1.5–2 mm, greenish, hairy; callus elongate, 0.2–0.4 mm long, hairy. *Pedicel ca.* 4 × 2–3 mm, similar to rachis internode. *Lower glume* narrowly ovate, 6–6.5 × *ca.* 2 mm, cymbiform, margins neither inflexed nor infolded, scabridulous, entire near base, apex acuminate, chartaceous, dorsal surface scabridulous and long pilose, ventral surface scabridulous–puberulent, hairs seen towards upper half, dorsally keeled towards upper half, keel scabridulous, greenish, 12-nerved. *Upper glume* narrowly ovate, 5–5.5 × 2–2.5 mm, cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, apex aristate, chartaceous, dorsal surface scabridulous and long pilose, ventral surface scabridulous–puberulent, dorsally keeled towards upper half or upper 2/3rd, keel scabridulous at upper half, greenish, 5-nerved; arista *ca.* 1 mm long. *Lower lemma* narrowly elliptic, 4.5–5 × 1–1.2 mm, cymbiform, margins narrowly inflexed at lower 1/3rd, narrowly infolded and ciliate

at upper 2/3rd, apex acute, membranous, dorsal surface scabridulous or puberulent on upper half, ventral surface scabridulous or puberulent at upper half or upper 1/3rd, hyaline, 3-nerved. *Lower palea* elliptic, 4–4.2 × 1.2–1.5 mm, margins inflexed or infolded at lower half or lower 1/3rd, infolded at upper half or upper 2/3rd, infolded margins keeled and ciliate, keel scabrous–scabridulous, apex acute, membranous, dorsal surface scabridulous on lateral keels and towards apex (*ca.* at upper 1/3rd), ventral surface glabrous, hyaline, 2-nerved. *Upper lemma* ovate, 3.8–4 × 1.8–2 mm, cymbiform, margins inflexed or infolded and ciliate, apex bifid, not deeply lobed upto the base of awn, awned from the sinus, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, usually 3-nerved, rarely 4-nerved, nerves jointed at the base of awn; *awn* geniculate, *ca.* 10 mm long; column twisted, *ca.* 4 mm long, scabridulous, dark brownish; bristle *ca.* 6 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 3.8–4 × 1–1.2 mm, margins inflexed or infolded, ciliate–ciliolate towards upper half, apex acute–acuminate, membranous, hyaline, 2-nerved. *Lodicules* 2, triangular or cuneate, 0.6–0.8 × 0.3–0.4 mm. *Stamens* 3; anthers 2.2–2.5 mm long, yellowish. *Caryopsis* not seen.

Notes: Lemmas and paleas of pedicelled spikelets more or less similar to that of sessile spikelets.

Flowering & Fruiting: November to April.

Distribution: Tropical and Subtropical Old World. In India, it is distributed in Assam, Andhra Pradesh, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Tamil Nadu and West Bengal.

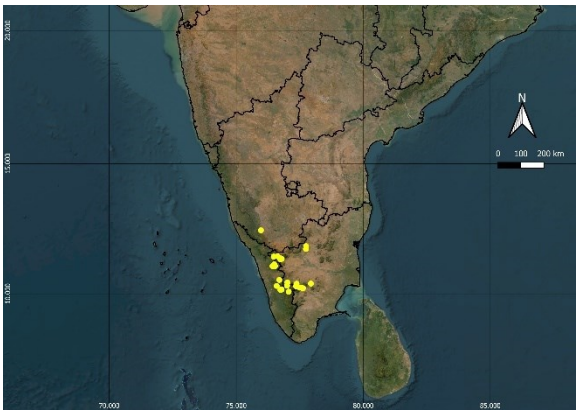

Fig. 57. Distribution of *Ischaemum polystachyum* J.Presl in southern Peninsular India

Habitat: Plants usually found growing along the margins of streams, lakes and rivers, mainly seen on rock crevices in rivers.

Specimens examined: INDIA, **Karnataka**, Kodagu district, Fraserpet, Coorg, 06.06.1902, *s.coll. s.n*. (MH); **Kerala**, Ernakulam district, Kuttampuzha, 16.02.1970, *B.V. Shetty* 33529 (CAL); Pooyamkutty, Kannampara, 16.12.1988, *P. Bhargavan* 89956 (MH); Idukki district, Munnar, 13.11.1980, *P.V. Sreekumar* 68451 (BSID); Palakkad district, below Anavai, 14.04.1978, *N.C. Nair* 56806 (CAL & MH); Karivara forest, 25.01.1980, *P. Bhargavan* 65699 (CAL); Nelliyampathy, 06.02.1996, *K. Radhakrishnan* 28155 (TBGT); Silent Valley R.F., Kunthipuzha river bed, 21.04.1980, *V.J. Nair* 67219; *Ibid.*, Valiyaparathode, 12.12.1980, *N.C. Nair* 69578 (CAL); Thrissur district, Vazhachal, 12.12.2019, *V. Drisya* 176271 (CALI). **Tamil Nadu**, Coimbatore district, Anamalai Hills, 29.12.1911, *C.E.C. Fischer* 3232 (FRC); Upper Aliyar-Marappalam area, 24.01.2004, *K. Althaf Ahamed Kabeer* 117728 (MH); Dindigul district, Kodaikanal, 00.01.1963, *Range Officer s.n.* (DD); *Ibid.*, Thalayar slopes, 21.02.1986, *K.M. Matthew* 44298; Palamalai–Machur foot path, Thovarai aaru, 10.05.1986, *K.M. Matthew & N. Rajendren* 44941; Palamalai, Iruttaru junction, 13.01.1987; *K.M. Matthew* 48355; Palni Hills, Kukkal paddy fields along Kuthirayar, 22.08.1986, *K.M. Matthew* 46467; *Ibid.*, Thalayar banks, 14.01.1987, *K.M. Matthew* 48393; *Ibid.*, 04.12.1987, *K.M. Matthew* 51997; Kodavanar (Kanalkadu), 12.04.1987, *K.M. Matthew* 49235; Kuthirayar at Kukkal, 3 km towards Puthur from Kukkal Rest house, 20.05.1987, *K.M. Matthew & M. Charles* 49590 (RHT); Nilgiris district, Chinnachoondi, near Chunnambupalam, 'O' Valley, 25.02.2018, *V. Drisya* 157835 [CALI184716, CALI184717, CALI184718, CALI184719, CALI184720, CALI184721, CALI184722, CALI184723, CALI184724 & CALI184725] (CALI); Keti, 26.03.2012, *J. Remya & R. Prasanna* 72257; Kunda–Coonoor road, 24.03.2012, *J. Remya* 72228 (TBGT); Nilgiris, *s.d.*, *Perrottet* 764 (DD).

Notes on typification: *Iscahemum nilagiricum* was originally described by Hackel in 1901. While describing this species, the author also provided the collection details as "India Orient. in montibus Nilgherries ad Canoor, 1800 m s.m. leg. Clarke 13–III.

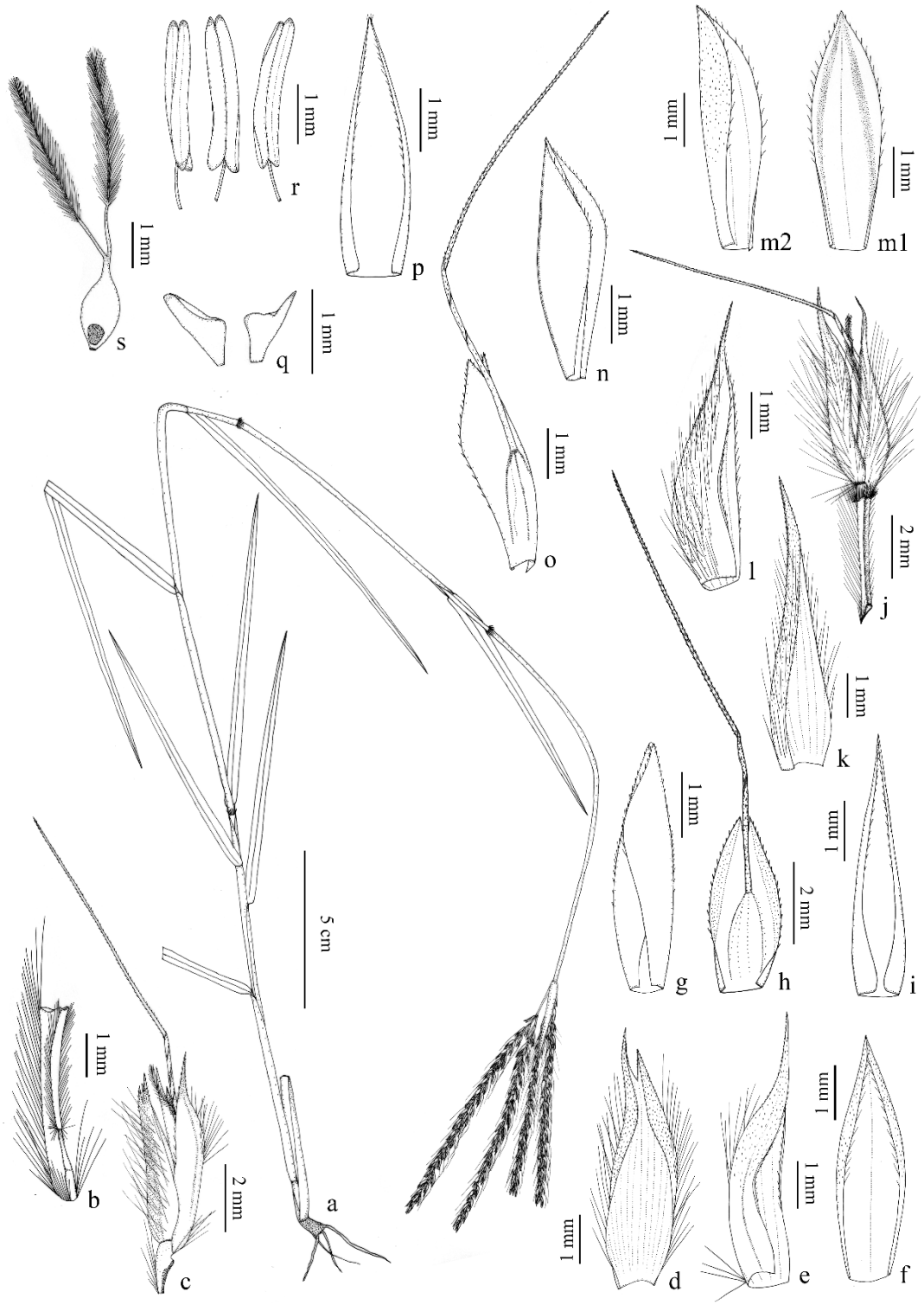

Fig. 58. *Ischaemum polystachyum* J.Presl: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**c–i:** Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume; **m1 & m2.** Lower lemma (different views); **n.** Lower palea; **o.** Upper lemma; **p.** Upper palea (**j–p:** Pedicelled spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium (from *V. Drisya* 176271, drawn by V. Drisya).

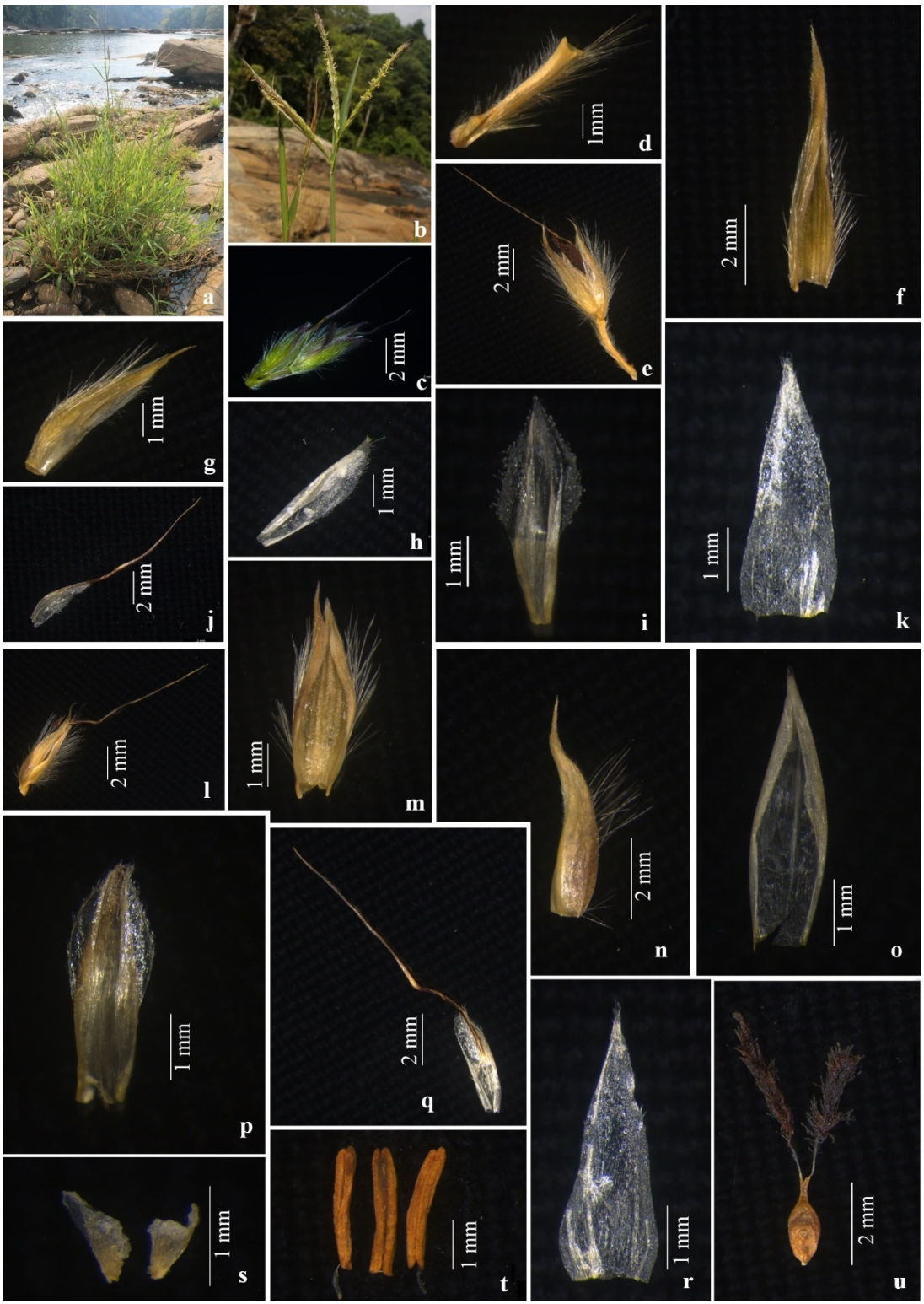

Fig. 59. *Ischaemum polystachyum* J.Presl: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea (**e–k:** Pedicelled spikelet); **l.** Sessile spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Lower palea; **q.** Upper lemma; **r.** Upper palea (**l–r:** Sessile spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium.

1870 sub nro. 10791". While searching for the original materials authors could trace two sheets, one at CAL [CAL0000002282!] and the other at W [W19160035730 digital image!], which matches exactly with the details in the protologue. Since Hackel failed to specify a single sheet, both the sheets from CAL and W constitutes syntypes. Regardless of this, the sheet from CAL simply bears an 'isotype' label and sheet from W bears a typification label with annotation as 'Holotypus' and 'typificavit L. Pignotti (W) 2011-04-28'. But mere presence of these labels on both sheets cannot be considered to be an effective typification. Thus, here required to select one sheet as lectotype as per article 9.12 of the Shenzhen Code (Turland *et al*. 2018). Hence, the well preserved sheet from CAL with barcode CAL0000002282 is designated here as the lectotype, and the sheet at W [W19160035730] as the isolectotype.

Fig. 60. Lectotype of *Ischaemum nilagiricum* Hack. (*C.B. Clarke* 10791 [CAL0000002282]) © The Director, Botanical Survey of India.

16. Ischaemum pushpangadanii Ravi, N.Mohanan & Kiran Raj, Rheedea 10(1): 49. 2000; Srivastava & V.J.Nair, Nelumbo 52: 84. 2010. *Type*:—— INDIA, **Kerala**, Kozhikode district, Kakkayam Hills, 26.10.1999, *Ravi* 41460 (holo: TBGT!; iso: CAL [CAL0000002270!], KFRI [*n.v.*], MH [MH00001500 digital image!], TBGT!). *Ischaemum glabriglaucum* Sunil, Candollea 60(2): 387. 2005. *Type*:—— INDIA, **Kerala**, Thrissur district, Vazhachal, 04.10.1999, *Sunil* 2235 (holo: K [*n.v.*]; iso: BRIT [*n.v.*], CALI [CALI168692!], L [*n.v.*]).

Figs. 61–66

Plant annual, caespitose, erect or geniculately ascending, rooting at lower nodes or not, 50–120 cm tall; *nodes* glabrous, sometimes young nodes villous; *internode* terete–subterete, 4–10 cm long, glabrous, greenish with or without purplish tinge, young internodes glaucous or not. *Leaves* sessile or subsessile, basal leaves pseudopetiolate with cordate or attenuate bases; *leaf sheath* 3.5–8 cm long, dorsally rounded, keeled towards apex, margins entire, chartaceous, dorsally sparsely tubercle-based hairy towards margins near apex, ventral surface glabrous, greenish; *leaf blade* narrowly ovate, 6–16 × 0.8–1.6 cm, base cordate, margins scabridulous, apex acuminate, chartaceous, abaxial surface glabrous, adaxial surface sparsely scabridulous–glabrous, greenish. *Ligule* ovate, 1–7 mm long, apex acute or dissected, membranous, dorsally densely or sparsely scabrous–scabridulous, pale brownish, hairs hyaline. Petiole of upper leaves 1–2 mm long, densely scabrous–scabridulous on adaxial surface, hairs hyaline. *Pseudopetiole* of lower leaves 1–6 cm long. *Spathe* leafy with or without reduced lamina. *Peduncle* terete–subterete, 10–14 cm long, glabrous, greenish. *Racemes* 2, separate, 4–6 cm long, sparsely or densely long pilose, hairs yellowish. *Rachis internode* clavate, 2.5–4 × 1–1.2 mm, hollow, swollen, coriaceous, ventral surface membranous, ventrally compressed, densely scabrous–scabridulous except on ventral surface, long scabrous hairs seen at base and along the three margins, yellowish green. *Sessile spikelet* bisexual, hairy, awned, narrowly elliptic or narrowly ovate, 5–7 × 1–1.2 mm, yellowish green or yellowish brown; callus densely pilose, hairs yellowish brown. *Lower glume* narrowly ovate,

Fig. 61. Isotype of *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj (*Ravi* 41460 [CAL00002270]) © The Director, Botanical Survey of India.

5–6 × 1.5–2 mm, margins entire, inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, laterally keeled, 2–4-side noduled or not, keel scabridulous, apex notched or acute, coriaceous, dorsal surface densely scabrous–scabridulous and pilose, long hairs seen at lower half or lower 2/3rd, ventral surface scabridulous or puberulent at upper 2/3rd or at upper half, greenish or yellowish green, 10–13-nerved. *Upper glume* narrowly ovate, 5.5–6 × 1.5–1.8 mm, cymbiform, folded, margins inflexed or infolded, ciliate at middle, dorsally keeled, keel scabrous–scabridulous at upper 2/3rd, apex acuminate, subcoriaceous, dorsal surface scabrous–scabridulous and puberulent, ventral surface scabridulous at upper half, pale yellowish green or greenish, 3–4-nerved. *Lower lemma* narrowly ovate, 4.5–6 × 1–1.5 mm, margins inflexed at lower 1/3rd, inflexed or infolded at upper 2/3rd, sparsely ciliate at middle, apex acute–acuminate, chartaceous–membranous, dorsal surface scabridulous–puberulent, scabridulous at upper 1/3rd or at upper half and towards margins at upper half or at upper 2/3rd, ventral surface scabridulous at upper 1/3rd or at upper half, pale greenish–hyaline, 3-nerved. *Lower palea* narrowly elliptic or oblong, 4.5–5.5 × 0.8–1 mm, margins entire, inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, laterally keeled throughout, keel narrowly winged at lower 1/3rd or at lower half, keel or wing margin scabridulous at upper half or at upper 1/3rd, apex muticous, chartaceous–membranous, dorsal surface scabridulous at upper half or at upper 1/3rd, ventral surface glabrous or very sparsely scabridulous–puberulent near apex, pale greenish–hyaline, 2–3-nerved. *Upper lemma* narrowly ovate, 3.5–4.8 × 0.8–1 mm, folded, margins entire, inflexed or infolded, apex bilobed, awned from the sinus, membranous, subcoriaceous at lower half, lobe margins scabridulous, dorsal surface scabridulous, hairs seen mainly on lobes, ventral surface glabrous, hyaline, 3-nerved; *awn* geniculate, 13–22 mm long; column twisted, 6–10 mm long, scabridulous along spirals, dark brownish; bristle 7–12 mm long, scabridulous on margins, pale brownish. *Upper palea* narrowly ovate, 3.5–4.5 × 0.6–0.8 mm, margins scabridulous, inflexed or not, apex notched or bifid, membranous, dorsal surface scabridulous–puberulent, scabridulous, hairs prominently seen at upper half and on submargins at upper 2/3rd or at upper 3/4th, ventral surface glabrous, hyaline with or without brownish shade towards margins,

2-nerved. *Lodicules* 2, cuneate, 0.3–0.4 × 0.2–0.3 mm, hyaline. *Stamens* 2; anthers 2–3.5 mm long, yellowish. *Pedicelled spikelet* bisexual, narrowly elliptic or narrowly ovate, 5–6 × 1–1.2 mm, greenish; callus hairy, hairs hyaline and brownish toward tip. *Pedicel* oblong or minutely clavate, 1–3 × 0.4–0.6 mm, dorsiventrally compressed, coriaceous–subcoriaceous, dorsally densely pilose and scabrous, ventral surface sparsely scabridulous, hairs yellowish, yellowish green or greenish. *Lower glume* narrowly ovate, 4.5–6 × 1–2 mm, margins entire, inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or at upper half, laterally keeled, keel scabrous–scabridulous, 1–3-side noduled or not, apex acute or rarely notched, subcoriaceous, dorsal surface densely scabrous–scabridulous and long pilose at lower half, ventral surface scabridulous–puberulent at upper half or at upper 2/3rd, yellowish green or greenish, 8–11-nerved, nerves hard to count. *Upper glume* narrowly ovate, 4.5–5.5 × 1.5–1.8 mm, cymbiform, dorsally keeled, margins inflexed or infolded, ciliate at middle, apex acute–minutely aristate, chartaceous, dorsal surface scabridulous, dorsal keel scabridulous or sparsely scabridulous at upper half, ventral surface scabridulous–puberulent near apex, pale yellowish green or greenish, 3–5-nerved, midnerve prominent; arista *ca.* 0.1 mm long. *Lower lemma* narrowly ovate, 4.5–5 × 1–1.2 mm, margins ciliate–ciliolate at middle, inflexed at lower 1/3rd or at lower half, infolded at upper 2/3rd or at upper half, apex acute, membranous, dorsal surface scabridulous at upper 1/3rd or sparsely scabridulous upto upper half, ventral surface glabrous, hyaline, 3-nerved. *Lower palea* narrowly ovate or oblong, 4.2–4.8 × 0.6–0.8 mm, margins entire, infolded, inflexed or infolded near base, laterally keeled, keel scabridulous–puberulent at upper half, apex muticous, membranous, dorsal surface scabridulous at upper 1/3rd, ventral surface glabrous, hyaline, 3-nerved, midnerve seen at upper 1/3rd or at upper half. *Upper lemma* narrowly ovate, 3.8–4.5 × 0.8–1 mm, cymbiform, margins entire or ciliate at middle, inflexed or infolded, apex acute or mucronulate or minutely awned, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 3-nerved, midnerve prominent and sometimes 2 lateral shallow nerves seen; *awn* 1–5 mm long. *Upper palea* narrowly ovate, 3–4 × 0.6–0.8 mm, margins scabridulous, inflexed or infolded, apex muticous and sometimes minutely lobed, membranous,

dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, 2-nerved. *Ovary* narrowly ovate or narrowly elliptic, 1–1.5 × 0.2–0.4 mm, brownish; *style* 2, 2.5–3.5 mm long, hyaline; *stigma* 2, plumose, 1.5–2.5 mm long, purplish. *Caryopsis* narrowly elliptic or oblong, 1.8–2.2 × 0.3–0.6 mm, brownish, with persistent style base.

Flowering & Fruiting: October to December.

Distribution: Endemic to southern Peninsular India. Distributed in Kozhikode and Thrissur districts of Kerala state.

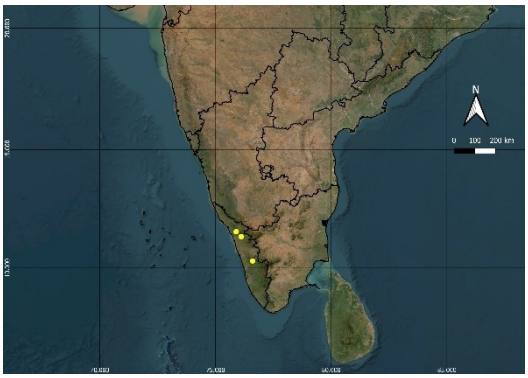

Fig. 62. Distribution of *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj

Habitat: Grown in rocky hill slopes near to rivers and streams.

Specimens examined: INDIA. **Kerala**, Kozhikode district, Kakkadampoyil, 19.10.2016, *V. Drisya* 150794; *Ibid.*, 19.10.2016, *V. Drisya* 150797; *Ibid.*, 19.10.2016, *V. Drisya* 150799; *Ibid.*, 20.11.2019, *V. Drisya* 176223; *Ibid.*, 20.11.2019, *V. Drisya* 176227; *Ibid.*, 20.11.2019, *V. Drisya* 176228; *Ibid.*, 20.11.2019, *V. Drisya* 176229; *Ibid.*, 20.11.2019, *V. Drisya* 17623; *Ibid.*, *V. Drisya* 176251; Kakkayam, Ambalappara, 30.11.2018, *V. Drisya* 157877 (CALI).

Notes: Sunil and Pradeep (2005) distinguished *Ischaemum glabriglaucum* from *I. pushpangadanii* in having 'glabrous nodes, glaucous young culms, upto 6 cm long pseudopetiole, basally attenuate lower leaves, short (1–2 mm long) pedicels, 17–22 mm long awn of upper lemma of pedicelled spikelets, 3–3.5 mm long anthers and awned upper lemma of pedicelled spikelets'. The quantitative characters showed variation in different plants of same population as well as in plants of different localities. The lower leaves are observed generally as a variable character in case of *Ischaemum*. In *I. glabriglaum*, the lower leaves are pseudopetiolate with narrowed or attenuate base whereas in *I. pushpangadanii*, the lower leaves are pseudopetiolate with cordate base while the upper leaves in both cases are with cordate bases.

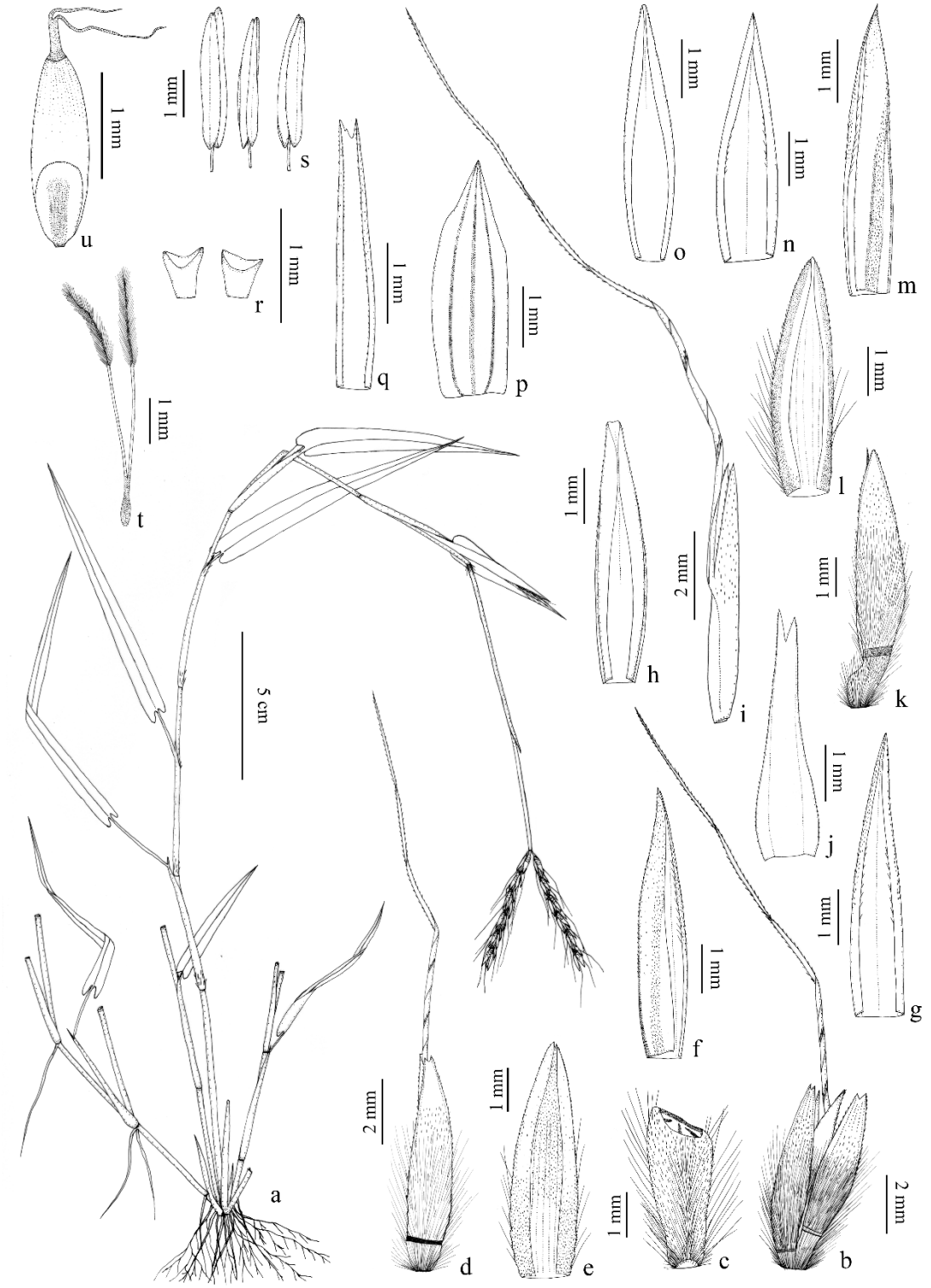

Fig. 63. *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj: **a.** Habit; **b.** Spikelet pair; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium; **u.** Caryopsis (from *V. Drisya* 176228, drawn by V. Drisya).

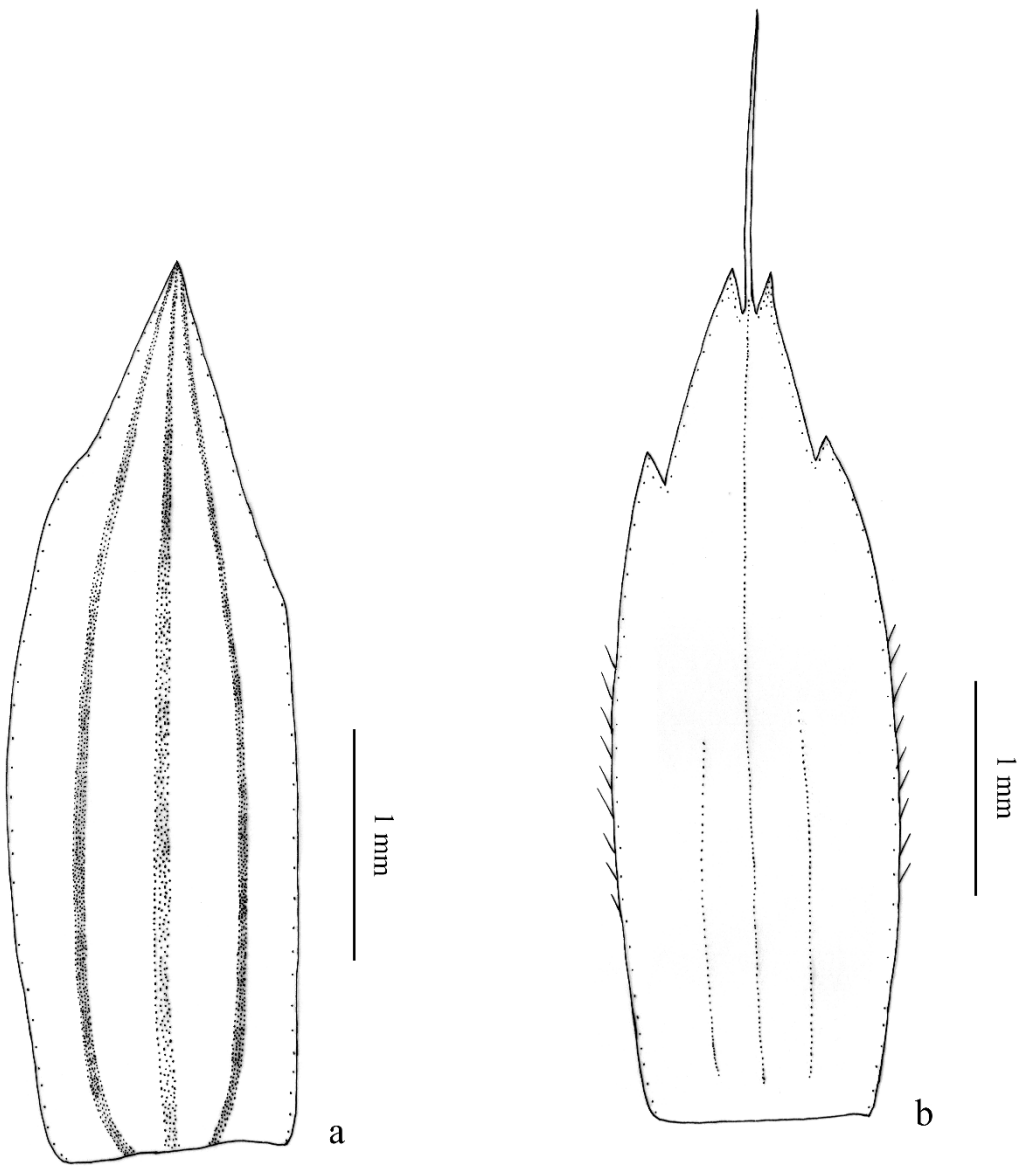

Fig. 64. *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj: **a & b.** Showing variation in upper lemma of pedicelled spikelet with and without awn (specimens from different localities).

Moreover, the awn in the pedicelled spikelet of *I. glabriglaucum* cannot be considered as a constant character since its size as well as occurrence varies even in different spikelets of single raceme. The nodes in both *I. pushpangadanii* and *I. glabriglaucum* are glabrous, but sometimes the younger nodes are villous in *I. pushpangadanii* as opposed to *I. glabriglaucum*. Moreover, these villous hairs are sometimes caducous.

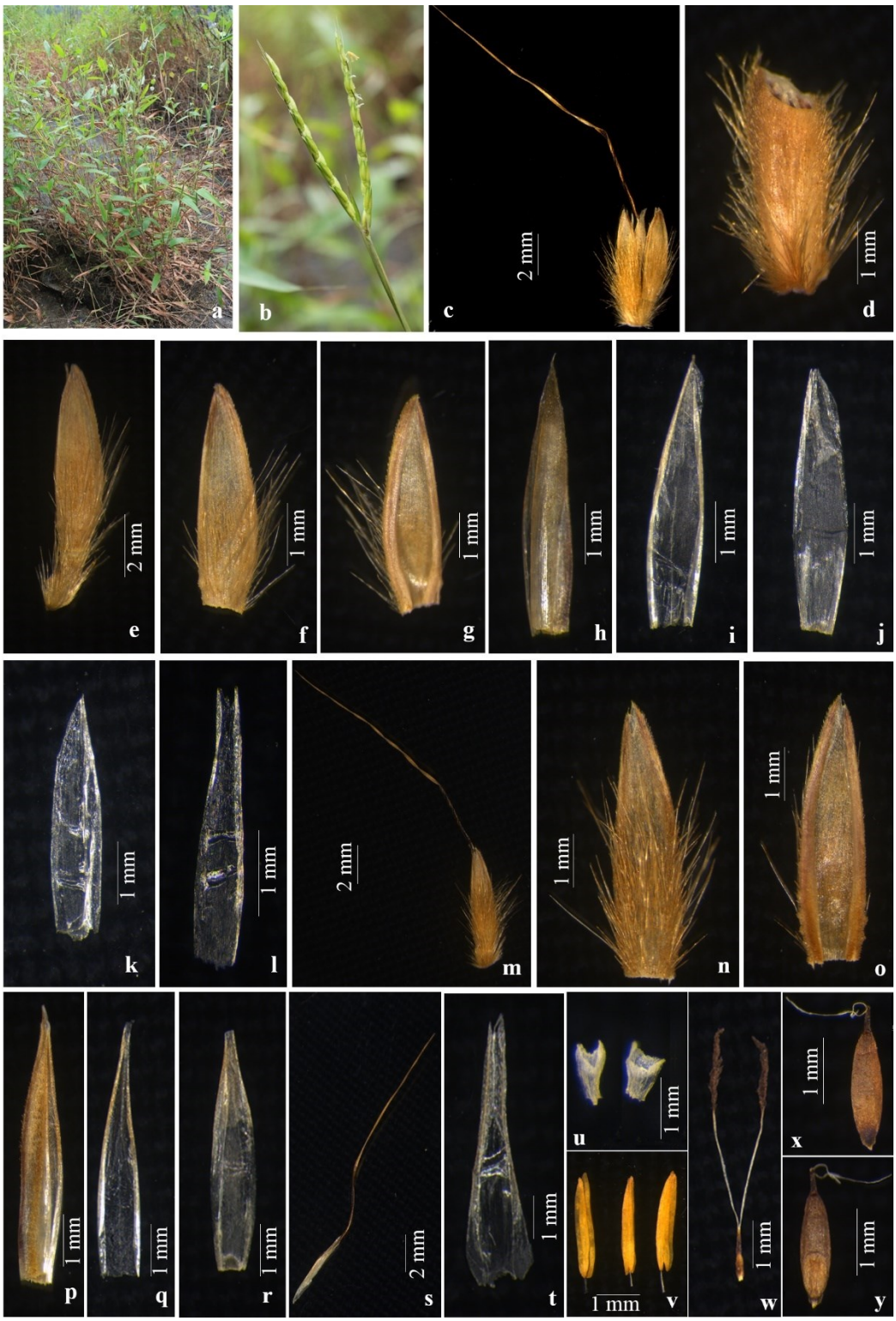

Fig. 65. *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Lower glume-dorsal view; **g.** Lower glume-ventral view; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**e–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume-dorsal view; **o.** Lower glume-ventral view; **p.** Upper glume; **q.** Lower lemma; **r.** Lower palea; **s.** Upper lemma; **t.** Upper palea (**m–t:** Sessile spikelet); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium; **x.** Caryopsis-dorsal view; **y.** Caryopsis-ventral view.

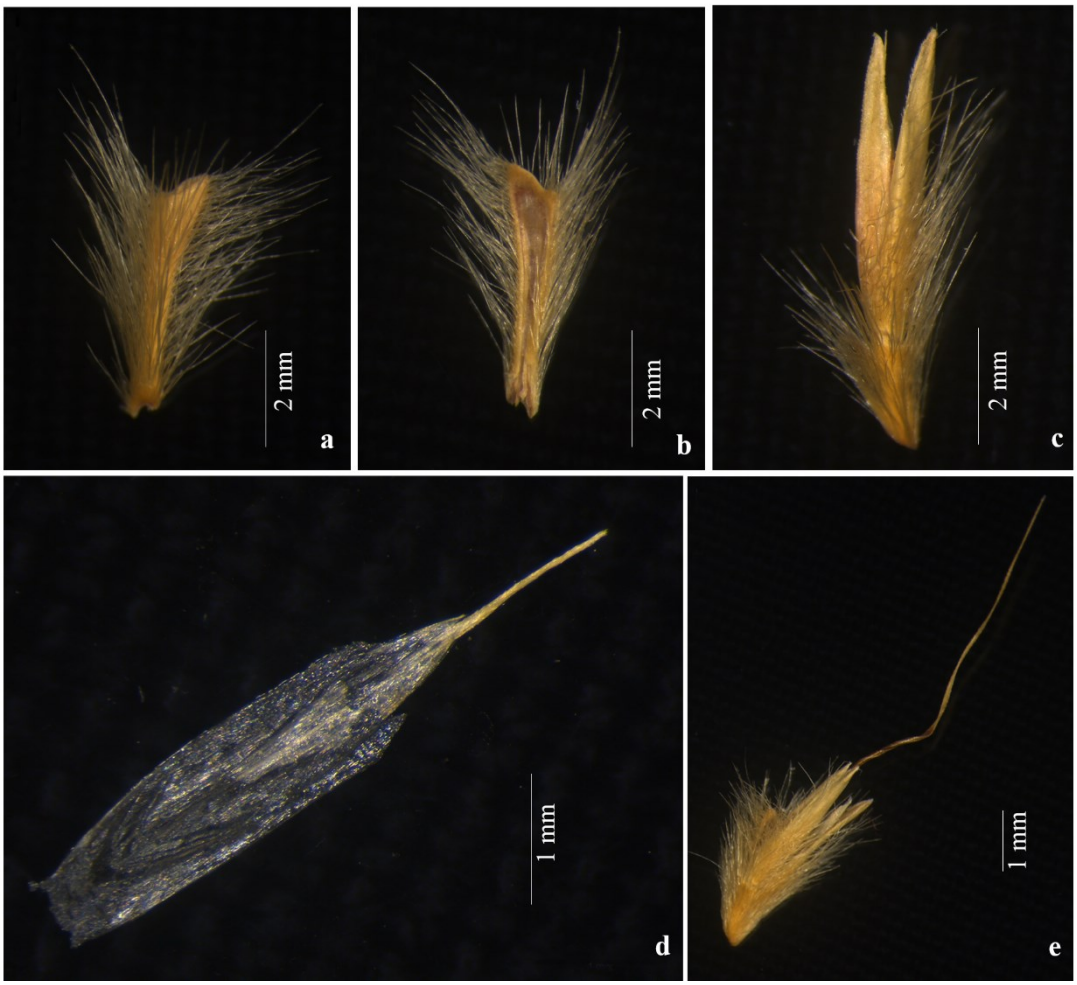

Fig. 66. *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj showing variation: **a.** Rachis internode-dorsal view; **b.** Rachis internode-ventral view; **c.** Pedicelled spikelet; **d.** Upper lemma of pedicelled spikelet; **e.** Sessile spikelet.

So, these minute differences in younger node hairs as well as glaucous young culms and the lower leaves cannot be considered as strong characters to retain *I. glabriglaucum* as distinct species. Since all these are observed as highly variable characters. All other characters of *I. glabriglaucum* comes under the variation range of *I. pushpangadanii*. Hence, *I. glabriglaucum* is treated here as the synonym of *I. pushpangadanii* following Kellogg *et al.* (2020).

12. Ischaemum rangacharianum C.E.C.Fisch., Bull. Misc. Inform. Kew 1933(7). 352. 1933; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 184. 1960; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 232. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 155. 1991; S.Moulik, Grasses Bamboos India 2: 296. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 427. 2001; Singh &

Rao, J. Econ. Taxon. Bot. 32(4): 820. 2008; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 441. 2009; Srivastava & V.J.Nair, Nelumbo 52: 86. 2010. *Type*:—— INDIA, **Kerala**, Shoranur, 23.11.1900, *K. Ranga Achariyar s.n.* (holo: K [K000245742 digital image!]).

Ischaemum fischeri Ravi & Kiran Raj, Bot. Bull. Acad. Sin. 42: 227. 2001. *Type*:—— INDIA, **Kerala**, Thiruvananthaputam district, Palode-TBGRI campus, 12.02.1998, *Ravi* 36706 (holo: TBGT!; iso: CAL [*n.v.*], KFRI [*n.v.*], MH [*n.v.*]).

Ischaemum sunilii Jabeena, Nithya, K.M.P.Kumar & Maya, Phytotaxa 556(2): 179. 2022, *syn. nov. Type*:—— INDIA, **Kerala**, Palakkad district, Nelliyampathy hills, Govindamala, 20.11.2020, *Jabeena M.K. & Maya C. Nair* 4469 (holo: MH [*n.v.*]; iso: CALI [*n.v.*], LWG [*n.v.*]).

Ischaemum aristatum sensu Rang. & Tadul. in Achariar & Mudaliyar, Handb. S. Ind. Grasses 151. 1921 *non* L. 1753.

Figs. 67–72

Annuals or perennials, culms erect or geniculate, sometimes creeping and rooting at nodes, pinkish; *nodes* glabrous but sometimes sparsely hairy, dark pinkish; *internodes* terete–subterete, 2–10 cm long, glabrous, pinkish. *Leaves* subsessile or petioled; *leaf sheath* 3–8 cm long, dorsally shallowly keeled, margins entire, chartaceous, both dorsal and ventral surfaces glabrous, sometimes dorsally tubercle-based hairy towards apex, greenish with purplish or pinkish tinge; *leaf blade* 2–15 × 0.5–1.5 cm, base rounded or shallowly cordate, margins undulate–sinuate, entire, apex acuminate, chartaceous, both adaxial and abaxial surfaces tubercle-based hairy, hairs hyaline, greenish. *Ligule* ovate, 2.5–5 × 3–3.5 mm, purplish or pale brownish with purple shade, dorsal surface sparsely scabrous or tubercle-based hairy, hairs hyaline, 0.5–1 mm long. *Petiole* 2–3 mm long, sparsely tubercle-based hairy and scabrous. *Lower leaves* rounded or narrowed at base with pseudopetioles. *Racemes* 2, adpressed together and looks like solitary, 2–10 cm long. Spathe often leafy with or without reduced lamina. *Peduncle* terete–subterete, 10–24 cm long, pinkish or greenish, glabrous, rarely hairy with bulbous based hairs. *Rachis internode* clavate–turbinate, 3–5.5 × 1–1.2 mm, hollow, 3-angled, swollen, slightly convex (or with a small dorsal bent), coriaceous, ventral surface membranous, dorsal margin densely

long pilose, apical margins with or without densely pilose hairs which are shorter than that of dorsal margin, yellowish green with purple shade. *Sessile spikelet* bisexual, awned, narrowly elliptic–oblong, 5–8 × 0.8–2.5 mm, greenish with purple shade mainly on lower glume; callus pilose, hairs hyaline. *Lower glume* oblong, 4–7.5 × 1–2.5 mm, margins entire, inflexed at lower half, infolded and keeled at upper half, keel winged, sometimes wing on one margin broad than the other, wing margin scabridulous, wing purplish, apex obtuse sometimes serrated, coriaceous–crustaceous below, subcoriaceous–chartaceous at upper half, dorsal surface punctate with few long pilose hairs nearly at the base of the lateral wings, infolded or inflexed portion scabridulous and punctate, ventral surface scabridulous and punctate, hairs seen more towards upper half, dorsally 2–6 side noduled, greenish with purple shade, 8–15-nerved; side nodules sharp, purplish, sometimes deeply or shallowly interconnected. *Upper glume* narrowly ovate, 4.5–7.5 × 1.6–1.8 mm, folded or symbiform, dorsally keeled, margins entire, inflexed or infolded, apex acuminate, chartaceous–sub coriaceous, dorsal surface scabridulous and punctate or glandular, ventral surface scabridulous, hairs usually seen towards apex, pale greenish, 5–12-nerved. *Lower lemma* narrowly ovate, 3.5–7.5 × 1–1.2 mm, margins entire, inflexed, infolded towards apex, apex acute–acuminate, membranous, dorsal surface scabridulous, hairs seen on submargins, ventral surface glabrous or puberulent, hyaline, 2–3-nerved, nerves faint. *Lower palea* narrowly elliptic–oblong, 3.5–7 × 1–1.2 mm, margins entire, inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, laterally keeled, keel minutely winged towards lower half, keel entire, apex acute–

Fig. 67. Holotype of *Ischaemum rangacharianum* C.E.C.Fisch. (*K. Ranga Achariyar s.n.* [K000245742]) © The Board of Trustees for The Royal Botanic Gardens, Kew.

obtuse, membranous, dorsal surface scabridulous near apex, ventral surface glabrous, hyaline–pale greenish, 2-nerved, sometimes nerves inconspicuous. *Upper lemma* narrowly ovate, 3–6.5 × 1.4–2 mm, folded, margins sparsely ciliolate, inflexed or infolded, apex bilobed, dorsally awned from the sinus, membranous, dorsal surface glabrous, ventral surface puberulent or glabrous, hyaline, 3-nerved or nerves inconspicuous; *awn* geniculate, 10–24 mm long; column twisted, 4.5–12.5 mm long, scabridulous on margins, dark brownish; bristle 5.5–11.5 mm long, scabridulous, pale brownish or purplish. *Upper palea* narrowly ovate, 3.5–6 × 0.8–1 mm, margins entire, inflexed at lower 1/3rd, upper 2/3rd neither inflexed nor infolded, apex acute–obtuse, membranous, both dorsal and ventral surfaces puberulent or glabrous, hairs very minute, hyaline, 2-nerved, sometimes nerves inconspicuous. *Lodicules* 2, cuneate, 0.5–0.75 × 0.3–0.5 mm. *Stamens* 3; anthers 2.5–3.5 mm long, yellowish or purplish. *Pedicelled spikelet* bisexual, usually unawned rarely awned, narrowly elliptic–oblong, 4.5–7.5 × 1.5–2 mm, greenish with purplish marginal wings and nodules; callus glabrous or very sparsely pilose. *Pedicel* almost oblong, 1–2.4 mm long, 3-angled, compressed, swollen, hollow, coriaceous, ventral surface membranous, dorsally long pilose, hairs hyaline, yellowish green. *Lower glume* narrowly elliptic–oblong, 4–7 × 2–2.5 mm, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, laterally keeled, one margin broadly winged throughout, wing margin scabridulous, scabrous at base, other margin side noduled at lower half (1–4 nodules) or sometimes side-nodules absent or inconspicuous, winged at upper 1/3rd or 1/4th, wing purplish, wing margin scabridulous, apex obtuse–rounded, sometimes minutely serrated, chartaceous–subcoriaceous at upper half, subcoriaceous–coriaceous at lower half, dorsal surface puberulent–sparsely puberulent, with without one or two long pilose hair at upper 1/3rd, scabridulous on infolded margins, ventral surface scabridulous, greenish with purplish marginal wings and nodules, 9–13-nerved. *Upper glume* narrowly ovate, 5.5–7 × 0.8–1 (when folded), dorsally keeled or folded, cymbiform, margins sparsely ciliate or entire, inflexed at lower 1/3rd or lower half, narrowly infolded at upper 2/3rd or upper half, apex acuminate, subcoriaceous, sometimes chartaceous towards margins, dorsal surface scabrous–scabridulous and punctate, ventral surface scabridulous, hairs seen

towards upper half, pale greenish with a brownish tinge, 5–9-nerved. *Lower lemma* narrowly ovate, 5.5–6.5 × 1–1.5 mm, cymbiform, margins entire, inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, apex acute–acuminate, membranous, laterally shallowly keeled, keel scabridulous, both dorsal and ventral surfaces glabrous or puberulent, hyaline, 2 or 3-nerved. *Lower palea* narrowly elliptic, 5–6.3 × 1–1.3 mm, margins entire, infolded, laterally keeled, keel narrowly winged, apex acute–acuminate, membranous, dorsal surface scabridulous towards apex, ventral surface glabrous, hyaline, 2-nerved, sometimes nerves inconspicuous. *Upper lemma* narrowly ovate, 3–5.2 × 1.6–1.8 mm, cymbiform, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex acute–acuminate or minutely aristate or bifid with upto 13 mm long awn, membranous, glabrous or puberulent, hyaline with brown tinge, 3-nerved, midnerve prominently seen. *Upper palea* narrowly ovate, 3.8–5 × 0.6–0.8 mm, margins entire, inflexed at lower 1/3rd, upper 2/3rd neither inflexed nor infolded, apex acute–obtuse, membranous, dorsal surface glabrous or puberulent, ventral surface puberulent, hyaline, 2-nerved, sometimes nerves inconspicuous. *Ovary* ovoid–ellipsoid, 0.5–0.8 × 0.3–0.4 mm; *style* 2, 1.8–2.3 mm long, hyaline; *stigma* plumose, 1.5–3 mm long, purplish. *Caryopsis* ellipsoid, 2–3 × 0.3–1 mm, brownish, style persistent or not.

Notes: *Ischaemum rangacharianum* exhibits wide range of variation in many characters. The plant shows size variation depending on the habitats. They may develop as geniculately ascending tufted form, often produces stilt roots from lower nodes especially when they grow near to water coarses and sometimes they are mat forming. The nodes are usually glabrous, but rarely hairy. This variation is seen within different plants of a population as well as seen within same plant. Similarly, in typical *I. rangacharianum* the lower glume of both sessile and pedicelled spikelets are side noduled and that of sessile spikelets are interconnected. Some collections show variation in the number of side nodules and these side nodules may be sharply interconnected or shallowly interconnected or not at all interconnected. Some plants having no nodules have also been observed from the same population. Also, the lower glume of the sessile spikelet may be broadly or very narrowly winged. Moreover, some specimens were collected with awned pedicelled spikelets.

Here, the upper lemma of the pedicelled spikelet is awned as seen in sessile spikelets and are awned from the sinus of bilobed upper lemma. Long geniculate awn reaching upto 13 mm have been observed in the pedicelled spikelets of some plants. These awned (pedicelled spikelet) plants are found growing along with plants having unawned pedicelled spikelets. This variation is found to be continuous, and also it is observed that the awn size may vary within the spikelets of a single raceme. In short, *I. rangacharianum* shows continuous variation in many characters.

Ischaemum fischeri was segregated from *I. rangacharianum* by Ravi *et al.* (2001) based on its perennial habit with mat forming culms which are rooting at nodes, lower leaves with narrowed or attenuate leaf bases, being with 1 or 2 peduncles and 2–4-side nodules on the lower glume of sessile spikelets. They also used the diiference in the indumentum on the lower glume of sessile spikelet to describe *I. fischeri*. But the present study showed the characters of *I. fischeri* overlap with that of *I. rangacharianum*. Following Kellogg *et al.* (2020), *I. fischeri* is treated here as a synonym of *I. rangacharianum*.

Jabeena *et al.* (2022) recently described one new species *I. sunilii* from Nelliyampathi hills (Govindamala) and distinguished it from *I. rangacharianum* in having "sparsely villous nodes, short stout raceme with prominently inflated and bulbous pilose peduncle, inflated rachis joints (rachis internodes) and pedicel, smooth lower glume of sessile spikelets, rarely 2–3 interconnected nodules and keeled margins, upper glume with acuminate apex, lower glume of pedicelled spikelets without nodules and oblong–elliptic caryopsis". Moreover, they also used some quantitative characters like size of the raceme, size of the lower and upper glume of sessile spikelet as well as the nodules on lower glume of pedicelled spikelet. But the present study showed the characters of *I. sunilii* overlaps with that of *I. rangacharianum*. The size of racemes and floral parts of *I. sunilii* falls within the variation range of *I. rangacharianum*. Also, there is no considerable differences in the shape of rachis internode, pedicel and caryopsis of *I. sunilii* to that of *I. rangacharianum*. As already mentioned, the side nodules as well as indumentum on nodes are variable characters in case of *I. rangacharianum*. Moreover, it is observed

that the plants with varying degree of pubescence on nodes and peduncles as well as spikelets with varying side nodules are growing together in the type locality of *I. sunilii*. These variations are seen even within same plants. The sessile spikelets with winged lower glumes are also not uncommon. The characters of *I. sunilii* fall within the variation range of *I. rangacharianum* and hence treated as the synonym of *I. rangacharianum.*

Flowering & Fruiting: September to February.

Distribution: Endemic to India. It is distributed in Maharashtra and southern Peninsular Indian states of Andhra Pradesh, Kerala and Tamil Nadu.

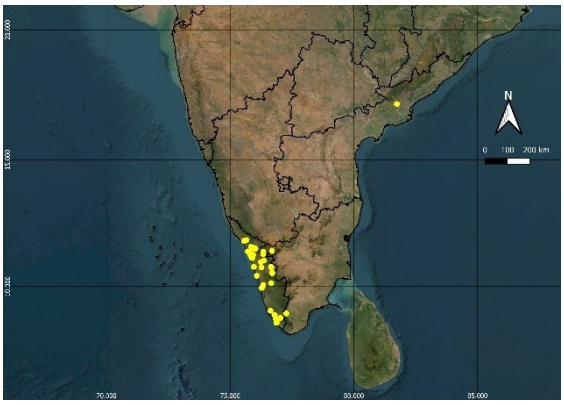

Fig. 68. Distribution of *Ischaemum rangacharianum* C.E.C.Fisch. in southern Peninsular India

Habitat: Common grass in open dry grasslands, roadsides, hill slopes and wastelands.

Specimens examined: INDIA, **Andhra Pradesh**, Godavari district, 00.09.1920, *V. Narayanaswami s.n.* (CAL); **Kerala**, Ernakulam district, Kalamassery, 12.11.2015, *V. Drisya* 144289 (CALI); Kochi [Cochin], 06.11.1956, *B.D. Patil* 912 (DD); Thundathil Forest range, Cherukadu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168701 (CALI); Willingdon Island, 04.11.1972, *T.A. Rao* 9732; *Ibid.*, 31.10.1972, *T.A. Rao* 9652 (CAL); Kannur district, Kannoth, 11.11.1978, *V.S. Ramachandran* 58672 (CAL); Thalassery, Pookkode, 13.12.1996, *N. Ravi & N. Mohanan* 33736 (TBGT); Kollam district, Ithikkara, 15.11.2017, *V. Drisya* 157736; near Sasthamkotta Lake, 15.11.2017, *V. Drisya* 157738 (CALI); Kozhikode district, Cheruppa, Ayyappankaavu, 28.08.2016, *Nikhil Krishna & V. Drisya* 150757; Chippilithodu, Wayanad Ghat roadside, 05.12.2016, *V. Drisya* 176733; Kakkayam, on the way to Oorakkuzhi Waterfalls, near Dam site, 30.11.2018, *V. Drisya* 157888; *Ibid.*, on the way to Search, 28.12.2017, *V. Drisya* 157797 (CALI); Kakkodi-Chelannur, 27.10.1981, *P.V. Sreekumar* 71783 (BSID); Kanjirakadavu, 08.12.2016,

V. Drisya 176735 (CALI); Kappad shore, 09.11.1972, *T.A. Rao* 9849 (CAL); Pokkunnumala, near Nanminda, 29.10.1981, *P.V. Sreekumar* 71810 (BSID); *Ibid.*, 26.10.2016, *V. Drisya* 150766; *Ibid.*, 26.10.2016, *V. Drisya* 150770; *Ibid.*, 23.11.2019, *V. Drisya* 170174; *Ibid.*, 23.11.2019, *V. Drisya* 170177; *Ibid.*, 23.11.2019, *V. Drisya* 176238; *Ibid.*, 23.11.2019, *V. Drisya* 176243; *Ibid.*, 23.11.2019, *V. Drisya* 17624; Wayanad Ghat roadside, 01.03.2016, *V. Drisya* 150779 (CALI); Malappuram district, Calicut University Campus, 16.03.2014, *Rinku J. Desai* 1055 (CAL); *Ibid.*, 20.11.2015, *Rinku J. Desai* 1770 (BARO); *Ibid.*, 19.11.2019, *V. Drisya* 176219; *Ibid.*, C.U. Botanical Garden, 10.12.2020, *V. Drisya* 169557; *Ibid.*, 14.02.2023, *V. Drisya* 169576; *Ibid.*, infront of IAAT, 11.12.2020, *V. Drisya* 169559; *Ibid.*, near Canteen, 14.11.2017, *V. Drisya* 157728; *Ibid.*, near Gymnasium, 26.10.2015, *V. Drisya* 144267; *Ibid.*, near Madhava Observatory, 26.10.2015, *V. Drisya* 144269; *Ibid.*, opposite to Botanical Garden, 25.12.2020, *V. Drisya* 169538 (CALI); Moodal, 10.12.1996, *N. Ravi* 31862 (TBGT); Nilambur, Nedumkayam, 30.10.1939, *T.N. Srivastava s.n.* (DD); Perinthalmanna, Karoompara, 15.12.1996, *N. Ravi* 33024 (TBGT); Puthuponnani to Kuttippuram road side, 23.11.2017, *V. Drisya & A.K. Pradeep* 157746 [CALI184711, CALI184712, CALI184713, CALI184714 & CALI184715] (CALI); Vazhikkadavu, 07.11.2012, *J. Remya* 75431 (TBGT); Palakkad district, Manappulli, 03.01.2016, *V. Drisya* 171473; *Ibid.*, 03.01.2016, *V. Drisya* 171479; Nelliyampathy, 07.11.2015, *V. Drisya* 176692; *Ibid.*, 07.11.2015, *V. Drisya* 176693; *Ibid.*, 07.11.2015, *V. Drisya* 176695; *Ibid.*, Valiya Govindamala, 10.12.2022, *V. Drisya* 169598; *Ibid.*, 10.12.2022, *V. Drisya* 169599; Palakkad, near Govt. Victoria College, 04.12.2015, *V. Drisya* 150786 (CALI); Shoranur, 23.11.1900, *R. Ranga Achariyar s.n.* (CAL); Thiruvizhamkunnu, 28.12.1969, *E. Vajravelu* 33392 (MH); Thiruvananthapuram district, Kariavattom campus, 10.11.2015, *V. Drisya* 150782; Kazhakkuttam, 24.03.1980, *P.V. Sreekumar* 67141 (BSID); Nedumparambu, 20.12.2019, *V. Drisya* 170196 (CALI); Palode, TBGRI Campus, 12.02.1998, *N. Ravi* 36076; *Ibid.*, 27.10.2003. *N. Mohanan* 46553; TBGRI Garden, 02.09.2011, *J. Remya* 67176 (TBGT); TBGRI Campus lawn, 02.02.2017, *V. Drisya* 176649; TBGRI Rock

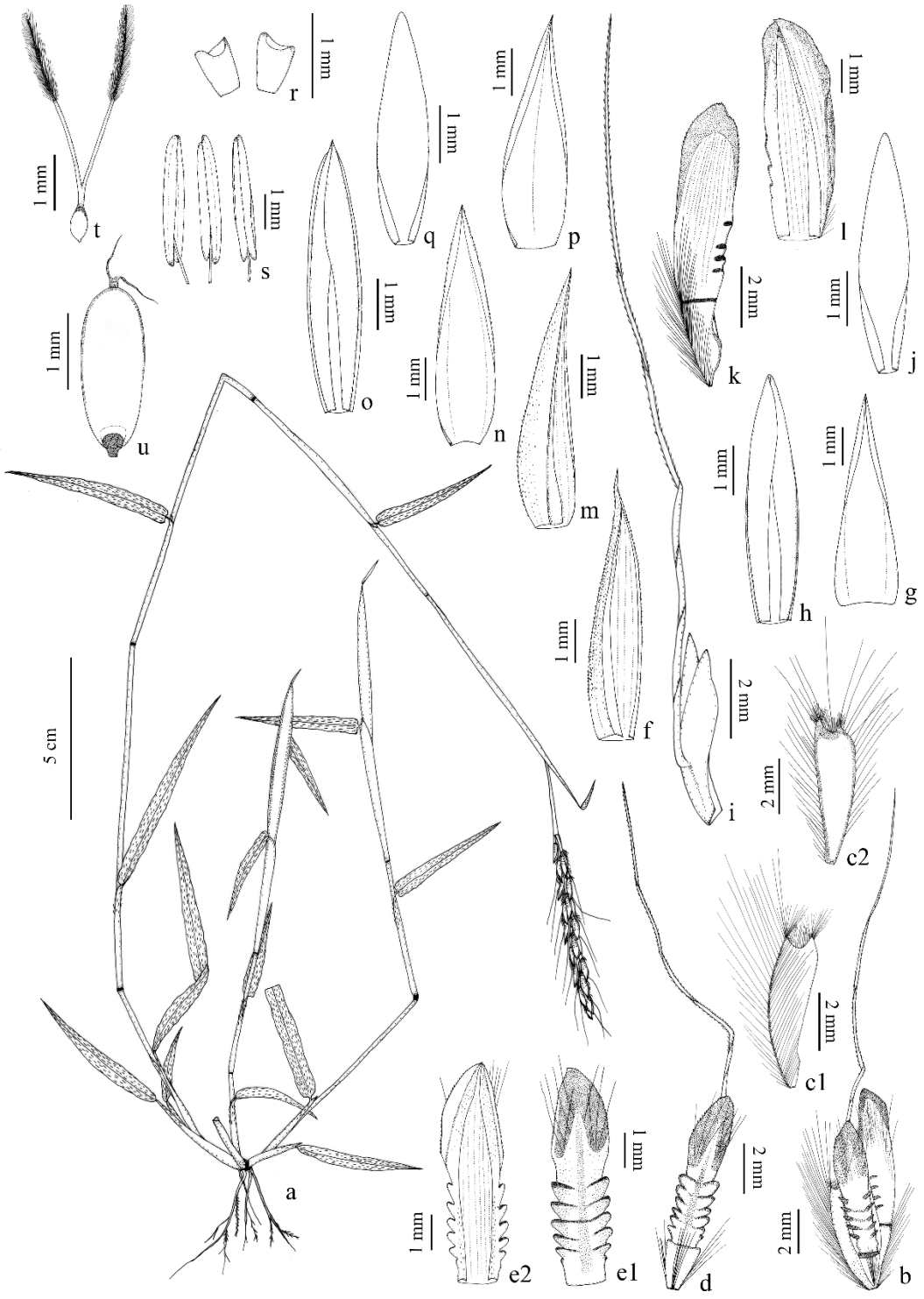

Fig. 69. *Ischaemum rangacharianum* C.E.C.Fisch.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c1.** Rachis internode-lateral view; **c2.** Rachis internode-ventral view; **d.** Sessile spikelet; **e1.** Lower glume-dorsal view; **e2.** Lower glume-ventral view; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium; **u.** Caryopsis (from *V. Drisya* 169559, drawn by V. Drisya).

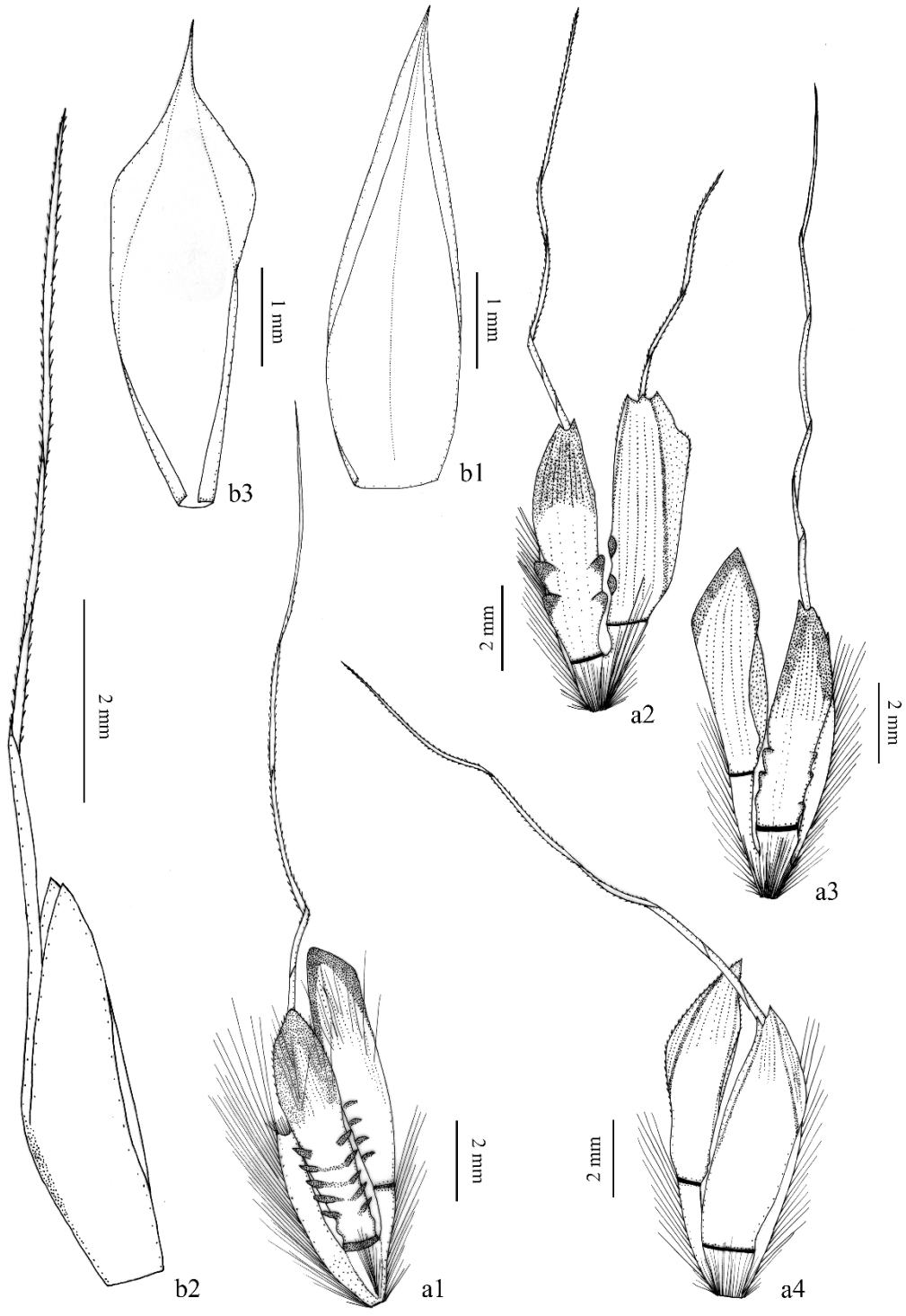

Fig. 70. *Ischaemum rangacharianum* C.E.C.Fisch.: **a1, a2, a3 & a4.** Showing variation in spikelet pairs; **b1, b2 & b3.** Showing variation in upper lemma of pedicelled spikelets corresponding to **a1, a2 & a3** respectively (**a1 & b1.** from *V. Drisya* 169559; **a2, b2, a3 & b3.** from *V. Drisya* 176650; **a4.** from *V. Drisya* 169598, drawn by V. Drisya).

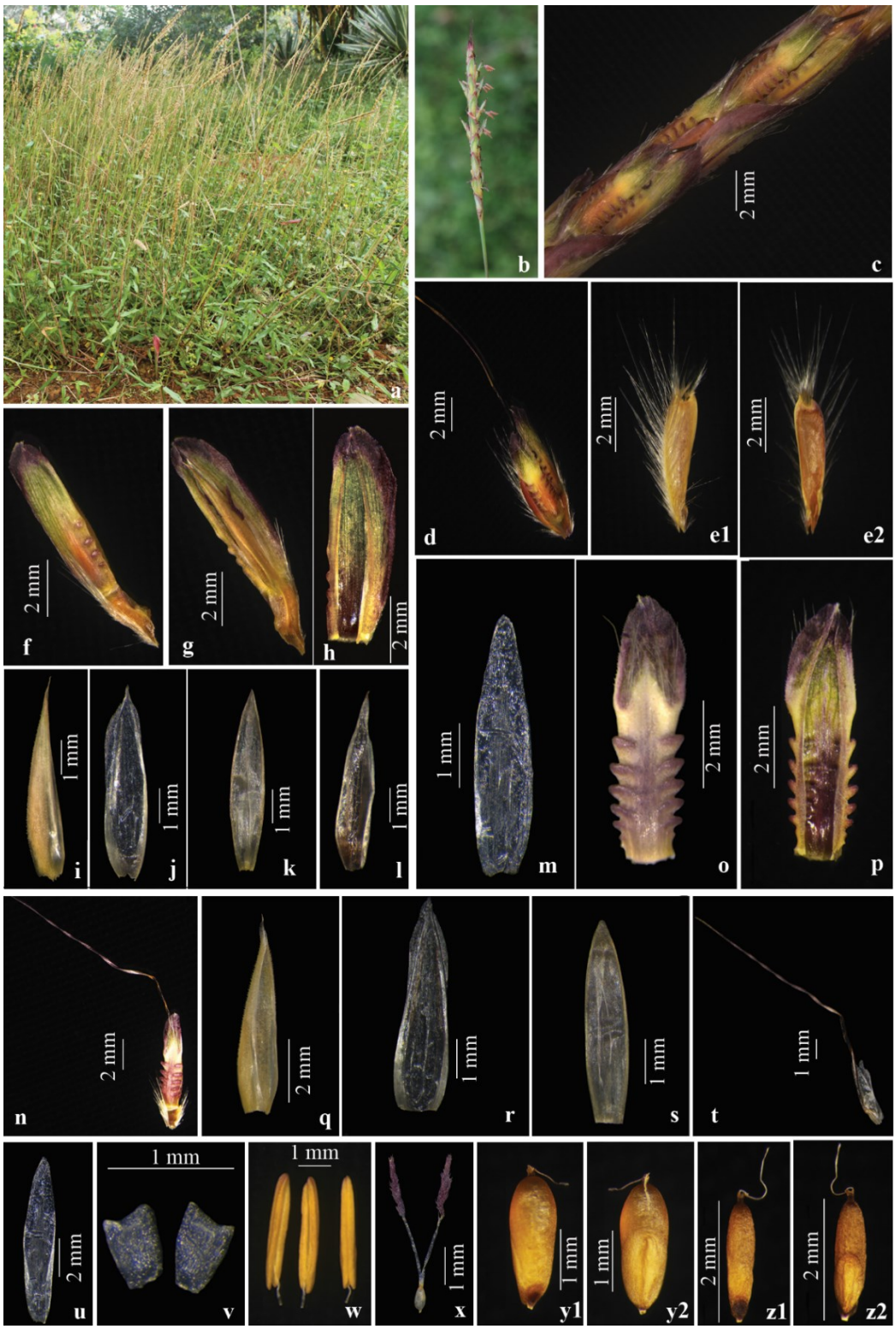

Fig. 71. *Ischaemum rangacharianum* C.E.C.Fisch.: **a.** Habit; **b.** Raceme; **c.** Portion of raceme; **d.** Spikelet pair; **e1 & e2.** Rachis internode-different views; **f.** Pedicelled spikelet-dorsal view; **g.** Pedicelled spikelet-ventral view; **h.** Lower glume; **i.** Upper glume; **j.** Lower lemma; **k.** Lower palea; **l.** Upper lemma; **m.** Upper palea (**f–m:** Pedicelled spikelet); **n.** Sessile spikelet; **o.** Lower glume-dorsal view; **p.** Lower glume-ventral view; **q.** Upper glume; **r.** Lower lemma; **s.** Lower palea; **t.** Upper lemma; **u.** Upper palea (**n–u:** Sessile spikelet); **v.** Lodicules; **w.** Stamens; **x.** Gynoecium; **y1.** Caryopsis-dorsal view; **y2.** Caryopsis-ventral view; **z1 & z2.** Caryopsis showing variation in shape (**z1.** Dorsal view; **z2.** Ventral view).

Fig. 72. *Ischaemum rangacharianum* C.E.C.Fisch. showing variation: **a.** Spikelet pair with pedicelled spikelet having reduced awn; **b.** Spikelet pair with awned pedicelled spikelet; **c.** Upper lemma of pedicelled spikelet with aristate apex; **d.** Upper lemma of pedicelled spikelet with awn; **e.** Spikelet pair with sessile spikelet having interconnected side-nodules; **f.** Spikelet pair with sessile spikelet in which side-nodules not interconnected; **g.** Upper lemma of pedicelled spikelet with acuminate–minutely aristate apex; **h.** Spikelet pair with awned pedicelled spikelet; **i.** Spikelet pair with unawned pedicelled spikelet; **j.** Spikelet pair with developed pedicelled spikelet; **k.** Spikelet pair with reduced pedicelled spikelet (**j & k.** also shows variation in side nodules); **l.** Rachis internode.

Garden, 02.02.2017, *V. Drisya* 176650 (CALI); Thrissur district, Snehatheeram beach, 23.11.2017, *V. Drisya & A.K. Pradeep* 171492; *Ibid.*, 23.11.2017, *V. Drisya & A.K. Pradeep* 171495 (CALI). **Tamil Nadu**, Nilgiris district, Udhagamandalam [Ootty], 09.12.1939, *G.N. Singh s.n.* (DD); Tirunelveli district, Main Falls, Courtallam, 16.12.1957, *K. Subramanyam* 4945 (CAL & MH).

13. Ischaemum rugosum Salisb., Icon. Stirp. Rar. 1, t.1. 1791; Hook.f., Fl. Brit. India 7: 127. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 184. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 122. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1869. 1983; Karthik. *et al*., Fl. Ind. Enum. Monocot. 233. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 159. 1991; S.Moulik, Grasses Bamboos India 2: 296. 1997; Pull., Fl. Andhra Pradesh 3: 1211. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 429. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 821. 2008; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 441. 2009; Srivastava & V.J.Nair, Nelumbo 52: 87. 2010; Potdar *et al*., Grasses Maharashtra 197. 2012; Pull. Fl. Telangana 3: 1139. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 132. 2017. *Type*:—— INDIA, **Orissa**, *s.d.*, *J. Koenig s.n.* (BM [BM000959774 digital image!]).

Ischaemum pappinisseriense Ravi, N.Mohanan & R.Rajesh, Rheedea 8: 155. 1998 (as '*pappinisseriensis*'), *syn. nov. Type*:—— INDIA, **Kerala**, Kannur district, Pappinisseri, 12.12.1996, *N. Ravi* 33707 (holo: TBGT!; iso: K [K000308183 digital image!], KFRI [*n.v.*], MH [*n.v.*]).

Figs. 73–79

Annuals, tufted, erect or geniculately ascending, 40–100 cm tall; *nodes* hairy, rooting from lower nodes; *internodes* terete or subterete with a ventral compression or with a shallow groove, 3–14 cm long, glabrous, greenish. *Leaves* sessile; *leaf sheath* 5–8 cm long, dorsally keeled, margins entire, chartaceous, dorsal surface bulbous-based or tubercle-based hairy on submargins, ventral surface glabrous, greenish; *leaf blade* narrowly ovate or narrowly elliptic, 8–22 × 0.8–1 cm, base obtuse–rounded or attenuate, margins scabridulous, apex acuminate, chartaceous, both abaxial and adaxial surfaces densely bulbous based hairy, hairs soft, greenish.

Ligule ovate, 1.8–2 mm long, membranous, dorsally densely bulbous-based hairy, brownish. *Racemes* 2, 4–7 cm long, adpressed together and looks as solitary, sparsely hairy. *Peduncle* terete–subterete or shallowly corrugated towards apex, 6–18 cm long, glabrous, greenish, encircled by a spathe. *Spathe* often leafy with reduced lamina. *Rachis internode* clavate, 3–3.5 × 1.2–1.6 mm, hollow, swollen, 3-angled, ventrally compressed, crustaceous, ventral surface membranous, glabrous except dorsal margin, dorsal margin densely pilose, yellowish. *Sessile spikelet* bisexual, awned, narrowly elliptic or narrowly ovate, 4–5 × *ca.* 0.8 mm, rugose, yellowish green with greenish towards apex, not densely long pilose; callus hairy. *Lower glume* narrowly ovate, 3.5–5 × 1.8–2 mm, margins entire, inflexed or infolded, laterally keeled, keel winged at upper 1/3rd, wing margin scabridulous, apex obtuse, crustaceous below (at lower 2/3rd) and chartaceous above (at upper 1/3rd), dorsally rugose with 5–6-ridges at lower half or at lower 2/3rd or with 3–5 side nodules which may or may not be sharply interconnected, dorsal surface puberulent–punctate, hairs usually seen towards upper half or at upper 1/3rd and on infolded portions of margins, ventral surface puberulent–scabridulous towards upper half or at upper 1/3rd, yellowish green with greenish towards apex, 12–15-nerved. *Upper glume* narrowly ovate, 4–5 × 1.8–2 mm, folded or cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, apex acute–acuminate, chartaceous–subcoriaceous, both dorsal and ventral surfaces scabridulous–puberulent, dorsally keeled, keel narrowly winged near apex, wing margin scabrous–scabridulous, pale yellowish green with greenish at apex or not, 3-nerved, midnerve divided into 3 nerves at upper half or at upper

Fig. 73. Type of *Ischaemum rugosum* Salisb. (*J. Koenig s.n.* [BM000959774]) © The Board of Trustees of The Natural History Museum, London. Reproduced with permission.

2/3rd or sometimes faintly 5-nerved. *Lower lemma* narrowly ovate, 3.5–4.5 × *ca.* 1.5 mm, cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, laterally keeled, keel scabridulous at upper half, apex acute, membranous, both dorsal and ventral surfaces scabridulous–puberulent, hyaline–pale greenish, 3-nerved. *Lower palea* narrowly ovate, 3.5–4 × 1–1.2 mm, margins entire, infolded and keeled, keel scabridulous at upper half, apex acute–obtuse, membranous, both dorsal and ventral surfaces puberulent–scabridulous, hyaline, 2-nerved. *Upper lemma* narrowly ovate, 3–4 × 1.5–1.8 mm, folded, margins inflexed at lower 1/3rd, inflexed or infolded and ciliate–ciliolate at upper 2/3rd, apex bilobed, awned dorsally from the base of lobes, membranous, dorsal surface puberulent, ventral surface glabrous or puberulent, hyaline, 3-nerved, nerves jointed at the base of awn; *awn* geniculate, 20.5–22.5 mm long; column twisted, 7.5–9 mm long, scabridulous along margin, dark brownish; bristle 11.5–15 mm long, scabridulous on margins, pale brownish. *Upper palea* narrowly ovate, 2.5–3 × 1–1.2 mm, broad at lower half, margins scabridulous, inflexed or infolded at lower half, apex obtuse, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous–puberulent, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–0.6 × 0.2–0.3 mm, hyaline. *Stamens* 3; anthers 1.5–2 mm long, yellowish. *Ovary* narrowly ovate or narrowly elliptic, 0.5–1.5 × 0.4–0.6 mm; *style* 2, 1–1.2 mm long, hyaline; *stigma* plumose, 1–1.5 mm long, purplish. *Pedicelled spikelet* unawned or minutely awned, well developed or reduced either with lower glume only or with lower and upper glumes only, if developed then female or bisexual, narrowly elliptic or narrowly ovate, *ca.* 4 × 1–1.6 mm [*ca.* 2 × 0.8–1 mm in reduced spikelet], yellowish green, not densely long pilose; callus sparsely pilose. *Pedicel* turbinate, 1–1.5 × 0.6–0.8 mm [2.5–3 × 0.6–0.8 mm in reduced spikelet], hollow, swollen, crustaceous–coriaceous, ventral surface membranous, dorsal margin densely pilose, glabrous except dorsal margin, hairs hyaline, ventrally compressed, yellowish green or greenish. *Lower glume* narrowly ovate, 2–4 × 0.8–1.6 mm, margins entire, infolded, inflexed at base, one margin keeled and broadly winged throughout, the other margin keeled at upper half or at upper 1/3rd and keel narrowly winged or not, keel or wing margin scabridulous, apex obtuse–rounded or acute, chartaceous–subcoriaceous, both dorsal and ventral surfaces puberulent, dorsally with or without shallow nodules, sometimes nodules shallowly jointed or rugose, yellowish green with greenish towards apex, 10–12-

nerved. *Upper glume* narrowly ovate, 3.5–4 × 1.5–1.8 mm (1–2 mm long in reduced spikelet), folded, dorsally keeled, margins inflexed at lower 1/3rd or at lower half, infolded and ciliate at upper 2/3rd or at upper half, apex acute, chartaceous, dorsal surface scabrous–scabridulous and punctate, ventral surface scabridulous, yellowish green with green tinge towards apex, 5-nerved (2 or 3-nerved in reduced spikelets), sometimes nerves hard to distinguish between. *Lower lemma* narrowly ovate, 3–3.5 × 0.8–1 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, ciliate at upper 2/3rd or at middle, apex acute, membranous, dorsal surface scabridulous, hairs usually seen at upper half, ventral surface scabridulous–puberulent near apex, hyaline–pale greenish, 2-nerved. *Lower palea* narrowly ovate, *ca.* 2.5 × 0.8–1 mm, margins entire or sparsely ciliolate, infolded and keeled, keel winged at lower half or lower 2/3rd, keel scabridulous at upper half, apex obtuse or minutely lobed, membranous, dorsal surface scabridulous–puberulent, hairs seen at upper half, ventral surface glabrous or puberulent near apex, hyaline, 2-nerved. *Upper lemma* narrowly ovate, 3–3.2 × 1–1.2 mm, cymbiform or folded, margins inflexed at lower 1/3rd, infolded and minutely ciliolate at upper 2/3rd, apex acute–acuminate, membranous, dorsal surface scabridulous towards upper half, ventral surface glabrous or puberulent near apex, hyaline, 3-nerved. *Upper palea* narrowly ovate, 2–2.2 × 0.6–0.8 mm, cymbiform, margins scabridulous or very minutely ciliolate, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex acute–acuminate, sometimes very minutely lobed, membranous, dorsal surface scabridulous–puberulent, hairs usually seen towards upper half and on infolded or inflexed portions of margins, ventral surface glabrous, hyaline, 2-nerved. *Caryopsis* ovoid–ellipsoid, 1.5–2 × 0.4–0.6 mm, brownish, style persistent or not.

Notes: Both reduced spikelet with only lower glume as well as well-developed pedicelled spikelets are seen. The pedicels seen in reduced pedicelled spikelets are longer than that of 'well-developed pedicelled spikelets'.

Ravi *et al.* (1998) described *Ischaemum pappinisseriensis* without citing any closely allied species. Shallowly rugose or shallowly interconnected side nodules are prevalent in the lower glume of sessile spikelets in *I. pappinisseriensis*. However, the sharply jointed or rugose upper side nodules are also common in this taxon.

Apart from this, some spikelets with sharply rugose or with all side-nodules sharply jointed are also observed in the same racemes. Moreover, the pedicel length of the pedicelled spikelets is also varies with respect to the varying reduced and well developed pedicelled spikelets. The present study showed that there are no considerable differences between *I. pappinisseriensis* and *I. rugosum* to treat them as to two distinct species. Both reduced pedicelled spikelets and developed pedicelled spikelets are seen in both the cases. Hence, *I. pappinisseriensis* is treated here under the synonymy of *I. rugosum*.

Flowering & Fruiting: October to February.

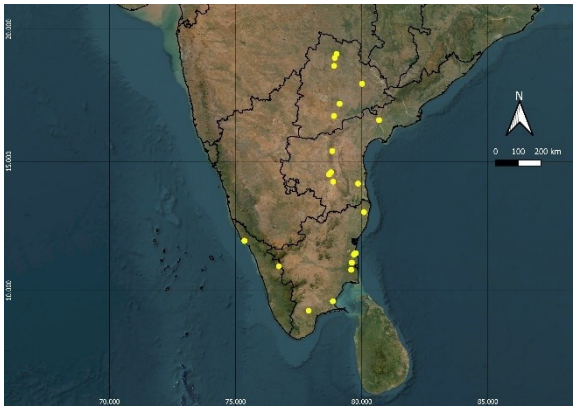

Fig. 74. Distribution of *Ischaemum rugosum* Salisb. in southern Peninsular India

Distribution: Tropical Africa, Tropical & Subtropical Asia to W. Pacific. In India, it is distributed in Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Delhi, Dadra and Nagar Haveli, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh and West Bengal.

Habitat: Bunds and margins of paddy fields, sandy soil in the banks of rivers.

Specimens examined: INDIA, **Andhra Pradesh**, Kadapa district, Ramireddy Kottalu, on the way to Narasareddy Palli, 30.12.2019, *V. Drisya* 169502; Sivalapalli, 31.12.2019, *V. Drisya* 169507 (CALI); Krishna district, Nunna, 05.02.1986, *P. Venkanna* 5918 (MH); Kurnool district, way to Diguvametta, 24.10.1964, *J.L. Ellis* 22160 (MH); Nellore district, Gudur, 03.02.1929, *K. Cherian Jacob* 18531 (CAL & MH); Visakhapatnam district, Palkonda R.F., 18.12.1923, *K.C. Jacob* 17260 (MH). **Kerala**, Kannur district, Pappinisseri, 12.12.1997, *N. Ravi* 37076 (CAL & TBGT); *Ibid.*, near Vallapatanam bridge, 16.12.2019, *V. Drisya* 169541 [CALI184999,

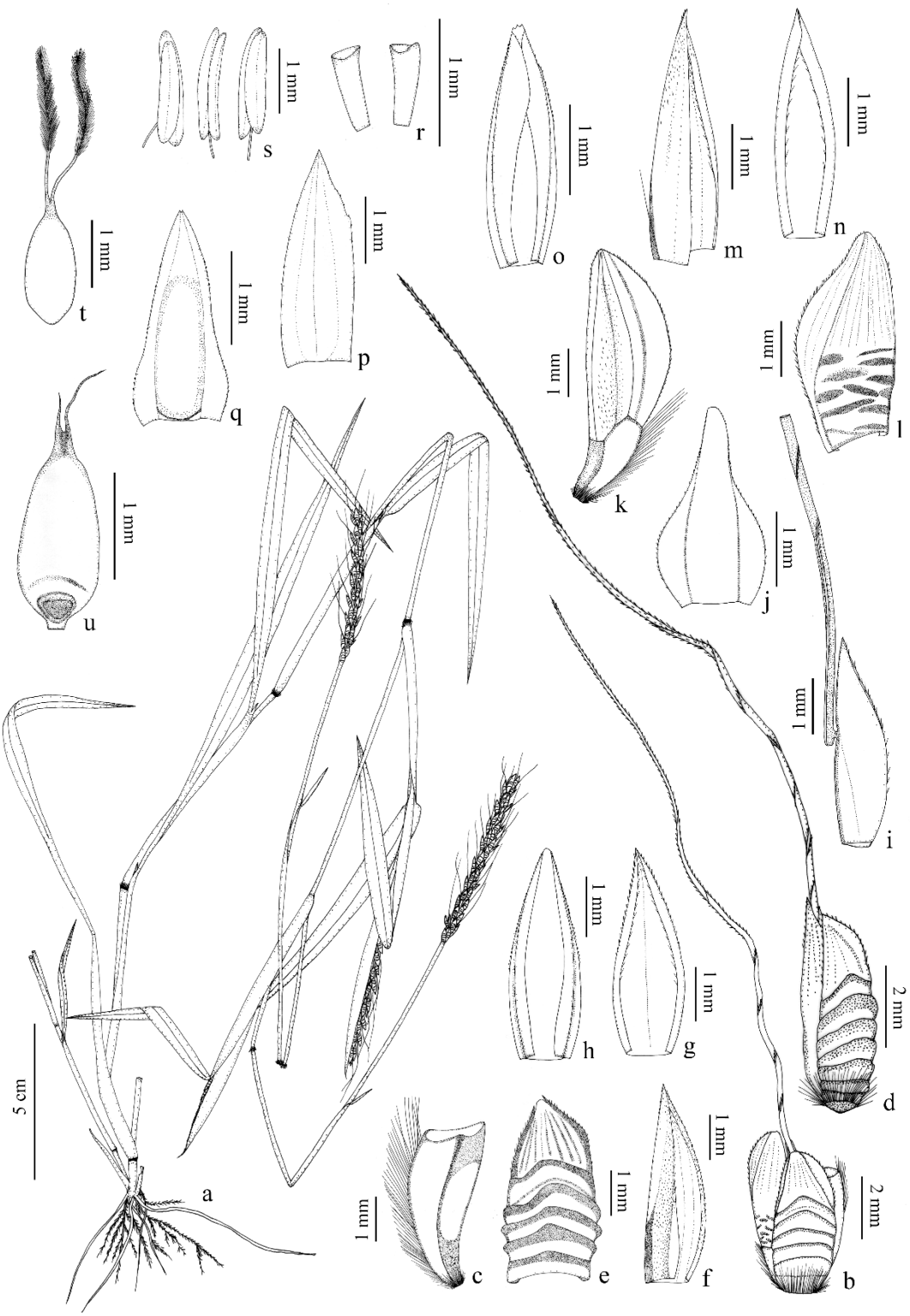

Fig. 75. *Ischaemum rugosum* Salisb.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium; **u.** Caryopsis (from *V. Drisya* 169502, drawn by V. Drisya).

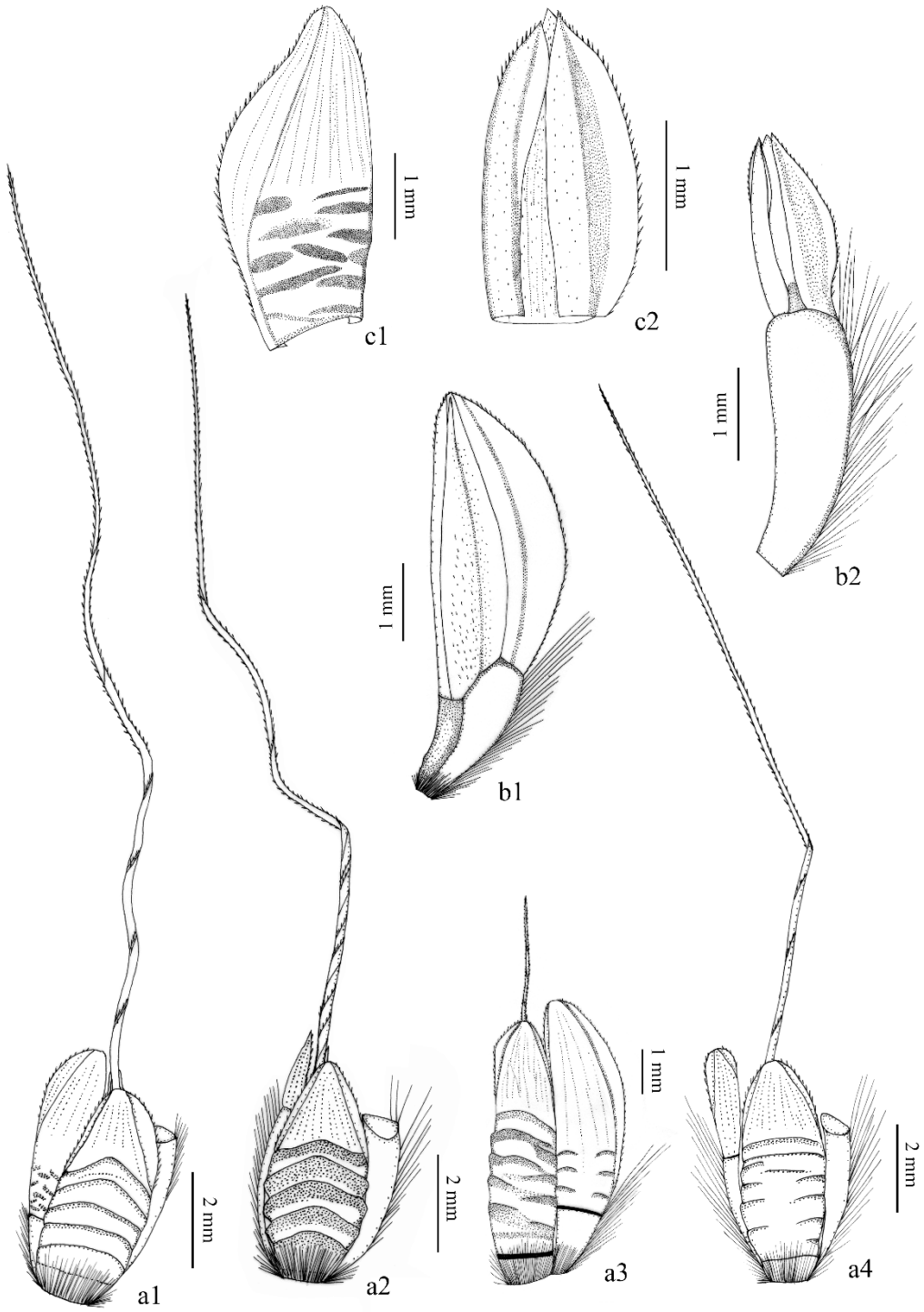

Fig. 76. *Ischaemum rugosum* Salisb.: **al, a2, a3 & a4.** Spikelet pairs showing variation in pedicelled spikelet, pedicel length of pedicelled spikelet and ornamentation in lower glumes; **b1 & b2.** Pedicelled spikelet showing variation (**b1:** well-developed pedicelled spikelet; **b2:** reduced pedicelled spikelet); **c1 & c2.** Lower glume of pedicelled spikelet showing variation in apex (**a1, b1, c1, a2, b2 & c2:** from *V. Drisya* 169502; **a1, b1 & c1** belongs to one and the same spikelet pair whereas **a2, b2 & c2** belongs to another; **a3 & a4:** from *V. Drisya* 169541, drawn by V. Drisya).

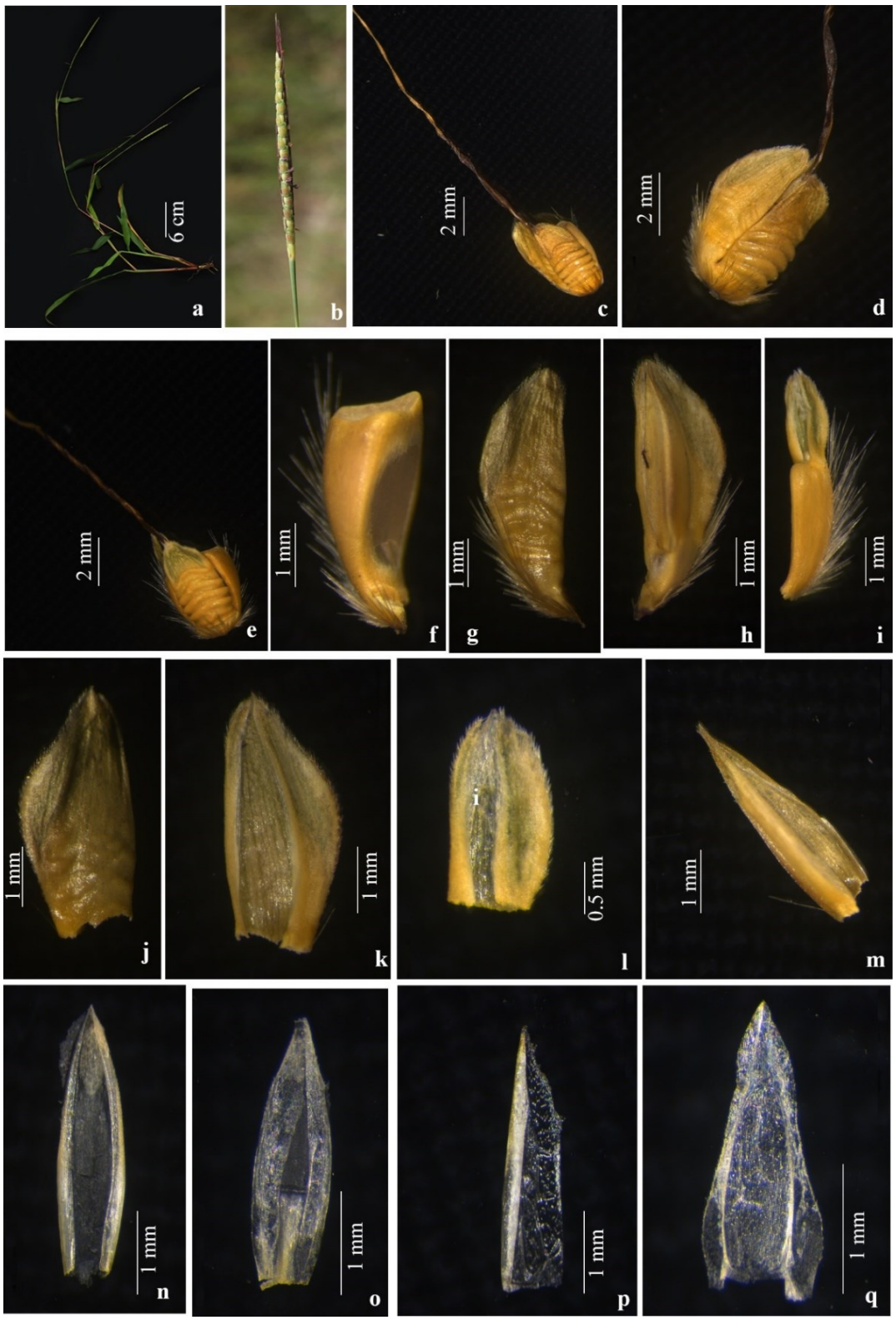

Fig. 77. *Ischaemum rugosum* Salisb.: **a.** Habit; **b.** Raceme; **c & d.** Spikelet pair with developed pedicelled spikelet; **e.** Spikelet pair with reduced pedicelled spikelet; **f.** Rachis internode; **g & h.** Pedicelled spikelet (**g:** dorsal view; **h:** ventral view); **i.** Reduced pedicelled spikelet; **j & k.** Lower glume (**j:** dorsal view; **k:** ventral view); **l.** Lower glume of reduced pedicelled spikelet; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**g–n:** Pedicelled spikelet).

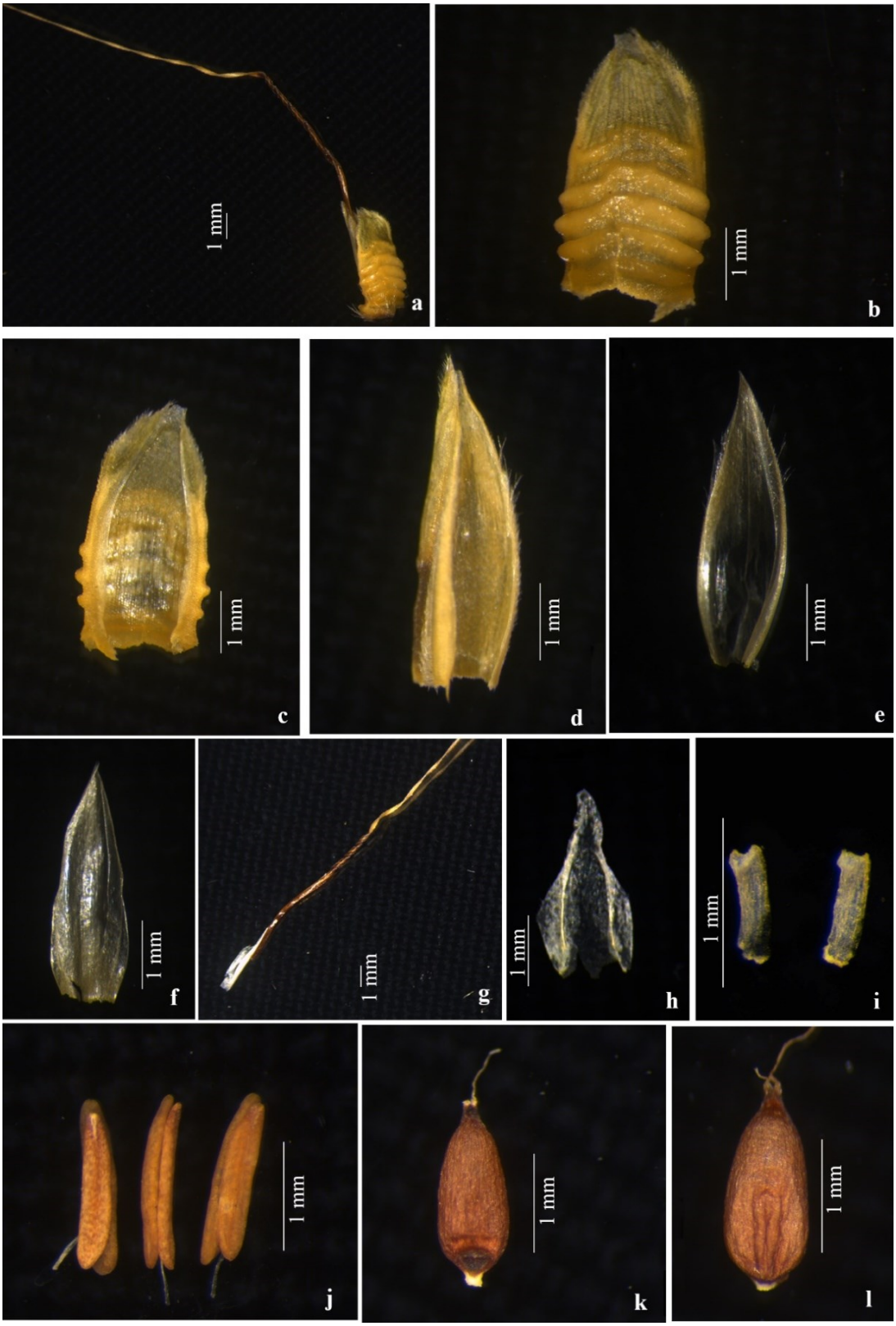

Fig. 78. *Ischaemum rugosum* Salisb.: **a.** Sessile spikelet; **b.** Lower glume-dorsal view; **c.** Lower glume-ventral view; **d.** Upper glume; **e.** Lower lemma; **f.** Lower palea; **g.** Upper lemma; **h.** Upper palea (**a–h:** Sessile spikelet); **i.** Lodicules; **j.** Stamens; **k.** Caryopsis-dorsal view; **l.** Caryopsis-ventral view.

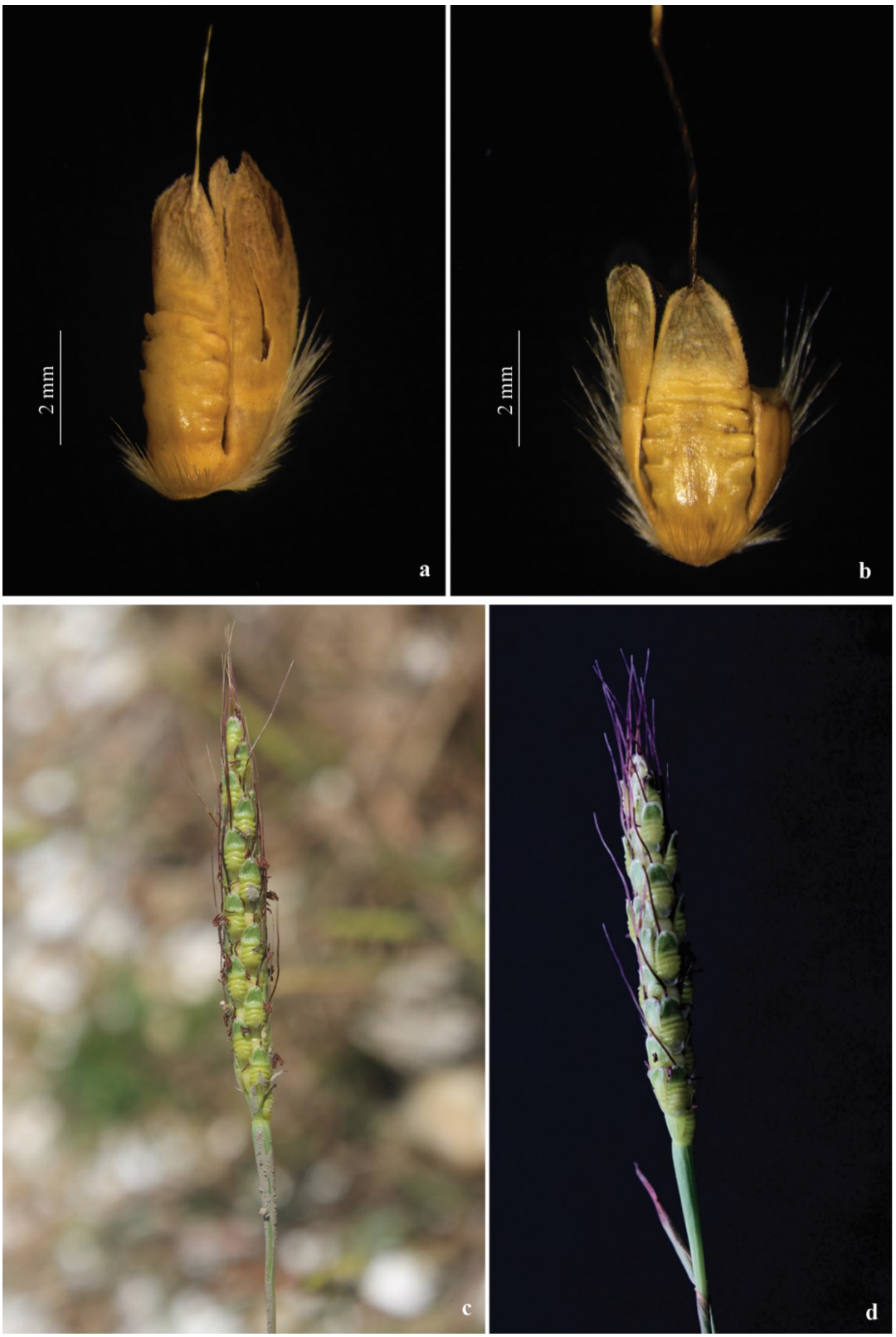

Fig. 79. *Ischaemum rugosum* Salisb. showing variation: **a & b.** Spikelet pair with partially rugose sessile spikelet (**a:** with developed pedicelled spikelet; **b:** with reduced pedicelled spikelet); **c & d.** Different racemes showing variation in rugose nature in lower glume of sessile spikelet.

CALI185000, CALI185001, CALI185002, CALI185003, CALI185004, CALI185005, CALI185006, CALI185007, CALI185008, CALI185009, CALI185010, CALI185011 & CALI185012] (CALI); **Tamil Nadu**, Coimbatore district, Shiruvani, 28.12.1956, *K. Subramanyam* 1839 (MH); Cuddalore district, Chidambaram, 01.02.1958, *K.M. Sebastine* 5269 (MH); Kille, Anuvampattu, 28.01.1979, *N. Venugopal* 21358; 4 km from Chidambaram towards Kille, 04.02.2000, *K.M. Matthew* 71192 (RHT); Madurai district, Ring road, Madurai, 13.02.2002, *K. Althaf Ahamed Kabeer* 113246 (MH); Ramanathapuram district, Sozhandur, 26.02.1988, *V. Balasubramaniam* 1688 (MH); Thanjavur district, Aduthurai to Mayuram, 28.01.1978, *K. Ramamurthy* 53653; Mannakkal, 09.01.1989, *S. Ragupathy* 939 (CAL); Virudhunagar district, Thotiluvampatti, Sathur, 29.01.2003, *K. Althaf Ahamed Kabeer* 116129 (MH). **Telangana**, Karimnagar district, Kodimial, 19.12.1964, *G.V. Subbarao* 21851; Rechapalli, 23.12.1964, *G.V. Subbarao* 22277 (MH); Mancherial district, Indhanpalli Range, Narlapur-Beat, Kawal Tiger Reserve, 26.10.2013, *P.S. Annamma* 003924 (BSID); Nalgonda district, Sleabelli Konda, Peddagattu, 23.08.2011, *A. Baleshwar Reddy* 005031; Jairam Konda, Sherepally, 15.10.2012, *A. Baleshwar Reddy* 001312 (BSID); Warangal district, Pakhal R.F., 28.11.1960, *K.M. Sebastine* 11663 (MH).

14. Ischaemum semisagittatum Roxb., Fl. Ind. 1: 321. 1820; Hook.f., Fl. Brit. India 7: 130. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 185. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 123. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 233. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 160. 1991; S.Moulik, Grasses Bamboos India 2: 297. 1997; Pull., Fl. Andhra Pradesh 3: 1212. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 430. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 822. 2008; Srivastava & V.J.Nair, Nelumbo 52: 88. 2010; Potdar *et al.*, Grasses Maharashtra 199. 2012; Pull., Fl. Telangana 3: 1139. 2015. *Lectotype* (designated here): Roxb. No. 1780 (Icones Roxburghianae).

Ischaemum conjugatum Roxb., Fl. Ind. 1: 323. 1820. *Lectotype* (designated here): Roxb. No. 1940 (Icones Roxburghianae).

Ischaemum semisagittatum var. *glabrescens* Hook.f., Fl. Brit. India 7: 131. 1897. *Type*:—— INDIA. Sheet not traceable.

Ischaemum dalzellii Stapf ex Bor, Kew Bull. 6(3): 448. 1951, *syn. nov. Type*:—— INDIA, Bombay, Yellapur, 25.10.1884, *W.A. Talbot* 738 (holo: K [K000245691 digital image!]; iso: CAL [CAL0000002280!]).

Ischaemum ritchiei Stapf ex Bor, Kew Bull. 6(3): 449. 1951, *syn. nov. Type*:—— INDIA, Bombay, Kanara, *D. Ritchie s.n.* (K [K000245692 digital image!]).

Ischaemum tumidum Stapf ex Bor, Kew Bull. 6(3): 450. 1951, *syn. nov. Type*:—— INDIA, Madras, Concan, *J.E. Stocks s.n.* (K [K000245693 digital image!]).

Ischaemum calicutensis Sreek., V.J.Nair & N.C.Nair, J. Econ. Taxon. Bot. 4(3): 1007. 1983, *syn. nov. Ischaemum tumidum* var. *calicutensis* (Sreek., V.J.Nair & N.C.Nair) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 826. 2008.

Type:——INDIA, **Kerala**, Kozhikode (Calicut) district, Pokkunnumala [Pokkunnamalai], near Nanminda, ± 850 m, 29.10.1981, *P.V. Sreekumar* 71803 (holo: CAL [CAL0000002275!]; iso: K [K000245753 digital image!], MH [MH00001622!]).

Ischaemum malabaricum Sreek., V.J.Nair & N.C.Nair, Kew Bull. 39(4): 743. 1984, *syn. nov. Type*:—— INDIA, **Kerala**, Kannur (Cannanore) district, Paramba ± 150 m, 16.10. 1981, *P.V. Sreekumar* 71720 (holo: CAL [CAL0000007133!]; iso: K [K000245753 digital image!], MH [*n.v.*]).

Ischaemum copeanum Sreek., V.J.Nair & N.C.Nair, J. Bombay Nat. Hist. Soc. 82(2): 390. 1985, *syn. nov. Type*:—— INDIA, **Kerala**, Kannur (Cannanore) district, Cherkala, 24.11.1981, *P.V. Sreekumar* 71838 (holo: CAL [CAL0000002271!]; iso: K [K000245752 digital image!], MH [*n.v.*]).

Ischaemum keralensis Sreek., V.J.Nair & N.C.Nair, Bull. Mus. Natl. Hist. Nat., B, Adansonia Ser. 4, 7(2): 135. 1985, *syn. nov. Ischaemum burmanicum* var. *keralensis* (Sreek., V.J.Nair & N.C.Nair) R.Kr.Singh & P.S.N.Rao, J. Econ. Taxon. Bot. 32(4): 805. 2008. *Type*:—— INDIA, **Kerala**, Kannur (Cannanore) district, Cherkala, 24.11.1981, *P.V. Sreekumar* 71839 (holo: CAL [CAL0000002273!]; iso: K [K000245753 digital image!], MH [MH00001589!]).

Ischaemum raui Sreek., V.J.Nair & N.C.Nair in P.V.Sreekumar & V.J.Nair, Fl. Kerala - Grasses 459, 157. 1991, *syn. nov. Type*:—— INDIA, **Kerala**, Kasaragod

District [Cannanore district], Mugu road, 17.10.1981, *P.V. Sreekumar* 71747 (holo: CAL [*n.v.*]; iso: K [K002383665 digital image!], MH [*n.v.*]).

Ischaemum lanatum Ravi, N.Mohanan & Shaju, Rheedea 10(2): 91. 2000. *Type*: INDIA, **Kerala**, Kasaragod district, Hosdurg taluk, Periya, 29.11.1999, *Ravi* 41535 (holo: TBGT!; iso: CAL [*n.v.*], K [K000308182 digital image!], KFRI [*n.v.*], MH [*n.v.*], TBGT [*n.v.*]).

Figs. 80–87

Annuals, culms creeping or geniculately ascending or tufted, rooting from lower nodes or not; *upper nodes* villous, *lower nodes* glabrous or hairy; *internode* 3–8 cm long, terete–subterete with a ventral depression or with a shallow groove, glabrous, greenish. *Leaves* sessile or shortly petioled; *leaf sheath* 1–9 cm long, dorsally keeled, margins entire, chartaceous, dorsal surface densely or sparsely tubercle-based hairy or scabrous, ventral surface glabrous, greenish; *leaf blade* ovate–narrowly ovate or triangular, 1–11 × 0.4–2 cm, base cordate, margins scabridulous, apex acuminate, chartaceous, abaxial surface tubercle-based hairy, adaxial surface tubercle-based hairy or glabrous, hairs prominently seen in lower leaves, greenish, tubercle-based hairs soft. *Lower leaves* sessile or pseudopetiolate, blade upto 21 cm long, base sagittate–semisagittate. *Ligule* ovate, 0.5–3 mm long, membranous, glabrous or dorsally sparsely scabrous towards lateral margins near base, brownish. *Petiole ca.* 3 mm long, sparsely scabrous, hairs may dehisce when dry, greenish.

Fig. 80. Lectotype of *Ischaemum semisagittatum* Roxb. Drawing in Icones Roxburghianae no. 1780 (K) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

Racemes usually 2 rarely 1 or 3, separate, sometimes adpressed together or solitary, 2–7 cm long, sparsely–densely hairy, hairs pale yellowish or hyaline. *Spathe* leafy with reduced lamina. *Peduncle* corrugated, 8–12 cm long, densely scabridulous near apex (at upper 1/3rd or at upper 1/4th), greenish. *Rachis internode* clavate–turbinate, 2.5–6.5 × 0.6–2.5 mm, dorsiventrally compressed, swollen or not, coriaceous–crustaceous, or chartaceous, ventral surface membranous, dorsal surface, lateral margins and apical margins densely long pilose, yellowish green with or without purple shade, hairs hyaline or pale yellowish. *Spikelets* usually paired, sometimes lowest group of spikelets in three. *Sessile spikelet* bisexual, awned, narrowly ovate or narrowly elliptic, 3.5–8 × 1–1.5 mm, more or less pilose, yellowish green; callus hollow, densely pilose, hairs pale yellowish. *Lower glume* narrowly ovate, 3–8 × 1–2.2 mm, margins entire, inflexed or infolded, laterally narrowly keeled near apex, apex acute–obtuse, crustaceous–coriaceous or chartaceous, laterally side noduled or not, sometimes nodules interconnected by deep or shallow ridges, dorsal surface densely pilose–sparsely pilose, scabrous–scabridulous towards margins, ventral surface scabridulous, yellowish green, hairs hyaline–pale yellowish, 9–16-nerved. *Upper glume* narrowly ovate, 3.5–6.5 × 1.5–2 mm, folded or cymbiform, margins inflexed at lower 1/3rd, inflexed or infolded and ciliate at upper 2/3rd, apex acuminate, chartaceous–subcoriaceous, tip membranous, dorsal surface surface densely scabrous–scabridulous, dorsally keeled, keel broad and entire at lower 1/3rd, scabridulous and long pilose at upper 2/3rd, ventral surface scabridulous, hairs seen at upper half or at upper 2/3rd, yellowish green, 3–7-nerved, midnerve prominent. *Lower lemma* narrowly ovate, 3.5–6 × 0.7–1.5 mm, margins inflexed at lower half or lower 2/3rd, infolded at upper half or upper 1/3rd, sparsely ciliate and hairs seen towards middle, infolded margins shallowly keeled towards apex, keel scabridulous, apex acute–acuminate, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, 3–5-nerved. *Lower palea* narrowly ovate, 3–5.5 × 0.7–1.5 mm, margins entire, infolded, laterally keeled throughout, apex acute–obtuse or muticous, membranous–chartaceous, dorsal surface scabridulous throughout and long scabrous towards base (at lower 1/4th or at lower 1/3rd), ventral surface glabrous, hyaline–pale greenish, 2-nerved; keel broad at lower 1/3rd or at lower half,

scabridulous and long pilose at lower 1/4th towards middle. *Upper lemma* narrowly ovate, 2.5–5 × 0.7–1.4 mm, cymbiform, margins entire, inflexed or infolded, apex bilobed, awned from the sinus, membranous, dorsally shallowly folded, dorsal surface puberulent, ventral surface glabrous, hyaline, 3-nerved, nerves jointed at the base of awn, midnerve prominent; *awn* geniculate, 10–25 mm long; column twisted, 4–10 mm long, scabridulous along spirals, dark brownish; bristle 6–15 mm long, scabridulous on margins, pale brownish. *Upper palea* narrowly ovate, 2–4.5 × 0.5–1 mm, margins inflexed or infolded, scabridulous at upper half, apex acute–acuminate, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.4–0.6 × 0.2–0.3 mm, hyaline. *Stamens* 3; anthers 2–3.5 mm long, yellowish. *Ovary* narrowly ovate, 0.5–1 × 0.2–0.4 mm, pale yellowish or pale brownish; *style* 2, 1–2.5 mm long, hyaline; *stigma* 2, plumose, 1.5–3.5 mm long, purplish. *Pedicelled spikelet* bisexual, usually not prominently awned with reduced arista or awn but sometimes awn little developed and seen out of the spikelet, narrowly ovate or narrowly elliptic, 3.5–6.5 × 0.8–1.5 mm, more or less pilose, yellowish green; callus densely pilose, hairs pale yellowish. *Pedicel* clavate, 0.5–2.5 × 0.8–1 mm, hollow, swollen, coriaceous–crustaceous, sometimes chartaceous, dorsally densely pilose, yellowish green with or without purple shade, similar to rachis internode. *Lower glume* narrowly ovate, 3.5–6.5 × 0.7–2 mm, margins entire, inflexed, laterally keeled near apex, keel scabrous–scabridulous, laterally side noduled or not, apex acute–acuminate, coriaceous–crustaceous or chartaceous, dorsal surface densely long pilose, hairs pale yellowish or hyaline, ventral surface scabridulous, hairs seen at upper half or at upper 2/3rd, greenish, 7–16-nerevd, nerves sometime faint. *Upper glume* narrowly ovate, 3.5–6 × 1–2 mm, cymbiform, margins inflexed at lower 1/3rd, inflexed or infolded at upper 2/3rd, ciliate at upper 2/3rd or at upper half, infolded margins shallowly keeled near apex, apex acuminate, chartaceous– coriaceous, dorsal surface densely scabridulous, scabrous and long pilose, dorsally shallowly keeled near apex, ventral surface scabridulous at upper half or at upper 2/3rd, greenish, keel scabridulous, 5–9-nerved, sometimes some nerves are faint. *Lower lemma* narrowly ovate, 3–5.5 × 0.7–1 mm, margins inflexed at lower half, infolded at upper half, ciliate at middle towards upper half, laterally

shallowly keeled near apex, keel scabridulous, apex acute or obtuse, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline with pale green shade, 3–5-nerved. *Lower palea* oblong, 3–4.5 × 0.5–1 mm, margins entire, infolded, laterally keeled, keel narrowly winged or broad at lower half or at lower 2/3rd, keel or wing margin scabridulous at upper 2/3rd or at upper half, apex acute, membranous–subcoriaceous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline with pale green tinge, 2-nerved. *Upper lemma* narrowly ovate, 2.5–4.7 × 0.7–1.5 mm, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex acute–acuminate or shortly bifid with a central reduced arista or awn, sometimes awn developed and seen outside of spikelet, membranous, dorsal surface scabridulous–puberulent, scabridulous hairs seen near apex, ventral surface glabrous, hyaline, 3-nerved, midnerve prominent, lateral nerves seen towards apex; *awn* 0.1–18 mm long; *coulumn* upto 6 mm long. *Upper palea* narrowly ovate, 2–4 × 0.5–0.8 mm, margins inflexed or infolded, scabridulous at upper 2/3rd, apex acute–obtuse or notched, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline, 2-nerved. *Caryopsis* ellipsoid, 1.5–2 × 0.4–0.8 mm, brownish, with persistent style base.

Notes: An examination of large number of specimens including the types and protologues of many recently described taxa (Bor, 1951b; Sreekumar *et al.*, 1983, 1984, 1985a, 1985b; Sreekumar & Nair, 1991; Ravi *et al.*, 2000b) revealed *Ischaemum semisagittatum* as a highly polymorphic taxon. A number of specimens from each of the populations were also examined to understand the variability. Pedicelled spikelets having pedicel less than or equal to the 1/3rd the length of the sessile spikelet as well as more than 1/3rd the length of sessile spikelet were seen among the plants of same population. The indumentum on spikelets also shows variations, they are sometimes densely hairy or sparsely hairy or almost glabrous. Spikelets in the single raceme shows variation in pubescence, sparsely hairy lower spikelets are common when the upper ones densely hairy, sometimes all are densely hairy. Racemes with all spikelet pairs (ie, the lower glume of all sessile spikelets) having interconnected side nodules, all spikelet pairs having no side nodules as well as racemes with only basal spikelets pairs having interconnected or non-

interconnected side nodules when upper spikelet pairs having no side nodules are observed within plants of same population. The rachis internode shows variation in shape (linear to clavate or turbinate) as well as in the indumentum pattern. In some cases the rachis internode is hairy on dorsal surface, apical margins and along lateral margins whereas in other cases it is hairy along three margins or angles only. It is also noted that in some cases the lateral margins densely hairy with dorsal surface sparsely hairy and shallowly angled. Another type of rachis internode seen has hairs only at lateral margins or angles and at apices. Apart from this the upper lemma of pedicelled spikelet may have very minute awn initial or may have short awn/arista (0.1–0.2 mm long) or may have comparatively short awn (0.5–0.8 mm long) or comparatively long awn (3.5 mm also seen) were also observed within a single population from Calicut University campus. In all these cases the upper lemma of pedicelled spikelet is seen as notched or minutely bifid at apex. Moreover, authors could collect plants with awned pedicelled spikelets as well as plants with unawned pedicelled spikelets from Pokkunnumala, the type locality of *I. calicutensis*. The plants from Pokkunnumala also exhibited awn variation (upto 18 mm long) within plants of same population as well as within the spikelets of single raceme. These awn or awn initial variation is seen in previously described taxa (*I. malabaricum, I. lanatum, I. tumidum* & *I. calicutensis*). This awn size varies within plants of the same population as well as within the racemes of single plant. Moreover, it is also observed that the awn size variation within the spikelets of a single raceme (comparatively long awned spikelets or those spikelets with awns seen towards outside is mainly observed at the middle of the raceme and while going towards apices the size of the awn is reduced or may not be able to seen out of the spikelets). Another type of variation observed was the presence of awned as well as unawned lower most spikelet pair (both sessile and pedicelled spikelets) when all other above spikelets (mainly sessile spikelets) are awned. Apart from this the lowermost spikelet pair varies with their indumentum, side nodules (in number, presence or absence as well as they are interconnected or not) and awn character (present or absent or reduced). Plants with lower most spikelets as triads are rarely seen. Racemes with lower most spikelets as pairs as well as lower most spikelets as triads

are observed within same plants. So the number of lower most spikelets is not considered here as a reliable character since it shows variation within the racemes of same plants as well as within the plants of same population. The racemes are usually binate in all above cases but solitary racemed plants are also seen in the same habitat or in same population. Moreover, several intermediate forms having different combinations of above-mentioned characters are available and all are growing in same populations or same habitats. The indumentum pattern on nodes, spikelets and rachis internode; characters of basal leaves such as base and pseudopetiole; length of pedicel; shape of rachis internode; texture and ornamentation of glumes; size and occurrence of awn as well as size of anthers were usually used to segregate *I. calicutensis, I. copeanum, I. dalzellii, I. keralensis, I. lanatum, I. malabaricum, I. raui, I. ritchiei, I. semisagittatum* and *I. tumidum*. But the present study revealed that the characters of above taxa are overlapping and most of them clearly shows continuous variation. Though the continuous variations are available within the same micro habitat, it can be evidently seen when moving from open areas to shady areas or as moving from low elevation to high elevations. So, it is better to accommodate all these variable forms within a single variable species. Hence, *I. calicutensis, I. copeanum, I. dalzellii, I. keralensis, I. lanatum, I. malabaricum, I. raui, I. ritchiei* and *I. tumidum* are treated here as the synonyms of one variable *I. semisagittatum*.

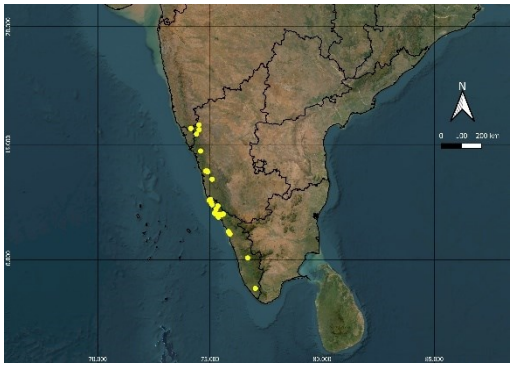

Fig. 81. Distribution of *Ischaemum semisagittatum* Roxb. in southern Peninsular India

Flowering & Fruiting: September to December.

Distribution: Bangladesh, India and Sri Lanka. In India, it is distributed in Andhra Pradesh, Dadra and Nagar Haveli, Daman and Diu, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra Tamil Nadu, Telangana and West Bengal.

Habitat: Lateritic plateaus, ghat sides and hill slopes (more common in lateritic soils).

Specimens examined: INDIA, **Karnataka**, Belagavi [Belgaum] district, Belgaum, *s.d.*, *Ritchie* 872 (CAL); Khanapura [Khanapur], 07.11.2006, *Arun N. Chandore* 156; Sada, 04.11.2006, *Arun N. Chandore* 109 (SUK); Shivamogga district, Agumbe, 08.09.2015, *V. Drisya* 144202; Kodachadri, 08.10.2022, *V. Drisya* 176287; *Ibid.*, 08.10.2022, *V. Drisya* 176288; Udupi district, Kollur, on the way to Souparnikatheertham, 08.10.2022, *V. Drisya* 176297; *Ibid.*, 08.10.2022, *V. Drisya* 176298 (CALI); Meghan Valley, Mookambika WLS, 20.12.2007, *P.G. Diwakar & R.Kr. Singh* 193798; *Ibid.*, 20.12.2007, *P.G. Diwakar & R.Kr. Singh* 193769 (BSI); Uttara Kannada district, Tinai ghat, 08.11.1992, *P.V. Prasanna* 176660; North Kanara, 00.00.1885, *W.A. Talbot* 2328 (BSI). **Kerala**, Kannur district, Chooral, 17.10.2019, *V. Drisya* 170172 (CALI); Ezhimala, 12.12.1996, *N. Ravi* 33735 (TBGT); *Ibid.*, 28.11.2016, *Shinoj & V. Drisya* 176746; Ezhimala Kurisumala, 12.11.2017, *V. Drisya* 157723; *Ibid.*, 12.11.2017, *V. Drisya* 157724; *Ibid.*, 12.11.2017, *V. Drisya* 157725; *Ibid.*, Kunnaru side, 12.11.2017, *V. Drisya* 157720; *Ibid.*, 12.11.2017, *V. Drisya* 157721; *Ibid.*, on the way to Kunnaru, 12.11.2017, *V. Drisya* 157719; Irikkur, Chithrai–Nayattupara road, 30.11.2017, *A.K. Pradeep & V. Drisya* 157753; *Ibid.*, 30.11.2017, *A.K. Pradeep & V. Drisya* 157754; Kannur, Women's College campus, 06.11.2017, *C. Pramod & V. Drisya* 171450; near Nadukani, 19.09.2015, *V. Drisya* 144207; on the way to Madayippara, Pazhayangadi side, 14.11.2018, *V. Drisya* 157872 (CALI); Parassinikadavu, 27.10.1999, *N. Mohanan* 41471 (TBGT); Pazhanjira, near Pappinissery, 30.12.2016, *V. Drisya* 176643 (CALI); Kasaragod district, Chattanchal (Chattamchal), 13.12.1997, *N. Ravi* 36918, *Ibid.*, 13.12.1997, *N. Ravi* 36924 (TBGT); Cherkala, 25.12.2016, *V. Drisya* 176623; *Ibid.*, 25.12.2016, *V. Drisya* 176625; *Ibid.*, 25.12.2016, *V. Drisya* 176627; *Ibid.*, 25.12.2016, *V. Drisya* 176638; *Ibid.*, 02.11.2017, *V. Drisya* 157199; *Ibid.*, 11.11.2018, *V. Drisya* 157848; Iria, 20.09.2015, *V. Drisya* 144210; Koipady, near Kumbla, 11.11.2018, *V. Drisya* 157850; *Ibid.*, 11.11.2018, *V. Drisya* 157851; *Ibid.*, 11.11.2018, *V. Drisya* 157852; *Ibid.*, 11.11.2018, *V. Drisya* 157856; *Ibid.*, 11.11.2018, *V. Drisya* 157857 (CALI); Parampa, 13.12.1997, *N. Ravi* 36913; *Ibid.*, 13.12.1997, *N. Ravi* 36914; Periya, 13.12.1997, *N. Ravi* 36911 (TBGT); *Ibid.*, 25.12.2016, *V. Drisya* 176632; *Ibid.*, 25.12.2016, *V. Drisya* 176633; *Ibid.*,

25.12.2016, *V. Drisya* 176636; *Ibid.*, 25.12.2016, *V. Drisya* 176639; *Ibid.*, 02.11.2017, *V. Drisya* 157190; *Ibid.*, 02.11.2017, *V. Drisya* 157196; *Ibid.*, 02.11.2017, *V. Drisya* 171440; *Ibid.*, 02.11.2017, *V. Drisya* 171441; *Ibid.*, 02.11.2017, *V. Drisya* 171442; *Ibid.*, 02.11.2017, *V. Drisya* 171443; *Ibid.*, 02.11.2017, *V. Drisya* 171444; *Ibid.*, 02.11.2017, *V. Drisya* 171446; *Ibid.*, 11.11.2018, *V. Drisya* I57847; *Ibid.*, 11.11.2018, *V. Drisya* 157855; Puthige, near Seethamgolli, 23.01.2020, *V. Drisya* 169526 (CALI); Kozhikode district, Pokkunnumala, near Nanminda, 29.10.1981, *P.V. Sreekumar* 71815 (BSID); *Ibid.*, 26.10.2016, *V. Drisya* 150761; *Ibid.*, 26.10.2016, *V. Drisya* 150762; *Ibid.*, 26.10.2016, *V. Drisya* 150764; *Ibid.*, 26.10.2016, *V. Drisya* 150769; *Ibid.*, 26.10.2016, *V. Drisya* 150773; *Ibid.*, 26.10.2016, *V. Drisya* 150775; *Ibid.*, 23.11.2019, *V. Drisya* 176247; *Ibid.*, 23.11.2019, *V. Drisya* 176248; *Ibid.*, 23.11.2019, *V. Drisya* 176249; *Ibid.*, 23.11.2019, *V. Drisya* 176250; *Ibid.*, 23.11.2019, *V. Drisya* 176251; *Ibid.*, 23.11.2019, *V. Drisya* 176252; *Ibid.*, 23.11.2019, *V. Drisya* 176253; *Ibid.*, 23.11.2019, *V. Drisya* 176254; *Ibid.*, 23.11.2019, *V. Drisya* 176255; *Ibid.*, 23.11.2019, *V. Drisya* 176256; *Ibid.*, 23.11.2019, *V. Drisya* 176257; Malappuram district, Calicut University, near NH roadside, 11.11.2017, *V. Drisya* 171435; *Ibid.*, 11.11.2017, *V. Drisya* 171436; *Ibid.*, 11.11.2017, *V. Drisya* 171437; Calicut University Campus, 19.11.2019, *V. Drisya* 176220; *Ibid.*, 19.11.2019, *V. Drisya* 176221; *Ibid.*, 12.12.2020, *V. Drisya* 169562; *Ibid.*, 12.12.2020, *V. Drisya* 169563; *Ibid.*, 12.12.2020, *V. Drisya* 169564; *Ibid.*, C.U. Botanical Garden, 17.11.2019, *V. Drisya* 176214; *Ibid.*, 17.11.2019, *V. Drisya* 176215; *Ibid.*, 17.11.2019, *V. Drisya* 176217; *Ibid.*, 09.12.2020, *V. Drisya* 169530; *Ibid.*, 09.12.2020, *V. Drisya* 169531; *Ibid.*, 09.12.2020, *V. Drisya* 169532; *Ibid.*, 09.12.2020, *V. Drisya* 169533; *Ibid.*, 09.12.2020, *V. Drisya* 169545; *Ibid.*, 10.12.2020, *V. Drisya* 169535; *Ibid.*, 10.12.2020, *V. Drisya* 169536; *Ibid.*, 10.12.2020, *V. Drisya* 169537; *Ibid.*, 10.12.2020, *V. Drisya* 169554; *Ibid.*, 10.12.2020, *V. Drisya* 169555; *Ibid.*, 10.12.2020, *V. Drisya* 169556; *Ibid.*, near pond, 10.12.2020, *V. Drisya* 169534; *Ibid.*, 17.11.2019, *V. Drisya* 176216; *Ibid.*, in front of language block, 24.11.2017, *V. Drisya* 157751; *Ibid.*, near Ladies hostel, 09.12.2017, *V. Drisya* 157759; *Ibid.*, 09.12.2017, *V. Drisya* 157760; *Ibid.*, near

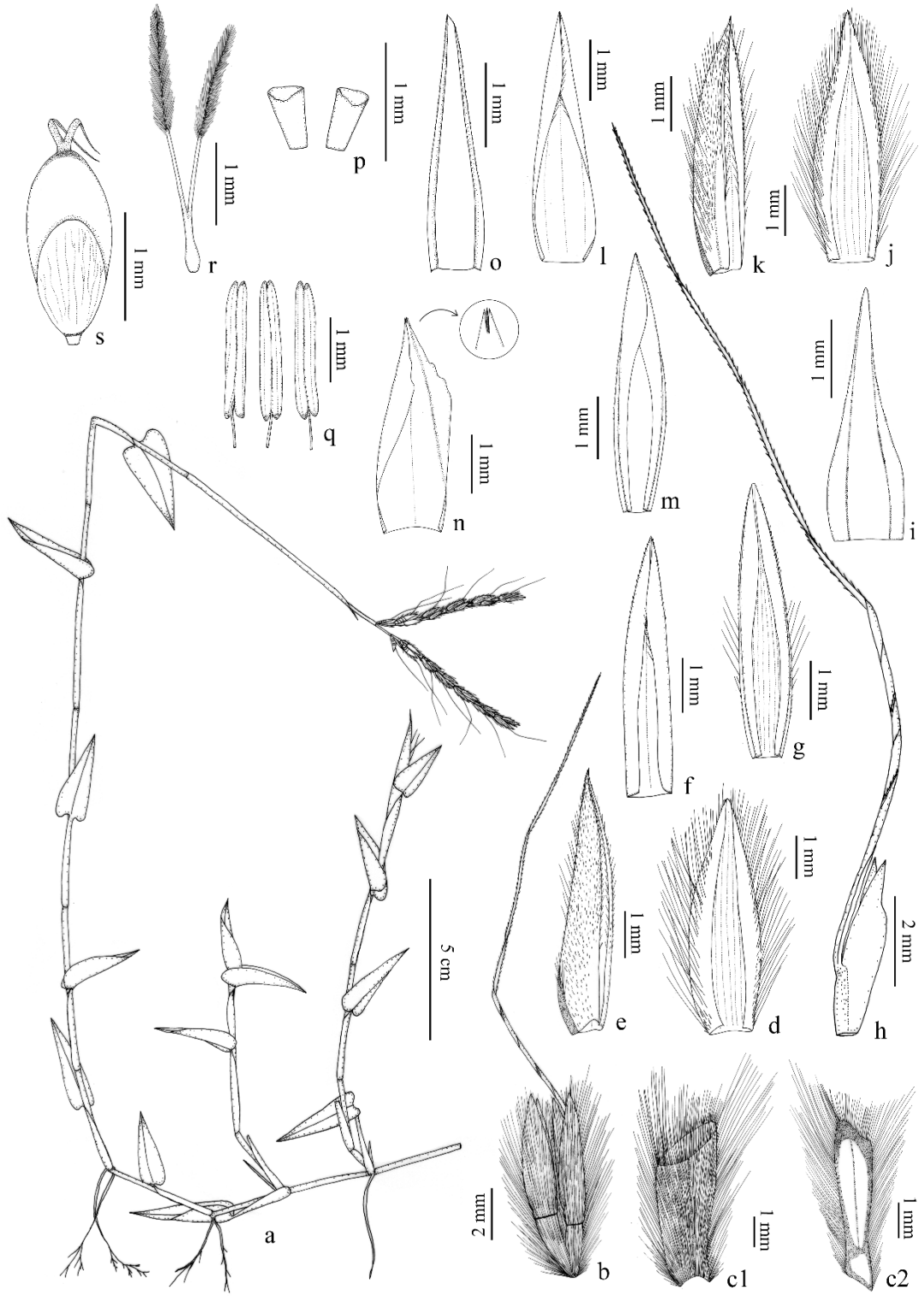

Fig. 82. *Ischaemum semisagittatum* Roxb.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c1.** Rachis internode-dorsal view; **c2.** Rachis internode-ventral view; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**d–i:** Sessile spikelet); **j.** Lower glume; **k.** Upper glume; **l.** Lower lemma; **m.** Lower palea; **n.** Upper lemma; **o.** Upper palea (**j–o:** Pedicelled spikelet); **p.** Lodicules; **q.** Stamens; **r.** Gynoecium; **s.** Caryopsis (from *V. Drisya* 169556, drawn by V. Drisya).

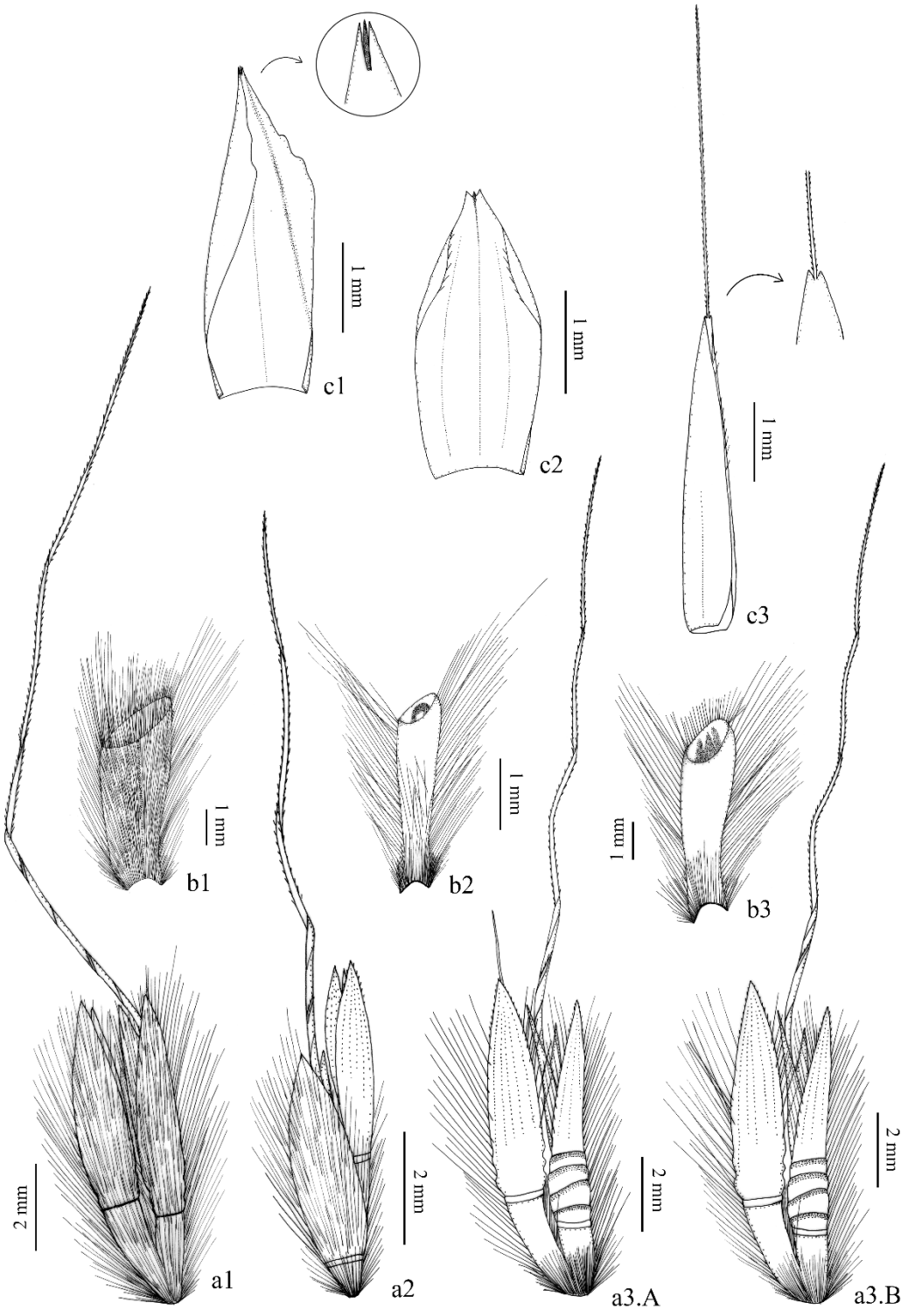

Fig. 83. *Ischaemum semisagittatum* Roxb.: **a1, a2, a3.A & a3.B.** Spikelet pair showing variation; **b1, b2 & b3.** Rachis internode showing variation; **c1, c2 & c3.** Upper lemma of pedicelled spikelet showing variation (**a1, b1 & c1:** from *V. Drisya* 169556; **a2, b2 & c2:** from *V. Drisya* 169531; **a3.A, a3.B, b3 & c3:** from *V. Drisya* 169561, whereas **c3** from **a3.A,** drawn by V. Drisya).

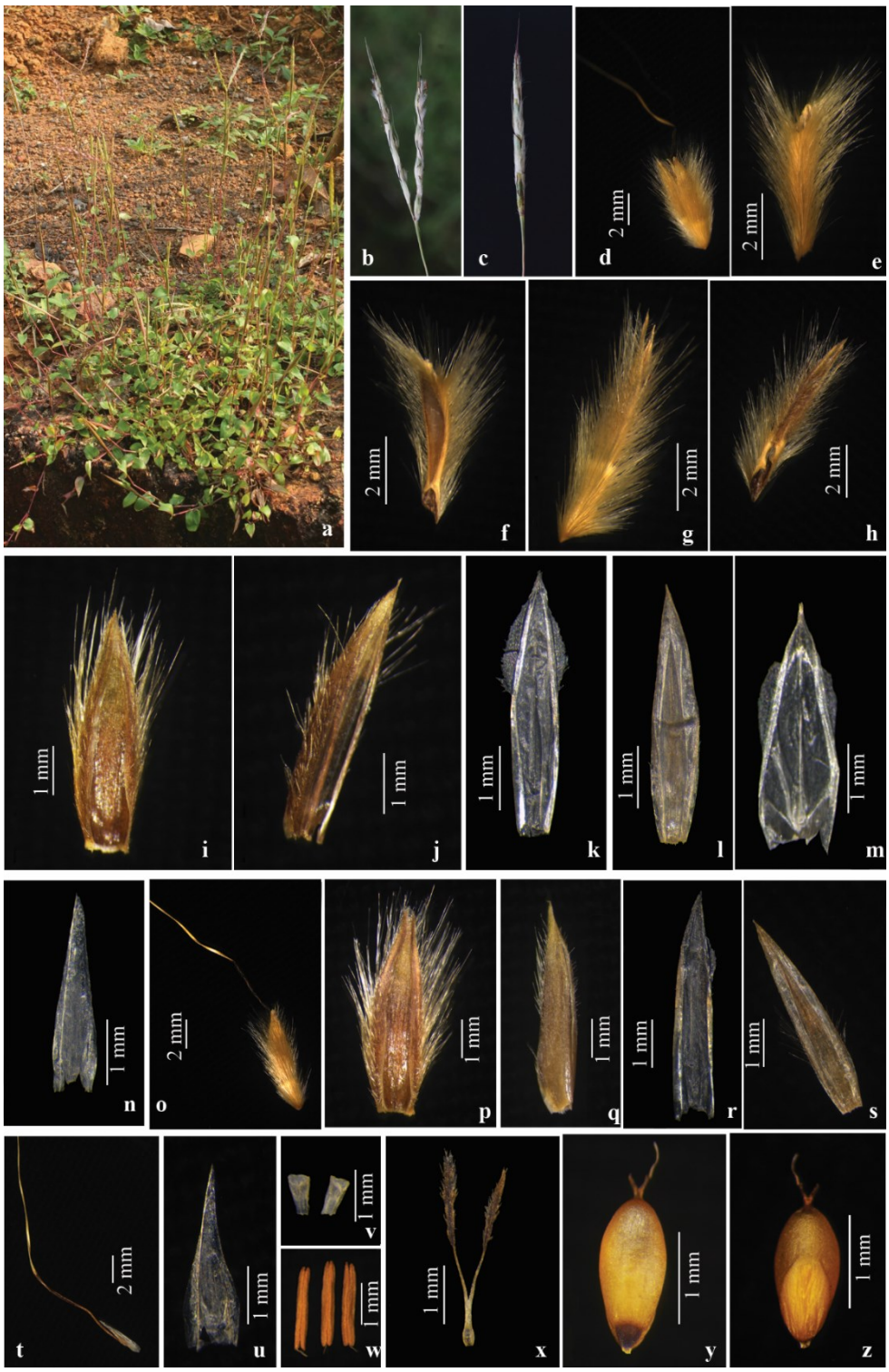

Fig. 84. *Ischaemum semisagittatum* Roxb.: **a.** Habit; **b & c.** Raceme; **d.** Spikelet pair; **e.** Rachis internode-dorsal view; **f.** Rachis internode-ventral view; **g.** Pedicelled spikelet-dorsal view; **h.** Pedicelled spikelet-ventral view; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Lower palea; **m.** Upper lemma; **n.** Upper palea (**g–n:** Pedicelled spikelet); **o.** Sessile spikelet; **p.** Lower glume; **q.** Upper glume; **r.** Lower lemma; **s.** Lower palea; **t.** Upper lemma; **u.** Upper palea (**o–u:** Sessile spikelet); **v.** Lodicules; **w.** Stamens; **x.** Gynoecium; **y.** Caryopsis-dorsal view; **z.** Caryopsis-ventral view.

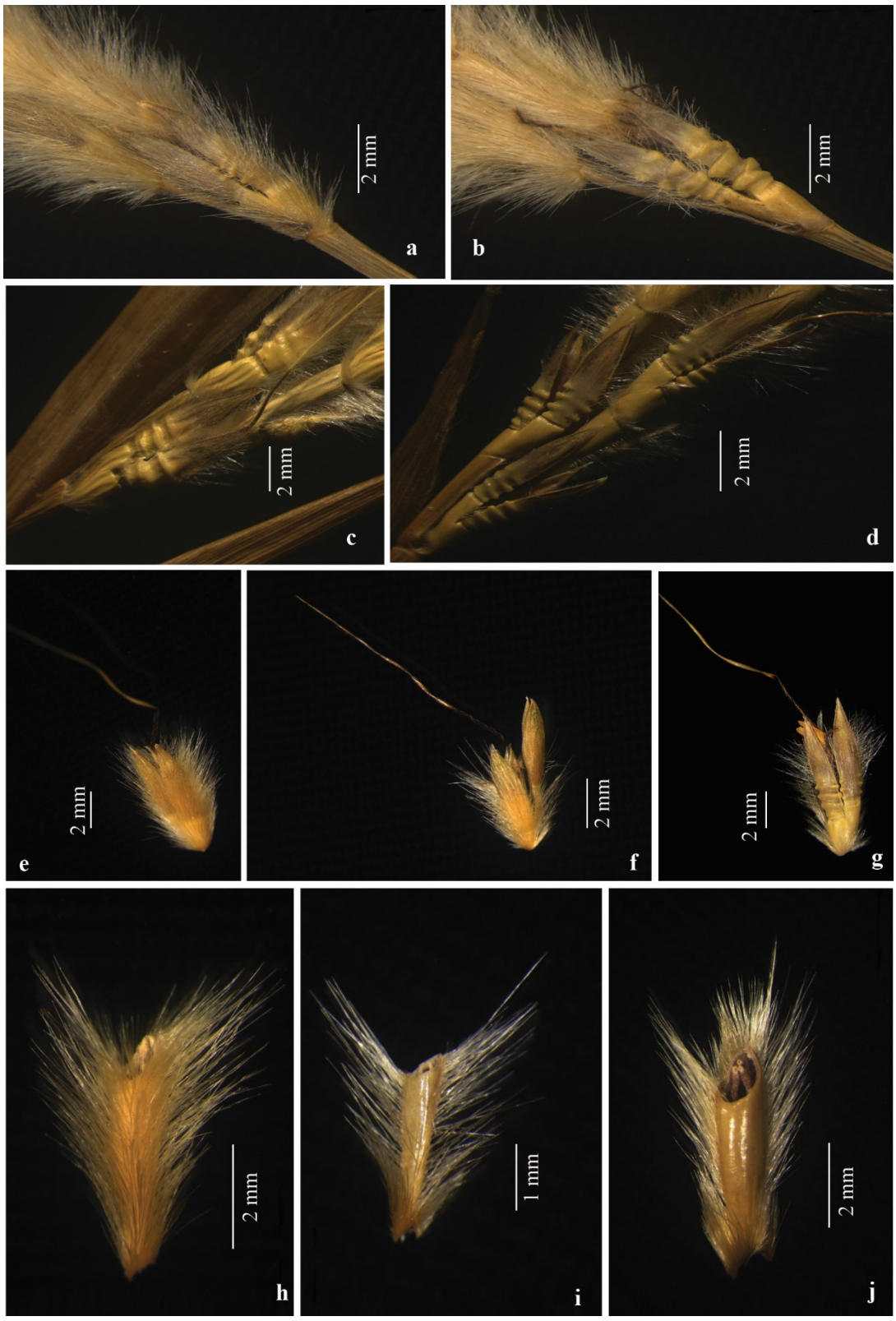

Fig. 85. *Ischaemum semisagittatum* Roxb.: **a–d.** Lowermost spikelet pairs showing variation (**a & b.** showing variation in indumentum; **c & d.** showing variation in awn, **c.** with awned & **d.** with unawned sessile spikelet); **e–g.** Spikelet pairs showing variation in indumentum and relative length of pedicel; **h–j.** Rachis internodes showing variation.

Fig. 86. *Ischaemum semisagittatum* Roxb.: **a.** Spikelet pair with unawned pedicelled spikelet; **b.** Spikelet pair with awned pedicelled spikelet; **c–e.** Spikelet pairs from single raceme showing variation in the awn of pedicelled spikelet (**c:** with unawned pedicelled spikelet; **d:** with intermediately awned pedicelled spikelet; **e:** with prominently awned pedicelled spikelet); **f.** Upper lemma of awned pedicelled spikelet.

Madhava Observatory, 05.09.2015, *V. Drisya* 144283; *Ibid.*, 05.09.2015, *V. Drisya* 144284; *Ibid.*, 26.10.2015, *V. Drisya* 144266; *Ibid.*, 09.10.2016, *V. Drisya* 176765; *Ibid.*, 09.10.2016, *V. Drisya* 176766; *Ibid.*, Olipram Kadavu road side, near Ladies hostel, 02.09.2016, *V. Drisya* 150758; *Ibid.*, 02.09.2016, *V. Drisya* 150759; *Ibid.*, near working women's hostel, 09.12.2017, *V. Drisya* 157761; *Ibid.,* opposite to garden, near to Museum, 12.12.2020, *V. Drisya* 169560; *Ibid.*, 12.12.2020, *V. Drisya* 169561; *Ibid.*, Rock Garden near Botany Department, 14.11.2017, *V. Drisya* 157726; *Ibid.*, 14.11.2017, *V. Drisya* 157727; *Ibid.*, 14.11.2017, *V. Drisya* 157729; *Ibid.*, 14.11.2017, *V. Drisya* 157730; Villunniyal, on the way to Chovva,

28.11.2020, *V. Drisya* 169528; *Ibid.*, 28.11.2020, *V. Drisya* 169529 [CALI184703 & CALI184704] (CALI); Thiruvananthapuram district, TBGRI campus, 24.03.2014, *Rinku J. Desai* 1108 (CAL).

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Kolhapur district, Tillari, 08.01.2017, *V. Drisya* 171427; Tillari Ghat, 08.01.2017, *V. Drisya* 171404; *Ibid.*, 08.01.2017, *V. Drisya* 171408; *Ibid.*, 08.01.2017, *V. Drisya* 171414 (CALI).

Fig. 87. Lectotype of *Ischaemum conjugatum* Roxb. Drawing in Icones Roxburghianae no. 1940 (K) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

Notes on typification: The names *Ischaemum semisagittatum* as well as *I. conjugatum* are appeared first in Hortus Bengalensis (1814). Later, Roxburgh itself validated both the names by providing a description in his *Flora Indica* (1820). While describing *I. semisagittatum*, Roxburgh mentioned that the plant is a native of newly formed pasture land in Bengal. There was no more information available regarding *I. semisagittatum*. We were not able to trace any original materials in various herbaria, since Roxburgh's descriptions in *Flora Indica* was mainly based on live plant materials. However, with the help of Indian artists Roxburgh had been made drawings of more than 2500 sp ecies out of about 2600 species that he had described (Sealy, 1956a, 1956b; Chakrabarty, 2019). Each drawing was made with more than one copy and are currently available at Kew and CAL. Hence, in the absence of original herbarium specimens the illustration of *I. semisagittatum* made by Roxburgh is selected here to serve as the lectotype.

The same is happened in the case of *I. conjugatum*. While describing *I. conjugatum* Roxburgh mentioned it as a 'native of pasture land in the vicinity of Calcutta' as similar to *I. semisagittatum*. Here also, we were not able to find any herbarium specimen originally used by Roxburgh. Hence, the illustration of *I. conjugatum* belonging to *Icones Roxburghianae* (collection of unpublished drawings by Roxburgh) is selected here to serve as the lectotype.

15. Ischaemum timorense Kunth, Revis. Gramin. 1: 369. 1830; Hook.f., Fl. Brit. India 7: 136. 1897, *p.p.*; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 184. 1960, *p.p.*; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 123. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 233. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 164. 1991; S.Moulik, Grasses Bamboos India 2: 297. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 432. 2001, *p.p.*; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 823. 2008, *p.p.*; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 444. 2009; Srivastava & V.J.Nair, Nelumbo 52: 89. 2010; Potdar *et al.*, Grasses Maharashtra 203. 2012. *Type*:—— INDONESIA, Timor, *M. Desfontaines s.n.* (P [P02045276 digital image!]).

Ischaemum timorense var. *zeylanicum* Hack. in A.L.P.P. de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 230. 1889. *Ischaemum zeylanicola* Bor, Grasses Burma, Ceylon, India & Pakistan 186. 1960 (as '*zeylanicolum*'). *Lectotype* (designated by Davidse in Dassanayake, 1994):—— SRI LANKA (CEYLON), *Thwaites* 3168 (lecto: PDA [*n.v.*]; isolecto: P [P02045279 digital image!, P02044738 digital image!], CAL [CAL0000025201!], W [W18890065098 digital image!, W19160035743 digital image!, W18890059605 digital image!], NY [NY00381264 digital image!]).

Ischaemum thomsonianum Stapf ex C.E.C.Fisch. in Gamble, Fl. Madras 3: 1722. 1934. *Lectotype* (first step designated by Bor, 1960; second step designated by Gurappa & Senthil Kumar, 2022):—— INDIA, Mysore & Carnatic, *s.d.*, *G. Thomson s.n.* (lecto: K [K000245702 digital image!]; isolecto: K [K000245701 digital image!], E [E00393557 digital image!]).

Ischaemum flumineum Bor, Kew Bull. 4(4): 572. 1950. *Lectotype* (designated by Bor, 1960):—— INDIA, Bombay, Jog, 28.04. 1939, *N.L. Bor* 11390 (lecto: K [K000245740 digital image!]).

Ischaemum agastyamalayanum Sreek., Janarth. & A.N.Henry, J. Bombay Nat. Hist. Soc. 84(3): 643. 1988. *Type*:—— INDIA, **Kerala**, Trivandrum district, western slopes of Agastyamalai, 06.10.1973, *J. Joseph* 44634 (holo: CAL [CAL0000007132!]; iso: MH [MH001610!, MH001612!]).

Ischaemum murinum sensu Hook.f., Fl. Brit. India 7: 136. 1897 *non* Forst., 1786.

Figs. 88–93

Perennials, tufted, stoloniferous or creeping; *nodes* hairy; *internodes* terete–subterete, 2.5–6 cm long, glabrous, greenish. *Leaves* sessile, sometimes lower leaves petioled; *leaf sheath* folded or keeled, 4–6 cm long, margins entire, dorsal surface tubercle-based hairy near apex, ventral surface glabrous, chartaceous, greenish; *leaf blade* narrowly ovate, 8–10 × 0.8–1 cm, base rounded or attenuate or narrowed, margins scabridulous, apex acuminate, both abaxial and adaxial surface tubercle-based hairy, hairs on abaxial surface more dense, chartaceous, greenish. *Ligule* ovate, 2.5–3.2 mm long, membran ous, glabrous. *Petiole* with narrowed or attenuate leaf bases may or may not be seen in lower leaves, 1.5–2.5 cm long, tubercle-based hairy on both surfaces and longer hairs seen near base. *Racemes* 2, rarely 3, 5–8 cm long, separate, more or less hairy. *Spathe* leafy with reduced lamina. *Peduncle* terete–subterete, 17–19 cm long, glabrous, greenish.

Fig. 88. Type of *Ischaemum timorense* Kunth (*M. Desfontaines s.n.* [P02045276]) © The Board of Trustees of Muséum National d'Histoire Naturelle, Paris (France).

Rachis internode clavate, *ca.* 3.5 × 0.6–0.8 mm, 3-angled, densely pilose along all the 3 margins, hairs hyaline, coriaceous, ventral side membranous. *Sessile spikelet* bisexual, awned, narrowly elliptic, 8–9 × 1.5–1.8 mm, pilose or not, greenish or brownish; callus pilose or glabrous, hairs pale brownish or hyaline. *Lower glume* ovate–narrowly ovate, 5.8–6 × *ca.* 3 mm, cymbiform, broad towards lower half or at lower 1/3rd, margins entire but looks like scabridulous at upper half or at upper 2/3rd due to dorsal hairs, inflexed at lower half or lower 1/3rd, infolded and keeled at upper half or at upper 2/3rd, keel winged, wing margin scabridulous, apex notched or bifid, chartaceous–subcoriaceous, dorsal surface scabridulous and densely pilose, ventral surface puberulent, hairs very minute, greenish or brownish, 14-nerved. *Upper glume* narrowly ovate, *ca.* 7.5 × 1.5–2 mm, cymbiform, margins inflexed or infolded, ciliate towards upper half, apex bilobed, awned from the sinus, chartaceous–subcoriaceous, dorsal surface scabridulous–puberulent and long pilose at middle, scabridulous hairs seen more towards margins at upper half, ventral surface scabridulous–puberulent, dorsally keeled at upper half, keel scabridulous, greenish or brownish, 6-nerved; *awn* straight, 3 mm long, scabridulous, brownish or greenish. *Lower lemma* narrowly ovate, 5.8–6 × 1.5–1.7 mm, cymbiform, margins inflexed at lower half or lower 1/3rd, infolded at upper half or at upper 2/3rd, infolded margins ciliate, apex acuminate, chartaceous, dorsal surface scabridulous towards apex and margins, ventral surface glabrous, pale brownish or hyaline, 3-nerved. *Lower palea* narrowly ovate, 4.8–5 × 2.5–3 mm, margins inflexed at lower 1/3rd or at lower 1/4th, infolded at upper 2/3rd or at upper 3/4th, infolded margins broad, ciliate and membranous, apex acute, chartaceous, dorsal surface scabridulous, ventral surface glabrous, pale brownish or hyaline, 2-nerved. *Upper lemma* narrowly ovate, *ca.* 5 × 1.5 mm, cymbiform, margins inflexed at lower 1/3rd or at lower 1/4th, infolded at upper 2/3rd or at 3/4th, infolded margins ciliate, apex bilobed, awned from the sinus, membranous, dorsal surface scabridulous–puberulent, hairs seen mainly at upper half, ventral surface glabrous, hyaline–pale brownish, 3-nerved; *awn* geniculate, 12.5–13.5 mm long; column twisted, 5.5–6 mm long, sparsely scabridulous–glabrous, dark brownish; bristle 7–7.5 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 4.5–5 × 1–1.2 mm, cymbiform, margins

scabridulous, inflexed or infolded, apex acute–acuminate, membranous, dorsal surface scabridulous, ventral surface glabrous, pale brownish or hyaline, 2-nerved. *Pedicelled spikelet* bisexual, awned, narrowly elliptic, 4–8 × 1.5–1.8 mm, more or less pilose, brownish or greenish; callus pilose, hairs pale brownish or hyaline. *Pedicel* 2.5–3.5 × 0.6–0.8 mm, densely pilose on all the 3 margins, similar to rachis internode. *Lower glume* narrowly ovate, *ca.* 6 × 2–2.2 mm, cymbiform, broad towards base, margins entire, inflexed, apex acuminate, chartaceous, subcoriaceous towards base, dorsal surface scabridulous with long pilose on lower half, ventral surface scabridulous or puberulent, dorsally keeled at upper half, keel scabridulous, brownish or greenish, 13–15-nerved. *Upper glume* narrowly ovate, 6–6.5 × 1.8–2 mm, cymbiform, apex minutely lobed and aristate, arista 0.5–0.8 mm long, pilose hairs on the dorsal surface not confined to the middle portion as seen in that of sessile spikelet, but seen throughout on lower half and sometimes pilose hairs are sparse, 5–6-nerved, all other characters are similar to that of sessile spikelet. *Lower lemma*, *lower palea*, *upper lemma* and *upper palea* are similar to that of sessile spikelet. *Lodicules* 2, cuneate, 0.6–0.8 × 0.6–0.8 mm, hyaline. *Stamens* 3; anthers 2.8–3 mm long, yellowish. *Ovary* elliptic–oblong, 0.8–1 × 0.4–0.6 mm, brownish; *style* 2, 2–2.5 mm long, hyaline; *stigma* plumose, 2–3.5 mm long, purplish. *Caryopsis* oblong–elliptic, 2–2.2 × 0.6–0.8 mm, brownish, styles persistent or not.

Flowering & Fruiting: September to January.

Distribution: Tropical and Subtropical Asia to W. Pacific. In India, it is distributed in Andaman and Nicobar Islands, Assam, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Meghalaya, Tamil Nadu, Tripura and West Bengal.

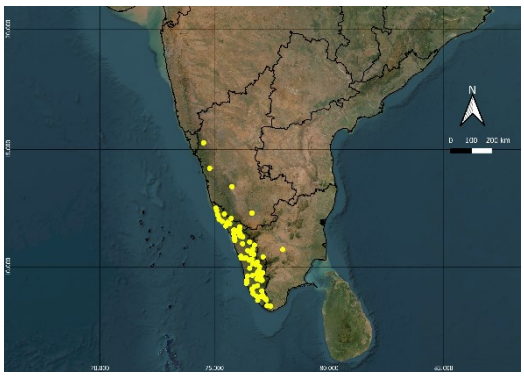

Fig. 89. Distribution of *Ischaemum timorense* Kunth in southern Peninsular India

Habitat: Open grassy hill slopes, forest margins and road cuttings.

Notes: Singh & Rao (2008) provided a detailed note on the variation shown by *Ischaemum timorense*. We agree with his treatment and accepting the previously available *I. agastyamalayanum*, *I. flumineum*, *I. thomsonianum* and *I. zeylanicola* as the synonyms of *I. timorense*. There is no taxonomic significance to retain them as separate species as they are separated mainly by size, petioles (lower leaves pseudopetioled in *I. zeylanicola*), indumentum on leaves and spikelets (Lower glume of spikelets glabrous in *I. zeylanicola* whereas usually hairy in all others), colour of hairs seen on spikelets and callus (hyaline or pale greenish in *I. zeylanicola* whereas pale brownish in others and this colour variation is also seen in spikelets too). The variation shown by size of spikelets, awns or arista or vegetative parts are continuous. It is also observed that some plants growing on rock crevises with less soil are more stoloniferous than those growing in well soiled substratum. This stoloniferous tendancy can be seen in almost all specimens (the lowland specimens or those growing in better soils may no need to produce roots from each and every node). The presence of velvety hairs or indumentum at the base of so called *I. flumineum* (which is usually grown in river beds) cannot be consider as a good character to treat it as distinct since its all other floral characters comes under the variation range of *I. timorense*. From the field experience, *I. thomsonianum* seems to be an intermediate form that connects *I. zeylanicola* and *I. agastyamalayanum*.

Specimens examined: INDIA, **Karnataka**, Chikmagalur district, Baba Budangiri, on the way to Kemmanagundi, 03.03.2016*, V. Drisya* 176724; *Ibid.*, on the way to Manikyadhara, 03.03.2016, *V. Drisya* 176719 (CALI); Kodagu district, Makutta, 03.01.1942, *A.A. Khan s.n.* (DD); Uttara Kannada district, Jog, 01.05.1939, *N.L. Bor* 11323; *Ibid.*, 28.11.1939, *N.L. Bor* 11390; Supa, 22.11.1889, *W.A. Talbot* 2101 (DD). **Kerala**, Alappuzha district, Champakkulam, 18.03.1980, *P.V. Sreekumar* 66755 (BSID & MH); Kumarakodi, on the way to Pallana River, 15.12.2017, *V. Drisya* 157772 (CALI); way to Kumarakam, 14.03.1980, *P.V. Sreekumar* 66721 (BSID & MH); Ernakulam district, Bhoothathankettu Dam catchment area, 13.12.2018, *V. Drisya* 168708; Mamalakkandam, 19.12.2016, *Shinoj & V. Drisya* 176760; *Ibid.*, 19.12.2016, *Shinoj & V. Drisya* 176762; Mayiladumkunnu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168711; Shoolamudi, 14.12.2016, *Shinoj*

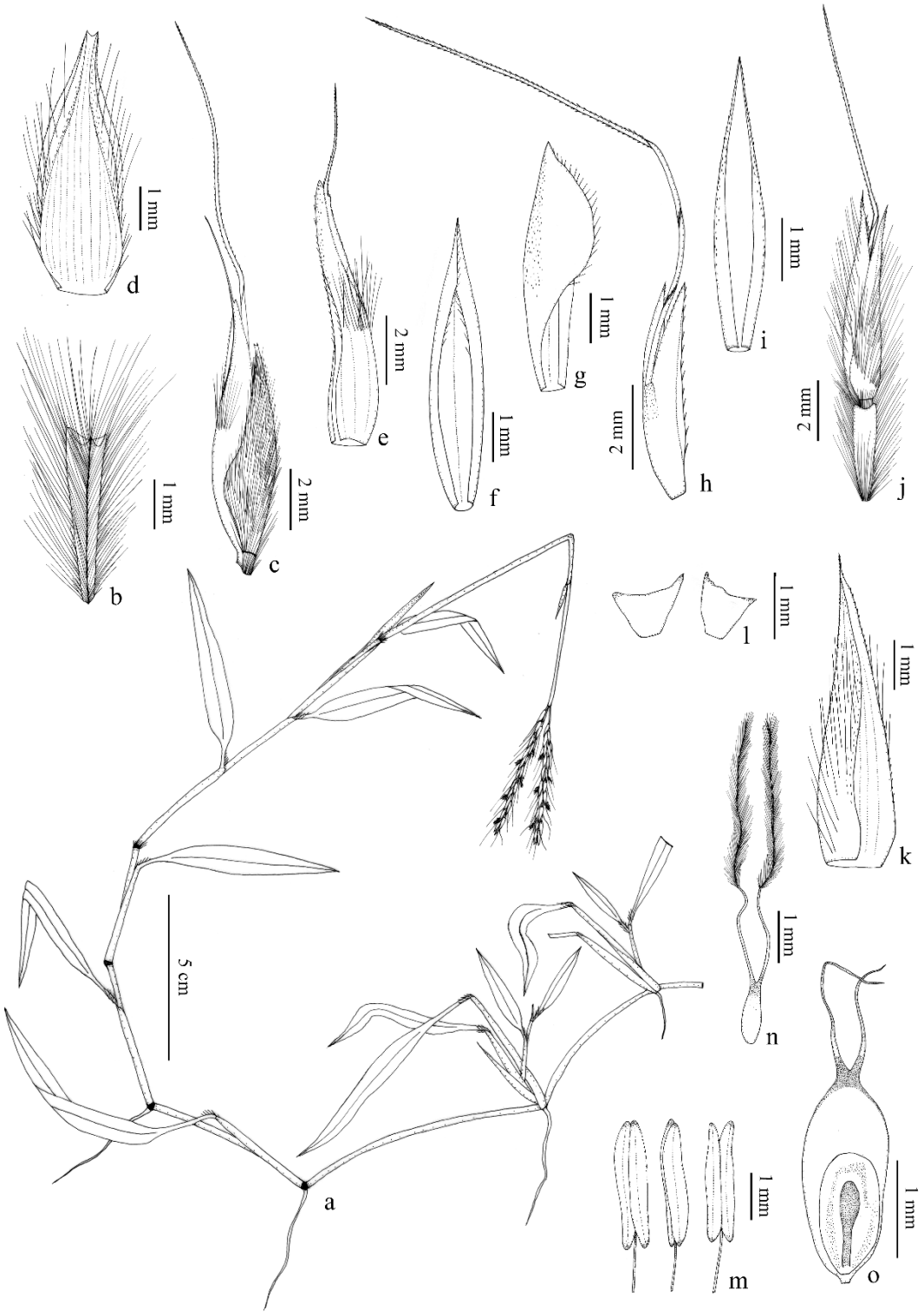

Fig. 90. *Ischaemum timorense* Kunth: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma; **i.** Upper palea (**c–i:** Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume (Pedicelled spikelet); **l.** Lodicules; **m.** Stamens; **n.** Gynoecium; **o.** Caryopsis. [Upper glume, Lower lemma, Lower palea, Upper lemma & Upper palea of Pedicelled spikelet are similar to those of sessile spikelet] (**a.** from *V. Drisya* 169575; **b–o**: from *V. Drisya* 168724, drawn by V. Drisya).

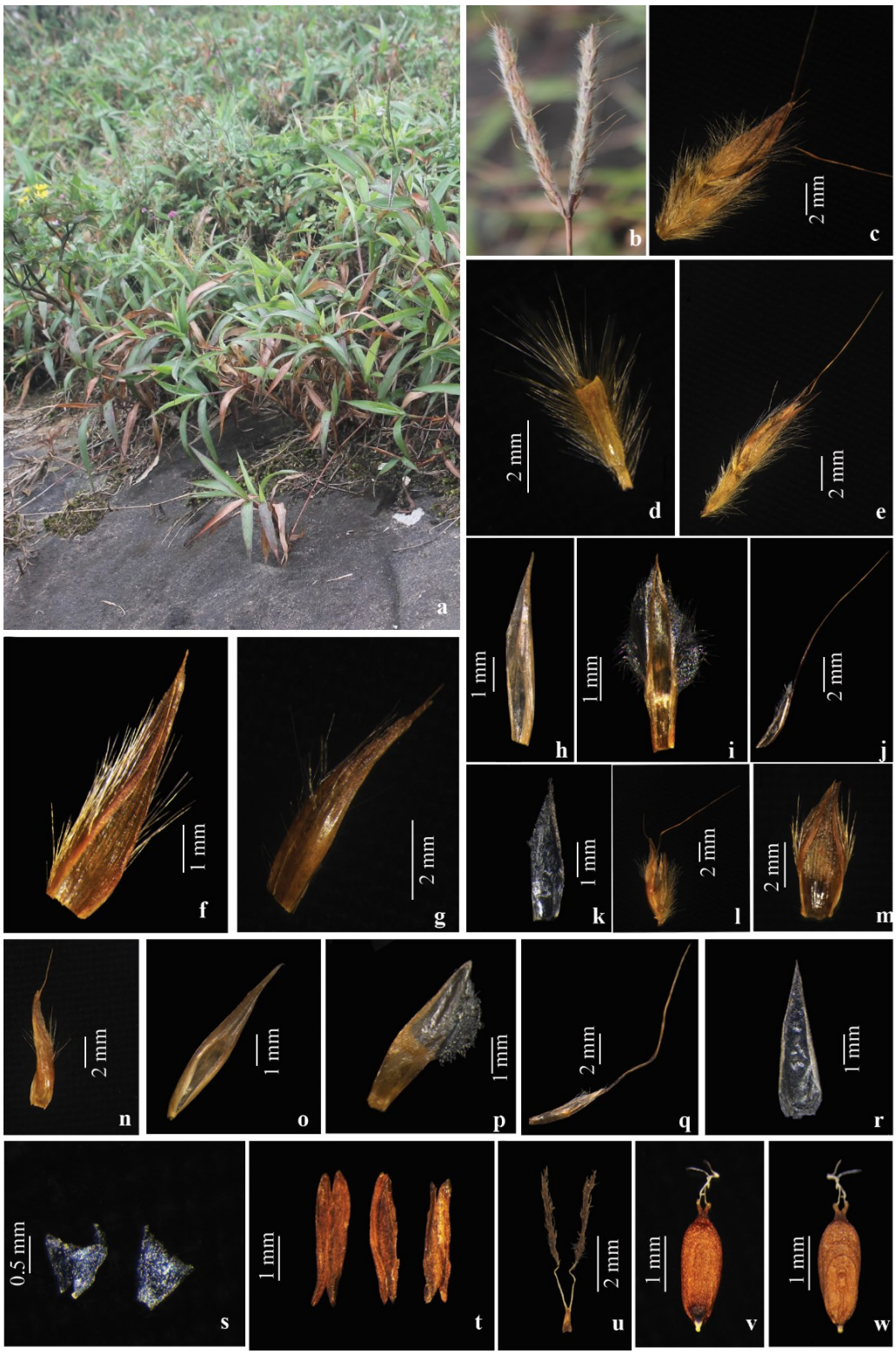

Fig. 91. *Ischaemum timorense* Kunth: **a.** Habit; **b.** Single raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea (**e–k:** Pedicelled spikelet); **l.** Sessile spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Lower palea; **q.** Upper lemma; **r.** Upper palea (**l–r:** Sessile spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium; **v.** Caryopsis-dorsal view; **w.** Caryopsis-ventral view.

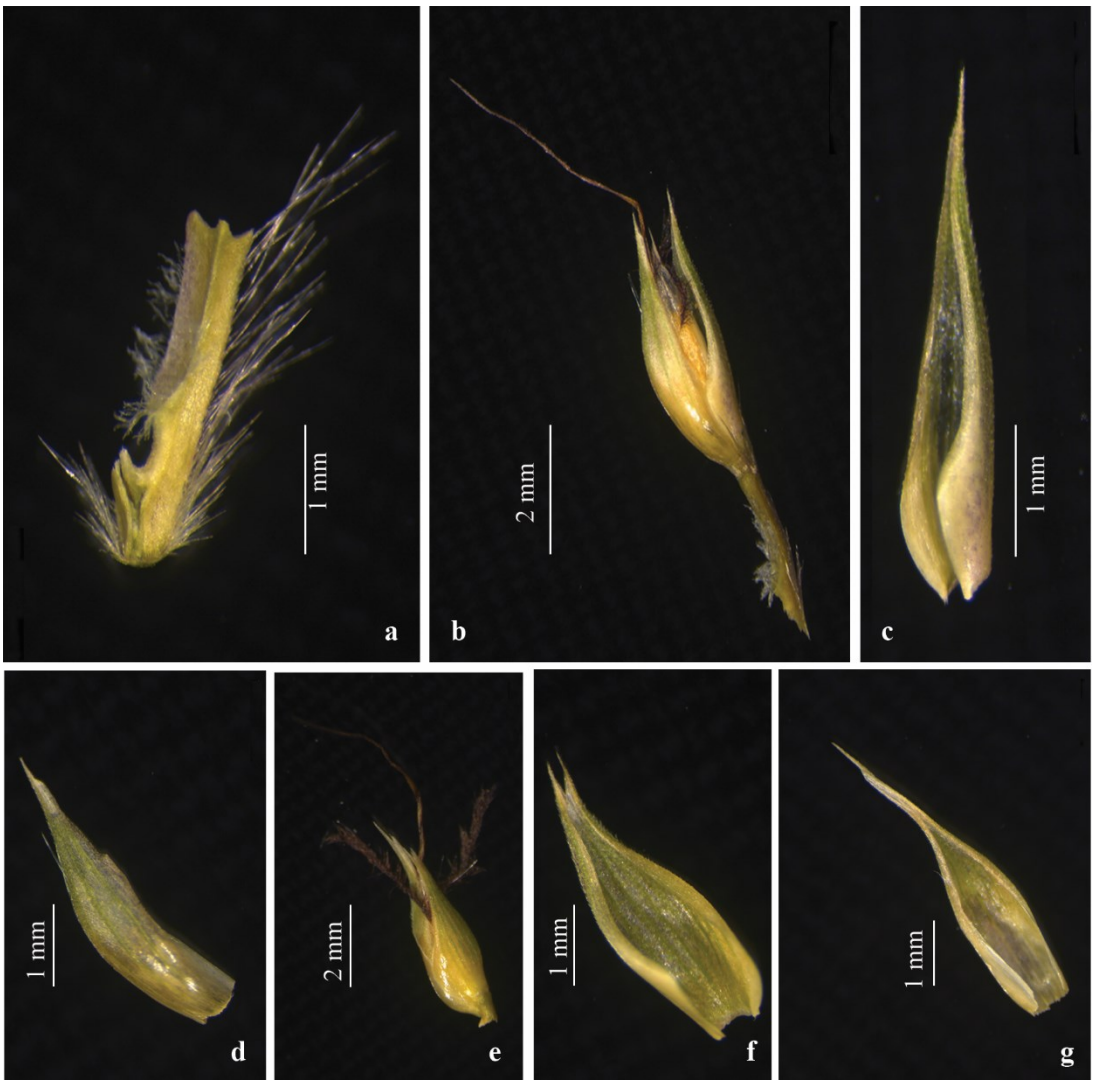

Fig. 92. *Ischaemum timorense* Kunth showing variation: **a.** Rachis internode; **b.** Pedicelled spikelet; **c.** Lower glume; **d.** Upper glume (**b–d:** Pedicelled spikelet); **e.** Sessile spikelet; **f.** Lower glume; **g.** Upper glume (**e–g:** Sessile spikelet).

& V. Drisya 176680; *Ibid.*, 14.12.2016, *Shinoj & V. Drisya* 176682; *Ibid.*, Variyam, 14.12.2016, *Shinoj & V. Drisya* 176688; Thundathil Forest range, Cherukadu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168702; *Ibid.*, Kanichamkandam, Karimpani, 14.12.2018, *V. Drisya* 168710; *Ibid.*, Thottapalam, 14.12.2018, *V. Drisya* 168709 (CALI); Idukki district, Adimali ghat road side, 15.12.2018, *V. Drisya* 170139; *Ibid.*, 15.12.2018, *V. Drisya* 170141; Arippara, near Kulamavu, 25.03.2016, *V. Drisya* 150724; Kalvary Mount kurisumala, 27.10.2017, *V. Drisya* 157156 (CALI); Kuttikkanum, 28.11.1996, *N. Ravi & N. Mohanan* 24796 (TBGT); Kuttikkanam–Mundakkayam road, 15.10.2015, *V. Drisya & A.K. Pradeep* 144238

(CALI); Kuttikkanam–Peermade, 23.11.1967, *K. Vivekananthan* 20307 (CAL); Kodayurutty, ghat road side, near Kulamavu, 26.03.2016, *V. Drisya* 150714; Kodayurutty kandam, near Kulamavu, 26.03.2016, *V. Drisya* 150715; *Ibid.*, 26.03.2016, *V. Drisya* 150725; Menmala, in between Kuttikkanam and Elappara, 17.10.2015, *V. Drisya & A.K. Pradeep* 144257; near 8th mile, in between Kattappana and Pynavu, 17.10.2015, *V. Drisya & A.K. Pradeep* 144259; Painavu, Microwave Power Hill, 27.10.2017, *V. Drisya* 157155; *Ibid.*, 27.10.2017, *V. Drisya* 157162;

Fig. 93. *Ischaemum timorense* Kunth showing variation: **a.** Pedicelled spikelet; **b.** Lower glume; **c.** Upper glume (**a–c:** Pedicelled spikelet); **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume (**d–f:** Sessile spikelet).

Parunthupara, 16.10.2015, *V. Drisya & A.K. Pradeep* 144252 (CALI); Peermade, 12.12.1996, *N. Ravi & N. Mohanan* 31827 (TBGT); Thrisanku Hill, 17.10.2015, *V. Drisya* 144256; Vagamon, 15.10.2015, *V. Drisya* 144244; *Ibid.*, 12.12.2016, *C. Pramod & V. Drisya* 176755; *Ibid.*, roadside on the way to Vagamon Kurisumala, 26.10.2017, *V. Drisya* 157148; Vagamon Kurisumala, 26.10.2017, *V. Drisya* 157140; *Ibid.*, 26.10.2017, *V. Drisya* 157154; *Ibid.*, 01.12.2019, *V. Drisya* 170185; *Ibid.*, 26.10.2017, *V. Drisya* 170186; *Ibid.*, 26.10.2017, *V. Drisya* 170187; *Ibid.*, 26.10.2017, *V. Drisya* 170188 (CALI); Kannur district, Eenthodu, near Pappinissery, 30.12.2016, *V. Drisya* 176644 (CALI); Ezhimala, 12.12.1996, *N. Ravi & N. Mohanan* 33732 (TBGT); *Ibid.*, Ezhimala kurisumala, 12.11.2017, *V. Drisya* 157712 (CALI); Kaitheriyidam, 13.12.1996, *N. Ravi & N. Mohanan* 33737 (TBGT); Kannoth, 28.02.1978, *V.S. Ramachandran* 62000 (CAL); Kunnaru, near Ezhimala, 12.11.2017, *V. Drisya* 157715; Pullingome, on the way to Kottathalachi mala, 14.11.2018, *V. Drisya* 157863 [CALI184726, CALI184727 & CALI184728] (CALI); Thalassery [Tellicherry], 00.01.1951, *S.K. Jain & R.C. Bharadwaja s.n.*; *Ibid.*, 25.01.1951, *S.K. Jain & R.C. Bharadwaja s.n.* (DD); Kasaragod district, Cherkala, 24.11.1981, *P.V. Sreekumar* 71837 (BSID); Nileshwaram, 24.12.2016, *V. Drisya* 176618; Periya, 02.11.2017, *V. Drisya* 157195; *Ibid.*, 02.11.2017, *V. Drisya* 171445; Thottam–Padne road, near Pilicode, 24.12.2016, *V. Drisya* 176604; Veethukunnu, Pilicode, 24.12.2016, *V. Drisya* 176613 (CALI); Kollam district, Adoor, 20.05.1980, *C.N. Mohanan* 68321 (MH); back of Kottayilkunnu temple, 08.12.2000, *N. Mohanan* 44831 (TBGT); Murarimukku, near Murari temple, Mukhathala, 15.11.2017, *V. Drisya* 157732; near Sasthamkotta Lake, 15.11.2017, *V. Drisya* 157740; Thenmala, near railway station, 21.12.2019, *V. Drisya* 170200; *Ibid.*, Chandanakunnu, 21.12.2019, *V. Drisya* 170198 (CALI); Kottayam district, Erumely range, 25.12.1957, *Sethi & Negi* 25932 (DD); Koruthod–Kuzhimavu, 24.12.1980, *P.V. Sreekumar* 69459 (BSID); Kozhikode district, Kakkadampoyil, 19.10.2016, *V. Drisya* 150796; *Ibid.*, 20.11.2019, *V. Drisya* 176222; *Ibid.*, 20.11.2019, *V. Drisya* 176225; *Ibid.*, 20.11.2019, *V. Drisya* 176226; *Ibid.*, 20.11.2019, *V. Drisya* 176230; *Ibid.*, 20.11.2019, *V. Drisya* 176231; *Ibid.*, 20.11.2019, *V. Drisya* 176234; *Ibid.*, 20.11.2019, *V. Drisya* 176237; Kakkayam,

Ambalappara Grassland, 30.11.2018, *V. Drisya* 157879; *Ibid.*, 30.11.2018, *V. Drisya* 157885; *Ibid.*, ghat road side, 28.12.2017, *V. Drisya* 157802; *Ibid.*, 28.12.2017, *V. Drisya* 157805; *Ibid.*, 28.12.2017, *V. Drisya* 157807; *Ibid.*, 28.12.2017, *V. Drisya* 157808; *Ibid.*, 30.11.2018, *V. Drisya* 157886; *Ibid.*, Search, 28.12.2017, *V. Drisya* 157798; *Ibid.*, on the way to Ambalappara, Dam site, 30.11.2018, *V. Drisya* 157878; *Ibid.*, on the way to Search, near Dam site, 30.11.2018, *V. Drisya* 157891; *Ibid.*, 30.11.2018, *V. Drisya* 157892; *Ibid.*, road side, on the way to Dam, 28.12.2017, *V. Drisya* 157801; Narinada, 08.12.2016, *V. Drisya* 176744; Pariyangad, 08.10.2015, *V. Drisya* 144292; *Ibid.*, 25.12.2020, *V. Drisya* 169547; *Ibid.*, 30.01.2023, *V. Drisya* 169575; *Ibid.*, Marumayil padam, 25.12.2020, *V. Drisya* 169549; *Ibid.*, Punathil, 18.12.2016, *V. Drisya* 176756; Olichuchattam, 09.12.2018, *Nikhil Krishna & V. Drisya* 170143; on the way to Olichuchattam, 24.12.2019, *V. Drisya* 169567; Perambra Estate, near Peruvannamoozhi, 08.12.2016, *V. Drisya* 176738; *Ibid.*, 08.12.2016, *V. Drisya* 176739; *Ibid.*, 08.12.2016, *V. Drisya* 176740; *Ibid.*, 08.12.2016, *V. Drisya* 176741; Pokkunnumala, near Nanminda, 23.11.2019, *V. Drisya* 176245; Thonikkadavu, near Narinada, 08.12.2016, *V. Drisya* 176742; *Ibid.*, 08.12.2016, *V. Drisya* 176743; Wayanad Ghat roadside, 01.03.2016, *V. Drisya* 150778 (CALI); Malappuram district, Calicut University Botanical Garden, 09.12.2020, *V. Drisya* 169546 (CALI); Manathumangalam, 15.12.1996, *N. Ravi* 33030 (TBGT); *Ibid.*, 03.12.2016, *V. Drisya* 150703; Nilambur, Adyanpara, 12.02.2016, *Shinoj & V. Drisya* 150727 (CALI); Nilambur Division, Amarambalam Range, *s.d.*, *S.P. Sethi & Negi* 25954 (DD); Villunniyal, near Kuroor Ayyappan kavu, 04.12.2016, *V. Drisya* 176689 (CALI); Palakkad district, Chemmanthode, 24.11.1998, *N. Mohanan* 39551 (TBGT); Chindakki, 12.01.1980, *N.C. Nair* 65428 (CAL); Manappulli, 03.01.2016, *V. Drisya* 171475; *Ibid.*, 03.01.2016, *V. Drisya* 171477; Nelliyampathy, 07.11.2015, *V. Drisya* 176694; *Ibid.*, Valiya Govindamala, 10.12.2022, *V. Drisya* 169597 (CALI); Pathanamthitta district, Konni, Kalleli, 14.10.1998, *T. Shaju & M.S. Kiran Raj* 37503 (TBGT); Sabarimala, 23.12.1980, *P.V. Sreekumar* 69447; way to Sabarimala, 23.12.1980, *P.V. Sreekumar* 69438 (BSID); Villoonipara, 27.11.1996, *N. Ravi & N. Mohanan* 24752 (TBGT); Thiruvananthapuram district, Agasthyamala, in between Pongalappara and

Agastyarkoodam, 20.12.2018, *V. Drisya* 168720; *Ibid.*, 20.12.2018, *V. Drisya* 168724; Nadukanippara, 20.12.2018, *V. Drisya* 168716; *Ibid.*, near Agastyarkoodam peak, 20.12.2018, *V. Drisya* 168718; *Ibid.*, on the way to Athirumala, 20.12.2018, *V. Drisya* 168727; *Ibid.*, 20.12.2018, *V. Drisya* 168728; *Ibid.*, Pongalappara, 20.12.2018, *V. Drisya* 168717; Chippanchira, near TBGRI quarters, 02.02.2017, *V. Drisya* 176645; Kariavattom campus, 10.11.2015, *V. Drisya* 150783; *Ibid.*, 10.11.2015, *V. Drisya* 150784; Nedumparambu, 20.12.2019, *V. Drisya* 170197 (CALI); Ponmudi, 13.11.1996, *N. Ravi* 31755; way to Bonacaud, 14.11.1996, *N. Ravi* 31778 (TBGT); Thrissur district, Avittappilly, 15.01.2018, *V. Drisya* 157816; Chembuchira, 10.02.2019, *V. Drisya* 170161; Kattoor, Thekkupadam, 09.02.2019, *V. Drisya* 170148; Kodali, 10.02.2019, *V. Drisya* 170155; *Ibid.*, 10.02.2019, *V. Drisya* 170157; Kodakara, near highway roadside, 10.02.2019, *V. Drisya* 170149; Mandhirappilly, 10.02.2019, *V. Drisya* 170150; *Ibid.*, 10.02.2019, *V. Drisya* 170153; near Charpa Falls, in between Athirappilly & Vazhachal, 12.12.2019, *V. Drisya* 176277; Pullu, 14.01.2018, *V. Drisya* 157813; Vazhachal, 12.12.2019, *V. Drisya* 176270; *Ibid.*, 12.12.2019, *V. Drisya* 176272 (CALI); *Ibid.*, Peringalkuthu, near the dam site on the western side, 19.12.1984, *s.coll.* 10758 (FRC); Wayanad district, Chembra, 30.12.2015, *V. Drisya* 176701; *Ibid.*, on the way to Lake, 30.12.2015, *V. Drisya* 176707; Kalpetta, 31.12.2015, *V. Drisya* 176720; Kurichiar mala, 31.12.2015, *V. Drisya* 176711; *Ibid.*, 31.12.2015, *V. Drisya* 176712; *Ibid.*, 31.12.2015, *V. Drisya* 176714 (CALI). **Tamil Nadu**, Coimbatore district, Siruvani, 07.12.1956, *K. Subramanyam* 1671; *Ibid.*, 25.10.1968, *D.B. Deb* 31232 (CAL); Topslip, 00.11.1937, *N.L. Bor* 77265 (DD); Kanyakumari district, Ingikadavu to Asanbu, 05.12.2005, *K. Althaf Ahamed Kabeer* 118710 (MH); Tirunelveli district, Thulukkamparai, 28.11.1969*, B.V. Shetty* 32946 (CAL). '**South India**', 21.01.1942, *Indian Forest College Student s.n.* (DD). Madras & Concan, 00.00.1852, *G. Thomson s.n.* (CAL).

Notes on typification: Bor (1960) published the new species name *Ischaemum zeylanicolum* by providing a new status to Hackel's variety '*zeylanicum*' of *Ischaemum timorense*. Though Bor cited many specimens under his new species as "*Alston* 1098, Kandy; *Thwaites* C.P. 963, Ceylon"; Hackel's (1889) treatment was

based on another specimen "Ceylon (Thwait. 3168). Sur (2001) selected specimen with collection number '*Thwaites* C.P. 963' housed at CAL herbarium as type. But as per articles 7.11 and 9.23 of the Shenzhen Code (Turland *et al*. 2018), Sur's type designation cannot be considered as effective. Also, the better choice for lectotype is '*Thwaites* C.P. 3168' than that of '*Thwaites* C.P. 963'. Moreover, Davidse in Dassanayake (1994) also made a lectotype designation. They selected *Thwaites* C.P. 3861 at PDA herbarium as type, instead of *Thwaites* C.P. 3168. This typographic error is corrected here as *Thwaites* C.P. 3168. In addition to this, we were able to trace seven more herbarium sheets of Thwaites with the same collection number as 'C.P. 3168' at various herbaria. It includes two sheets at herbarium P [P02045279 digital image! & P02044738 digital image!], one at CAL [CAL0000025201!], three at W [W18890065098 digital image! W19160035743 digital image! & W18890059605 digital image!] and one at NY [NY00381264 digital image!]).

16. Ischaemum travancorense Stapf ex C.E.C.Fisch., Bull. Misc. Inform. Kew 1933(7): 353. 1933; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1723. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 186. 1960; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 233. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 165. 1991; S.Moulik, Grasses Bamboos India 2: 297. 1997; Sur, J. Econ. Taxon. Bot. 25(2): 433. 2001; Singh & Rao, J. Econ. Taxon. Bot. 32(4): 825. 2008; Srivastava & V.J.Nair, Nelumbo 52: 90. 2010; Potdar *et al.*, Grasses Maharashtra. 203. 2012. *Type*:—— INDIA, **Kerala**, Alappuzha district, Alleppy in back waters, 20.12.1993, *M.A. Lawson* 130 (holo: K [K000245746 digital image!]; iso: CAL [CAL0000002286!], DD!).

Ischaemum aristatum sensu Hook.f. *non* L., 1753 subsp. *rottleri* Hook.f., Fl. Brit. India 7: 127. 1897. *Type*:—— INDIA, Deccan. Sheet not traceable.

Ischaemum vembanadense R.B.Patil & D'Cruz, J. Bombay Nat. Hist. Soc. 70(2): 324. 1974. *Type*:—— INDIA, **Kerala**, Alappuzha district, Alleppy back waters, 10.01.1970, *Patil* I-919 (holo: Herbarium of College of Agriculture, Pune [*n.v.*]; iso: BSI [*n.v.*]).

Figs. 94–99

Aquatic or semiaquatic perennials, 30–200 cm tall; culm erect or geniculate; *nodes* glabrous, younger ones hairy; *internode* terete–subterete, 9–15 cm long, glabrous or puberulent, glaucous or not, greenish. *Leaves* sessile or shortly petioled; *leaf sheath* 8–10 cm long, dorsally keeled, margins entire, chartaceous, dorsal surface glabrous or scabrous towards apex in younger leaves, ventral surface glabrous, greenish; *leaf blade* narrowly ovate, 9–20 × 1–1.5 cm, base rounded–subcordate or acute (narrowed) in younger leaves, margins scabridulous, apex acuminate, chartaceous, both abaxial and adaxial surface sparsely scabridulous–puberulent or glabrous, densely scabrous on both surfaces in young leaves, hairs seen more towards lower half, greenish; petiole and collar densely scabrous, hairs hyaline. *Ligule* ovate, 4–6 mm long, membranous, dorsally scabrous, brownish. *Racemes* 2, adpressed together and looks like solitary, 7–10 cm long, glabrous. *Spathe* leafy with reduced lamina. *Peduncle* terete–subterete, 13–25 cm long, glabrous, greenish. *Rachis internode* clavate–turbinate, *ca.* 4 × 1–1.5 mm, swollen, 3-angled, margins glabrous, crustaceous, ventral side membranous, glabrous or very minutely puberulent, greenish. *Sessile spikelet* bisexual, awned or not, narrowly ovate, *ca.* 6 × 1.6–1.8 mm, greenish; callus glabrous. *Lower glume* narrowly ovate, 5.2–5.5 × 1.8–2 mm, margins entire, inflexed or infolded, apex acute or notched, margins keeled, keel narrowly winged or not towards apex, keel or wing margin scabridulous near apex, coriaceous–crustaceous, chartaceous–sub coriaceous near apex, dorsal surface glabrous–

Fig. 94. Holotype of *Ischaemum travancorense* Stapf ex C.E.C.Fisch. (*M.A. Lawson* 130 [K000245746]) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

puberulent, scabridulous on keel near apex and scabrous–scabridulous near base especially on inflexed or infolded portions, ventral surface scabridulous, 3–4-side noduled, nodules interconnected by deep or shallow ridges, 4–5 shallow ridges seen on lower half at dorsal surface, greenish, 10–12-nerved (nerves inconspicuous). *Upper glume* narrowly ovate, 5.2–5.5 × 2–2.2 mm, dorsally keeled, folded, margins inflexed at lower 1/3rd or at lower half, infolded and ciliate at upper 2/3rd or at upper half, apex acute–acuminate, coriaceous, dorsal keel scabridulous near apex, dorsal surface punctate throughout, scabrous–scabridulous near apex and towards margins at upper half, ventral surface scabridulous–puberulent (hairs seen at upper half), greenish, 7–10-nerved (mid vein prominent). *Lower lemma* narrowly ovate, 4.8–5 × 1.5–1.8 mm, cymbiform, margins inflexed at lower half, infolded and ciliate–ciliolate at upper half, apex acute, membranous–chartaceous, both dorsal and ventral surface scabridulous–puberulent, hairs seen at upper half, greenish, 4–5-nerved. *Lower palea* narrowly ovate, 4.5–4.8 × 1–1.2 mm, margins inflexed or infolded, ciliate–sparsely ciliate at upper 1/3rd or at upper half, laterally keeled, keel scabridulous at upper 2/3rd or upper half, apex acute–obtuse, chartaceous–sub coriaceous, dorsal surface puberulent or punctate and scabridulous near apex and on keel at upper 2/3rd or upper half, ventral surface scabridulous–puberulent near apex, greenish, 7–9-nerved, nerves inconspicuous. *Upper lemma* narrowly ovate, 4.5–5 × 1.5–1.8 mm, dorsally keeled, folded, margins inflexed or infolded, ciliate at upper half or at middle or at lower half, apex bifid with small arista or with an awn from the sinus, membranous, dorsal and ventral surface scabridulous at upper half or at upper 1/3rd or near apex only, dorsal keel sparsely scabridulous, hyaline with pale green tinge, 3-nerved; *arista* 0.2–0.4 mm long; if awned, *awn* 5–6 mm long with reduced column and bristle. *Upper palea* narrowly ovate, 4–4.2 × 0.8–1 mm, margins sparsely scabridulous, inflexed or infolded, apex obtuse or shallowly notched, membranous, dorsal surface scabridulous–puberulent, ventral surface glabrous, hyaline with pale green tinge, 2-nerved. *Pedicelled spikelet* bisexual, unawned, narrowly ovate, 4.8–5 × 1.2–1.5 mm, greenish; callus glabrous. *Pedicel* clavate, 1.8–2 × 0.6–0.8 mm, greenish, similar to rachis internode. *Lower glume* narrowly ovate, 4.5–4.8 × 1.5–1.8 mm, margins entire or very sparsely scabridulous

near apex, inflexed or infolded, laterally keeled, one margin narrowly winged or not and scabridulous near apex (at upper 1/4th or upper 1/3rd), the other margin narrowly or broadly winged throughout and wing margin scabridulous, apex muticous or notched, coriaceous, dorsal surface glabrous or sparsely puberulent or minutely punctate, ventral surface scabridulous, greenish, sometimes 2–3-side noduled on one margin, 7–9-nerved, nerves inconspicuous. *Upper glume* narrowly ovate, 4.2–4.5 × 1.8–2 mm, shallowly folded or cymbiform, dorsally keeled, keel scabridulous near apex, margins inflexed or infolded at lower 1/3rd, infolded and ciliate at upper 2/3rd, apex acute–obtuse, chartaceous–subcoriaceous, dorsal surface scabridulous–puberulent, ventral surface scabridulous at upper 1/3rd or at upper half, greenish, 7–10-nerved, nerves hard to count. *Lower lemma* narrowly ovate, 4.2–4.5 × 1–1.2 mm, margins inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, one margin ciliate throughout, the other ciliate at upper 2/3rd, apex acute–acuminate, membranous, dorsal surface scabridulous–puberulent at upper 2/3rd, hairs usually seen towards apex and margins, ventral surface glabrous or puberulent, hyaline with or without pale green tinge, *ca.* 4-nerved, nerves inconspicuous. *Lower palea* narrowly ovate, 4.2–4.5 × 0.6–0.8 mm, margins infolded and keeled, sparsely ciliate at middle portion, keel winged, wing broad at upper half or at upper 2/3rd, wing margins scabridulous at upper 2/3rd, apex acute, chartaceous, dorsal surface scabridulous–puberulent at upper half or at upper 2/3rd, ventral surface glabrous or puberulent, pale greenish, nerves not seen. *Upper lemma* narrowly ovate, 4.2–4.5 × 0.5–0.8 mm (when folded), folded or cymbiform, margins inflexed or infolded, sparsely ciliate near to middle portion, apex acute, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 3-nerved. *Upper palea* narrowly ovate, 3.8–4 × 0.6–0.8 mm, margins entire or sparsely ciliolate, inflexed or infolded, apex acute–obtuse, membranous, both dorsal and ventral surface scabridulous–puberulent, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.6–0.8 × 0.3–0.5 mm, hyaline. *Stamens* 3; anthers 1.5–3.2 mm long, yellowish. *Ovary* narrowly elliptic or narrowly ovate, 0.6–0.8 × 0.2–0.4 mm, ventrally compressed, brownish; *style* 2, 2–2.5 mm log, hyaline; *stigma* 2, plumose, 3–3.5 mm long, purplish. *Caryopsis* not seen.

Notes: The awn size of the upper lemma of sessile spikelet shows continuous variation ranging from 0.2 mm to 6 mm (Coll. Nos., *Drisya* 157771, *Drisya* 157781 & *Drisya* 157793). Hence, this character cannot be taken into consideration for distinguishing species. Hence, Singh and Rao (2008) reduced *I. vembanadense* under the synonymy of *I. travancorense*. However, none of the subsequent authors (Srivastava & Nair, 2010; Kellogg *et al.*, 2020) followed this treatment. In the present treatment, the author prefer to accept the treatment of Singh and Rao (2008).

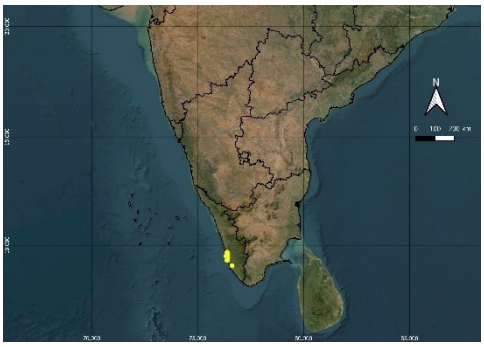

Fig. 95. Distribution of *Ischaemum travancorense* Stapf ex C.E.C.Fisch. in southern Peninsular India

Flowering & Fruiting: October to January.

Distribution: Endemic to India. Its distribution is restricted to Peninsular India especially in Kerala and Maharashtra states.

Habitat: Seen in back waters, canals and marshy places in wetlands (collected only from Alappuzha, Kollam and Kottayam districts of Kerala).

Specimens examined: INDIA, **Kerala**, Alappuzha district, Chennamkary, 17.12.2017, *V. Drisya* 157789; Chithira Kayal, 17.12.2017, *V. Drisya* 157786; Karumadi, Karumadikkuttan road, 16.12.2017, *V. Drisya* 157779 (CALI); Kumarakodi, Pallana, 29.12.1996, *N. Ravi & N. Mohanan* 33085 (TBGT); *Ibid.*, 15.12.2017, *V. Drisya* 157770; *Ibid.*, 15.12.2017, *V. Drisya* 157771; Manikandanchira, on the way to Mahadevikadu, 15.12.2017, *V. Drisya* 157777; Nedumudi, 17.12.2017, *V. Drisya* 157788 (CALI); R Block, 10.03.1980, *P.V. Sreekumar* 67008 (MH); Thakazhi, 16.12.2017, *V. Drisya* 157780; *Ibid.*, 16.12.2017, *V. Drisya* 157781; *Ibid.*, 16.12.2017, *V. Drisya* 157782 (CALI); Thottappally, 06.12.1981, *P.V. Sreekumar* 71857 (BSID); *Ibid.*, 29.12.1996, *N. Ravi & N. Mohanan* 33078 (TBGT); Thrikkunnapuzha, 14.03.1980, *P.V. Sreekumar* 66741 (BSID & MH); Vembanadu Lake, near Arunooru Block, 17.12.2017, *V. Drisya* 157787 (CALI); Kollam district, Sasthamkotta Lake, 15.11.2017, *V. Drisya* 157734 (CALI); Kottayam district, Kumarakom, 17.12.2017, *V. Drisya* 157793 (CALI).

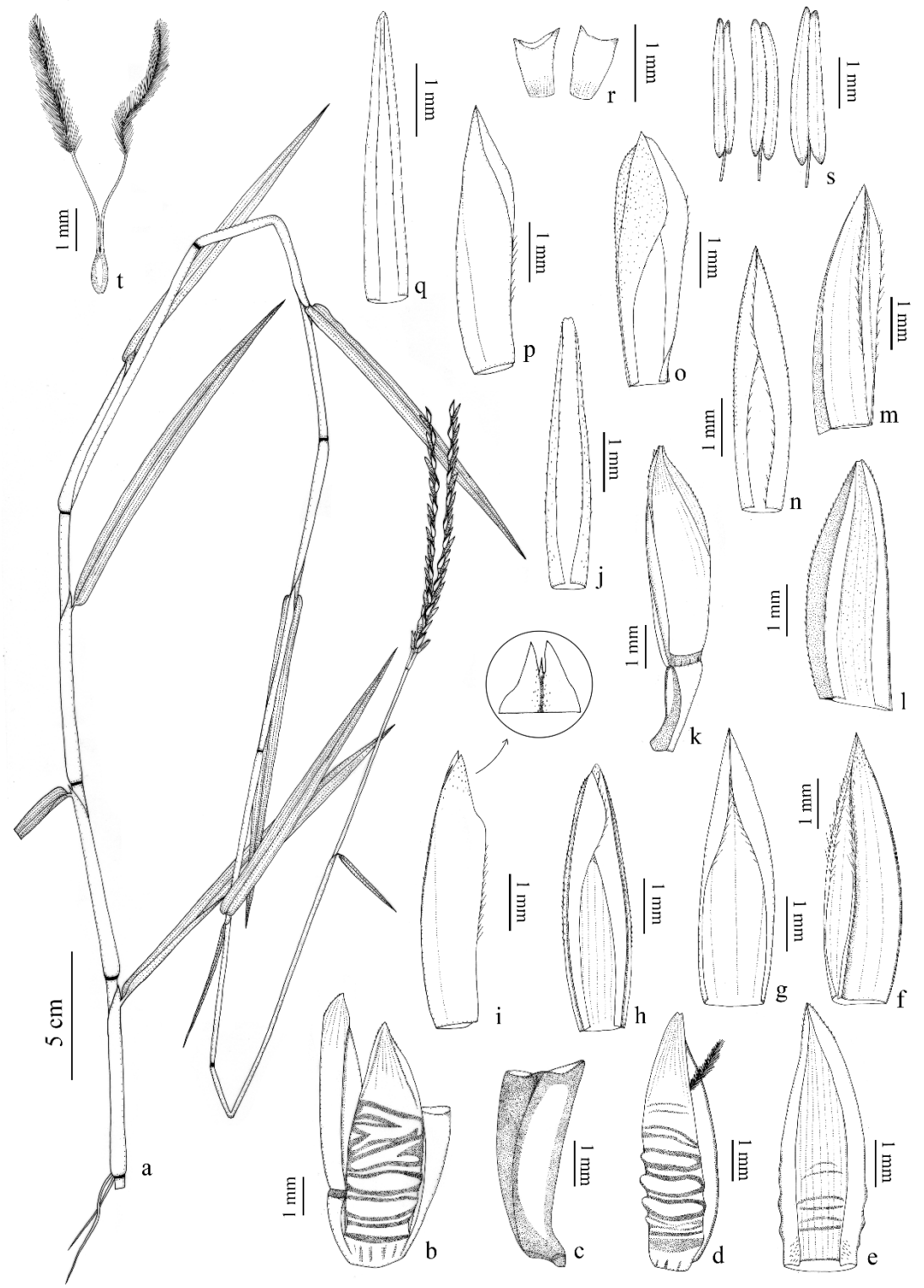

Fig. 96. *Ischaemum travancorense* Stapf ex C.E.C.Fisch.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea (**d–j:** Sessile spikelet); **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium (**a.** from *V. Drisya* 157771; **b–t:** from *V. Drisya* 157770, drawn by V. Drisya).

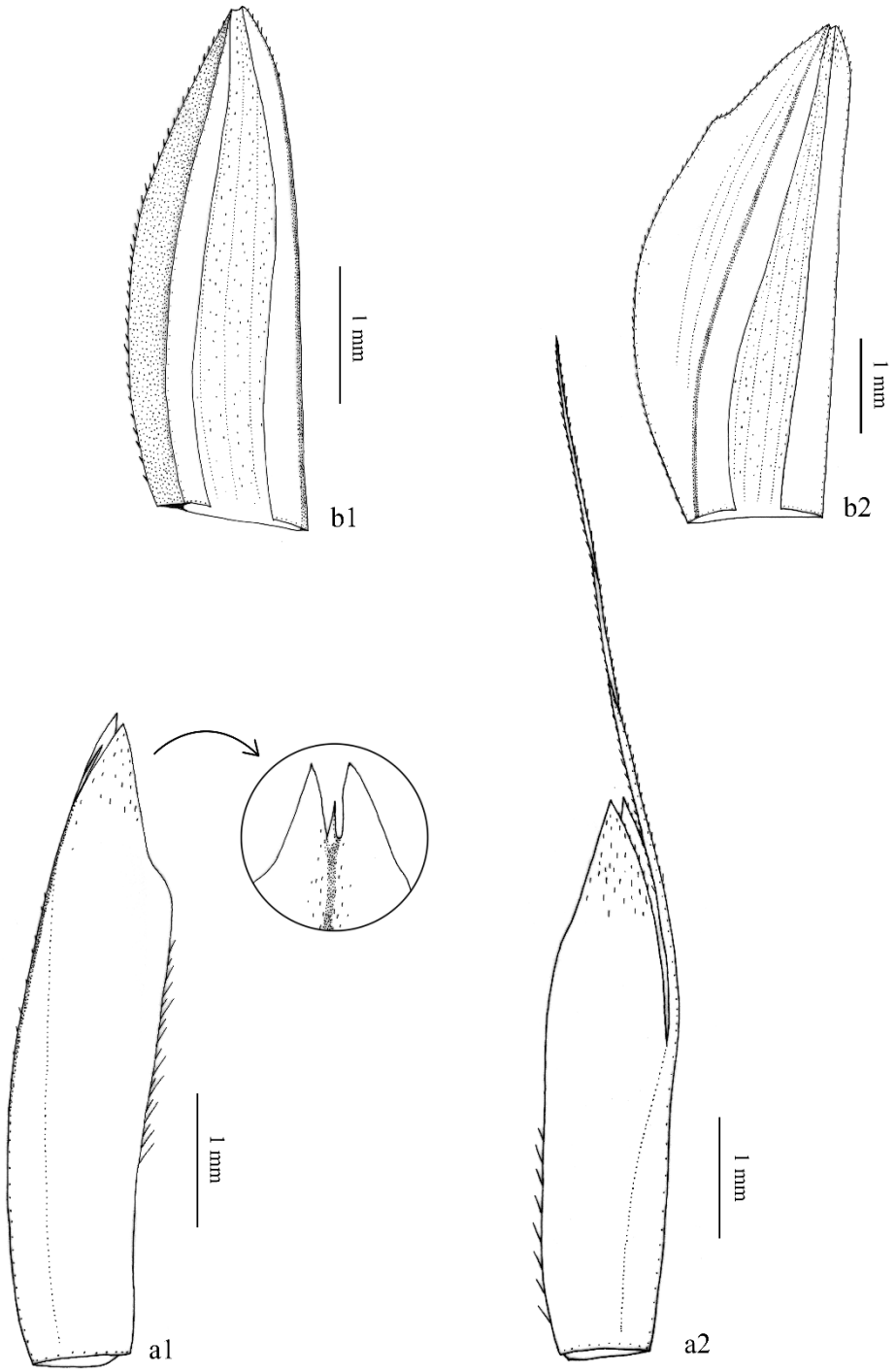

Fig. 97. *Ischaemum travancorense* Stapf ex C.E.C.Fisch.: **a1 & a2.** Upper lemma of sessile spikelet showing variation in awn; **b1 & b2.** Lower glume of pedicelled spikelet showing variation in marginal wing (**a1 & b1:** from *V. Drisya* 157770; **a2 & b2:** from *V. Drisya* 157793, drawn by V. Drisya).

Fig. 98. *Ischaemum travancorense* Stapf ex C.E.C.Fisch.: **a.** Habit; **b.** Raceme; **c.** Portion of raceme enlarged; **d.** Spikelet pair; **e.** Rachis internode; **f.** Pedicelled spikelet-dorsal view; **g & h.** Pedicelled spikelet-ventral view showing variation in side-nodules; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Lower palea; **m.** Upper lemma; **n.** Upper palea (**f–n:** Pedicelled spikelet); **o.** Sessile spikelet; **p.** Lower glume-dorsal view; **q.** Lower glume-ventral view; **r.** Upper glume; **s.** Lower lemma; **t.** Lower palea; **u.** Upper lemma; **v.** Upper lemma-apex; **w.** Upper palea (**o–w:** Sessile spikelet); **x.** Lodicules; **y.** Stamens; **z.** Gynoecium.

Fig. 99. *Ischaemum travancorense* Stapf ex C.E.C.Fisch.: **a–l.** Spikelet pair showing variation in awn and lower glume nodules in sessile spikelet; **m & n.** Lower glume of pedicelled spikelet showing variation in marginal wing; **o.** Upper lemma of sessile spikelet with rudimentary awn; **p.** Apex of upper lemma of sessile spikelet; **q.** Upper lemma of sessile spikelet with intermediate awn; **r.** Upper lemma of sessile spikelet with developed awn.

3. Sehima Forssk.

Sehima Forssk., Fl. Aegypt.-Arab. 178. 1775; Clayton & Renvoize, Gen. Gram., Grasses World: 348. 1986; Watson & Dallwitz, Grass Gen. World: 862. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 295. 2015. *Ischaemum* sect. *Sehima* Hook.f. Fl. Brit. India 7: 136. 1897. *Type*: *Sehima ischaemoides* Forssk.

Annuals or perennials, caespitose. *Ligule* hairy. *Inflorescence* a solitary terminal raceme; *spikelets* paired, one sessile and one pedicelled. *Rachis internode* and pedicel are often similar in shape and pubescence. *Sessile spikelet* bisexual, slightly dorsally compressed; *lower glume* with a median groove; *upper lemma* awned from the sinus, *awn* geniculate. *Pedicelled spikelets* male or sterile, *lower glume* setaceous or mucronate.

Distribution: Old World tropics; Australia, India and Warm Africa. About 5 species in the world; 4 in India and 2 in southern Peninsular India (Clayton & Renvoize, 1986; Watson & Dallwitz, 1992 ; Kellogg in Kubitzki, 2015; Kellogg *et al.*, 2020).

Habitat: Open habitats, dry bushlands and hill slopes.

Key to the species of *Sehima* in southern Peninsular India

1. Pedicel and rachis internode pilose on one margin; lower glume of sessile spikekelet rounded on the back with a deep longitudinal slit-like groove . ...2. ***S. sulcata***

1. Pedicel and rachis internode pilose on both the margins; lower glume of sessile spikelet grooved deeply but without a slit like groove .....1. ***S. nervosa***

1. Sehima nervosa (Rottler) Stapf, Fl. Trop. Afr. 9(1): 36. 1917; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1724. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 218. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 125. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1898. 1983; Sur, J. Econ. Tax. Bot. 12(1): 74. 1988; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 258. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 189. 1991; Pull., Fl. Andhra Pradesh 3: 1250. 1997;

K.M.Matthew, Fl. Palni Hills 3: 1587. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses. 468. 2009; Potdar *et al.*, Grasses Maharashtra 249. 2012; Pull., Fl. Telangana 3: 1172. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 172. 2017. *Andropogon nervosus* Rottler, Neue Schriften Ges. Naturf. Freunde Berlin iv: 218. 1803. *Lectotype* (designated here): INDIA, **Tamil Nadu**, Tirunelveli district, Palayamkottai [Palamcotta], 14.11.1795, *J.P. Rottler s.n.* (K [K000245767 digital image!]). Other original material: INDIA, **Tamil Nadu**, Tekkumalai [Tekkumalei], 04.12.1795, *J.P. Rottler s.n.* (K [K000974834 digital image!]); Tiruvannamalai district, Vandavasi [Wandawasi], 05.01.1800 & 06.01.1800, *J.P. Rottler* 454 (JE [JE00007303 digital image!]).

Ischaemum laxum R.Br., Prod. 205. 1810; Hook.f., Fl. Brit. India 7: 136. 1897. *Lectotype* (designated here): —— AUSTRALIA, 00.00.1802, *R. Brown* 6155 (lecto: BM [BM001209170 digital image!]; isolecto: K [K000974832 digital image!], E [E00393660 digital image!]).

Figs. 100–104

Tufted perennial, upto 60 cm high. *Nodes* geniculate, brownish or purplish, hairy (pilose), hairs very small, 0.1– 2 mm long; *internodes* terete, 9–16 cm long, glabrous, greenish. *Leaf sheath* rounded, 6–10 cm long, striated, margins entire and hyaline, coriaceous, dorsal surface densely scabridulous, hairs very minute, ventral surface glabrous, greenish. *Leaf blade* linear–lanceolate, 12–27 × 0.2–0.4 cm, base obtuse, margins scabridulous, apex long acuminate, coriaceous, both the surfaces densely scabridulous, hairs minute, collar (on both dorsal & ventral surfaces) scabrous, hairs hyaline, 0.1–1 mm long, greenish. *Ligule* hairy, hairs jonted at the base and appears as membranous, hairs hyaline, 1.5–2 mm long. *Raceme* solitary, 10–12 cm long, spikelets paired, one sessile and one pedicelled, awns usually oriented towards one side. *Peduncle* terete, 6–14 cm long, glabrous, scabridulous towards apex (*ca.* upper $1/4^{th}$), greenish. *Spathe* often leafy with ligule and reduced lamina; sheath 10–13.5 cm long, lamina 1–7 cm long. *Rachis internode* similar to the pedicel of pedicelled spikelet, oblong–clavate, 4–4.5 × 0.6–0.8 mm, swollen, convex, ventrally compressed, base and apex oblique, coriaceous, ventral surface

membranous, glabrous except on margins and base, densely pilose on both margins and dorsally on base, hairs hyaline, 0.1–4.5 mm long. *Sessile spikelet* bisexual, with 2-florets, narrowly elliptic, *ca.* 10 × 0.8–1 mm, greenish, 2-awned. *Lower glume* narrowly ovate, 9–10 × 1–1.5 mm, cymbiform, margins entire, inflexed at lower half or lower 2/3rd, upper half or upper 1/3rd infolded and keeled, keel scabrous to scabridulous, hairs hyaline, upto 0.5 mm long, apex setaceous, chartaceous, dorsal surface puberulent or scabridulous with very minute hairs, scabrous–scabridulous on submargins, hairs 0.2–0.4 mm long, ventral surface glabrous, dorsally grooved but not rounded on the back, greenish, 8-nerved, two middle nerves bifurcates at upper half. *Upper glume* awned, narrowly ovate, *ca.* 6.5 × 1.8–2 mm, cymbiform, dorsally keeled, keel winged at upper 1/4th, wing margin scabrous–scabridulous, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, margins entire, infolded submargins ciliate, hairs hyaline, 0.5–1 mm long, apex acute–acuminate, chartaceous, dorsal surface puberulent, ventral surface glabrous, pale greenish–hyaline, 3–5-nerved, lateral nerves faint and bifurcates nearly at upper 1/3rd, dorsal keel extends to an awn; *awn ca.* 18 mm long, straight, scabridulous, greenish. *Lower floret* male. *Lower lemma* narrowly elliptic–lanceolate, *ca.* 5.5 × 1–1.2 mm, margins infolded, ciliate (usually at upper 3/4th), hairs hyaline, 0.5–0.8 mm long, apex obtuse, membranous, dorsal surface glabrous except puberulent infolded portions, ventral surface glabrous, hyaline, 2-nerved. *Lower palea* narrowly ovate–elliptic, 4.5–5 × 1–1.2 mm, margins inflexed at lower 1/4th, infolded at upper 3/4th, apex acute–obtuse, membranous, dorsal surface

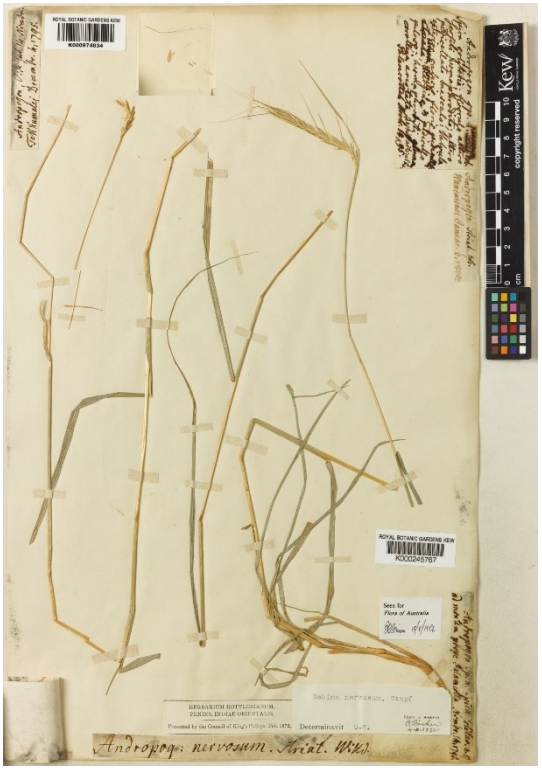

Fig. 100. Lectotype of *Sehima nervosa* (Rottler) Stapf [*J.P. Rottler s.n.* (K000245767)] © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

puberulent, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–0.6 × 0.3–0.4 mm. *Stamens* 3; anthers 3–3.5 mm long, yellowish; filament hyaline. *Upper floret* bisexual. *Upper lemma* narrowly ovate–elliptic, 5.5–6 × *ca.* 1 mm, margins infolded, ciliate, entire near base, hairs hyaline, 0.5–1 mm long, apex bilobed, lobe *ca.* 2 mm long, awned from the sinus, membranous, dorsal surface glabrous–sparsely puberulent, ventral surface glabrous, hyaline, 3-nerved, nerves jointed at the base of the awn. *Awn* twisted, geniculate, 49–50 mm long, brownish; column *ca.* 23 mm long, scabridulous along spiral and median line, dark brownish; bristle *ca.* 26 mm long, scabridulous throughout, pale brownish. *Upper palea* narrowly ovate, *ca.* 4.5 × 1 mm, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, keeled at upper half or upper 2/3rd, keel scabrous–scabridulous, hairs hyaline, 0.1–0.3 mm long, apex muticous–obtuse or notched, membranous, dorsal surface glabrous except puberulent–scabridulous infolded and inflexed portions, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–0.6 × 0.3–0.4 mm, with a tuft of hairy appendage either on one or on the two upper lobes, hairs 0.5–0.6 mm long and hyaline. *Stamens* 3. similar to that of pedicelled spikelet. *Gynoecium* 7–8 mm long; ovary narrowly elliptic, broader towards apex, 0.8–2.2 × 0.3–0.5 mm; style 2, 1.5–2 mm long, hyaline; stigma 2, plumose, 2.5–3.5 mm long, purple. *Pedicelled spikelet* male with 2-florets, narrowly ovate, 12–13 × 1–1.2 mm, greenish, sometimes greenish with purple tinge. *Pedicel* oblong–clavate, 3–3.5 × *ca.* 0.8 mm, dorsiventrally compressed, convex, hollow, coriaceous, ventral surface membranous, glabrous except margins, densely pilose on both the margins, hairs hyaline, 0.2–4 mm long, longer hairs seen towards apex and shorter towards base, greenish. *Lower glume* narrowly ovate, *ca.* 12 × 1.8–2 mm, margins inflexed and keeled, keel winged, one keel broadly winged and the other narrowly winged, keel and wing

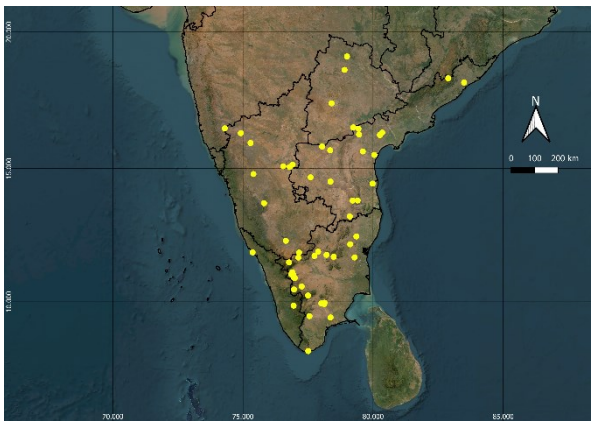

Fig. 101. Distribution of *Sehima nervosa* (Rottler) Stapf in southern Peninsular India

margin scabrous–scabridulous, hairs hyaline, 0.1–0.2 mm long, margins entire, inflex ed portion densely pilose, hairs hyaline, 2–3 mm long, apex acuminate and setaceous, setae 2–3 mm long, chartaceous, dorsal surface scabridulous and vesicular, ventral surface scabridulous, dorsally 2-grooved, grooves shallow, greenish, 9-nerved, nerves dark greenish. *Upper glume* narrowly ovate, 7.5–8 × *ca.* 1.5 mm, cymbiform, margins infolded at upper 2/3rd or 3/4th, inflexed at lower 1/3rd or 1/4th, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex acuminate, shortly setaceous, chartaceous, dorsal surface puberulent, hairs very minute and hard to see, ventral surface glabrous, 3-nerved. *Lower lemma* narrowly ovate–elliptic, 7–7.5 × 1.3–1.8 mm, margins inflexed at lower 1/4th, infolded at upper 3/4th, margins ciliate at upper 3/4th, hairs hyaline, 0.5–0.8 mm long, entire or sparsely ciliate on lower 1/4th, apex acute–obtuse, or notched, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 2-nerves prominent. *Lower palea* narrowly ovate–elliptic, 6.5–7 × 1–1.2 mm, margins infolded at upper 2/3rd, inflexed at lower 1/3rd, margins entire or sparsely ciliate, hairs hyaline, 2–3 mm long, apex acute–obtuse, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 2-nerves prominent. *Lodicules* 2, cuneate, 0.4–0.5 × 0.3–0.4 mm. *Upper lemma* narrowly ovate–elliptic, *ca.* 6.5 × 1–1.2 mm, margins infolded at upper 2/3rd or 3/4th, inflexed at lower 1/4th or 1/3rd, infolded margins ciliate, hairs hyaline, 0.5–0.8 mm long, apex acute, membranous, dorsal surface puberulent, more hairs seen on submarginal portion, ventral surface glabrous, hyaline, 3-nerved. *Upper palea* narrowly elliptic–lanceolate, *ca.* 6.5 × 0.8 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, margins sparsely ciliate towards upper half, hairs hyaline, 0.2–0.3 mm long, apex obtuse, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.5–0.6 × 0.3–0.5 mm. *Stamens* 3; anthers 3–3.2 mm long, yellowish; filament hyaline. *Caryopsis* ellipsoid, 2.5–3 × *ca.* 0.6 mm, brownish, style somewhat persistent.

Flowering & Fruiting: October to November.

Distribution: Eritrea to S. Tropical Africa, Arabian Peninsula & S. Central China to Tropical Asia. In India, it is distributed in Andhra Pradesh, Bihar, Chhattisgarh,

Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Rajasthan, Tamil Nadu and Telangana. It is common in Eastern Ghats than Western Ghats. In southern Peninsular India, it is widely distributed in Andhra Pradesh, Tamil Nadu and Telangana than Karnataka and Kerala.

Habitat: Hill slopes and Scrub Jungles.

Specimens examined: INDIA, **Andhra Pradesh**, Anantapuramu [Anantapur] district, Anantapur, 13.12.1911, *s.coll.* 3430 (DD); Chittoor district, Chittoor Reserve Forest, 06.10.1938, *K.C. Jacob* 436 (MH); Guntur district, Kondaveedu Fort, 12.10.2017, *V. Drisya* 157120 [CALI184770] (CALI); Kondaveedu Sacred Groove, 12.10.2015, *J. Swamy & S. Nagaraju* 007193; Nagarjuna Konda Sacred Groove, 13.10.2015, *J. Swamy & S. Nagaraju* 007238 (BSID); Nagarjuna Konda Valley, 14.07.1961, *K. Ahoshashri* 9669 (CAL); Perecherla, 10.10.2017, *V. Drisya* 157104 [CALI184750, CALI184751, CALI184752, CALI184754 & CALI184759] (CALI); Kadapa district, Balapalle, 20.02.1963, *J.L. Ellis* 15712 (MH); on the way to Polathala, Ganganapalli, 08.10.2016, *J. Swamy & S. Nagaraju* 009062 (BSID); Kurnool district, Chelama Hill top, 16.10.1964, *J.L. Ellis* 22055 (MH); Gundlabrahmeswaram, Nallamalais, 29.11.1969, *J.L. Ellis* 32674 (MH); Kurnool Hills, 00.00.1870, *R.H. Beddome s.n.* (MH); Manchalakatta, 00.02.1883, *J.S. Gamble* 18669; *s.loc.*, 00.02.1887, *J.S. Gamble* 18669 (DD); Nellore district, Nellore, 26.10.1917, *C.E.C. Fischer* 4193 (CAL & FRC); Palnadu district, Macherla, 11.10.2017, *V. Drisya* 157112 [CALI184771, CALI184772, CALI184773 & CALI184774] (CALI); Prakasam district, Malcondaperta, 03.08.1986, *V.B. Hosagoudar* 83979 (BSID); Ongole, 23.07.1907, *C.A. Barber* 7951 (FRC); Tirupati district, Talacona Central Beat, Sri Venkateswara National Park, 18.11.2002, *J.H.F. Benjamin* 112978 (BSID); Visakhapatnam district, back of Araku Inspection Bungalow, 11.10.1964, *G.V. Subba Rao* 21560 (MH); Vizianagaram district, Ramateertham, 16.11.1955, *G.H.M.* 154 (DD). **Karnataka**, Belagavi [Belgaum] district, Appachiwadi–Nipani road, 30.03.2009, *Arun M. Chandore* 1129 (SUK);

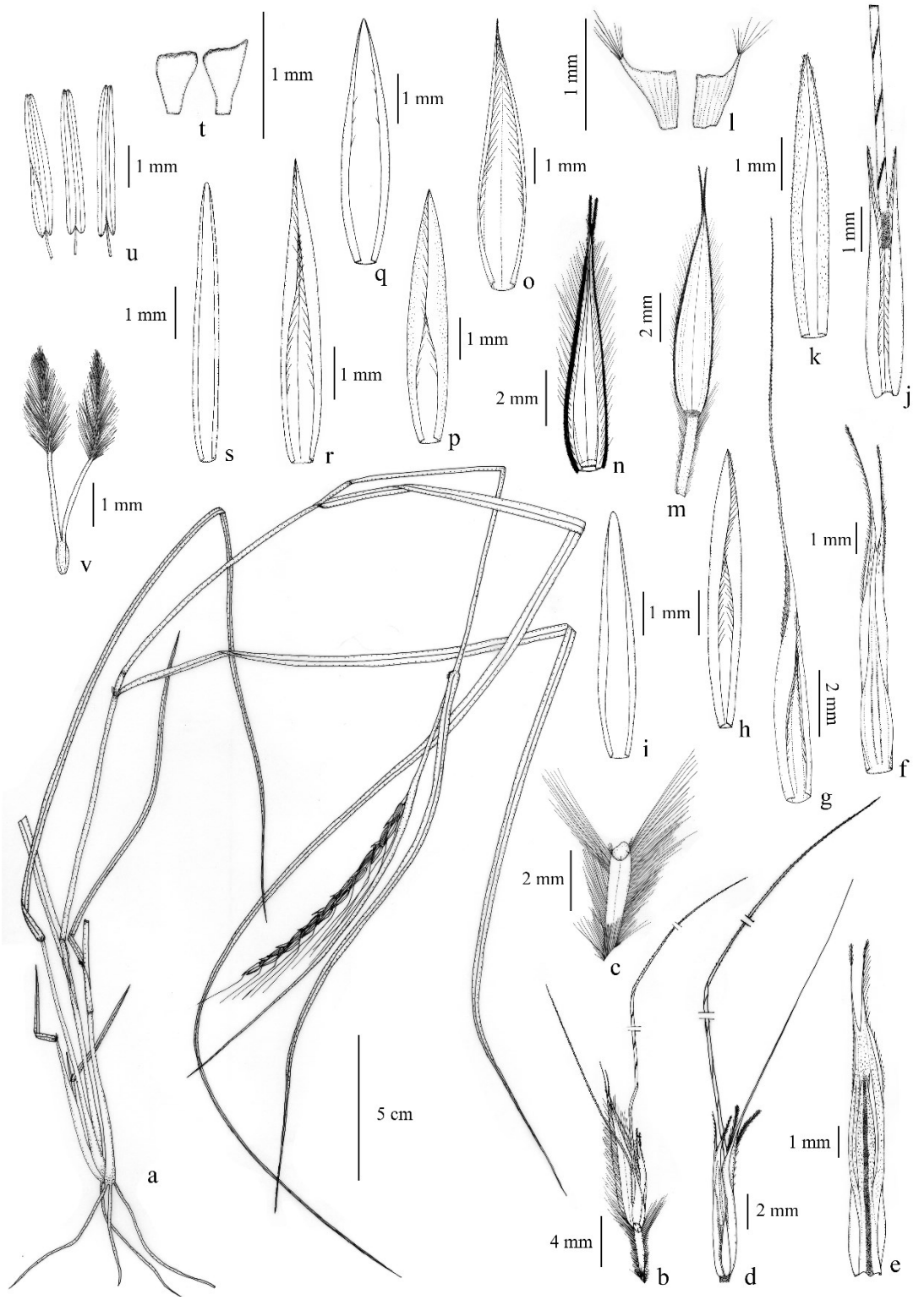

Fig. 102. *Sehima nervosa* (Rottler) Stapf: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Sessile spikelet; **e.** Lower glume-dorsal view; **f.** Lower glume-ventral view; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma; **k.** Upper palea; **l.** Lodicules; **m.** Pedicelled spikelet; **n.** Lower glume; **o.** Upper glume; **p.** Lower lemma; **q.** Lower palea; **r.** Upper lemma; **s.** Upper palea; **t.** Lodicules; **u.** Stamens; **v.** Gynoecium (from *V. Drisya* 169515, drawn by V. Drisya).

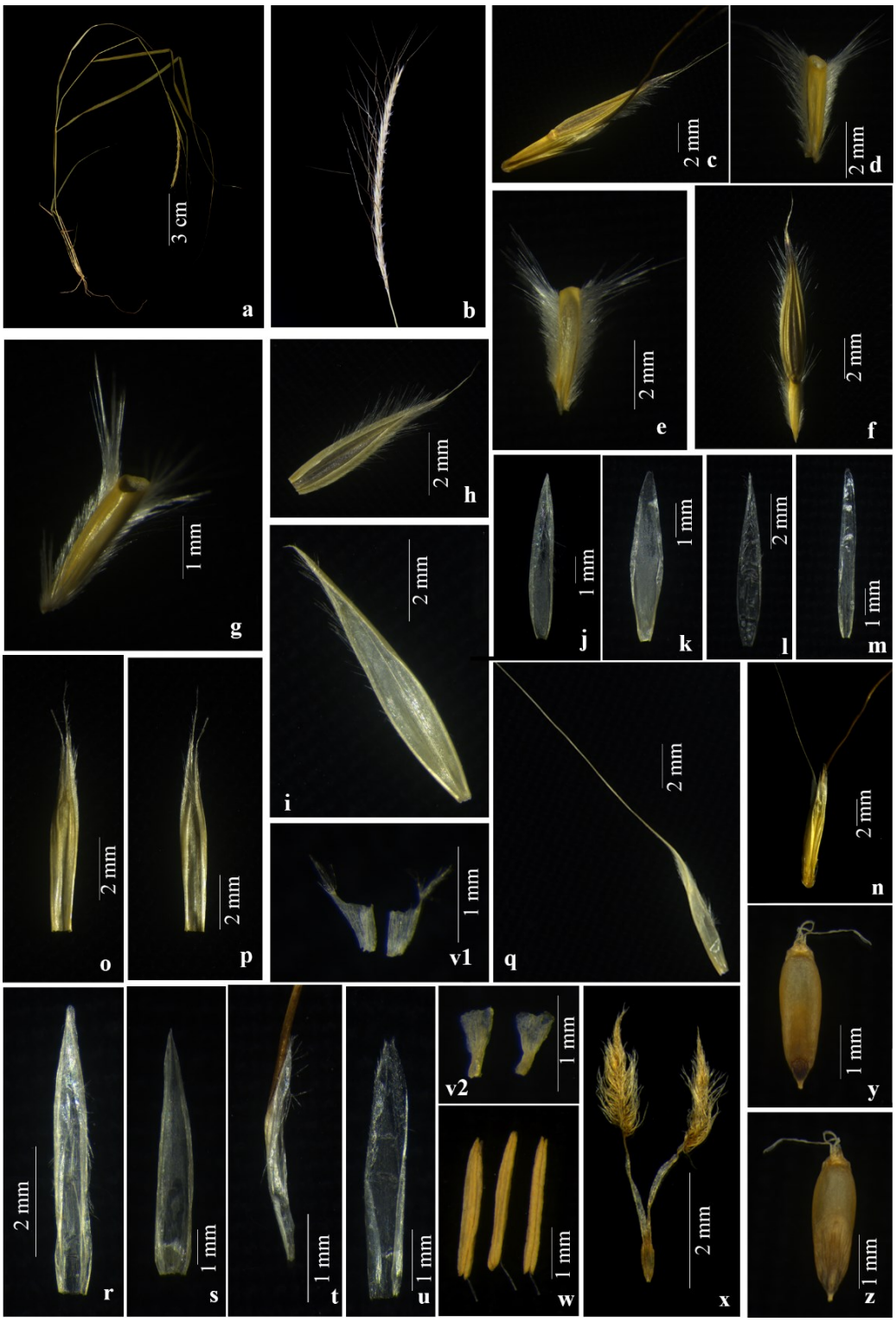

Fig. 103. *Sehima nervosa* (Rottler) Stapf: **a.** Habit; **b.** Single raceme; **c.** Spikelet pair; **d.** Rachis internode-dorsal view; **e.** Rachis internode-ventral view; **f.** Pedicelled spikelet; **g.** Pedicel; **h.** Lower glume; **i.** Upper glume; **j.** Lower lemma; **k.** Lower palea; **l.** Upper lemma; **m.** Upper palea (**f–m:** Pedicelled spikelet); **n.** Sessile spikelet; **o.** Lower glume-dorsal view; **p.** Lower glume-ventral view; **q.** Upper glume; **r.** Lower lemma; **s.** Lower palea; **t.** Upper lemma; **u.** Upper palea (**n–u:** Sessile spikelet); **v1 & v2.** Lodicules from different florets; **w.** Stamens; **x.** Gynoecium; **y.** Caryopsis-dorsal view; **z.** Caryopsis-ventral view.

Naganur, 10.11.1937, *N.L. Bor* 7588 (DD); Bellary district, Bellary Fort, 01.01.2020, *V. Drisya* 169515 [CALI184758, CALI184759, CALI184760, CALI184761, CALI184762, CALI184763, CALI184764, CALI184765, CALI184766, CALI184767, CALI184768 & CALI184769] (CALI); Malapanagudi, 00.10.1889, *J.S. Gamble s.n.*; Sanduru [Sandur], 00.10.1946, Shrinivasamurthi *s.n.* (DD); Ramandrug, 08.10.1919, *s.coll.* 15917 (MH); Chamarajanagar district, Arepalya road, BRT Wildlife Sanctuary, 22.12.2016, *J. Jayanthi* 206571 (BSI); Chikkamagaluru district, Tarikere, 00.10.1908, *A. Meebold* 10588 (CAL); Haveri district, Haveri, 26.12.1899, *W.A. Talbot* 2186 (DD); Mysore district, near Manasagangotri, Mysore University new campus area, 13.11.1963, *s.coll.* 36 (BSI). **Kerala**, Idukki district, on the way to Mattuchola top, 04.01.2019, *V. Drisya* 168789 (CALI); Kannur, Mugu road, 17.10.1981, *P.V. Sreekumar* 71744 (BSID). **Tamil Nadu**, Coimbatore district, Agriculture College Estate, 22.06.1957, *K. Subramanyam* 3530 (CAL); Kurudimalai, 24.11..2002, *K.A.A. Kabeer* 114757; Madukkarai, 09.11.2002, *K.A.A. Kabeer* 114484; Malumitchampatty, way to Pollachi, 15.12.2002, *K.A.A. Kabeer* 114792; Maruthamalai, 27.10.1971, *M.V. Viswanadhan* 1078 (MH); *Ibid.*, 04.12.2017, *V. Drisya* 157757 [CALI184755, CALI184756 & CALI184757] (CALI); Palamalai Hills, P.N. Palayam, 13.12.2003, *K.A.A. Kabeer* 117219 (MH); Parappalar Dam, Udumelpet, 12.11.1986, *K.M. Matthew* 47342 (RHT); Upper Aliyar Dam, 24.01.2004, *K.A.A. Kabeer* 117717 (MH); Dindigul district, Kodaikanal, 28.10.1956, *S.C. Agarwal* 685 (DD); Erode district, Hassanur, 22.06.1929, *K. Cherian* Jacob 018567 (MH); Kanyakumari district, Marunthuvalmalai, 30.11.2005, *K.A.A. Kabeer* 118627, *Ibid.*, 30.11.2005, *K.A.A. Kabeer* 118629; *Ibid.*, 30.11.2005, *K.A.A. Kabeer* 118631 (MH); Maruthwamalai, 30.10.2015, *V. Drisya* 144268 (CALI); Madurai district, Madurai, Aerodrome area, 27.10.1956, *P.C. Nanda* 646; *Ibid.*, Millowners Bungalow, 27.10.1956, *P.C. Nanda* 705 (DD); Madurai Kamaraj University Campus, 12.02.2002, *K.A.A. Kabeer* 113238 (MH); Nilgiri district, Ebanad (Koir Peak and surroundings), 11.09.1970, *G.V. Subba Rao* 36636 (MH); North Arcot district, Tippukadu R.F., 26.11.1963, *K. Ramamurthy* 17929 (MH); Ramanathapuram district, Kamuthi, 31.10.1988, *V. Balasubramaniam* 1958 (MH); Salem district,

Gonur R.F. off Kunjandiyur, Mettur, 21.12.1976, *K.M. Matthew & V. Alphonse Raj* 5982 (RHT); Mannur R.F., 24.11.1961, *P.C. Nanda* 3294 (CAL); Yercaud, 10.12.2017, *Nikhil Krishna & V. Drisya* 157765 (CALI); South Arcot district, Chettupattu to Pennathur, 19.02.1979, *K. Ramamurthy* 60317 (MH); Ulundurpettai, Pulloorkkadu, 18.03.1984, *K.M. Matthew & S.J. Britto* 29835 (RHT); Virudhunagar district, Sokkanathan Puthur Hill, Rajapalayam, 26.01.2003, *K.A.A. Kabeer* 114885 (MH). **Telangana**, Hyderabad district, Hyderabad, 00.00.1941, *M.R. Saxena* 198; *Ibid.*, 00.00.1941, *M.R. Saxena* 213; *Ibid.*, 00.00.1941, *M.R. Saxena* 214; *Ibid.*, 00.00.1941, *M.R. Saxena* 233 (DD); Karimnagar district, Kodimial, 28.09.1965, *G.V. Subba Rao* 25673 (MH); Mancherial district, Kawal Tiger Reserve, Birsaipet-Range, Gandigopalpur-Beat, 27.10.2013, *P.S. Annamma* 003984 (BSID).

Additional specimens examined (from other than study area): INDIA, **Madhya Pradesh**, Ujjain district, Kolping, Maksi, 07.11.2017, *V. Drisya* 157707 (CALI).

Notes: *Sehima nervosa* can easily be identified by the pedicels and rachis internode (joint of rachis) being densely pilose on both the margins.

Typification: *Andropogon nervosus* Rottler, the basionym of *Sehima nervosa* (Rottler) Stapf, was originally published by Rottler (1803) as '*Andropogon nervosum*. *Nob., hab. ad radices montium*' in 4th volume of *Der Gesellsschaft Naturforschender Freunde zu Berlin, neue Schriften*. Later, Roemer and Schultes (1817) provided a brief description for

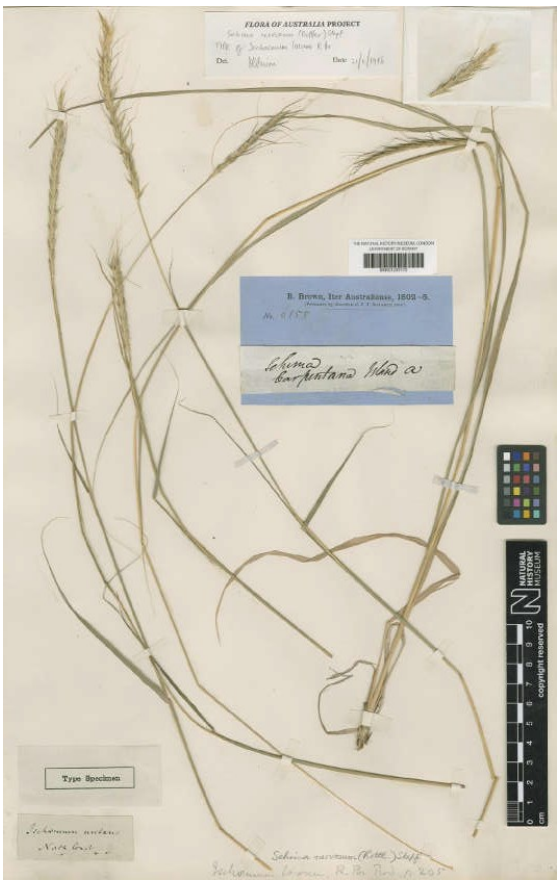

Fig. 104. Lectotype of *Ischaemum laxum* R.Br. [*R. Br.* 5560 (BM001209170)] © The Board of Trustees of The Natural History Museum, London. Reproduced with permission.

Andropogon nervosus and cited reference to Rottler's (1803) treatment. Apart from this, Roemer and Schultes also mentioned the habitat is in India as '*In Ind. or.*' While searching for the original materials of *Sehima nervosa*, the authors could trace two sheets of Rottler's collection, one at K and the other at JE. The single sheet with a 'Herbarium Rottlerianum' label available at K, bears two gatherings with spikelets, collected from different localities in Tamil Nadu state of India. The sheet bear annotation labels referring to three different localities, *viz.*, 'Palamcotta' [Palayamkottai], 'Tekkumalei' [Tekkumalai], and 'Wandawasi' [Vandavasi]. The labels, Palamcotta and Tekkumalei are seen more closer to the two well preserved specimens, hence we assume that one specimen may be from Palayamkottai [barcode K000245767] and the other may be from Tekkumalai [barcode K000974834]. Another sheet available at JE [barcode JE00007303] bears an annotation label having locality as Wandawasi, but without a 'Herbarium Rottlerianum label'. From these three available specimens (one sheet from K with two gatherings and one sheet from JE), the well-preserved specimen at K [barcode K000245767], possibly collected by Rottler from Palayamkottai having a brief description is selected here as the lectotypte. Whereas, the other specimen from Tekkumalai on the same sheet at K [barcode K000974834] and the remaining sheet at JE [barcode JE00007303] constitutes other original materials.

Ischaemum laxum was originally published in 1810 by Robert Brown in his *Prodromus Florae Novae Hollandiae*. While publishing this name, Robert Brown did not cite any specific material upon which the name was based. However, a number of herbarium sheets belonging to Robert Brown's collection from Australia are available in various herbaria. Probably, these materials would also include the original materials. There are two such sheets available at herbarium BM [BM001209170 digital image! & BM001209171 digital image!], two sheets at herbarium E [barcode E00393659 digital image! & barcode E00393660 digital image!] and a single sheet at herbarium K [barcode K000974832 digital image!]. The specimens at BM [barcode BM001209170 & barcode BM001209171] and K [K000974832] are seen and verified by B.K. Simon for 'Flora of Australia Project'. Moreover, Simon verified one of the sheets at BM with collection number 6155

[barcode BM001209170] as the 'type of *Ischaemum laxum* R.Br. by using an annotation label. Whereas, the two specimens at E were verified by M. Lazarides. However, these 5 sheets constitute the syntypes of *I. laxum*. According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), a single specimen should be selected to serve as a lectotype. Hence, one of the well-preserved specimens at BM (barcode BM001209170), with collection number 6155 and which is verified by B.K. Simon as 'type' is selected here as the lectotype. The other sheets having the same collection number R. Br. 6155 constitutes the isolectotypes. Thus, the two specimens at K [K000974832] and E [E00393660] constitutes isolectotypes, since these two sheets having collection number as R. Br. 6155. Whereas, rest of the two specimens (BM001209171 & E00393659) remains as other original materials.

2. Sehima sulcata (Hack.) A.Camus, Bull. Mus. Natl. Hist. Nat. 27: 373. 1921; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1724. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 219. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 125. 1976; Sur, J. Econ. Tax. Bot. 12(1): 78. 1988; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 258. 1989; S.Moulik, Grasses Bamboos India 2: 301. 1997; Pull., Fl. Andhra Pradesh 3: 1251. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 469. 2009; Potdar *et al.*, Grasses Maharashtra 251. 2012; Pull., Fl. Telangana 3: 1172. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 173. 2017. *Ischaemum sulcatum* Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 248. 1889; Hook.f., Fl. Brit. India 7: 137. 1897. *Lectotype* (designated by Tiwari *et al.*, 2018):—— INDIA, **Maharashtra**, Solapur district, *E. Stead s.n.* (W [W19160035785 digital image!]).

Figs. 105–108

Annuals, upto 45 cm high, geniculately ascending. *Nodes* geniculate, pale brownish or purplish, glaucous; *internodes* terete, 1–7 cm long, glabrous, sometimes sparsely puberulent towards apex near the nodes, greenish. *Leaf sheath* rounded, 2–5 cm long, striated, margins entire, chartaceous, membranous on margins, dorsal surface densely vesicular throughout, scabridulous towards apex, hairs very minute, ventral surface glabrous, greenish. *Leaf blade* narrowly ovate–lanceolate, 6–10 × 0.3–0.5

cm, base rounded, margins scabridulous, apex acuminate, chartaceous, both the surfaces densely scabridulous, hairs minute, *ca.* 0.1 mm long, few tubercle-based hairs seen on ventral surface, tubercle-based hairs 1–1.5 mm long, greenish; collar on both surfaces (dorsal and ventral) and auricle scabrous–pilose hairy, hairs hyaline, 0.4–2.5 mm long. *Ligule* hairy, jointed at the base and appears to be membranous on lower half, hairs hyaline, 1–1.2 mm long. *Raceme* solitary, 7–8 cm long, spikelets paired, one sessile and one pedicelled, awns usually oriented towards one side. *Peduncle* terete, *ca.* 9 cm long, striated, glabrous, puberulent towards upper half, greenish. *Spathe* often leafy with ligule and reduced lamina, 10–11 cm long; sheath 7–7.5 cm long, lamina 3–3.5 cm long. *Rachis internode* clavate, 5–5.5 × 0.3–0.5 mm, base and apex oblique, ventrally compressed and convex, coriaceous, ventral surface membranous, glabrous except margins and base, pilose along one margin, greenish; marginal hairs are subequal in size, hyaline, 1–3 mm long, scabridulous on other margin, hairs minute, base pilose, hairs hyaline and 0.1–3 mm long. *Sessile spikelet* bisexual, with 2-florets, 2-awned, narrowly elliptic, 9–10 × 0.8–1 mm, greenish. *Lower glume* narrowly ovate, *ca.* 9 × 1.5 mm, cymbiform, rounded on the back with a longitudinal slit like deep groove, margins entire, inflexed at lower half or lower 2/3rd, upper half or upper 1/3rd infolded and keeled, keel winged, wing scabridulous, apex shortly setaceous, chartaceous, dorsal surface scabridulous–vesicular, ventral surface glabrous, greenish, 6-nerved. *Upper glume* awned, narrowly ovate, 5.8–6 × *ca.* 1.3 mm, cymbiform, margins inflexed at

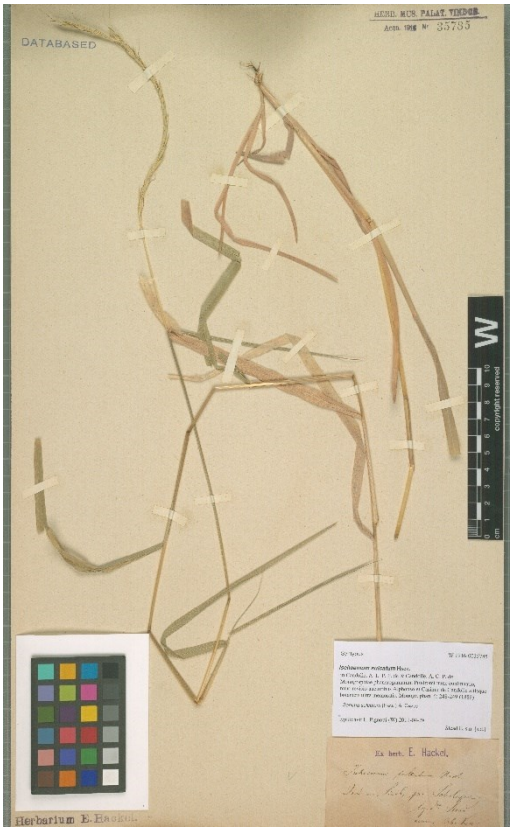

Fig. 105. Lectotype of *Sehima sulcata* (Hack.) A.Camus [*E. Stead s.n.* (W19160035785)] © The Board of Trustees of Natural History Museum, Vienna.

lower half, narrowly infolded at upper half, infolded margins or submargins ciliate, hairs hyaline, 0.3–0.6 mm long, apex acute–acuminate, chartaceous, dorsal surface puberulent, ventral surface glabrous, dorsally keeled towards apex, keel scabridulous, keel extends into an awn, greenish, 3-nerved; *awn* straight, 8–9 mm long, scabridulous, greenish. *Lower floret* male. *Lower lemma* narrowly ovate, 5–5.2 × *ca.* 1.4 mm, margins inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, ciliate at upper half, hairs hyaline, 0.2–0.3 mm long, keeled towards apex (nearly at upper 1/4th), keel scabridulous, apex notched or bifid, membranous, dorsal surface glabrous or puberulent and infolded portions sparsely scabridulous, ventral surface glabrous, hyaline, 2-nerved. *Lower palea* narrowly ovate–elliptic, *ca.* 5 × 1 mm, margins inflexed at lower 1/3rd lower half, infolded at upper 2/3rd or upper half, ciliate at upper 1/3rd or upper half, hairs hyaline, 0.1–0.2 mm long, infolded margins shortly keeled near apex, keel scabridulous, apex notched or bifid, membranous, dorsal surface glabrous or puberulent, ventral surface glabrous, hyaline, 2-nerved. Lodicules 2, cuneate, 0.3–0.4 × 0.2–0.3 mm. Stamens 3; anthers 2.5–3 mm long, yellowish; filament hyaline. *Upper floret* bisexual. *Upper lemma* ovate, 5.2–5.5 × 0.8–1.3 mm, cymbiform, margins inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, ciliate at upper 2/3rd, entire near base, hairs hyaline, 0.3–0.5 mm long, apex bilobed, lobe 1–1.5 mm long, awned from the sinus, membranous, dorsal surface puberulent, hairs very hard to see, ventral surface glabrous, hyaline, 3-nerved. *Awn* twisted, geniculate, 24–25 mm long, brownish; column *ca.* 12.5 mm long, scabridulous along spiral and median line, dark brownish; bristle *ca.* 11.5 mm long, scabridulous throughout, pale brownish. *Upper palea* narrowly ovate, 5–5.5 × 0.8–1 mm, margins entire, inflexed at lower 1/4th, infolded at upper 3/4th, shallowly keeled at upper 1/3rd, keel scabridulous, apex obtuse, membranous, dorsal surface glabrous except scabridulous infolded portion, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.6–0.8 × 0.3–0.4 mm. *Stamens* 3, anthers 3.5–3.8 mm long, yellowish; filament hyaline. *Gynoecium* 5–6 cm long; ovary narrowly elliptic–elliptic, 0.8–1× 0.3–0.5 mm; style 2, *ca.* 2.5 mm long, hyaline; stigma 2, plumose, 1.8–2 mm long, purple. *Pedicelled spikelet* male with 2-florets, narrowly ovate, *ca.* 8.5 × 1–1.2 mm, greenish. *Pedicel* linear, clavate or broad at apex, 5–6 × 0.2–0.3

mm long, convex, hollow, coriaceous, ventral surface membranous, glabrous–sparsely scabridulous, densely pilose only along one margin and base, greenish; hairs along margin are subequal in size, hyaline, 1–3 mm long, basal hairs 0.5–3 mm long, other margin minutely scabridulous. *Lower glume* narrowly ovate, 8–8.5 × *ca.* 1 mm, margins entire, inflexed, infolded near apex, keeled and winged throughout, wing broader towards apex, wing margin scabridulous, apex bifid, chartaceous, dorsal surface puberulent or vesicular, ventral surface glabrous, dorsally not grooved, flat, sometimes shallowly depressed, greenish, 7-nerved. *Upper glume* narrowly ovate, *ca.* 6 × 1–1.2 mm, cymbiform, margins inflexed, narrowly infolded at upper half, ciliate and scabrous on margins and submargins at upper half, hairs hyaline, 0.3–0.6 mm long, apex acute–acuminate or shortly mucronate, chartaceous, dorsal surface puberulent–scabridulous, ventral surface glabrous, pale greenish–hyaline, 3-nerved. *Lower lemma* narrowly ovate, *ca.* 5.5 × 1–1.2 mm, margins inflexed at lower 1/4th to1/3rd, infolded at upper 3/4th or 2/3rd, infolded margins ciliate at upper half and infolded portions scabridulous, hairs hyaline, *ca*. 0.1 mm long, apex acute or notched, membranous, dorsal surface puberulent or glabrous and sparsely scabridulous near apex, ventral surface glabrous, hyaline, 2-nerved. *Lower palea* narrowly ovate–elliptic, 4.8–5 × *ca.* 0.8 mm, margins infolded at upper 2/3rd, inflexed at lower 1/3rd, margins ciliate on upper half, hairs hyaline, 0.1–0.2 mm long, infolded margins shallowly keeled, keel entire or sparsely scabridulous near apex, apex acute or notched, membranous, dorsal surface glabrous or puberulent, ventral surface glabrous, hyaline, 2-nerved. *Lodicules* 2, cuneate, 0.3–0.4 × 0.3–0.4 mm. *Upper lemma* narrowly ovate, *ca.* 5.5 × 1–1.2 mm, margins infolded at upper 2/3rd, inflexed at lower 1/3rd, infolded margins ciliate, hairs hyaline, 0.2–0.4 mm long, apex bifid with a minute central arista, membranous, dorsal surface glabrous except scabridulous or puberulent infolded marginal portions, ventral surface glabrous, hyaline, 3-nerved. *Upper palea* narrowly ovate–elliptic, *ca.* 5 × 0.8 mm, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, laterally shallowly keeled near apex, keel sparsely scabridulous, apex obtuse or notched, membranous, dorsal surface glabrous or puberulent, ventral surface glabrous, hyaline, 2-nerved.

Lodicules 2, cuneate, 0.4–0.5 × 0.2–0.3 mm. *Stamens* 3; anthers 3 mm long, yellowish; filament hyaline. *Caryopsis* not seen.

Flowering & Fruiting: October to January.

Distribution: India and Myanmar. In India, it is distributed in Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Telangana. It is poorly represented in southern Peninsular India.

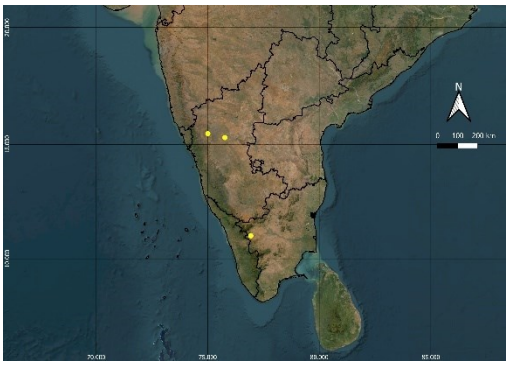

Fig. 106. Distribution of *Sehima sulcata* (Hack.) A.Camus in southern Peninsular India

Habitat: Open places.

Specimens examined: INDIA, **Karnataka**, Dharwad district, Dharwad, 26.12.1889, *W.A. Talbot* 2186; Dumobal, 21.02.1890, *W.A. Talbot* 2324 (BSI); South of Hubli, 00.02.1919, *Sedgwick* 9946 (BLAT). **Tamil Nadu**, Coimbatore district, Central Farm (cultivated), Coimbatore, 01.02.1967, *E. Vajravelu* 19788 (MH).

Additional specimens examined (from other than study area): INDIA, **Madhya Pradesh**, Ujjain district, Vikram University Campus, 06.11.2017, *V. Drisya* 157705 [CALI184780, CALI184781 & CALI184782] (CALI). **Maharashtra**, Kolhapur district, Shivaji University Campus, 14.01.2017, *V. Drisya* 171420 [CALI184775, CALI184776, CALI184777, CALI184778 & CALI184779] (CALI).

Notes: This species is exceptional for its annual habit with pedicel and rachis interdode having pilose hairs only along one margin. The lower glume of the sessile spikelet rounded on the back with a deep longitudinal slit-like groove.

The occurrence of this species is rare and not common in southern Peninsular India. Authors could examine southern Peninsular Indian herbarium specimens available at BSI, BLAT and MH but the present description and illustrations are based on author's own collections from Madhya Pradesh and Maharashtra.

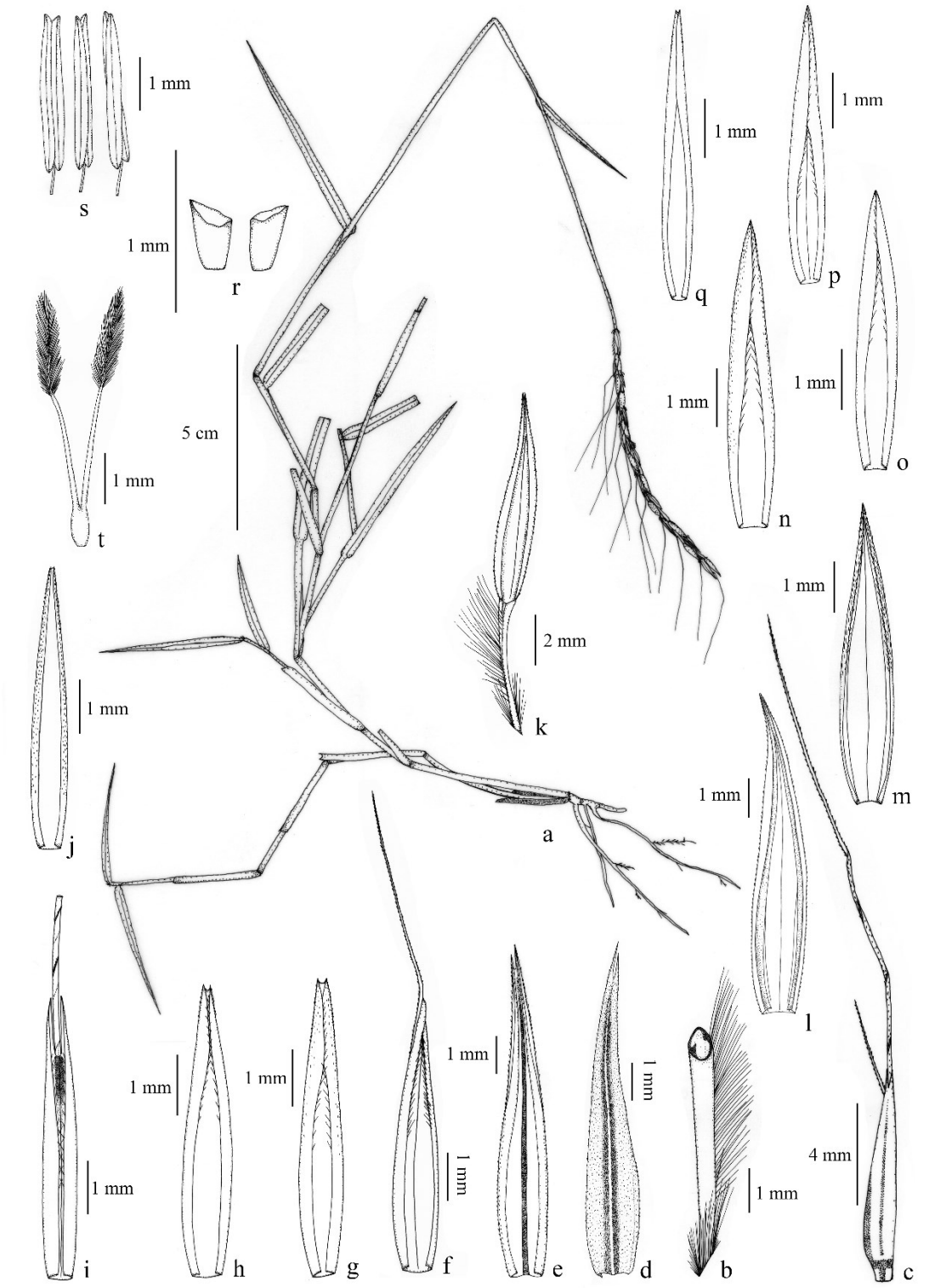

Fig. 107. *Sehima sulcata* (Hack.) A.Camus: **a.** Habit; **b.** Rachis internode; **c.** Sessile spikelet; **d.** Lower glume-dorsal view; **e.** Lower glume-ventral view, **f.** Upper glume; **g.** Lower lemma; **h.** Lower palea; **i.** Upper lemma; **j.** Upper palea; **k.** Pedicelled spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Lower palea; **p.** Upper lemma; **q.** Upper palea; **r.** Lodicules; **s.** Stamens; **t.** Gynoecium (from *V. Drisya* 171420, drawn by V. Drisya).

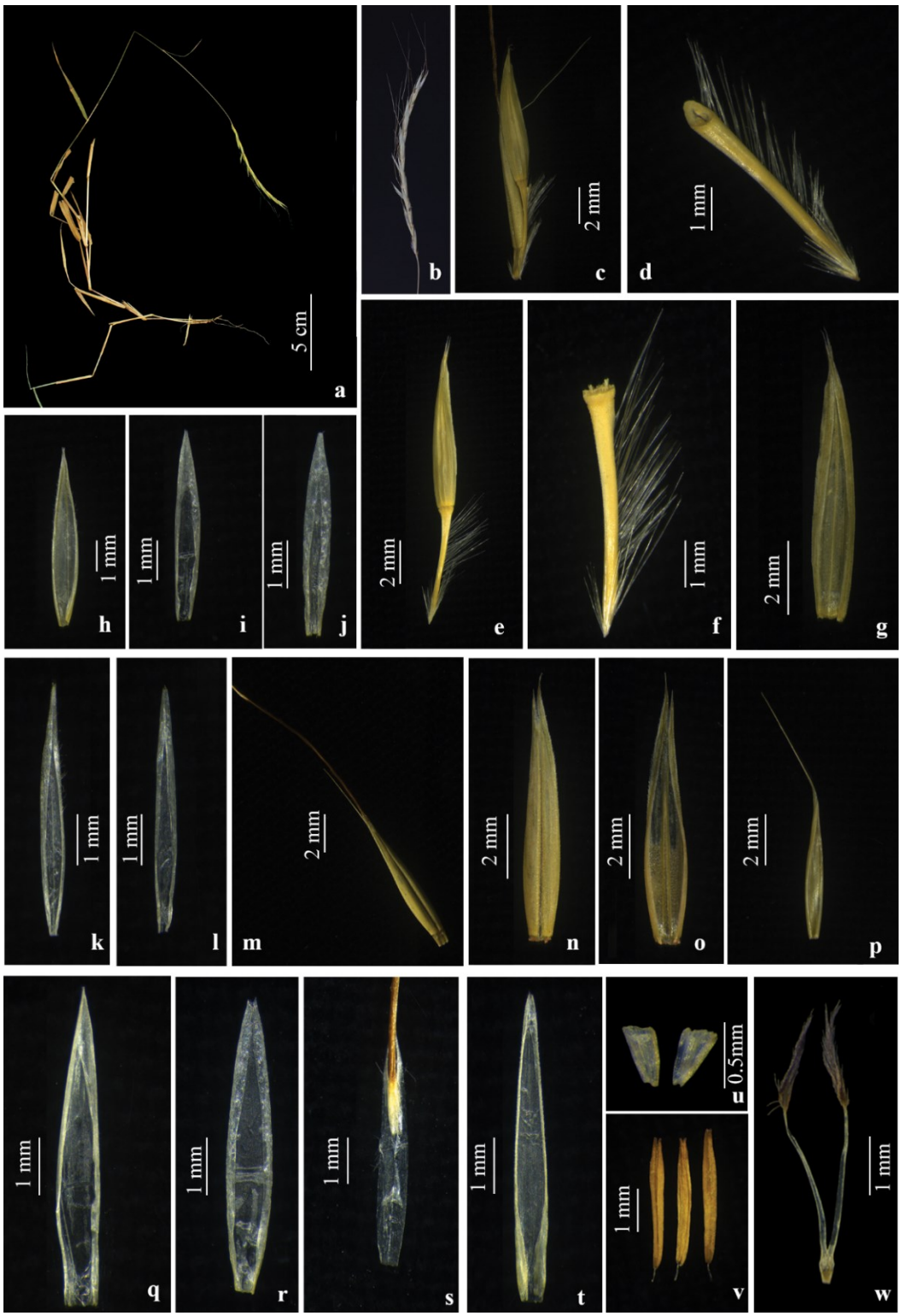

Fig. 108. *Sehima sulcata* (Hack.) A.Camus: **a.** Habit; **b.** Single raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Pedicel; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Lower palea; **k.** Upper lemma; **l.** Upper palea (**e–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume-dorsal view; **o.** Lower glume-ventral view; **p.** Upper glume; **q.** Lower lemma; **r.** Lower palea; **s.** Upper lemma; **t.** Upper palea (**m–t:** Sessile spikelet); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium.

4. Thelepogon Roth ex Roem. & Schult.

Thelepogon Roth ex Roem. & Schult., Syst. Veg. 2: 46 & 788. 1817; Clayton & Renvoize, Gen. Gram., Grasses World: 346. 1986; Watson & Dallwitz, Grass Gen. World: 938. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 296. 2015. *Type*: *Thelepogon elegans* Roth ex Roem. & Schult.

Annuals, often rooting from lower nodes. *Leaf blade* with base cordate or sub-cordate and margins undulate. *Ligule* membranous or fringed membrane. *Inflorescence* terminal, racemes digitate, 2–many, rarely solitary. *Rachis internode* clavate. *Spikelets* paired, *pedicelled spikelet* reduced into pedicel. *Lower glume* of the sessile spikelet dorsally rugose to warty ridged with or without scabrous hairs. *Upper lemma* awned from the sinus. *Awn* geniculate.

Distribution: Monotypic genus distributed mainly in Tropical Africa and Asia.

Habitat: Open areas.

Thelepogon elegans Roth ex Roem. & Schult., Syst. Veg. 2: 46 & 788. 1817; Hook.f., Fl. Brit. India 7: 148. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1893. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan. 247. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 126. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 268. 1989; S.Moulik, Grasses Bamboos India 1: 302. 1997; Pull., Fl. Andhra Pradesh 3: 1263. 1997; Potdar *et al.*, Grasses Maharashtra 265. 2012; Pull., Fl. Telangana 3: 1181. 2015. *Neotype* (designated by Turner, 2021): INDIA, Concan, *Law s.n.* (K [K001129785 digital image!]).

Figs. 109–112

Annual, robust, branched, erect herb, 20–150 cm tall, rooting at lower nodes, lower internodes prostrate or erect. *Nodes* pilose–glabrous, hairs hyaline, upto 1 mm long. *Internodes* terete, 1.5–6 cm long, glabrous, greenish. *Leaf sheath* keeled, 1.5–2.5(5) cm long, one margin entire, other margin tubercle-based hairy, hairs 1–2 mm long, chartaceous, dorsal surface densely tubercle-based hairy, hairs hyaline, 1–2.5 mm long, ventral surface glabrous, smooth, greenish. *Leaf blade* narrowly ovate–

lanceolate, amplexicaul, 3–20 cm long, base cordate–subcordate, margins undulate, scabrid, hairs 0.1–0.3 mm long; apex acuminate, dorsal and ventral surface tubercle-based hairy, hairs hyaline, 0.5–2 mm long, greenish. *Ligule ca*. 1 mm long, ciliate at apex, cilia 0.3–0.5 mm long, membranous, hyaline. *Inflorescence* terminal, racemes digitate, 2–many, sometimes only 1. *Peduncle* 9–14 cm long, scabridulous, glabrous towards base, pilose–glabrous at apex; hairs hyaline, 0.4–0.8 mm long, greenish with purple spots. *Callus of the spikelet pair* truncate–rounded, pilose, hairs hyaline, 0.2–1.2 mm long. *Rachis* jointed, fragile, greenish; *rachis internode* clavate, swollen, *ca.* 6.5 × 0.5–1.5 mm, subcoriaceous–coriaceous, shortly 3-angled, laterally compressed and convexed, dorsal angle scabrous, scabridulous towards base, hairs 0.1–0.3 mm long, apex scabrous–scabridulous, hairs 0.1–0.3 mm long, dorsal surface pilose at base, hairs hyaline, 0.2–1.2 mm long, dehisce along with spikelet pair. *Spikelets* paired. *Sessile spikelet* ovate, 5–5.4 × *ca.* 1.5 mm, greenish. *Lower glume* ovate, 5–5.2 × 1.5-1.8 mm, cymbiform, margins inflexed, keeled towards apex, keel scabrous, hairs hyaline, 0.1–0.3 mm long, apex acuminate, coriaceous, ventral surface glabrous, dorsal surface rugose–warty ridged with or without scabrous hairs, scabridulous towards margin, pilose at base, hairs hyaline, 0.1–1 mm long; greenish, 9-veined. *Upper glume* narrowly ovate, *ca.* 5.5 × 1–1.5 mm, cymbiform, margins narrowly inflexed, ciliate, hairs hyaline, 0.1–0.3 mm long, apex acuminate, coriaceous, subcoriaceous–membranous towards margin, ventral surface glabrous, dorsal surface transversely ridged or warty with or without scabrous hairs and puberulent, dorsally keeled towards apex, keel scabrous–scabridulous, hairs 0.1–0.3 mm long; pale greenish, 3-veined. *Lower lemma* ovate-narrowly ovate, 4–4.5 × 1.5–1.8 mm, margins infolded, ciliate at upper

Fig. 109. Neotype of *Thelepogon elegans* Roth ex Roem. & Schult. [*Law s.n.* (K001129785)] © The Board of Trustees for The Royal Botanic Gardens, Kew.

half, apex obtuse and ciliate, hairs hyaline, 0.2–0.3 mm long, membranous, dorsal surface glabrous–very sparsely puberulent, ventral surface glabrous; hyaline, 2-veined. *Lower palea* ovate–narrowly ovate, *ca.* 3.5 × 1.5–1.8 mm, margins entire–sparsely ciliolate, hairs usually seen towards apex, 0.1–0.2 mm long and hyaline, infolded, narrowly keeled, keel scabridulous at upper half, apex notched, membranous, dorsal and ventral surface glabrous, hyaline, 2-veined. *Upper lemma* ovate, *ca.* 4 × 1.8–2 mm, cymbiform, margins entire, ciliate towards apex, hairs hyaline, 0.1–0.2 mm long, apex bilobed, awned from the sinus, membranous, dorsal surface glabrous, ventral surface sparsely scabridulous, hyaline, 3-veined. *Awn* geniculate, *ca.* 18 mm long, twisted, scabridulous, brownish; column *ca.* 7 mm long, scabridulous–sparsely scabridulous, dark brownish; bristle *ca.* 11 mm long, scabridulous, pale brownish. *Upper palea* ovate–narrowly ovate, *ca.* 3 × 0.7–0.9 mm, margins ciliate, infolded, keeled, hairs *ca.* 0.1 mm long, keel scabridulous; apex obtuse–notched, sometimes ciliolate; membranous, dorsal surface glabrous–sparsely puberulent, ventral surface glabrous; hyaline, 2-veined. *Lodicules* 2, cuneate or triangular, 0.4–0.6 × 0.4–0.6 mm, fleshy or membranous, hyaline. *Stamens* 3; anthers 1.8–2.5 mm long, yellowish. *Gynoecium ca.* 3.5 mm long; ovary narrowly elliptic, 0.7–0.8 × 0.2–0.4 mm, pale brownish; style 2, *ca.* 0.8 mm long, hyaline; stigma 2, feathery, 1.8–2 mm long, purple. *Pedicelled spikelet* reduced to a pedicel, linear, *ca.* 6 × 0.4–0.5 mm, vesicular, margins scabrous and sparsely tubercle-based hairy, hairs usually seen along one margin and towards the apex of the other, hairs hyaline, 0.1–1 mm long, apex obtuse, ventrally compressed, chartaceous–subcoriaceous, dorsally sparsely scabridulous, hairs hyaline, 0.1–0.2 mm long, ventral surface sparsely scabridulous-glabrous, hairs *ca.* 0.1 mm long; greenish. *Caryopsis* narrowly elliptic, *ca.* 2.5 × 0.8 mm, brownish, style persistent.

Flowering & Fruiting: September to January.

Distribution: Tropical Africa to Namibia, India to W. Indo-China, S. Malesia. In India, it is distributed in Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil

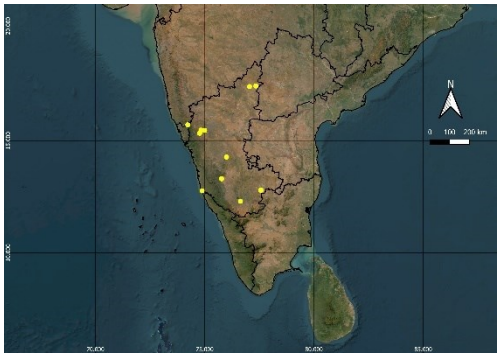

Fig. 110. Distribution of *Thelepogon elegans* Roth ex Roem. & Schult. in southern Peninsular India

Nadu and Telangana.

Habitat: Open areas, hill sides and bunds of paddy fields.

Specimens examined: INDIA, **Karnataka**, Belgaum district, Kankumbi, 01.09.2007, *Arun M. Chandore* 366 (SUK); Bengaluru district, Bannerghatta, 13.01.1957, *G. Saran & party* 40769 (LWG); Dharwad district, Alnavar, near railway line, 20. 09.1890, *W.A. Talbot* 2303 (BLAT & BSI); Dharwad, 00.10.1916, *L.G. Sedgwick* 9488 (BLAT); Bada (Malgudi), 18.11.1997, *P.V. Prasanna* 176754 (BSI); Gulburga district, Sulahpet, 27.10.1979, *S.R. Ramesh & S.B. Manohar* 10084 (CAL); Kodagu district, Andanpura, near Hebbale on road to Fraserpet from Banavar, 17.10.1963, *A.S. Rao* 94774 (BSI); Mysore district, Banneraghatta, 10.01.1953, *H.C. Govindu s.n.*; *Ibid.*, 15.01.1953, *H.C. Govindu s.n*. (MH); Mysore, *s.d.*, *s.coll.*, 16617 (BSI); Chikmagalur, 02.11.1964, *R.S. Raghavan* 104078 (BSI); Uttara Kannada district, Haliyal, 30.11.1889, *W.A. Talbot* 2142 (CAL & BSI); *Ibid.* 10.12.1889, *W.A. Talbot* 2094 (BSI); Malabar & Concan, *s.d.*, *Stocks & Law s.n.* (CAL).

Additional specimens examined (from other than study area): INDIA, **Madhya Pradesh**, Ujjain district, Kolping, Maksi, 07.11.2017, *V. Drisya* 171434 [CALI184783, CALI184784, CALI184785, CALI184786 & CALI184787] (CALI). **Maharashtra**, Kolhapur district, Kolhapur, 08.01.2017, *V. Drisya* 171424 [CALI184788, CALI184789, CALI184790, CALI184791 & CALI184792] (CALI).

Notes: The plant is usually found growing luxuriantly in black cotton soil. It is not common in southern Peninsular India. Authors could examine the southern Peninsular Indian specimens available at various herbaria, BLAT, BSI, CAL, LWG, MH and SUK. The present description and illustrations are mainly based on author's own collection from Madhya Pradesh and Maharashtra.

The generic name *Thelepogon elegans* appeared first in *Systema Vegetabilium* 2 (1817) which was a nomen nudum. However, the generic name was valid as a description to it was provided by Roth (Turland *et al.*, 2018). Since no specimen was cited by the author in the protologue, Turner (2021) considered the name constituting a "descriptio- generico-specifica" for *Thelepogon* and *T. elegans*, and a specimen at K collected by Law from Concan, India was designated as the neotype.

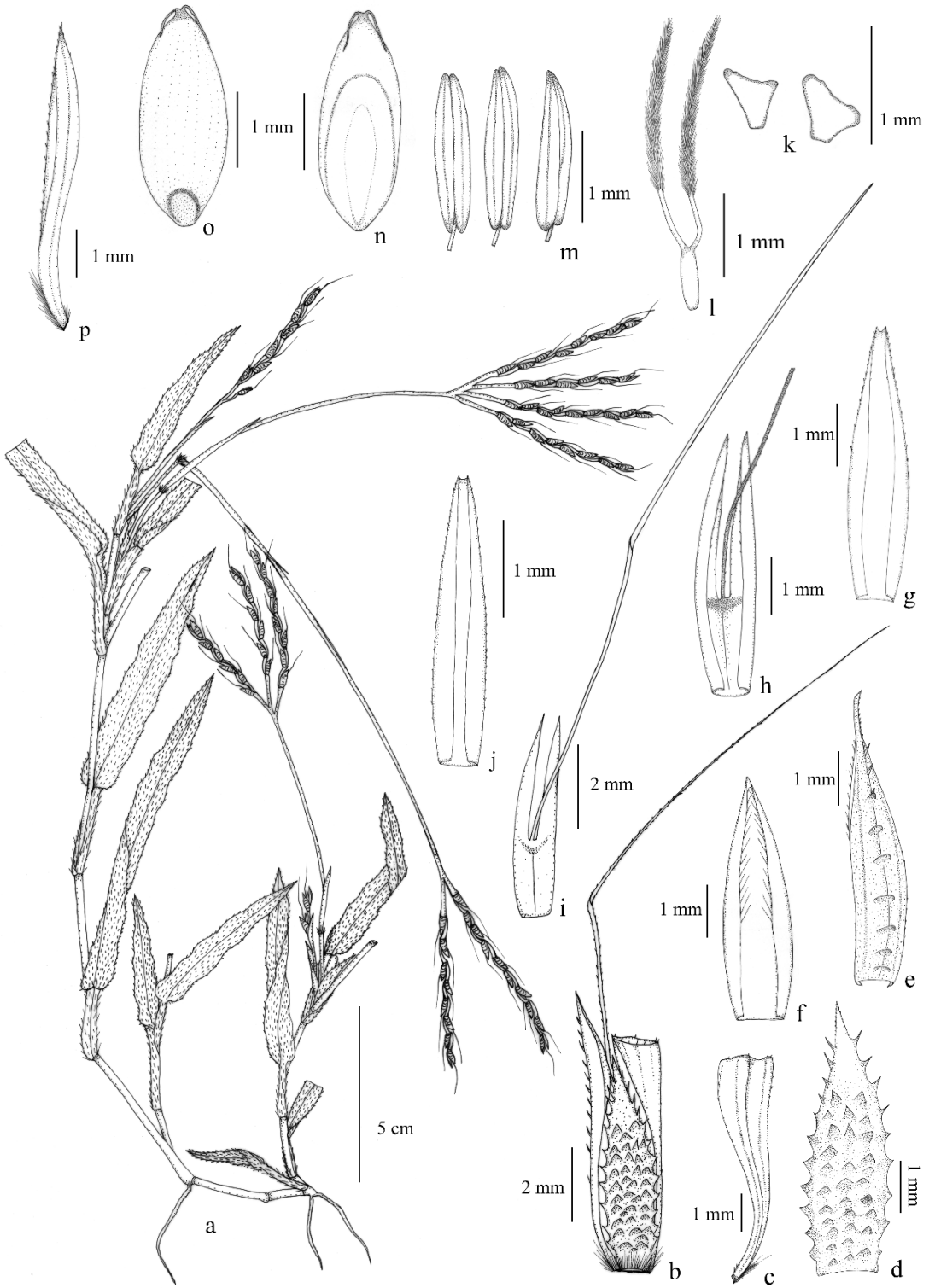

Fig. 111. *Thelepogon elegans* Roth ex Roem. & Schult.: **a.** Habit; **b.** Spikelet pair with rachis internode; **c.** Rachis internode; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Lower palea; **h.** Upper lemma–ventral view; **i.** Upper lemma–dorsal view; **j.** Upper palea; **k.** Lodicules; **l.** Gynoecium; **m.** Stamens; **n.** Caryopsis–ventral view; **o.** Caryopsis–dorsal view (**d–o**: Sessile spikelet); **p.** Pedicelled spikelet (reduced) (from *V. Drisya* 171424, drawn by V. Drisya).

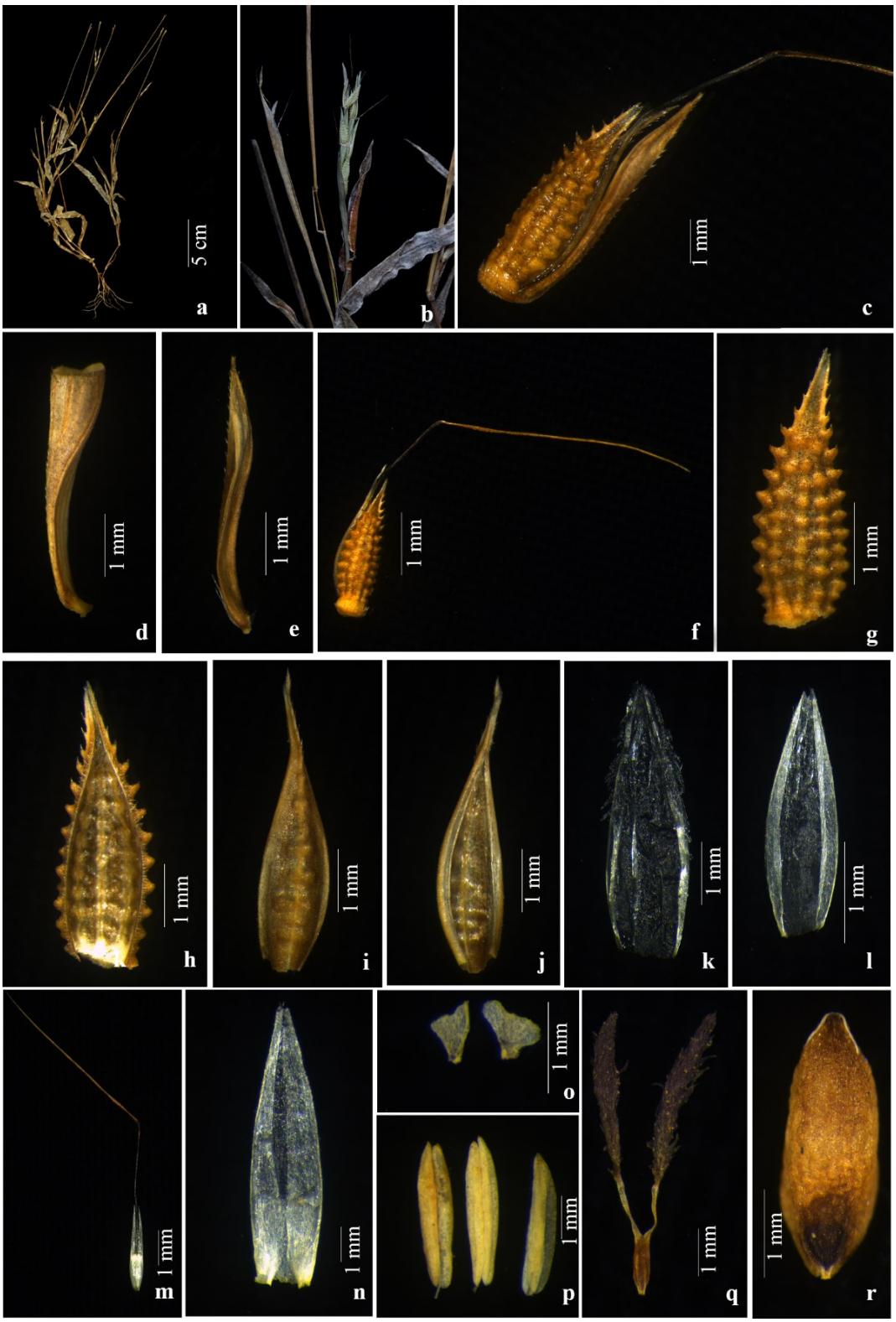

Fig. 112. *Thelepogon elegans* Roth ex Roem. & Schult.: **a.** Habit; **b.** Raceme; **c.** Spikelet pair; **d.** Rachis internode; **e.** Pedicelled spikelet; **f.** Sessile spikelet; **g.** Lower glume-dorsal view; **h.** Lower glume-ventral view; **i.** Upper glume-dorsal view; **j.** Upper glume-ventral view; **k.** Lower lemma; **l.** Lower palea; **m.** Upper lemma; **n.** Upper palea (**f–n:** Sessile spikelet); **o.** Lodicules; **p.** Stamens; **q.** Gynoecium; **r.** Caryopsis.

Subtribe Anthistiriinae

Anthistiriinae J.Presl, Reliq. Haenk. 1(4–5): 347. 1830 (as 'Anthistiriaceae'); Clayton & Renvoize, Gen. Gram., Grasses World: 354. 1986. *Type*: *Anthistiria* Naezén.

Annuals or perennials. Inflorescence axillary or terminal; single or paired racemes or aggregated into compound panicle. Rachis articulated; rachis internode slender. Spikelets paired, dissimilar, lower pairs often homogamous. Sessile spikelets (except in case of lower homogamous pairs) bisexual, mostly subterete; callus pungent or not; lower glume coriaceous or chartaceous; upper lemma stipitiform, awned, entire or bilobed; awn geniculate. Pedicelled spikelet sometimes with elongated callus.

Distribution: Throughout the tropics and subtropics.

The subtrib. Anthistiriinae include 12 genera with 155 species in the world (Clayton & Renvoize, 1986; modified from POWO); 6 genera with 17 species are represented in southern Peninsular India (Bor, 1960; Kellogg *et al.*, 2020).

Key to the genera of Anthistiriinae *s.l.* in southern Peninsular India

1. Inflorescence a false panicle interrupted by spathes and spatheoles **2**
1. Inflorescence solitary or digitate racemes without spathes and spatheoles **4**
2. Involucral spikelets present **3**
2. Involucral spikelets absent ..... 5. ***Pseudanthistiria***
3. Involucral spikelets sessile ..... 6. ***Themeda***
3. Involucral spikelets pedicelled ..... 3. ***Iseilema***
4. Lower glume of upper sessile spikelet chartaceous and greenish; upper lemma bidentate ..... 4. ***Parahyparrhenia***
4. Lower glume of upper sessile spikelet coriaceous and brownish; upper lemma entire **5**

5. Inflorescence unbranched or with digitate unbranched branches; lower glume of upper sessile spikelet medianly grooved .....1. ***Agenium***

5. Inflorescence always unbranched; lower glume of upper sessile spikelet not medianly grooved ..... 2. ***Heteropogon***

1. Agenium Nees

Agenium Nees, Nat. Syst. Bot. (ed.2): 447. 1836; Clayton & Renvoize, Gen. Gram., Grasses World: 359. 1986; Watson & Dallwitz, Grass Gen. World: 78. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 308. 2015. *Type*: *Agenium nutans* Nees.

Perennials, caespitose. *Ligule* membranous or fringed membrane. *Inflorescence* single or subdigitate racemes, terminal or axillary. *Lower sessile spikelet* male. *Upper sessile spikelet* bisexual, lower glume grooved, upper lemma entire with a geniculate awn. *Pedicelled spikelets* male.

Distribution: India, Myanmar and South America (Brazil to Argentina). A total of 4 species available in the world (Clayton & Renvoize, 1986; Watson & Dallwitz, 1992; Kellogg in Kubitzki, 2015).

Habitat: Dry open savanna, hill slopes and bunds of cultivation fields.

Agenium ritchiei (Hook.f.) Drisya & Pradeep, *comb.nov. Andropogon ritchiei* Hook.f., Fl. Brit. India 7: 201. 1897. *Heteropogon ritchiei* (Hook.f.) Blatt. & McCann, J. Bombay Nat. Hist. Soc. 32: 623. 1928; Bor, Grasses Burma, Ceylon, India & Pakistan 165. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 121. 1976; Deshp., Bull. Bot. Surv. India 30(1−4): 124. 1988; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 227. 1989; S.Moulik, Grasses Bamboos India 2: 227. 1997; Potdar *et al.*, Grasses Maharashtra 165. 2012; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 128. 2017. *Lectotype* (designated by Deshpande, 1988):—INDIA, **Karnataka**, Belgaum, *Ritchie* 884 (lecto: BM [*n.v.*]; isolecto: K [K000245946 digital image!], CAL [CAL0000002307!], E [E01007967 digital image!]).

Figs. 113–117

Annuals or perennials, tufted, 30–100 cm tall. *Culm* erect; *node* glabrous, purplish; *internode* 1.5–7.5 cm long, glabrous, pale greenish. *Leaf sheath* keeled, 2–5 cm long, chartaceous, dorsal surface usually densely tubercle-based hairy and that of younger leaves somewhat glabrous with hairs confined to the margins, ventral surface glabrous, hairs yellowish, 1–2.5 mm long; greenish. *Leaf blade* narrowly ovate–lanceolate, 2.5–14 × 0.5–1 cm, base rounded, margins scabridulous and tubercle-based hairy, apex acuminate, chartaceous, both abaxial and adaxial surface densely tubercle-based hairy, with scabridulous–puberulent hairs on abaxial surface and with or without puberulent on adaxial surface, tubercle-based hairs yellowish, 1–4 mm long, greenish. *Ligule* narrowly ovate–lanceolate, 2–3 mm long, apex divided into small lobes, membranous, glabrous with bulbous based hairs on dorsal surface along lateral margins, hyaline. *Inflorescence* terminal, solitary raceme, 2–8 cm long (including awn), densely tubercle-based hairy, hairs yellowish. *Spathe* 6–9 cm long, rounded or keeled, leafy with or without reduced lamina, chartaceous, dorsal surface glabrous or puberulent, with tubercle-based hairs on margins and sub-margins, ventral surface glabrous, greenish. *Spikelets* paired, one sessile and one pedicelled with basal homogamous and upper heterogamous pairs. *Peduncle* 9–12 cm long, tuberclae-based hairy, greenish, hairs hyaline–pale yellowish, 0.5–3 mm long. *Rachis* jointed, rachis internode linear, 2–2.5 mm long, base and apex oblique, dorsally or dorsi-ventrally compressed, coriaceous–subcoriaceous, pilose on base and margins towards apex, sometimes hairy along entire margin; yellowish green, hairs 0.5–1.5 mm long, golden brownish, or golden brownish–hyaline hairs seen in lower pair. *Lower spikelet pairs* 2–3, homogamous,

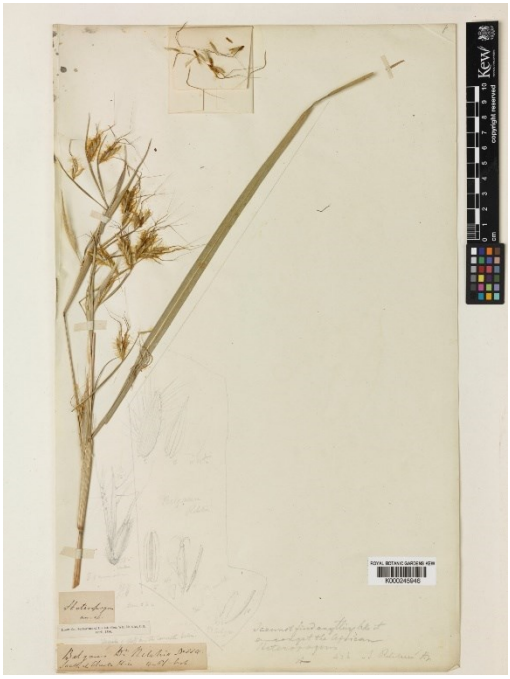

Fig. 113. Lectotype of *Agenium ritchiei* (Hook.f.) Drisya & Pradeep [*Ritchie* 884 (K000245946)] © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

male; callus oblique, not pungent, pilose, hairs brownish, 0.1–2 mm long. *Lower sessile* spikelet narrowly elliptic, 6.5–7 × *ca.* 1 mm, greenish, tubercle-based hairy. *Lower glume* narrowly ovate, 10.5–11 × 1–1.2 mm, cymbiform, margins entire, inflexed at lower half, infolded and keeled at upper half, one margin broadly infolded as compared to the other, keel scabridulous, shallowly winged on one margin; apex acute–acuminate, chartaceous, dorsal surface tubercle-based hairy along submarginal area, hairs yellowish, 1–3 mm long, ventral surface glabrous, greenish, 10–12-nerved, nerves inconspicuous. *Upper glume* narrowly ovate or narrowly elliptic, 6.5–7 × 1.5–2.2 mm, cymbiform, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margins ciliate, hairs hyaline, 0.5–0.8 mm long, apex acute–acuminate, chartaceous, dorsally keeled on upper 3/4th, dorsal surface and keel scabridulous, ventral surface glabrous, pale greenish, 3-nerved. *Lower lemma* narrowly ovate or narrowly elliptic, *ca.* 7 × 1–1.2 mm, margins inflexed at lower half, infolded at upper half, infolded margins ciliate, hairs hyaline, 0.3–0.6 mm long, apex truncate or acute, membranous, dorsal and ventral surface glabrous, hyaline, 1-nerved. *Lower palea* absent or reduced. *Upper lemma* linear–lanceolate, *ca.* 6 × 0.6–1 mm, sometimes folded, margins entire, infolded, apex acute–minutely aristate, ciliate–ciliolate, membranous, dorsal surface and ventral surface glabrous, hyaline, 1-nerved. *Upper palea* present or absent, narrowly elliptic–linear, 1.5–2 × *ca.* 0.2 mm, apex bifid, sparsely cilate, margins entire, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.8–1 × 0.5–0.6 mm, hyaline. *Stamens* 3; filaments hyaline; anthers *ca.* 4.5 mm long, yellowish. *Lower pedicelled spikelet* narrowly elliptic, twisted, 10–11 × *ca.* 1.5 mm, tubercle-based hairy, greenish. *Callus* elongated, linear–oblong, 1–1.2 × 0.3–0.6 mm long, dorsiventrally compressed, base oblique, subcoriaceous, very sparsely scabridulous or puberulent, greenish, hairs very minute. *Pedicel* oblique, 1–1.2 mm long, coriaceous, glabrous, yellowish green. *Lower glume* narrowly ovate, twisted, 8–9 × 1.5–2 mm, margins entire, one margin inflexed, other margin infolded and keeled throughout, keel winged, wing margin entire, scabridulous near apex, apex acute–acuminate, chartaceous, dorsal surface tubercle-based hairy, hairs seen throughout along the submarginal area of infolded margin and at along upper 1/4th of that of the inflexed margin , tubercle-based hairs

yellowish, 2–3.5 mm long, ventral surface glabrous, greenish, 15–18-nerved, sometimes shallow median depression seen on dorsal surface. *Upper glume* narrowly ovate–elliptic, 8–9 × 1.5–2 mm, cymbiform, twisted, margins ciliate, hairs hyaline, 0.8–1 mm long, one margin infolded, other inflexed at lower half and infolded at upper half, apex acute, chartaceous, dorsally keeled near apex, dorsal surface and keel scabridulous, ventral surface glabrous, pale greenish, 3-nerved. *Lower lemma* narrowly elliptic, 7.5–9 × 1–2 mm, cymbiform, margins inflexed at lower 1/4th or lower half, infolded at upper 3/4th or upper half, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex acute, membranous, dorsal and ventral surface glabrous, hyaline, 1-nerved. *Lower palea* absent or reduced. *Upper lemma* narrowly elliptic–linear, 6–7.5 × 0.5–1 mm, margins inflexed at lower 3/4th or lower half, infolded at upper 1/4th or upper half, infolded margins sparsely ciliate, hairs hyaline, 0.5–0.8 mm long, apex acute–mucronulate, membranous, dorsal surface and nerve sparsely scabridulous, ventral surface glabrous, hyaline, 1-nerved. *Upper palea* narrowly elliptic–linear, 2.5–3 × 0.2–0.3 mm, apex acute or shortly bifid and sparsely ciliate–ciliolate, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 1 × 0.8–0.9 mm, hyaline. *Stamens* 3; filaments hyaline; anthers 2–2.2 mm long, yellowish. *Upper heterogamous pair* 7; callus oblique, pungent, densely pilose; hairs brownish, 0.1–2 mm long. *Upper sessile spikelet* bisexual, subterete, 5.5–7 × 0.6–1 mm, brownish. *Lower glume* oblong, *ca.* 5 × 1 mm, dorsally grooved, margins entire, incurved, apex obtuse or rounded, coriaceous, dorsal surface densely scabridulous except on groove, hairs pale brownish–hyaline, 0.1–0.2 mm long, ventral surface glabrous, brownish, nerves inconspicuous. *Upper glume* narrowly ovate or narrowly elliptic, 5–5.5 × 0.8–1 mm, cymbiform, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margin ciliate, hairs hyaline, 0.3–0.6 mm long, apex acute, coriaceous, dorsally keeled, keel broad, grooved on both sides of the keel, dorsal surface scabridulous on broad keel, hairs pale brownish–hyaline, 0.1–0.2 mm long, ventral surface glabrous, brownish, nerves inconspicuous. Lower floret reduced or absent, sometimes lower lemma present. *Lower lemma* narrowly ovate, 3.8–4.5 × 1–1.2 mm, margins entire, ciliate near apex, apex obtuse–rounded and ciliate, hairs hyaline, 0.3–0.5 mm long, membranous, glabrous, hyaline, nerves

not seen. *Lower palea* absent or reduced. *Upper lemma* reduced to the hyaline base of the awn, linear, 3–3.5 mm long, membranous. *Awn* 3.3–3.5 cm long, twisted, geniculate, scabridulous, brownish; column *ca.* 1.8 cm long; bristle *ca.* 1.5 cm long. *Upper palea* narrowly ovate–linear, 1–1.8 × 0.3–0.5 mm, apex acute–acuminate, or lobed, margins sparsely ciliate at upper half, hairs hyaline, 0.2–0.5 mm long, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 1 × 0.4–0.5 mm. *Stamens* 3; filaments hyaline; anthers 3–4.5 mm long, yellowish. *Ovary* oblong, 1.2–1.5 × 0.3–0.4 mm, glabrous, brownish; style 2, 1.5–2 mm long, jointed at base, glabrous, hyaline; stigma 2, feathery, 1.8–5 mm long, purplish. *Upper pedicelled spikelet* narrowly elliptic, *ca.* 9 × 1–1.5 mm, twisted, tubercle-based hairy, greenish, tubercle-based hairs yellowish. *Callus* elongated, oblong, thickened towards apex, 1.5–2 × 0.4–0.6 mm, dorsi-ventrally compressed, base oblique, subcoriaceous, sparsely scabridulous–pilose, greenish, hairs pale brownish, 0.1–0.5 mm long. *Pedicel* oblong, *ca.* 1.5 × 0.2–0.3 mm, dosiventrally compressed, base and apex oblique, coriaceous, brown pilose hairs seen at base and few on apex, hairs 1–2 mm long. *Lower glume* narrowly ovate or elliptic, 7.5–9 × 1.5–2 mm, cymbiform, twisted, margins entire, one margin inflexed, other margin infolded and keeled, keel winged throughout, wing margin entire, scabridulous near apex, apex acute–acuminate, chartaceous, dorsal surface tubercle-based hairy, tubercle-based hairs seen on upper 1/4th, throughout along the submarginal portion of one margin (usually along infolded and keeled margin) and at upper 1/4th of that of the other margin, tubercle-based hairs yellowish, 2–5 mm long, sometimes few tubercle-based hairs present on the ventral surface of the wing, ventral surface glabrous, greenish, 15–18-nerved, nerves inconspicuous. *Upper glume* narrowly ovate or elliptic, 6.5–8 × 1–1.8 mm, cymbiform, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margins ciliate, hairs hyaline, 0.3–0.5 mm long, apex acute–acuminate, dorsally keeled near apex, chartaceous, dorsal surface scabridulous, ventral surface glabrous, greenish, 3-nerved. *Lower lemma* narrowly elliptic, 6.5–8 × 0.8–1 mm, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margins ciliate, hairs hyaline, 0.3–0.5 mm long, apex acute, membranous, dorsal surface sparsely scabridulous, ventral surface glabrous, hyaline with green nerve, 1-nerved. *Lower*

palea reduced or absent. *Upper lemma* linear–lanceolate, 5.5–7.5 × 0.5–0.6 mm, margins inflexed or infolded at lower half, infolded and ciliate at upper half, hairs hyaline, 0.2–0.3 mm long, apex acute–shortly aristate, membranous, dorsally shallowly keeled near apex, keel scabridulous, dorsal surface sparsely scabridulous, ventral surface glabrous, hyaline, 1-nerved. *Upper palea* narrowly elliptic–lanceolate, 2.5–3 × 0.3–0.4 mm, apex acute or dissected, apex and margins sparsely ciliate, hairs hyaline, 0.2–0.3 mm long, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.5–0.6 × 0.4–0.5 mm. *Stamens* 3; filaments hyaline; anthers 2–3 mm long, yellowish. *Caryopsis* not seen.

Flowering & Fruiting: September to January.

Distribution: Endemic to India. Distributed in Gujarat, Karnataka, Maharashtra and Rajasthan.

Habitat: Hill slopes and on the bunds of cultivation fields.

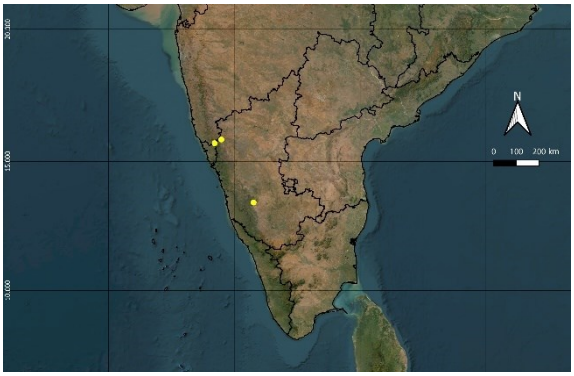

Fig. 114. Distribution of *Agenium ritchiei* (Hook.f.) Drisya & Pradeep in southern Peninsular India

Specimens examined: INDIA, **Karnataka**, Belgaum district, Kankumbi, 30.10.2007, *K.V.C. Gosavi* 2843; *Ibid.*, 20.12.2007, *Arun M. Chandore* 447 (SUK); Chikmagalur district, Baba Budangiri, near Manikyadhara, 03. 03.2016, *V. Drisya* 176716 (CALI).

Notes: In 1928, Blatter and McCann made a new combination in the genus *Heteropogon* as *Heteropon ritchiei* based on Hooker's *Andropogon ritchiei* and provided a reference to Hooker's description. Where as in Hooker's (1897) treatment he had been placed this taxon under the subgenus *Heteropogon* of the genus *Andropogon* and provided a detailed description for *Andropogon ritchiei* as well as a citation as "The Deccan; Belgaum, *Ritchie*" regarding the specimen based on. In this description he had clearly mentioned that lower glume of sessile spikelet is dorsally rufous villous and not chanelled and also it is clear from the

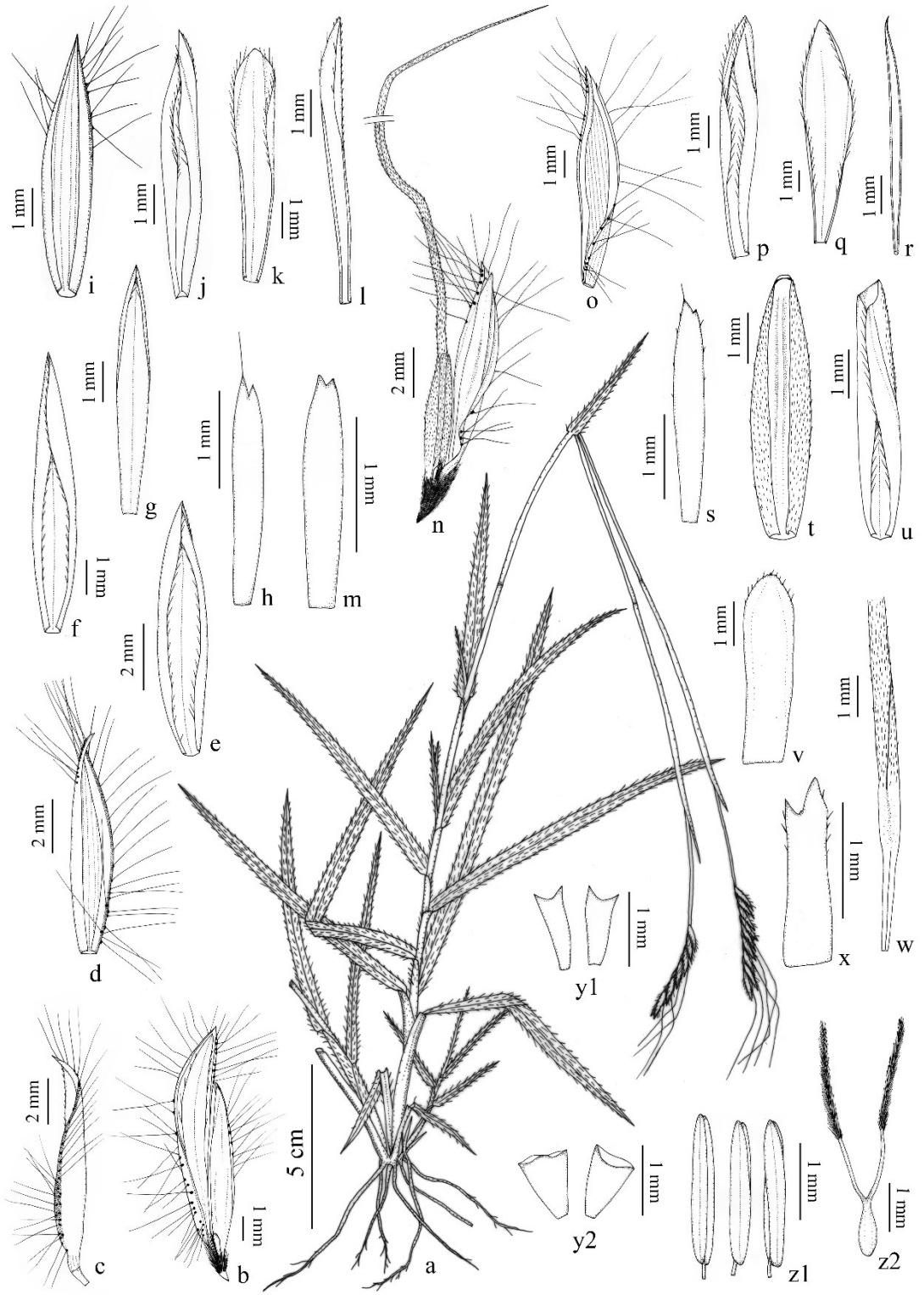

Fig. 115. *Agenium ritchiei* (Hook.f.) Drisya & Pradeep: **a.** Habit; **b.** Lower homogamous spikelet pair; **c.** Lower pedicelled spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Upper lemma; **h.** Upper palea (**c–h**: Lower pedicelled spikelet); **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Upper lemma; **m.** Upper palea (**i–m**: Lower sessile spikelet); **n.** Upper heterogamous spikelet pair; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma; **r.** Upper lemma; **s.** Upper palea (**o**–**s**: Upper pedicelled spikelet); **t.** Lower glume; **u.** Upper glume; **v.** Lower lemma; **w.** Upper lemma; **x.** Upper palea (**t–x**: Upper sessile spikelet); **y1 & y2**. Lodicules; **z1**. Stamens; **z2.** Gynoecium (from *V. Drisya* 176716, drawn by V. Drisya).

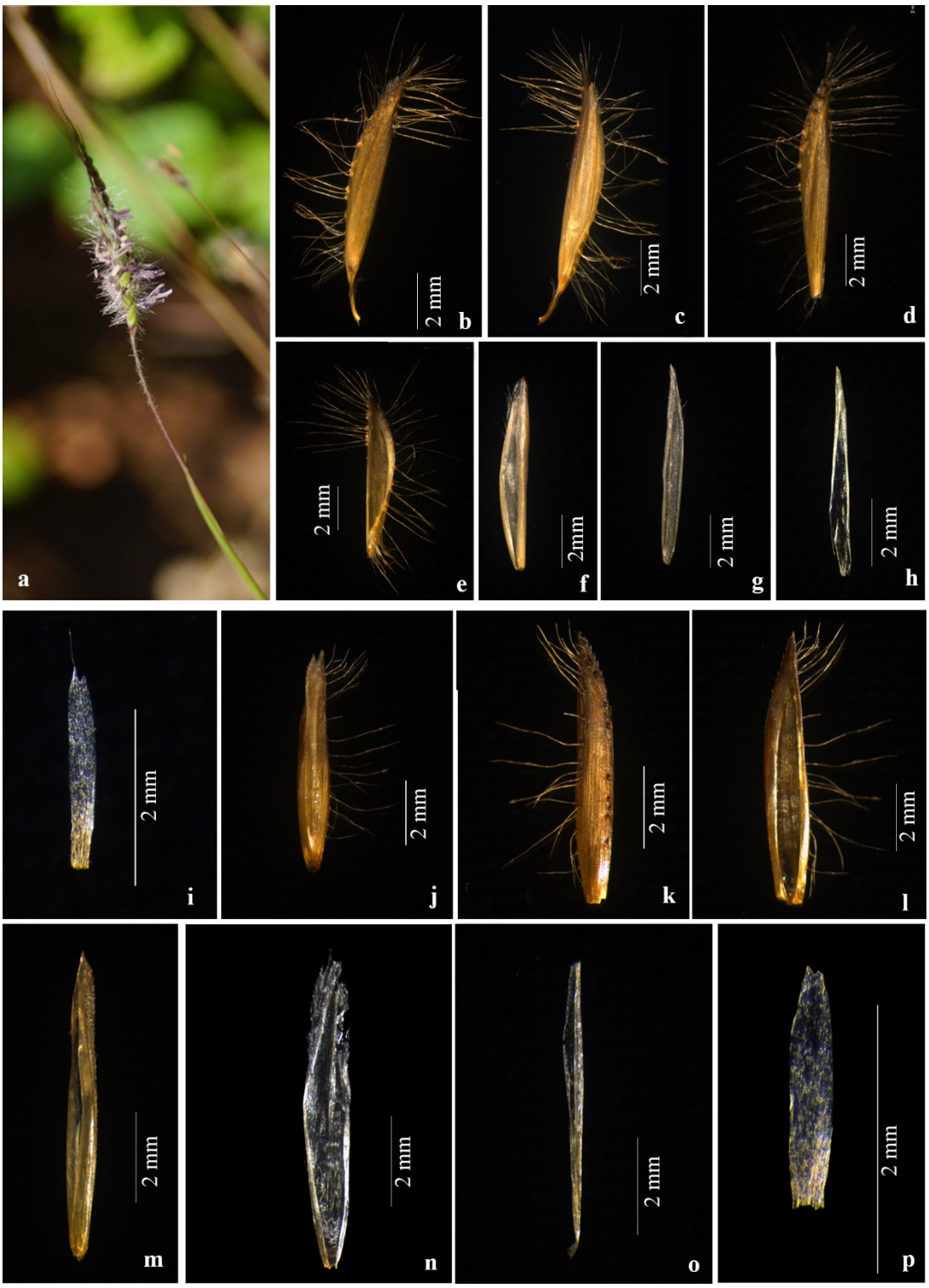

Fig. 116. *Agenium ritchiei* (Hook.f.) Drisya & Pradeep: **a.** Single raceme; **b & c.** Lower pedicelled spikelet (**b:** dorsal view; **c:** ventral view); **d.** Lower glume-dorsal view; **e.** Lower glume-ventral view; **f.** Upper glume; **g.** Lower lemma; **h.** Upper lemma; **i.** Upper palea (**b–i:** Pedicelled spikelet of lower homogamous spikelet pair); **j.** Lower sessile spikelet; **k.** Lower glume-dorsal view; **l.** Lower glume-ventral view; **m.** Upper glume; **n.** Lower lemma; **o.** Upper lemma; **p.** Upper palea (**j–p:** Sessile spikelet of lower homogamous spikelet pair).

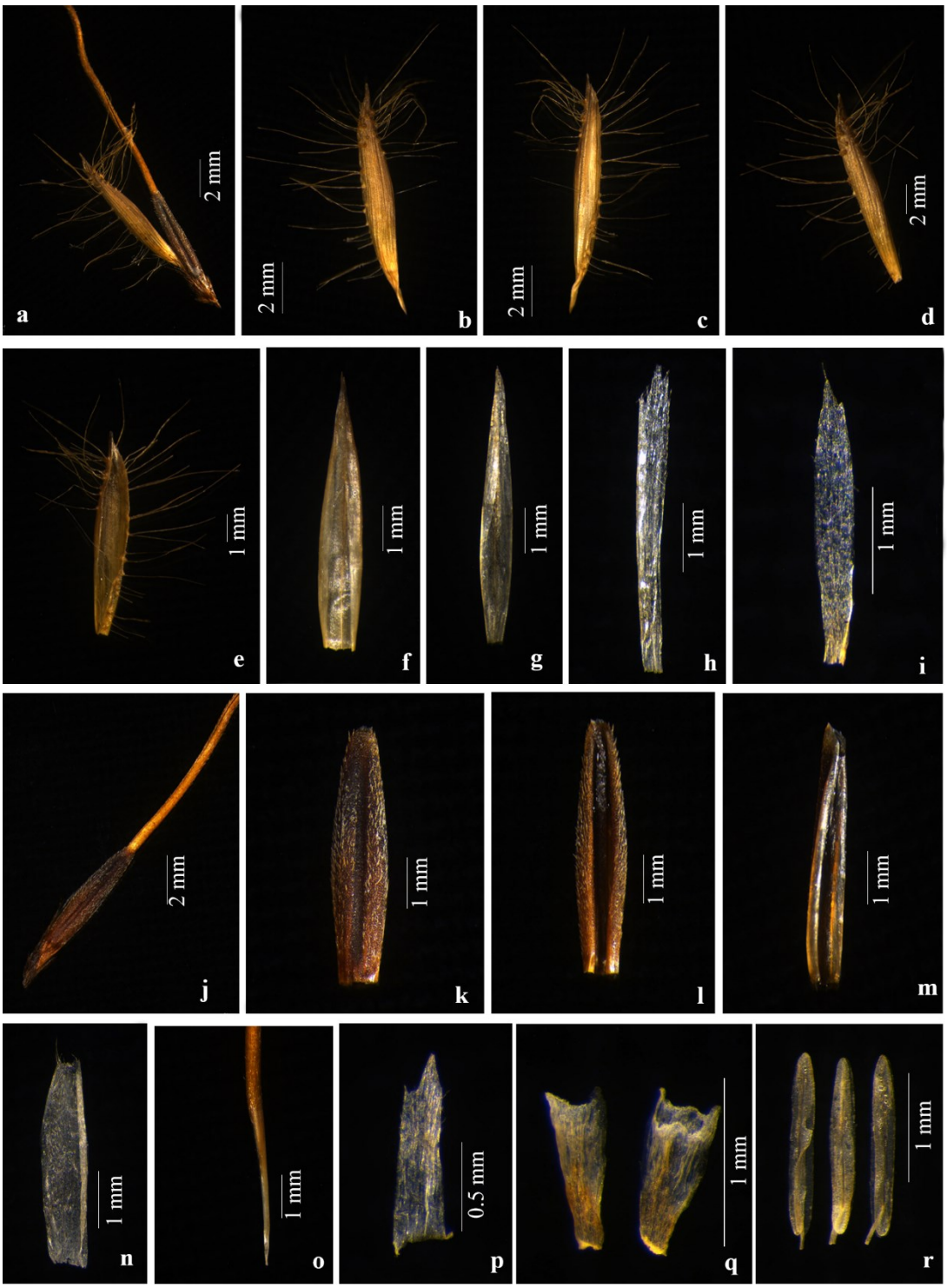

Fig. 117. *Agenium ritchiei* (Hook.f.) Drisya & Pradeep: **a.** Upper heterogamous spikelet pair; **b & c.** Upper pedicelled spikelet (**b:** dorsal view; **c:** ventral view); **d.** Lower glume-dorsal view; **e.** Lower glume-ventral view; **f.** Upper glume; **g.** Lower lemma; **h.** Upper lemma; **i.** Upper palea (**b–i:** Pedicelled spikelet of upper heterogamous spikelet pair); **j.** Upper sessile spikelet; **k.** Lower glume-dorsal view; **l.** Lower glume-ventral view; **m.** Upper glume; **n.** Lower lemma; **o.** Upper lemma; **p.** Upper palea (**j–p:** Sessile spikelet of upper heterogamous spikelet pair); **q.** Lodicules; **r.** Stamens.

description that he was uncertain about the nature of ligule as whether it is 'membranous' or 'a row of stiff bristles connate below' or 'imperfect'. Later in 1988, Deshpande in her revisionary work provided a detailed note about these two characters. According to her, the ligule is membranous and sometimes split upto base into a number of segments, whereas the lower glume of sessile spikelet is channelled and are covered with hairs.

During the revisionary studies on Ischaeminae and Anthistiriinae, the authors could also collect the so called *H. ritchiei* from Karnataka. While studying this specimen we could observe the dorsal groove on the lower glume of sessile spikelet which is normally not visible due to the presence of hairs. The collected specimen strongly agree with the observation made by Deshpande on both the characters such as sessile spikelet lower glume groove as well as nature of ligule, Since our material also posses membranous ligule and some were just started splitting. A thorough study on original materials by Ritchie available at CAL, E and K also supports this view.

All these features support to place *Andropogon ritchiei* under the genus *Agenium* Nees. *Agenium* is an allied genus of *Heteropogon* restricted to South America and are characterized by the presence of dorsal groove on the lower glume of sessile spikelet. Also *Agenium* is separated from *Heteropogon* mainly by the presence and absence of dorsal groove on lower glume of sessile spikelet. Thus, here we propose a new combination in *Agenium* as *Agenium ritchie* (Hook.f.) Drisya & Pradeep.

2. **Heteropogon** Pers.

Heteropogon Pers., Syn. Pl. 2: 533. 1807; Clayton & Renvoize, Gen. Gram., Grasses World: 359. 1986; Deshp., Bull. Bot. Surv. India 30(1−4): 120. 1988; Watson & Dallwitz, Grass Gen. World: 457. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 310. 2015. *Andropogon* L. subgenus *Heteropogon* Hack., Monogr. Phan. 6: 583. 1889; Hook.f., Fl. Brit. India 7: 199. 1897. *Lectotype*

(designated by Nash, 1912):—— *Heteropogon glaber* Pers. *nom. illeg.* [= *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.].

Annuals or perennials, caespitose. *Ligule* membranous or fringed membrane (highly dissected). *Inflorescence* terminal or axillary, hairy or glabrous, single raceme with basal homogamous spikelets and upper heterogamous spikelet pairs. *Callus* of upper spikelet pair pungent. *Upper sessile spikelet* bisexual; *lower glume* not grooved; *upper lemma* entire. *Pedicelled spikelets* male or empty; callus elongated and looks like pedicel; pedicel reduced.

Distribution: Tropics and subtropics. All the three species described in the genus is distributed in India. Two of them occur in southern Peninsular India (Clayton & Renvoize, 1986; Watson & Dallwitz, 1992; Kellogg in Kubitzki, 2015; Kellogg *et al.*, 2020).

Habitat: Common in dry open places.

Key to the species of *Heteropogon* in southern Peninsular India

1. Culms 100─300 cm tall; lower glume of upper sessile spikelet 7─7.5 mm long, dorsally 2- grooved ..... 2. ***H. triticeus***

1. Culms 15─80 cm tall; lower glume of upper sessile spikelet 4─5.5 mm long, dorsally not grooved ..... 1. ***H. contortus***

1. Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult., Syst. Veg. 2: 836. 1817; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1743. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 163. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 121. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1862. 1983; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 226. 1989; S.Moulik, Grasses Bamboos India 1: 226.1997; Pull., Fl. Andhra Pradesh 3: 1206. 1997; Sreek. & V.J.Nair, Fl. Kerala - Grasses 112. 1991; K.M.Matthew, Fl. Palni Hills 3: 1596. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 427. 2009; Potdar *et al.*, Grasses Maharashtra 163. 2012; Pull., Fl. Telangana 3: 1135. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 127. 2017. *Andropogon contortus* L., Sp. Pl. 2:

1045. 1753, (as "*contortum*"); Hook.f., Fl. Brit. India 7: 199. 1897. *Heteropogon contortus* var. *contortus* Deshp., Bull. Bot. Sur. India 30(1−4): 121. 1988. *Heteropogon hirtus* Pers., Syn. Pl. 2: 533. 1807, *nom. Illeg. superfl. Lectotype* (designated by Cope in Nasir & Ali, 1982): ——Plukenet, Phytogr. 3: tab. 191. f. 5. 1692.

Andropogon contortum All., Fl. Pedem. 2. n. 2277: 260. 1785, *non* L. 1753, *nom. illeg. Andropogon allionii* Lam. ex DC., Fl. Franc. (ed.3): 97. 1805. *Heteropogon allionii* (Lam. ex DC.) Roem. & Schult., Syst. Veg. 2: 835. 1817. *Heteropogon glaber* Pers., Syn. Pl. 2: 533. 1807, *nom. illeg. superfl. Type*:—— *Andropogon contortum* All., Fl. Pedem. 3. t. 91. f. 4. 1785.

Andropogon polystachyos Roxb., Fl. Ind. 1: 265. 1820. *Heteropogon polystachyos* (Roxb.) Schult., Mant. 2: 460. 1824 (as "polystachyus"). *Heteropogon contortus* var. *polystachyos* (Roxb.) Deshp., Bull. Bot. Sur. India 30(1−4): 121. 1988. *Lectotype* (Designated by Deshpande, 1988): Roxb. no. 2020 (Icones Roxburghianae).

Heteropogon fischerianus Bor, Kew. Bull. 6(2): 170. 1951. *Type*:—— INDIA, **Tamil Nadu**, Kodaikanal, Pulneys, Jesmond Hill, 01.07.1901, *Bourne* 2025 (holo: K [K000245941 digital image!]).

Figs. 118–123

Annuals or Perennials, 15–80 cm high. *Culm* erect or decumbent, glabrous, pale pinkish; *nodes* glabrous, sometimes younger nodes villous, pinkish or purplish, hairs hyaline; *internodes* 1–8.5 cm long. Leaves simple, distichous or not. *Leaf sheath* folded or keeled, 2.5–7 cm long, dorsal surface glabrous or villous, hairs hyaline, deciduous, 1–3 mm long, greenish, pinkish towards base and margins, or margins hyaline. *Leaf blade* linear–lanceolate, 2.5–24 × 0.3–0.6 cm, base obtuse–rounded or truncate, margins scabridulous–glabrous, sometimes few tubercle-based hairs present near to base, tubercle-based hairs hyaline, 2.5–5 mm long, apex acute–acuminate or obtuse, abaxial surface densely scabrous or papillose, hairs hyaline, less than 1 mm long, adaxial surface hispid with tubercle-based hairs on lower 1/4 or 2/4 but densely hispid when young or scabridulous–papillose and a row of hairs at the junction of leaf sheath and leaf blade, hairs hyaline, 1–4 mm long, greenish. *Ligule* 0.5–1 mm long, membranous, highly dissected at apex and sometimes looks

like it as hairy, hyaline–pale brownish. *Inflorescence* terminal, solitary raceme with reduced spathe, 3.5–8 cm long (including awn), hairy or glabrous, *spikelets* paired, one sessile and one pedicelled, spikelet pairs towards lower half homogamous and towards upper half heterogamous. *Peduncle* terete or subterete, 5–14 cm long, glabrous, scabridulous towards apex, greenish–pinkish. *Rachis* jointed; rachis internode of lower spikelet pairs linear, 1–7 mm long, terete–suterete, scabridulous–sparsely scabridulous or pilose, hairs hyaline, 0.1–0.5 mm long, greenish; rachis internode of upper pairs *ca.* 1 mm long, apex oblique, fragile, coriaceous, glabrous, yellowish green, adjoined to the callus of spikelet pair. *Lower homogamous spikelet pairs* 5–14, male; callus acute–obtuse, glabrous or scabridulous–sparsely scabridulous, hairs hyaline, less than 1 mm long. *Lower sessile spikelet* male, elliptic–narrowly elliptic, 6–9 ×1–1.5 mm, tubercle-based hairy or glabrous. *Lower glume* narrowly ovate or narrowly elliptic, 5–9 × 1–1.8 mm, cymbiform, margins ciliate, hairs hyaline, *ca.* 0.5 mm long, one margin infolded and keeled throughout, keel winged, other margin infolded, keeled and winged at upper half, lower half inflexed, keel scabridulous, wing margin ciliolate or minutely denticulate towards apex, apex acute–obtuse, chartaceous, dorsal surface tubercle-based hairy or glabrous–sparsely hispid, tubercle-based hairs hyaline, 1–2 mm long, ventral surface glabrous, greenish, 15–20-nerved, nerves inconspicuous. *Upper glume* elliptic–narrowly elliptic, 5.5–8 ×1–1.5 mm, cymbiform, margins infolded or infolded at upper 3/4th and inflexed at lower 1/4th, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex acute–acuminate, chartaceous–membranous, dorsal surface glabrous, dorsally keeled or not, if keeled then keel scabridulous, ventral surface glabrous or

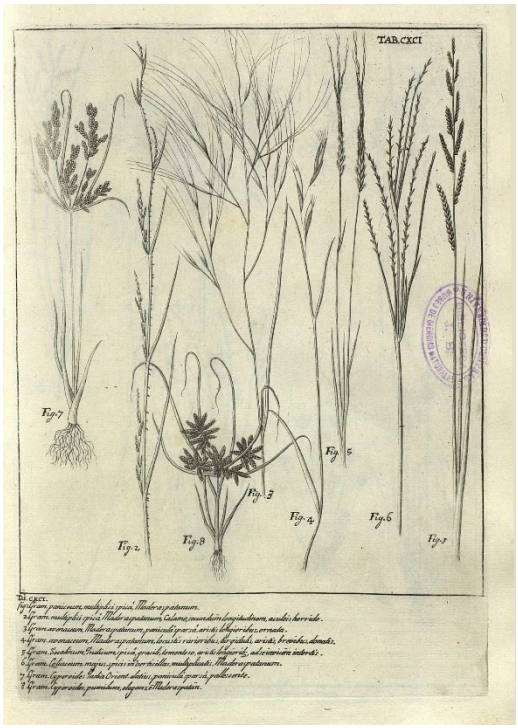

Fig. 118. Lectotype (Fig. 5) of *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.

puberulent, pale greenish–hyaline, 3-nerved. *Lower lemma* narrowly obovate or narrowly elliptic, 4.5–7 × 0.8–2.2 mm, margins infolded at upper 1/3rd–1/2nd, infolded margins ciliate, hairs 0.5–1 mm long, hyaline, lower 1/2–2/3rd inflexed and entire or sparsely ciliate, apex obtuse, membranous, glabrous, hyaline, 1-nerved. *Lower palea* absent. *Upper lemma* narrowly obovate or narrowly elliptic–linear, 4–6 × 1–1.2 mm, sometimes folded, margins infolded at upper 1/3–1/2, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex mucronate–aristate or bifid or acute, arista 0.1–0.2 mm long, membranous, glabrous, dorsally shallowly keeled or not, hyaline, 1-nerved. *Upper palea* narrowly obovate or narrowly elliptic–linear, 1–1.7 × 0.2–0.4 mm, apex acute–obtuse, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.4–0.8 × 0.4–0.8 mm, hyaline. *Stamens* 3; filament hyaline; anthers 2.5–4 mm long, yellowish or purplish. *Lower Pedicelled spikelet* elliptic–narrowly elliptic, 5–10 × 1–2 mm, twisted, tubercle- based hairy or glabrous. *Callus* elongate, pedicel like, linear, 1–2.2 mm long, dorsiventrally compressed, margins pilose–scabrous, hairs hyaline–pale brownish, 0.1–0.5 mm, pale greenish. *Pedicel* reduced. *Lower glume* elliptic–narrowly elliptic, 5–9 × 1–2 mm, twisted, margins ciliate at upper half, entire at lower half, hairs *ca.* 0.5 mm long, hyaline, one margin infolded and keeled, keel winged throughout, wing hyaline, wing margin ciliolate near apex, other margin inflexed, both inflexed and infolded margin hyaline, apex acute–obtuse, chartaceous, dorsal surface tubercle-based hairy or glabrous, ventral surface glabrous or puberulent, greenish, 9–14-nerved, nerves inconspicuous. *Upper glume* elliptic–narrowly elliptic, 5–9 × 1–1.8 mm, cymbiform or folded, margins infolded or inflexed at lower 1/4th and infolded at upper 3/4th, infolded margin membranous, ciliate and hyaline, hairs hyaline, 0.5–1 mm long, apex acute–acuminate or oblique, chartaceous–membranous, glabrous except keel, pale greenish–hyaline, dorsally keeled towards apex (at upper 1/4th), keel sparsely scabrous–scabridulous, 3-nerved. *Lower lemma* narrowly elliptic or narrowly ovate, 4–7 × 0.8–1.2 mm, cymbiform, margins infolded at upper 2/3rd or upper half, inflexed at lower 1/3rd or lower half, infolded margins ciliate, hairs hyaline, 0.5–2 mm long, apex acute or obtuse–rounded, membranous, glabrous, hyaline, 1-nerved. *Lower palea* absent. *Upper lemma* narrowly elliptic–linear or narrowly obovate, 4–6.5 × 0.5–1 mm, sometimes

folded, margins inflexed and entire at lower 1/3rd or lower half, infolded and ciliate at upper 2/3rd or upper half, hairs hyaline, 0.5–1 mm long, apex obtuse or mucronulate–aristate or bifid with a very small arista, membranous, glabrous, hyaline, 1-nerved. *Upper palea* absent or reduced, narrowly ovate, 1–1.2 × 0.3–0.4 mm, base truncate, apex acute–obtuse, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.6–1 × 0.3–0.5 mm, hyaline. *Stamens* 3; filament hyaline; anthers 2–3 mm long, yellowish. *Upper heterogamous pair* 2–9; callus pungent, 1–3 mm long, densely rufous hairy; hairs 0.5–3 mm long. *Upper sessile spikelet* bisexual, subterete, 4–6 × 0.8–1 mm, brownish. *Lower glume* narrowly ovate or narrowly elliptic, 4–5.5 × 0.8–1 mm, margins entire, inflexed–incurved, apex obtuse–rounded, coriaceous, dorsal surface densely scabrous–scabridulous, hairs pale brownish–hyaline, upto 0.6 mm long, ventral surface glabrous or puberulent, hairs very minute; brownish, 4–5-nerved, nerves inconspicuous. *Upper glume* narrowly elliptic–oblong, 4.5–6 × 0.5–0.8 mm, cymbiform, margins entire, inflexed–incurved, apex acute, subcoriaceous, dorsally keeled, keel broad, grooved on both side of the keel, dorsal surface scabrous–scabridulous on broad keel, hairs pale brownish–hyaline, 0.3–0.4 mm long, ventral surface glabrous or puberulent, pale brownish, nerves inconspicuous. *Lower lemma* narrowly elliptic or narrowly ovate–linear, 2–4 × 0.5–1 mm, margins entire, or ciliate near apex, hairs hyaline, *ca.* 0.5 mm long, apex acute–obtuse, membranous, glabrous, hyaline, nerves not seen. *Lower palea* absent. *Upper lemma* reduced to the hyaline base of the awn, linear, 2–4 mm long, membranous. *Awn* 4.5–7.5 cm long, twisted, geniculate, scabridulous, brownish; column 2.5–4 cm long; bristle 2–3.5 cm long. *Upper palea* absent or reduced, ovate, 1–1.2 × *ca.* 0.5 mm, base truncate, apex and margins towards apex ciliate, hairs 0.5–0.6 mm long; membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 0.3–0.4 × 0.2–0.3 mm. *Stamens* 3; filaments hyaline; anthers 2–4 mm long, yellowish. *Ovary* oblong, 1–2.5 × 0.4–0.8 mm, glabrous, pale brownish; style 2, 1–4.5 mm long, glabrous, hyaline–pale brownish; stigma 2, feathery, 2–6 mm long, purplish. *Upper pedicelled spikelet* male, elliptic–narrowly elliptic, 6.5–13 × 1–2 mm, twisted, greenish. *Callus* elongate, pedicel like, oblong or linear, 1.2–2.5 mm long, dorsi-ventrally compressed, glabrous–sparsely scabridulous or sparsely pilose,

hairs hyaline–brownish, 0.1–0.5 mm long, sometimes rufous hairs seen at apex on ventral surface, greenish. *Pedicel* reduced. *Lower glume* narrowly ovate or narrowly elliptic, 5.5–10.5 × 1–2 mm, twisted, one margin inflexed and ciliate towards apex, other margin infolded, ciliate and keeled, keel winged, wing margin entire, denticulate near apex, hair 0.3–0.5 mm long, hyaline; apex acute–acuminate or oblique, sometimes very minutely aristate, chartaceous, dorsal surface glabrous or densely tubercle-based hairy, hairs hyaline, 2–3 mm long, ventral surface glabrous or puberulent, greenish, 12–14-nerved, nerves inconspicuous, dorsally not grooved. *Upper glume* narrowly ovate or narrowly elliptic, 6–11 × *ca.* 1 mm, cymbiform, margins inflexed or infolded and ciliate, hairs hyaline, 0.8–1 mm long, apex acuminate, dorsally keeled towards upper 1/3rd or upper half, chartaceous–membranous, dorsal surface scabrous–scabridulous on keel, sometimes with few tubercle-based hairs near apex, hairs 0.1–0.3 mm long, tubercle-based hairs 3–4 mm long, ventral surface glabrous or puberulent, hyaline with green nerves, 3-nerved. *Lower lemma* narrowly elliptic–linear, 4–7 × 0.8–1 mm, margins infolded or infolded at upper 3/4th and inflexed at lower 1/4th, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex obtuse–rounded, membranous, glabrous, hyaline, 1-nerved. *Lower palea* absent. *Upper lemma* narrowly obovate or narrowly elliptic–linear, 4–6 × 0.5–1 mm, margins infolded or infolded at upper half and inflexed at lower half, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex mucronulate or bifid with a very small arista, membranous, glabrous, hyaline, 1-nerved. *Upper palea* absent or reduced, narrowly elliptic or narrowly ovate or linear–lanceolate, 1–1.8 × 0.3–0.4 mm, apex acute, membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 0.5–1 × 0.5–1 mm. *Stamens* 3; filament hyaline; anthers 1.5–4 mm long, yellowish. *Caryopsis* oblong or ellipsoid, 3–4 × 0.5–0.8 mm, ventrally 2-grooved, glabrous, brownish, style persistent.

Flowering & Fruiting: September to May.

Distribution: Tropics and Subtropics to S. Central Europe. In India, it is distributed in Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Nagaland, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand and West Bengal. Very common in all southern Peninsular Indian states.

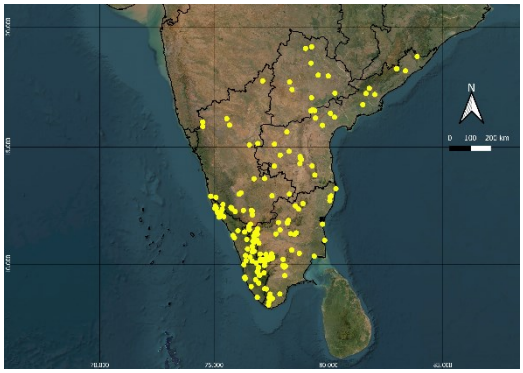

Fig. 119. Distribution of *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. in southern Peninsular India

Habitat: Open wastelands, road sides, hill slopes and plateaus.

Specimens examined:– INDIA, **Andhra Pradesh**, Anantapur district, Chillavaripalli, Katam, 04.10.2016, *J. Swamy & S. Nagaraju* 007978; Gutturu, 07.11.2009, *B. Ravi Prasad Rao & P. Priyadarsini* 37162 (BSID); Gooty Fort Hill, 26.12.2021, *V. Drisya* 169589; *Ibid.*, 26.12.2021, *V. Drisya* 169591 (CALI); Annamayya district, Chitvel R.F., 25.02.1984, *A. Madhusudhana Rao* 1502 (BSID); East Godavary district, Balabhadrapuram, Godavary Delta, 26.12.1901, *Bourne* 3227; Rampa Chodavaram, Rampa, 03.10.1920, *V. Narayanaswami* 412 (CAL); Eluru district, Polavaram, Kudimakonda, 08.01.1902, *Bourne* 3569 (CAL); Guntur district, Dhulipalla, 11.10.2017, *V. Drisya* 157111 (CALI); Kadapa district, Balapalle, 08.11.1962, *J.L. Ellis* 14956 (CAL); Gandikotta Fort, 25.12.2021, *V. Drisya* 169584 (CALI); Guvvalacheruvu, near the stream, 08.10.1958, *K. Subramanyam* 6838 (CAL); Jangam Palle, near Kamalapuram, 30.12.2019, *V. Drisya* 169503 (CALI); Kadapa [Cuddapah], 22.10.1938, *DFO s.n.* (DD); near Kadapa airport, 30.12.2019, *V. Drisya* 169504; near Pushpagiri Temple, 31.12.2019, *V. Drisya* 169509 (CALI); Thummalapalle Uranium mining area, Bumayyagaripalle, 15.10.2009, *K. Rajakullaiswamy, B. Sadasivaiah & T. Pullaiah* 37610 (BSID); Kurnool district, Hussainapuram, 26.12.2021, *V. Drisya* 169585 (CALI); Nallamala Hills [Nallamalais], Ramanapenta, 28.11.1969, *J.L. Ellis* 32625 (CAL & MH); Palnadu district, Ethipothala Water Falls, on the way to Ethipothala Krishna temple, 11.10.2017, *V. Drisya* 157109; Kondaveedu Fort, 12.10.2017,

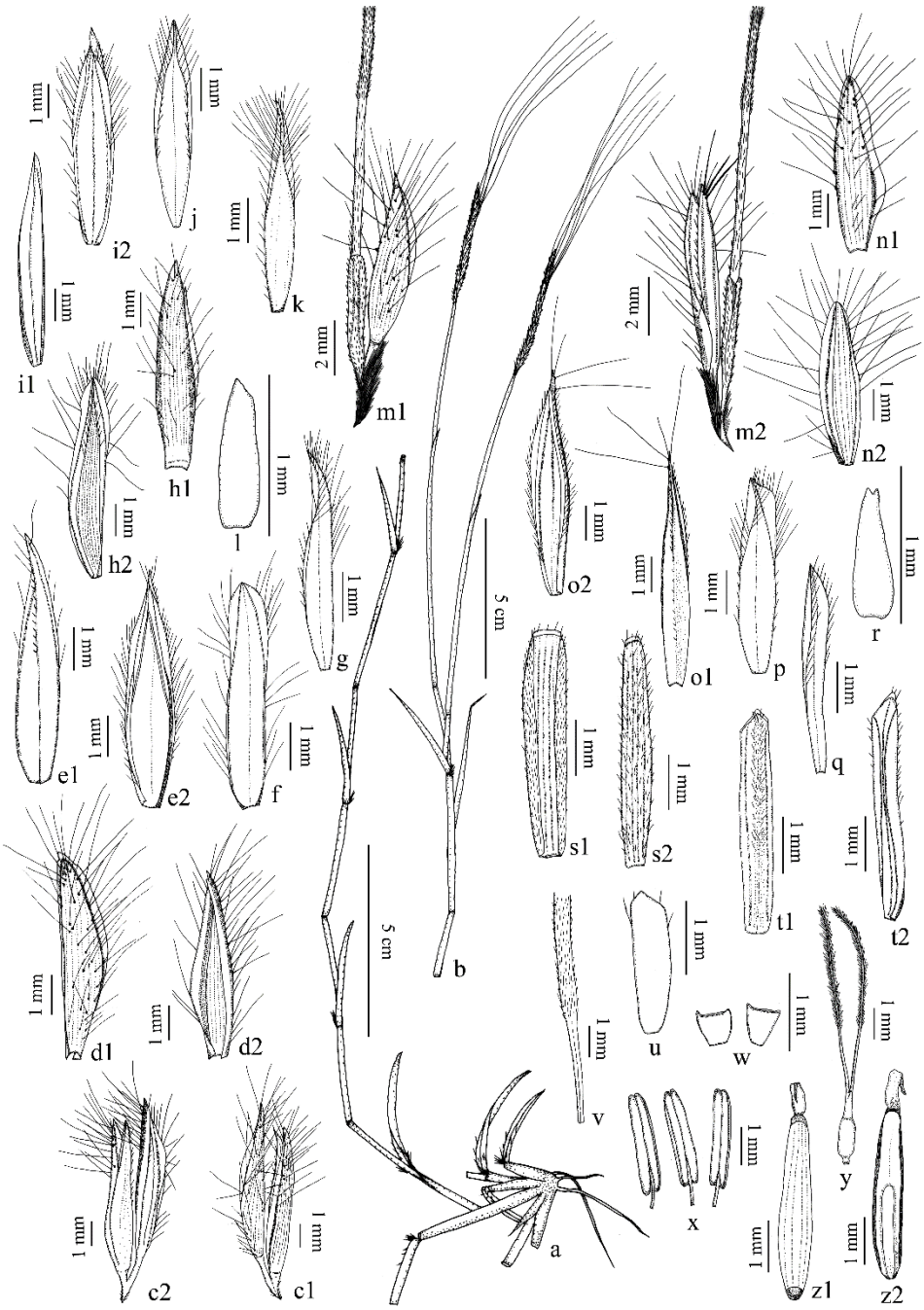

Fig. 120. *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.: **a & b.** Habit; **c1.** Lower homogamous spikelet pair-dorsal view; **c2.** Lower homogamous spikelet pair-ventral view; **d1.** Lower glume-dorsal view; **d2.** Lower glume-ventral view; **e1.** Upper glume-dorsal view; **e2.** Upper glume-ventral view; **f.** Lower lemma; **g.** Upper lemma (**e1–g**: Pedicelled spikelet of lower homogamous spikelet pair); **h1.** Lower glume-dorsal view; **h2.** Lower glume-ventral view; **i1.** Upper glume-dorsal view; **i2.** Upper glume-ventral view; **j.** Lower lemma; **k.** Upper lemma; **l.** Upper palea (**h1–l**: Sessile spikelet of lower homogamous spikelet pair); **m1.** Upper heterogamous spikelet pair-dorsal view; **m2.** Upper heterogamous spikelet pair-ventral view; **n1.** Lower glume-dorsal view; **n2.** Lower glume-ventral view; **o1.** Upper glume-dorsal view; **o2.** Upper glume-ventral view; **p.** Lower lemma; **q.** Upper lemma; **r.** Upper palea (**n1–r**: Pedicelled spikelet of upper heterogamous spikelet pair); **s1.** Lower glume-dorsal view; **s2.** Lower glume-ventral view; **t1.** Upper glume-dorsal view; **t2.** Upper glume-ventral view; **u.** Lower lemma; **v.** Upper lemma (**s1–v**: Sessile spikelet of upper heterogamous spikelet pair); **w.** Lodicules; **x.** Stamens; **y.** Gynoecium; **z1.** Caryopsis-dorsal view; **z2.** Caryopsis-ventral view (from *V. Drisya & A.K. Pradeep* 157843, drawn by V. Drisya).

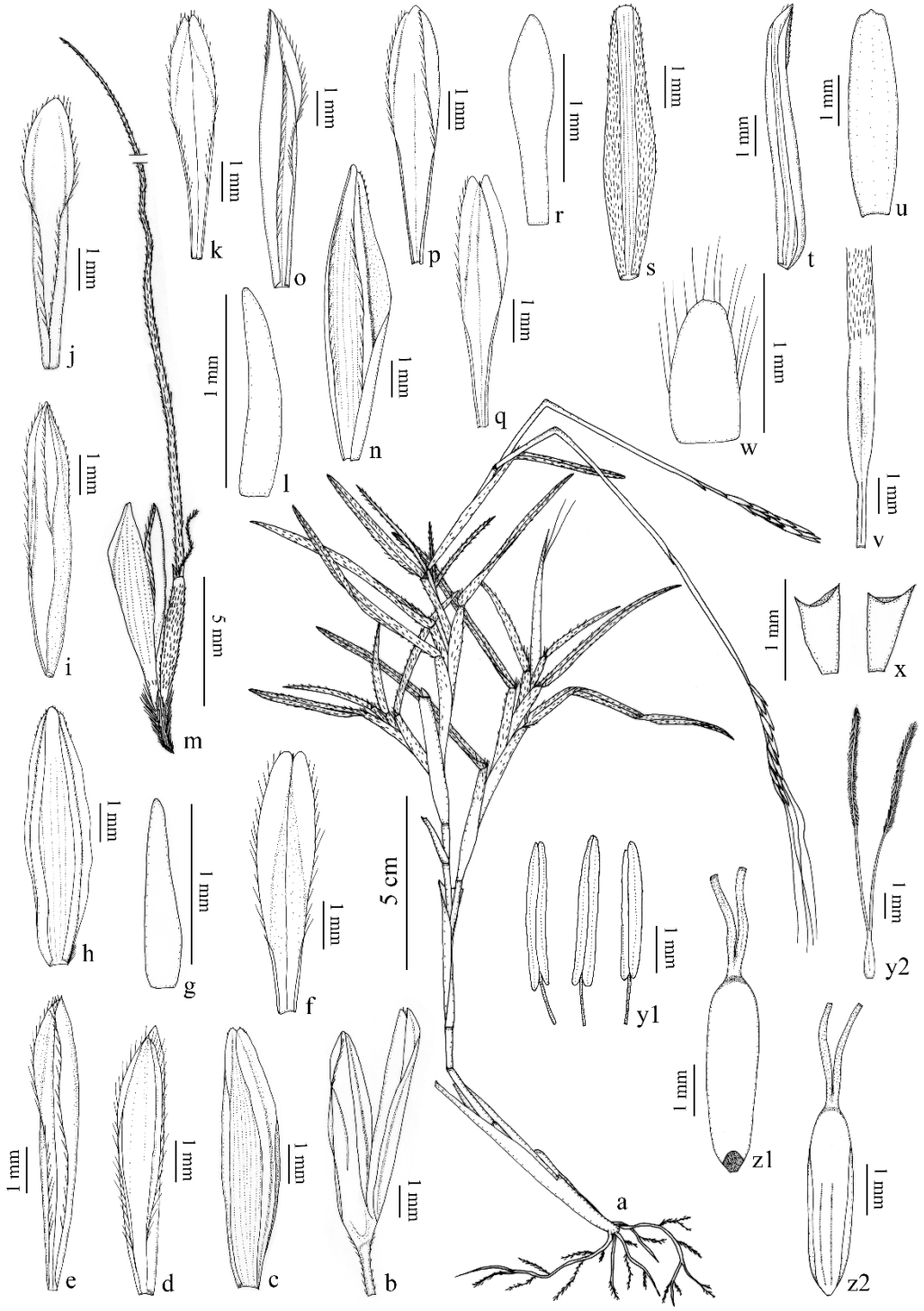

Fig. 121. *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. [with more or less glabrous racemes and distichous leaves]: **a.** Habit; **b.** Lower homogamous spikelet pair; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma; **f.** Upper lemma; **g.** Upper palea (**c–g**: Pedicelled spikelet of lower homogamous spikelet pair); **h.** Lower glume; **i.** Upper glume; **j.** Lower lemma; **k.** Upper lemma; **l.** Upper palea (**h–l**: Sessile spikelet of lower homogamous spikelet pair); **m.** Upper heterogamous spikelet pair; **n.** Lower glume; **o.** Upper glume; **p.** Lower lemma; **q.** Upper lemma; **r.** Upper palea (**n–r**: Pedicelled spikelet of upper heterogamous spikelet pair); **s.** Lower glume; **t.** Upper glume; **u.** Lower lemma; **v.** Upper lemma; **w.** Upper palea (**s–w**: Sessile spikelet of upper heterogamous spikelet pair); **x.** Lodicules; **y1.** Stamens; **y2.** Gynoecium; **z1.** Caryopsis-dorsal view; **z2.** Caryopsis-ventral view (from *V. Drisya & A.K. Pradeep* 144249, drawn by V. Drisya).

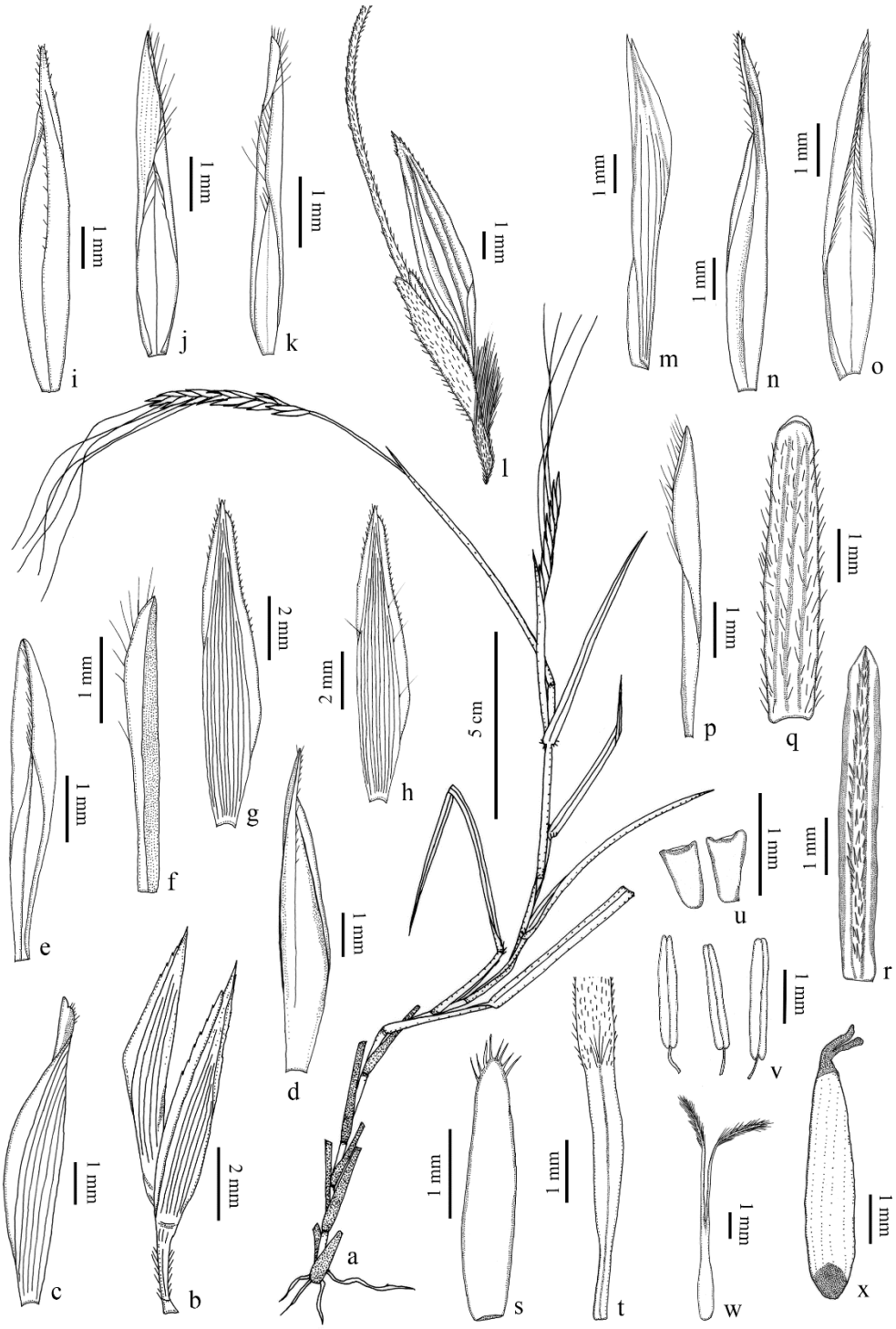

Fig. 122. *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. [with more or less glabrous racemes and non-distichous leaves]: **a.** Habit; **b.** Lower homogamous spikelet pair; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma; **f.** Upper lemma (**c–f**: Pedicelled spikelet of lower homogamous spikelet pair); **g & h.** Lower glume (showing variation in indumentum); **i.** Upper glume; **j.** Lower lemma; **k.** Upper lemma (**g–k**: Sessile spikelet of lower homogamous spikelet pair); **l.** Upper heterogamous spikelet pair; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Upper lemma (**m–p**: Pedicelled spikelet of upper heterogamous spikelet pair); **q.** Lower glume; **r.** Upper glume; **s.** Lower lemma; **t.** Upper lemma (**q–t**: Sessile spikelet of upper heterogamous spikelet pair); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium; **x.** Caryopsis (from *V. Drisya & A.K. Pradeep* 157833, drawn by V. Drisya).

Fig. 123. *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.: **a.** Habit; **b & c.** Inflorescence; **d.** Lower spikelet pair; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Upper lemma; **i.** Upper palea (**e–i:** Lower sessile spikelet); **j.** Lower glume; **k.** Upperglume; **l.** Lower lemma; **m.** Upper lemma (**j–m:** Lower pedicelled spikelet); **n.** Upper spikelet pair; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma; **r.** Upper lemma (**o–r**: upper sessile spikelet); **s.** Lower glume; **t.** Upper glume; **u.** Lower lemma; **v.** Upper lemma; **w.** Upper palea (**s–w**: Upper pedicelled spikelet).

V. Drisya 157117 [CALI184685 & CALI184686] (CALI); Nagarjuna Konda sacred groove, 13.10.2015, *J. Swamy & S. Nagaraju* 007237 (BSID); Parvathipuram Manyam district, Salur, 11.09.1962, *N.P. Balakrishnan* 1138 (CAL); Srikakulam district, Kotturu, 28.09.1961, *N.P. Balakrishnan* 867 (CAL); Visakhapatanam district, Adativalasa, 12.10.1964, *G.V. Subba Rao* 21605 (CAL & MH); Araku Valley, Foot hills of Galikonda, 16.10.2017, *V. Drisya* 157139; Galikonda, Ghat road side, 15.10.2017, *V. Drisya* 157127; Galikonda Hill, 16.10.2017, *V. Drisya* 157135 (CALI); *Ibid.*, Sunkarametta, 15.10.2017, *V. Drisya* 157130 (CALI). **Karnataka**, Bagalkot district, Badami, 03.12.2017, *Shinoj & V. Drisya* 157758 (CALI); *Ibid.*, 24.10.2000, *s.coll. s.n.* (SUK); Belgaum district, Belgaum, *s.d.*, *W.M. Munro* 880 (CAL); Sutagatti Ghat, 30.03.2009, *Arun M. Chandore* 217 (SUK); Bellary district, Bellary Fort, 01.01.2020, *V. Drisya* 169516 (CALI); Sanduru [Sandur], 00.10.1946, *Srinivasamurti s.n.* (DD); Bidar district, Humnabad, Korkanalli S.F., 18.11.1975, *N.P. Singh* 141846 (BSI); Chamarajanagar district, Gopalaswamy Hills, 30.09.2015, *V. Drisya* 144236 (CALI); Chitradurga district, Hosakere Hill (Jagalur–Ujjini road), 13.11.1978, *K.P. Sreenath & S.R. Ramesh* 4000 (CAL); Dakshina Kannada district, Mangaluru [Mangalore], 00.01.1902, *C.A. Barber* 4801 (MH); *Ibid.*, *s.d.*, *R.F. Hohenacker* 301 (K); Sullia, 25.10.1900, *C.A. Barber* 2176 (MH); Hassan district, Hassan, 29.09.2015, *V. Drisya* 144237; near Koravangala, 29.09.2015, *V. Drisya* 144224 (CALI); Kodagu district, Kodagu [Coorg], on way to Abbey Falls, 03.11.1976, *B.C. Banrjee* 11730 (CAL); Madikeri [Mercara], 21.11.1958, *G.S. Puri* 45972; Thithimathi, Mankal forest, 04.11.1963, *A.S. Rao* 95557 (BSI); Kolar district, Kammasandra S.F. III, 25.10.1975, *N.P. Singh* 140953 (BSI); Mysuru district, Chamundi Hills, 30.09.2015, *V. Drisya* 144230; near Nanjangud, 28.09.2015, *V. Drisya* 144221 (CALI); on the way to Hunsur, 09.10.1978, *S.R. Ramesh & P. Prakash* 3083; Mysore [Maisor & Carnatic], *s.d.*, *G. Thomson s.n.* (CAL); Tumakuru [Tumkur] district, Madhugiri S.R., 08.01.1976, *N.P. Singh* 142199; Sira, Bukkapatana S.F., 29.10.1975, *N.P. Singh* 141111; Tirthsampur S.F., 02.01.1976, *N.P. Singh* 141955 (BSI); Vijayapura [Bijapur] district, Tulsagiri R.F., 17.01.1976, *N.P. Singh* 142558 (BSI). **Kerala**, Alappuzha district, Ambalappuzha, 25.03.1980, *P.V. Sreekumar* 66789; Punnapra, 20.03.1980,

P.V. Sreekumar 66773; Vandaanam, Ambalappuzha, 18.06.1980, *P.V. Sreekumar* 67678 (BSID); Ernakulam district, Airport campus, Cochin, 20.06.1980, *P.V. Sreekumar* 67685 (BSID); Thundathil Forest Range, Cherukadu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168703 (CALI); Railway track near Cochin, 20.06.1980, *P.V. Sreekumar* 67686 (BSID); Idukki district, Arippara, near Kulamavu, 25.03.2016, *V. Drisya* 150723 (CALI); Munnar, Eravikulam National Park, Anamudi, 18.04.1997, *S.D. Biju* 36735; *Ibid.*, Chinnamudi slope, 11.11.1997, *S.D. Biju* 36582 (TBGT); *Ibid.*, Lakkam kudimala, 06.02.2018, *V. Drisya* 157831, Lakkam kurisumala, near Thookkupalam, 06.02.2018, *V. Drisya* 157830; *Ibid.*, Lakkam Kurisumala top, 01.01.2019, *V. Drisya* 168751 (CALI); *Ibid.*, Naykkoli, 01.10.1997, *S.D. Biju* 36420; *s.loc.*, 09.05.1993, *S.D. Biju* 35149 (TBGT); *Ibid.*, near Lakkam Kudi, 06.02.2018, *V. Drisya* 157832; *Ibid.*, 06.02.2018, *V. Drisya & A.K. Pradeep* 157833 [CALI184679, CALI184680, CALI184681, CALI184682, CALI184683 & CALI184684]; *Ibid*., 01.01.2019, *V. Drisya* 168736; *Ibid*., 01.01.2019, *V. Drisya* 168737; *Ibid.*, on the way to Bheemanoda, 06.01.2019, *V. Drisya* 170124; *Ibid.*, on the way to Lakkam kudi, 01.01.2019, *V. Drisya* 168738; Kollukkumala, 01.12.2019, *A.K. Pradeep & V. Drisya* 176264; Kumili to Theni Ghat Road, 16.10.2015, *V. Drisya & A.K. Pradeep* 144253; Mattuchola top, 04.01.2019, *V. Drisya* 168798; *Ibid.*, 04.01.2019, *V. Drisya* 168796; Mathikettan Shola National Park, Chundal, 22.07.2016, *V. Drisya* 150754; Painavu, Microwave Power Hill, 27.10.2017, *V. Drisya* 157160; Panjalimedu, 17.10.2015, *V. Drisya & A.K. Pradeep* 144262; Para, on the way to Arippara, near Kulamavu, 25.03.2016, *V. Drisya* 150720; Parunthumpara, 16.10.2015, *V. Drisya & A.K. Pradeep* 144249 [CALI184664, CALI184665, CALI184666, CALI184667, CALI184668, CALI184669, CALI184670, CALI184671, CALI184672, CALI184673, CALI184674, CALI184675, CALI184676 & CALI184677]; Perumala, on the way to Nakkupettikudi, 03.01.2019, *V. Drisya* 168785; Vagamon, 05.12.2019, *A.K. Pradeep & V. Drisya* 176266; *Ibid.*, Kurisumala, 26.10.2017, *V. Drisya* 157149 [CALI184678]; *Ibid.*, 01.12.2019, *V. Drisya* 170192; Vattippara, near Valara Waterfalls, 23.07.2016, *V. Drisya* 150755 (CALI); Kannur district, Chooral, 17.10.2019, *V. Drisya* 170164; *Ibid.*, 17.10.2019, *V. Drisya* 170165; *Ibid.*,

17.10.2019, *V. Drisya* 170167; Ezhimala, 28.11.2016, *Shinoj & V. Drisya* 176747; Kurisumala near Ezhimala, 12.11.2017, *V. Drisya 157713* (CALI); Kurumathur, near Sreekandapuram, 23.09.1982, *R. Ansari* 73959 (CAL); Madayippara, 14.11.2018, *V. Drisya* 157874; *Ibid.*, 14.11.2018, *V. Drisya* 157875; *Ibid.*, College–Fort side, 18.12.2010, *Pramod C.* 126641 (CALI); *Ibid.*, Madayi grassland, 18.11.2015, *Rinku J. Desai* 1730; *Ibid.*, 18.11.2015, *Rinku J. Desai* 1731 (BARO); *Ibid.*, near College, 31.10.2017, *V. Drisya* 157168; *Ibid.*, 14.11.2018, *V. Drisya* 157864; *Ibid.*, 14.11.2018, *V. Drisya* 157866; *Ibid.*, on the way to Madayikavu, 31.10.2017, *V. Drisya* 157174; Peringome, 14.11.2018, *V. Drisya* 157861 (CALI); Kasaragod district, Bekal Fort, 25.12.2016, *V. Drisya* 176637; Chattanchal, 25.12.2016, *V. Drisya* 176629; Iria, 20.09.2015, *V. Drisya* 144215 (CALI); Nileswar, 29.01.1979, *V.J. Nair* & *R. Ansari* 59986 (CAL); Paramba, 16.10.1981, *P.V. Sreekumar* 71723 (BSID); Periya, 25.12.2016, *V. Drisya* 176634; Thottam–Padne road, near Pilicode, 24.12.2016, *V. Drisya* 176610 (CALI); Kollam district, near Sasthamkotta Lake, 15.11.2017, *V. Drisya* 157739 (CALI); Residency ward, 17.03.1980, *P.V. Sreekumar* 67110 (BSID); Kozhikode district, Pokkunnumala, near Nanminda, 26.10.2016, *V. Drisya* 150768; *Ibid.*, 23.11.2019, *V. Drisya* 170175; *Ibid.*, 23.11.2019, *V. Drisya* 176241 (CALI); Malappuram district, Calicut University Botanical Garden, 02.09.2000, *Jayasree S.* 74310; Calicut University Campus, 04.02.2003, *Tomson Mani 90713* (CALI); *Ibid.*, 20.11.2015, *Rinku J. Desai* 1766 (BARO); *Ibid.*, 28.02.2018, *V. Drisya & A.K. Pradeep* 157843 [CALI184690 & CALI184690] (CALI); Vazhikkadavu, 07.11.2012, *J. Remya* 75433 (TBGT); Palakkad district, Manappulli, 03.01.2016, *V. Drisya* 171472; *Ibid.*, 03.01.2016, *V. Drisya* 171484 (CALI); Nelliyampathy, 12.12.1996, *K. Radhakrishnan* 29027 (TBGT); *Ibid.*, Manpara, 11.12.2016, *Shinoj & V. Drisya* 176752; *Ibid.*, Valiya Govindamala, 10.12.2022, *V. Drisya* 169596; *Ibid.*, Kesavanpara, 05.12.2015, *V. Drisya* 150789; Padur, 05.12.2018, *V. Drisya* 157899 (CALI); Silent valley, near watch tower, 06.11.2012, *Remya J.* 74559 **(**TBGT); Pathanamthitta district, Kattathipara, 27.11.1996, *Ravi & Mohanan* 24737 (TBGT); Thiruvananthapuram district, Kariavattom, 21.03.1980, *P.V. Sreekumar* 67126 (BSID); Kariavattom campus, 10.11.2015, *V. Drisya* 150781; Pandyanpara,

17.11.1995, *P. Deepti Dan* 26416 (TBGT); Thrissur district, Kodali, 10.02.2019, *V. Drisya* 170156; near Charpa Falls, in between Athirappilly & Vazhachal, 12.12.2019, *V. Drisya* 176274 (CALI). **Tamil Nadu**, Chengalpattu district, Tambaram, MCC campus, 01.10.1999, *K.T. Augustine* 61163 (RHT); Coimbatore district, Anaikatti, 29.12.2001, *K. Althaf Ahamed Kabeer* 113047; Bharathiar University, 30.12.2001, *K. Althaf Ahamed Kabeer* 113085 (MH); Coimbatore, *s.d.*, *E.K. Janaki Ammal s.n.* (DD); Madukkarai Hills, 09.11.2002, *K. Althaf Ahamed Kabeer* 114464 (MH); Maruthamalai, 04.12.2017, *V. Drisya* 157756 (CALI); Muthikulam-Siruvani, 24.10.1968, *D.B. Deb*, 28382; Nellimalai R.F., 22.03.1963, *K. Ramamurthy* 16055 (CAL); Siruvani adivaram, 20.10.1960, *A.N. Henry* 744 (BLAT); Upper Aliyar Dam, 24.01.2004, *K. Althaf Ahamed Kabeer* 117715; Velliangiri Hills, 11.01.2004, *K. Althaf Ahamed Kabeer* 117270 (MH); *Ibid.*, 30.09.2016, *A.K. Pradeep & V. Drisya* 150712 (CALI); Cuddalore district, Capper Hills, 07.01.2000, *K.T. Augustine* 61799 (RHT); Dindigul district, Kodaikanal, 16.09.1956, *J. Pallithanam* 2200 (RHT); Attuvampatti, 02.03.2002, *K. Althaf Ahamed Kabeer* 114005 (MH); Gundar, 27.08.1987, *K.M. Matthew & N. Rajendren* 50366; Gundar–Pumbarai road, 04.11.1987, *K.M. Matthew & K.T. Mathew* 51080; Perumalmalai, peak slopes, 30.10.1985, *K.M. Matthew & N. Rajendren* 42439; Palni Hills, Kukkal, Temple hill, 23.08.1986, *K.M. Matthew, M. Charles & N. Rajendren* 46581; *Ibid.* (Bhoothanachiamman Koil Hill), 19.10.1987, *K.M. Matthew* 50800; *Ibid.*, 03.10.1990, *K.M. Matthew* 54454; Palni Hills, Palani–Kodaikanal ghat road, 27.11.1985, *K.M. Matthew & N. Rajendren* 43301 (RHT); Pulneys, 01.07.1901, *Bourne* 2026 (CAL); Sirumalai, 08.11.1958, *J. Pallithanam* 3819; Vembadi slopes, 07.08.1984, *K.M. Matthew* 40667 (RHT); *Ibid.*, near Krishnankoil, 21.02.1979, *N.C. Nair* 61057 (CAL); Vadakavunchi–Perumal peak, just below the peak, 14.12.1989, *K.T. Mathew & S. Sebastian* 53852; way to Bear shola falls, 09.09.1991, *K.T. Mathew* 54617 (RHT); Kancheepuram district, Thiruvadisoolam, Whitaker campus, 24.02.1999, *K.M. Matthew & K.T. Augustine* 60500; Vandalur, near police training camp, 26.11.1999, *K.M. Matthew & J. Jayanthi* 70247 (RHT); Kanyakumari district, Nagercoil, near Mambazhathuraiyar reservoir, 29.10.2015, *V. Drisya* 144275 (CALI); Valayathuvayal, 26.11.2005, *K. Althaf Ahamed Kabeer* 118591 (MH);

Madurai district, Madurai Kamaraj University Campus, 11.02.2002, *K. Althaf Ahamed Kabeer* 113228 (MH); near Valve house, 15.10.1959, *K. Subramanyam* 9383 (CAL); Thiruparangundram Hill, 14.02.2002, *K. Althaf Ahamed Kabeer* 113270 (MH); Nagapattinam district, Porayar, TBML College campus, 24.11.1998, *K.M. Matthew & K.T. Augustine* 60143 (RHT); Namakkal district, Solakkadu, Thannipparuthai, 15.10.1977, *K.M. Matthew & V. Karunanidhi* 9634 (RHT); Nilgiris district, Kodanad, 27.07.2012, *Remya J.* & *Prasanna R.* 73826 (TBGT); Kotagiri, 25.10.1956, *K. Subramanyam* 1160 (CAL); Mudumalai, 07.11.2012, *J. Remya* 75405; Mulli–Manjur way, road side, 04.10.2008, *J. Remya* 63182 (TBGT); Naduvattam, 27th Division, view point, 25.07.2003, *K. Althaf Ahamed Kabeer* 116278 (MH); Pykara, Ootty, Needle view point, 24.02.2018, *V. Drisya* 157838 (CALI); way to Coonoor, 24.03.2012, *J. Remya* 72250 (TBGT); Pudukkottai district, Sittanavasal, 28.11.1984, *C. Arulappan* 269 (RHT); Ramanathapuram district, Piranmalai–Tirupathur, 19.12.1964, *K. Ramamurthy* 22784 (RHT); Salem District, Mettur, hill below Dam, 17.12.1976, *K.M. Matthew* 5751 (RHT); Yercaud, 10.12.2017, *Nikhil Krishna & V. Drisya* 157768 (CALI); *Ibid.*, Ghat road, 14.12.1977, *D.I. Arockiasamy* 10079 (RHT); *Ibid.*, Kauveri peak, 04.11.1968, *D.B. Deb* 31304 (MH); *Ibid.*, Kongampallam, 22.11.1976, *K.M. Matthew & D.I. Arockiasamy* 4914; Shevaroys, Ghat road, 15 km to Yercaud, 03.11.1978, *K.M. Matthew, N. Venugopal & Jayaseelan* 18727 (RHT); Tenkasi district, Courtallam, 02.12.1961, *S.P. Marwaha* 3353 (CAL); Thanjavur district, Adirampattinam [Adiramapatanam], 22.05.1978, *V.J. Nair* 57047 (CAL & MH); Manganipillayar Thope, 12.08.1960, *K.M. Sebastine* 10683 (MH); Thiruvannamalai district, Javadhu Hills [Javadi Hills], Jamunamarathur–Polur road, below Pattarakkadu, 06.01.2002, *K.M. Matthew* 73780 (RHT); Thiruvallur district, Ennore Creek, 17.05.2001, *K.M. Matthew* 73113; *Ibid.*, 08.12.2001, *K.M. Matthew* 73321 (RHT); Thoothukudi district, Vallanadu foot hills towards Palayamkottai, 27.01.2002, *K. Althaf Ahamed Kabeer* 113168 (MH); Tiruchirappalli district [Tiruchi], Thuraiyur taluk, Pachamalais, Sobanapuram, near rest house, 29.12.1975, *K.M. Matthew & C. Rajamani* 407; *Ibid.*, 12.12.1977, *K.M. Matthew* 10414; *Ibid.*, 08.12.1979, *K.M. Matthew* 24887 (RHT); Foot of Pachamalai, 26.10.1958, *K.M. Sebastine* 6988 (CAL

& MH); Tirunelveli district, Ambasamudram, 30.12.1977, *K.M. Matthew* 15605 (RHT); Kalakad, Sivanaperi, 07.11.1962, *J. Joseph* 15153; Manjolai [Mancholai], 12.10.1957, *K.M. Sebastine* 4400 (CAL); Vaichiparai, Kottangathatty, 10.12.2021, *K.K. Jeomol & V. Drisya* 169581 (CALI); Tiruppur district, Manjampatty, Pakkuthattanparai adivaram, 31.12.2002, *W. Arisdason* 115838 (BSID); Udumalaipettai [Udumelpet], Amaravathi Dam, 10.11.1986, *K.M. Matthew* 47198 (RHT); Virudhunagar district, Virudhunagar, Kepliyampatti, 01.02.2003, *K. Althaf Ahamed Kabeer* 116152 (MH). **Telangana**, Hanumakonda [Hanamkonda] district, Hanumakonda [Hanamkonda], 20.09.1995, *R.K. Premanath* 105384 (BSID); Hyderabad district, Hyderabad, 00.00.1941, *M.R. Saxena* 211 (DD); Karimnagar district, Bhoopathipuram [Bhupatipur], 05.10.1965, *G.V. Subba Rao*, 25708 (CAL & MH); Mahabubnagar district, Umamaheswaram top, 24.11.1999, *S.R. Srinivasan* 111327 (BSID); Mancherial district, Kawal Tiger Reserve, Birsaipet-Range, Jijipur-Beat, 27.10.2013, *P.S. Annamma* 003979; Tiryani-Range, Chintalamadira-Beat, 19.09.2014, *P.S. Annamma* 004096 (BSID); Medak district, Gandi Narsapuram [Narsapur], way to Pegarikutta East, 24.09.1958, *K.M. Sebastine* 6710 (CAL); Nalgonda district, Bottichalami, 15.12.1959, *K.M. Sebastine* 9789 (CAL & MH); Nagarjuna Sagar, 02.11.2015, *L. Rasingam & S. Nagaraju* 007306 (BSID); Warangal district, Pakhal R.F., 27.11.1960, *K.M. Sebastine* 11641 (CAL & MH).

Additional specimens examined (from other than study area): INDIA, **Gujarat**, Panchmahal district, Dhanpuri, 02.11.2018, *V. Drisya* 171463; Jambughoda Wildlife Sanctuary, 02.11.2018, *V. Drisya* 171467 (CALI); Vadodara district, Dabhoi, 03.11.2018, *V. Drisya* 171468 (CALI). **Madhya Pradesh**, Ujjain district, Kolping, Maksi, 07.11.2017, *V. Drisya* 157706; Vikram University Campus, 06.11.2017, *V. Drisya* 157844; *Ibid.*, 06.11.2017, *V. Drisya* 157703 (CALI). **Maharashtra**, Kolhapur district, Kolhapur, 08.01.2017, *V. Drisya* 171425; Panhala Fort, 13.01.2017, *V. Drisya* 171417 (CALI).

*Notes***:** Variations in the pattern of leaf arrangement (normal and distichous) and pubescence in the inflorescence (glabrous and hairy) are continuous. Plants with prominent distichous leaves are usually seen in high altitudes whereas normal leaves

are common in plains. Plants with glabrous racemes mostly seen in high altitude grasslands of Western Ghats in more or less isolated groups as well as mixed population of hairy and glabrous in lateritic plateaus.

Based on our observations paleas have no significance in species delimitation since it is absent or reduced in many specimens and shows variation in its presence and absence. Here, none of the specimens showed lower palea in any of the four types of spikelets, while upper paleas are seen in some spikelets of some specimens. We could see upper paleas in lower sessile spikelets and upper pedicelled spikelets in most of the specimens collected, both from low lands and high altitudes. Whereas upper palea in lower pedicelled spikelets as well as in upper sessile spikelets are mostly seen in high altitude specimens especially in distichously leaved forms. The other two species, *H. polystachyos* and *H. fischerianus* have been brought under its scope as *H. contortus* is showing high variation. Besides, molecular studies (Arthan *et al*. 2021) have already corroborated the view of including *H. fischerianus* under *H. contortus*.

Drisya and Pradeep (2020) recently reinstated the name *H. allionii*. But further field exploration by the authors revealed that, *H. allionii* shares the characters of *H. contortus* and so called *H. fischerianus*. When considering a comparatively larger geographic area, *H. allionii* is found to be an intermediate between *H. contortus* and *H. fischerianus*. The characters of *H. contortus*, *H. allionii*, *H. fischerianus* and *H. polystachyos* are overlapping or the variations are continuous in many cases. Hence, all the names are treated under the synonymy of one variable *H. contortus*.

2. Heteropogon triticeus (R.Br.) Stapf ex Craib, Bull. Misc. Inform. Kew 1912(10): 432. 1912; Bor, Grasses Burma, Ceylon, India & Pakistan 165. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 121. 1976; Deshp., Bull. Bot. Surv. India 30(1−4): 124. 1988; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 227. 1989; S.Moulik, Grasses Bamboos India 2: 228. 1997; Potdar *et al.*, Grasses Maharashtra 168. 2012. *Andropogon triticeus* R.Br., Prodr. Fl. Nov. Holland. 201. 1810; Hook.f., Fl. Brit. India 7: 200. 1897. *Lectotype* (designated here):—— AUSTRALIA, *Robert Brown*

6179 (lecto: BM [BM000991834 digital image!]; isolecto: BM [BM000991831 digital image!], K [K000911721 digital image!, K000911722 digital image!], E [E00691889 digital image!, E00691890 digital image!]).

Andropogon segaenensis Steud., Syn. Pl. Glumac. 1: 367. 1854. *Type*: ––INDIA, *Wallich* 8801 (K [K000245945 digital image!]).

Heteropogon insignis Thwaites, Enum. Pl. Zeyl. 437. 1864. *Lectotype* (designated here):––SRI LANKA, Mahning-galla, Matelle East, *Thwaites* C.P. 3804 (lecto: K [K000245943 digital image!]); isolecto [CAL!]).

Figs. 124–129

Perennial robust herb, 100–300 cm high. *Culm* erect; nodes glabrous; *internode* 10–20 cm long, glabrous. *Leaf sheath* 7–16 cm long, keeled, chartaceous, glabrous, greenish. *Leaf blade* narrowly ovate–linear, 5–80 × 1–2 cm, base rounded–auriculate, margin scabridulous with few tubercle-based hairs present near to base, tubercle-based hairs hyaline, 4–5 mm long, apex acuminate, chartaceous, both abaxial and adaxial surface scabridulous with minute hairs, greenish, 13–25-nerved. *Ligule* 1.5–2 mm long, membranous, apex ciliolate. *Inflorescence* terminal, solitary raceme with reduced spathe, 10–20 cm long (including awn), glabrous, spikelets paired, one sessile and one pedicelled. *Peduncle* terete–subterete, 15–30 cm long, glabrous, greenish. *Rachis* jointed, rachis internode of lower pair linear, subterete, 2–4 mm long, subcoriaceous, not fragile, sparsely scabridulous or sparsely pilose–glabrous, hairs hyaline, *ca.* 0.1 mm long; greenish; internode of upper pair 1–2 mm long, shallowly 3-angled, or dorsi-ventrally compressed, apex oblique, coriaceous, fragile, sparsely scabridulous–glabrous, sometimes rufous hairy on apical margin, yellowish green, hairs hyaline or brownish, 0.1–1 mm long. *Lower spikelet pairs* 11–17, homogamous, male; callus obtuse or slightly oblique but not pungent, 1–3 mm long. *Lower sessile spikelet* narrowly elliptic, 11–12 ×1–1.5 mm, greenish. *Lower glume* narrowly elliptic, 10.5–11 × 1–1.2 mm, cymbiform, margins entire, inflexed at lower half, infolded at upper half, one infolded margin keeled and the other infolded margin keeled near to apex only, keel scabridulous, apex acute–truncate or oblique, subcoriaceous, dorsal surface glabrous, ventral surface densely scabridulous, greenish, 20–22-nerved, nerves inconspicuous. *Upper glume* narrowly

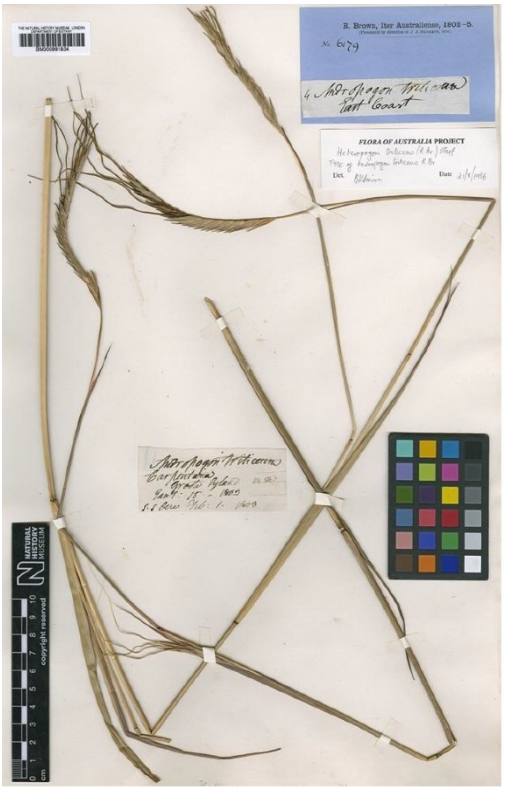

Fig. 124. Lectotype of *Heteropogon triticeus* (R.Br.) Stapf ex Craib [*Robert Brown* 6179 (BM000991834)] © The Board of Trustees of The Natural History Museum, London. Reproduced with permission.

elliptic, 11–11.5 × 1–1.5 mm, cymbiform, margins inflexed at lower 1/3rd and infolded at upper 2/3rd, infolded margins ciliate, hairs hyaline, 0.8–1 mm long, apex acute, subcoriaceous, dorsal surface glabrous, ventral surface densely scabridulous, hyaline–pale greenish, hairs very minute, 3-nerved. *Lower lemma* narrowly elliptic, 10.5–11.5 × 1–2 mm, cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, hairs hyaline, 0.5–1.5 mm long, apex truncate, subcoriaceous–membranous, dorsal surface glabrous, ventral surface scabridulous, hyaline, hairs very minute, 1-nerved. *Lower palea* absent. *Upper lemma* narrowly elliptic, 9.5–10 × 1–1.2 mm, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, hyaline, hairs hyaline, 0.8–1 mm long, apex acute–acuminate, subcoriaceous–membranous, dorsal surface glabrous, ventral surface scabridulous, hairs very minute, dorsally shallowly keeled at upper half, hyaline, 1-nerved. *Upper palea* elliptic–ovate, 1–1.3 × *ca.* 0.5 mm, apex acute–obtuse or shortly lobed, apex and margins at upper half ciliate, hairs hyaline, 1–1.5 mm long, membranous, glabrous, hyaline–pale yellowish. *Lodicules* 2, cuneate, 0.8–1 × 0.4–0.6 mm, hyaline. *Stamens* 3; filament hyaline; anthers 3–5 mm long, purplish or yellowish. *Lower pedicelled spikelet* narrowly elliptic, twisted, 10–11 × 1–1.8 mm, glabrous, greenish. *Callus* elongate, pedicel like, linear–oblong, 1–1.5 × 0.3–0.5 mm long, dorsi-ventrally compressed, ventrally small grooved, base oblique, subcoriaceous, scabridulous, greenish with purple tinge, hairs very minute. *Pedicel* reduced. *Lower glume* elliptic–narrowly elliptic, 10–11 × *ca.* 2 mm, twisted, margins entire, one margin inflexed, other margin infolded and keeled throughout, keel winged, wing margin

scabridulous, apex acute–acuminate or truncate, subcoriaceous, dorsal surface glabrous, ventral surface densely scabridulous, greenish, hairs minute, 20–22-nerved, nerves inconspicuous. *Upper glume* narrowly ovate or narrowly elliptic, 10.2–10.5 × 2–2.5 mm, cymbiform, twisted, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margin ciliate, hairs hyaline, 0.5–1 mm long, apex acute–oblique, subcoriaceous, dorsal surface glabrous except keel, ventral surface puberulent, hyaline with greenish tinge, dorsally keeled towards apex, keel sparsely scabridulous, 3-nerved. *Lower lemma* narrowly elliptic, 12.5–13 × *ca.* 1 mm, shallowly twisted, margins ciliate, inflexed at lower 1/3rd, infolded at upper 2/3rd, hairs hyaline, *ca.* 1 mm long, apex acute–acuminate, subcoriaceous–membranous, dorsal surface glabrous, ventral surface scabridulous, hairs hyaline, very minute, 1-nerved. *Lower palea* absent. *Upper lemma* narrowly elliptic, *ca.* 11 × 1–2 mm, margins ciliate, inflexed or incurved at lower 1/3rd, infolded at upper 2/3rd, hairs hyaline, 0.5–1 mm long, apex acute–mucronulate, subcoriaceous–membranous, dorsal surface glabrous, ventral surface scabridulous, hairs very minute; hyaline, 1-nerved. *Upper palea* ovate–narrowly ovate, 1–1.2 × 0.5–0.8 mm, apex acute–obtuse or shortly lobed, apex and margins at upper half ciliate, hairs hyaline, 1–1.5 mm long, membranous, glabrous, hyaline–pale yellowish. *Lodicules* 2, cuneate, 0.8–1 × 0.5–0.8 mm, hyaline. Stamens 3; filament hyaline; anthers 3–5 mm long, purplish or yellowish. *Upper heterogamous pair* 4–5; callus pungent, 3–4 mm long, densely pilose; hairs 0.5–3 mm long, golden brownish. *Upper sessile spikelet* bisexual, subterete, *ca.* 7 × 1.5–1.8 mm, brownish. *Lower glume* oblong, 7–7.5 × 1.5–1.8 mm, dorsally 2-grooved, margins entire, inflexed–incurved, apex rounded, coriaceous, dorsal surface densely scabridulous, hairs 0.1–0.2 mm long, ventral surface glabrous, brownish, 8-nerved. *Upper glume* narrowly elliptic, 6.5–7 × 1.8–2 mm, cymbiform, margin inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margin ciliate, hairs hyaline, *ca.* 0.5 mm long, apex truncate–mucronate, with two shallow depressions and ciliolate towards lateral sides, coriaceous, dorsally keeled, keel broad, grooved on both sides of the keel, dorsal surface scabridulous on broad keel except on grooves, hairs hyaline, 0.1–0.2 mm long, ventral surface glabrous, brownish, nerves inconspicuous. *Lower lemma* narrowly ovate, 3–3.3 × 0.8–1 mm,

margins entire–sparsely ciliate, hairs hyaline, *ca.* 0.1 mm long, apex acute–acuminate, membranous, glabrous, hyaline, nerves absent. *Lower palea* absent. *Upper lemma* reduced to the hyaline base of the awn, linear, 3–4 mm long, membranous. *Awn* 7.5–8 cm long, twisted, geniculate, scabridulous, brownish; column 3.4–3.5 cm long; bristle 4.1–4.3 cm long. *Upper palea* ovate, 1–1.5 × 0.8–1 mm, apex acute–rounded, or lobed, apex and margins at upper half ciliate, hairs 0.5–1 mm long, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 1–1.2 × 0.5–0.7 mm. *Stamens* 3; filament hyaline; anthers 2.5–4 × 0.3–0.5 mm, purplish or yellowish. *Ovary* oblong, 2.2–2.5 × 0.5–0.6 mm, glabrous, brownish; style 2, 3–3.5 mm long, glabrous, hyaline–pale brownish; stigma 2, feathery, *ca.* 7 mm long, purplish. *Upper pedicelled spikelet* narrowly elliptic, *ca.* 16 × 2–2.3 mm, twisted, greenish. *Callus* elongate, pedicel like, linear, 2–3 mm long, dorsi-ventrally compressed, base oblique, subcoriaceous, scabridulous, greenish. *Pedicel* reduced. *Lower glume* elliptic–narrowly elliptic, *ca.* 15 × 3–3.5 mm, twisted, margins entire, one margin inflexed, other margin infolded and keeled, keel winged, wing margin scabridulous at upper half, hairs minute, *ca.* 0.1 mm long, apex bifid or oblique, subcoriaceous, dorsal surface glabrous, ventral surface densely scabridulous, greenish, hairs very minute, nerves inconspicuous. *Upper glume* narrowly elliptic, 14–15 × 2–2.5 mm, cymbiform, margins inflexed at lower 1/ 3rd, infolded at upper 2/3rd, infolded margins membranous, ciliate, hairs hyaline, 0.5–1 mm long, apex acute–acuminate, dorsally shallowly keeled near apex, keel scabridulous, hairs *ca.* 0.1 mm long, subcoriaceous, dorsal surface glabrous, ventral surface densely scabridulous, greenish, hairs very minute, 3-nerved. *Lower lemma* narrowly elliptic, 13–14 × 2–2.2 mm, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margins membranous and ciliate, hairs hyaline, 0.8–1 mm long, apex acute–acuminate, subcoriaceous–membranous, glabrous, hyaline, 1-nerved. *Lower palea* absent. *Upper lemma* narrowly elliptic, 10–11 × 2–2.2 mm, folded, margins infolded, inflexed near base, infolded margins ciliate, hairs hyaline, 0.5–1 mm long, apex acute, subcoriaceous–membranous, glabrous, hyaline, 1-nerved. *Upper palea* similar to that of upper sessile spikelet, ovate, 1–1.2 × *ca.* 0.8 mm, apex rounded–truncate or lobed, apex and margins ciliate, hairs 1–1.5 mm long, membranous,

glabrous, hyaline–pale yellowish. *Lodicules* 2, cuneate, *ca.* 0.8 × 0.6–0.8 mm. *Stamens* 3; filament hyaline; anthers 3–5 mm long, purplish or yellowish. *Caryopsis* not seen.

Flowering & Fruiting: October to February.

Distribution: Hainan to Tropical Asia and Queensland. In India, Gujarat, Karnataka, Maharashtra and Telangana. It is poorly represented in southern Peninsular India and reported only from Karnataka and Telangana.

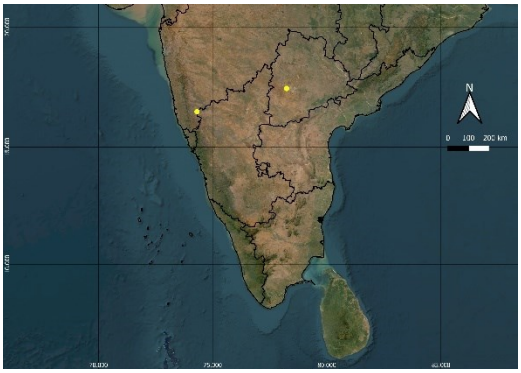

Fig. 125. Distribution of *Heteropogon triticeus* (R.Br.) Stapf ex Craib in southern Peninsular India

Habitat: On bunds of open cultivated fields and hill slopes.

Notes: *Heteropogon triticeus* is not very common in southern Peninsular India. Authors were unable to collect it from the study area, but able to study the herbarium specimen collected from study area which is available at the herbaria FRC and SUK. The present description and illustrations are mainly based on author's own collections from Maharashtra.

Specimens examined: INDIA, **Karnataka**, Belgaum district, Appachiwadi, 11.03.2007, *Arun M. Chandore* 244 (SUK); *s.loc.*, *s.d.*, *Stocks s.n.* (CAL). **Telangana**, Vikarabad district, on the way from Vikarabad to Hyderabad, Kancha Grassland, 11.11.1965, *K.N. Subramanian* 2323 (FRC).

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Kolhapur district, Tillari Ghat, 08.01.2017, *V. Drisya* 171402 [CALI184692, CALI184693, CALI184694, CALI184695, CALI184696 & CALI184697] (CALI).

Notes on typification: Stapf (1912) published *Heteropogon triticeus* as a new combination based on *Andropogon triticeus* R. Br. While transferring *Andropogon triticeus*, Stapf cited a specimen as "Chiengmai, Doi Sootep, in eng jungle,

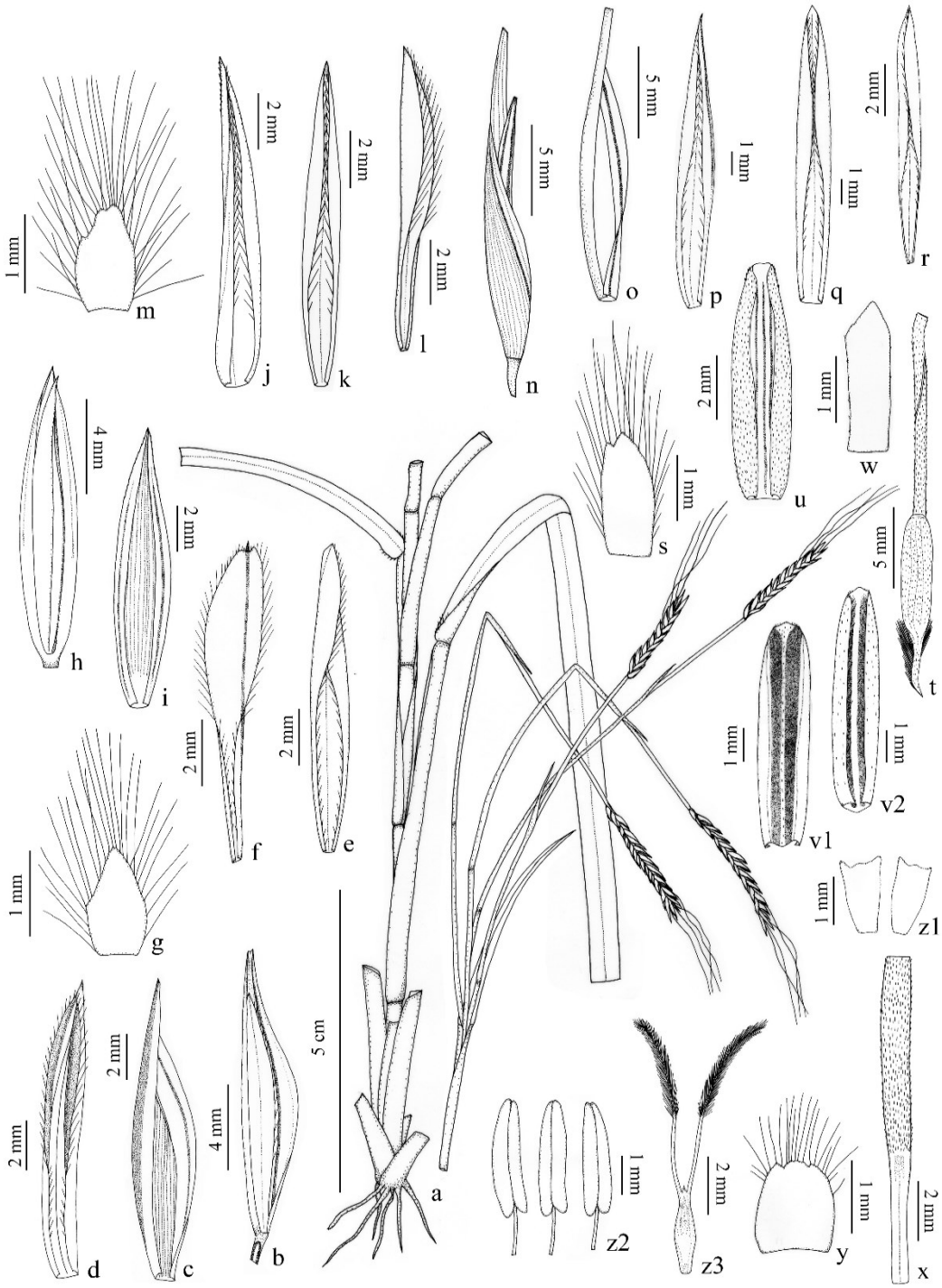

Fig. 126. *Heteropogon triticeus* (R.Br.) Stapf ex Craib: **a.** Habit; **b.** Lower pedicelled spikelet; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma; **f.** Upper lemma; **g.** Upper palea (**b–g**: Pedicelled spikelet of lower homogamous spikelet pair); **h.** Lower sessile spikelet; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Upper lemma; **m.** Upper palea (**h–m**: Sessile spikelet of lower homogamous spikelet pair); **n.** Upper pedicelled spikelet; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma; **r.** Upper lemma; **s.** Upper palea (**n–s**: Pedicelled spikelet of Upper heterogamous spikelet pair); **t.** Upper sessile spikelet; **u.** Lower glume; **v1.** Upper glume-dorsal view; **v2.** Upper glume-ventral view; **w.** Lower lemma; **x.** Upper lemma; **y.** Upper palea (**t–y**: Sessile spikelet of upper heterogamous spikelet pair); **z1.** Lodicules; **z2.** Stamens; **z3.** Gynoecium (from *V. Drisya* 171402, drawn by V. Drisya).

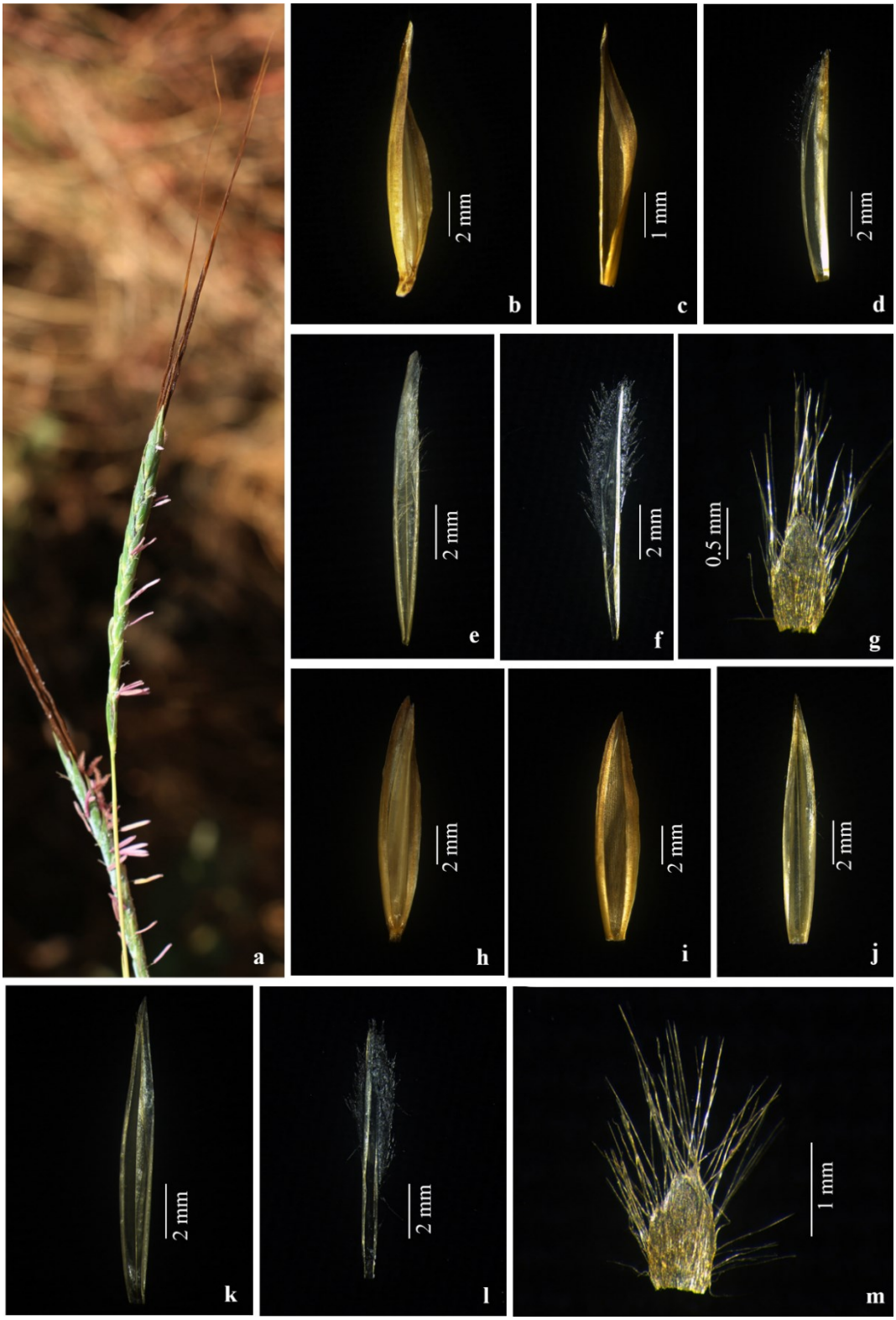

Fig. 127. *Heteropogon triticeus* (R.Br.) Stapf ex Craib: **a.** Single raceme; **b.** Lower pedicelled spikelet; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma; **f.** Upper lemma; **g.** Upper palea (**b–g:** Pedicelled spikelet of lower homogamous spikelet pair); **h.** Lower sessile spikelet; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Upper lemma; **m.** Upper palea (**h–m:** Sessile spikelet of lower homogamous spikelet pair).

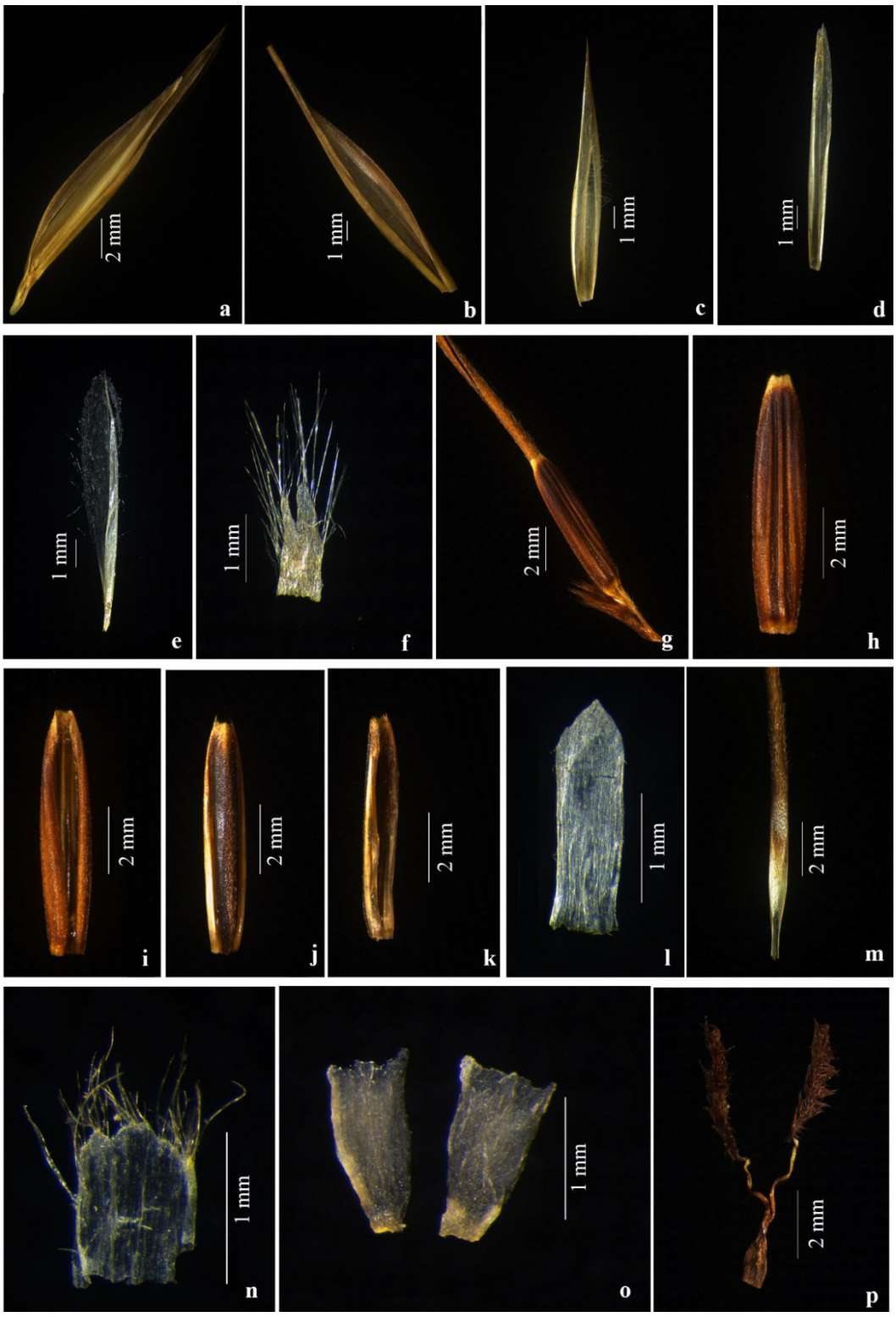

Fig. 128. *Heteropogon triticeus* (R.Br.) Stapf ex Craib: **a.** Upper pedicelled spikelet; **b.** Lower glume; **c.** Upper glume; **d.** Lower lemma; **e.** Upper lemma; **f.** Upper palea (**a–f:** Pedicelled spikelet of upper heterogamous spikelet pair); **g.** Upper sessile spikelet; **h.** Lower glume-dorsal view; **i.** Lower glume-ventral view; **j.** Upper glume-dorsal view; **k.** Upper glume-ventral view; **l.** Lower lemma; **m.** Upper lemma; **n.** Upper palea (**g–n:** Sessile spikelet of upper heterogamous spikelet pair); **o.** Lodicules; **p.** Gynoecium.

300–600 m., Kerr, 833". By searching specimens at various Herbaria, we could trace 3 specimens by A.F.G. Kerr at herbaria E and K with the same collection number 833; two sheets at K (with barcodes K000620597 & K000620598) and one at E (with barcode E01024055).

Whereas the basionym *Andropogon triticeus* was published by Robert Brown (1810) in Prodromus Florae Novae Hollandiae. But in this treatment, Robert Brown failed to cite any specimen along with plant description. However, there are 12 sheets of Robert Brown's collection from Australia available at various herbaria such as BM, E, K, MEL and P. The specimens from Australia by Robert Brown are the possible choice for original material, since New Holland is a historical European name for mainland Australia. Moreover, among these 12 specimens many of them were seen by B.K. Simon for 'Flora of Australia project' and verified it as original materials or types. But unfortunately, he failed to publish a single sheet as lectotype or type. Instead, he made annotation labels on few sheets as types. Among the 12 sheets available, 4 are there at BM (with barcodes BM000991831 digital image!, BM000991832 digital image!, BM000991833 digital image! & BM000991834 digital image!); 3 at E (with barcodes E00691888 digital image!, E00691889 digital image! & E00691890 digital image!); 2 sheets with 3 specimens at K (with barcodes K000911720 digital image!, K000911721 digital image! & K000911722 digital image!); 1 at MEL (barcode MEL1547816 digital image!) and 2 sheets at P (with barcodes P00745740 digital image! & P00745741 digital image!). All these available sheets constitute the syntypes. According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), there needs selection of a single specimen as lectotype.

Fig. 129. Lectotype of *Heteropogon insignis* Thwaites [*Thwaites* C.P. 3804 (K000245943)] © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

Hence, one of the well-preserved specimen at BM (BM000991834) with collection number 6179 and which is also verified by B.K. Simon as 'type' is selected here as the lectotype. Thus, all other sheets with collection number 6179 (BM000991831, K000911721, K000911722, E00691889 & E00691890) constitutes isolectotypes and rest of them remains as original materials.

The name *Heteropogon insisgnis* Thwaites was first appeared in Enumeratio Plantarum Zeylaniae in the year 1864. In this treatment, Thwaites cited a Ceylon plant number, 'C.P. 3804' along with a detailed description. Moreover, he also cited the habitat as 'Mahning-galla, Matelle East'. While searching the specimens of Thwaites with the number "C.P. 3804", authors could trace two sheets, one at K (K000245943 digital image!) and another one at CAL (with accession number 531482!). As per article 9.12 of the Shenzhen Code (Turland *et al*. 2018), from this two available syntypes, the well-preserved specimen at K (barcode K000245943) is selected here as the lectotype. Thus, the specimen at CAL constitutes the isolectotype.

3. **Iseilema** Andersson

Iseilema Andersson, Nova Acta Regiae Soc. Sci. Upsal. ser 3(2): 250. 1856; Clayton & Renvoize, Gen. Gram., Grasses World: 360. 1986; Watson & Dallwitz, Grass Gen. World: 502. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 310. 2015; Veldkamp, Reinwardtia 15(2): 124. 2016; K.C.Mohan & Y.Mahesh, J. Global Biosci. 9(8): 7836. 2020. *Themeda* sect. *Iseilema* Roberty, Boissiera. 99. 1960. *Type*: *Iseilema prostratum* (L.) Andersson.

Annuals or perennials, caespitose. *Ligule* a fringe of hairs or fringed membrane or membranous. *Inflorescence* false panicle interrupted by spathe and spatheole. *Raceme* comprises 4 involucral spikelets, 1 or 2 sessile spikelet and 2 or 3 pedicelled spikelets enclosed by a boat shaped spatheole. *Involucral spikelets* pedicelled, male or neuter, dehisces with sessile spikelet. *Sessile spikelet* bisexual, base fused to the rachis internode; upper lemma entire or bilobed with a geniculate awn. *Pedicelled spikelet* male or neuter, callus absent, pedicel slender.

Distribution: India to Australia. About 23 species in the world; 5 in India and 3 in southern Peninsular India (Kellogg in Kubitzki, 2015; Kellogg *et al.*, 2020).

Habitat: Mostly in open habitats. Seen in open grasslands, waste lands and cultivated lands.

Key to the species of *Iseilema* in southern Peninsular India

1. Pedicels of involucral spikelets as broad as long ..... 1. ***I. anthephoroides***

1. Pedicels of involucral spikelets longer than broad **2**

2. Tubercles present on the spatheoles and/ or on the spikelets ..... 3. ***I. prostratum***

2. Tubercles not present on the spatheoles and spikelets ..... 2. ***I. jainiana***

1. Iseilema anthephoroides Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 683: 1889; Hook.f., Fl. Brit. India 7: 219. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1748. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 187. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 123. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1870. 1983; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 233. 1989; S.Moulik, Grasses Bamboos India 2: 235. 1997; Pull., Fl. Andhra Pradesh 3: 1213. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 445. 2009; Potdar *et al.*, Grasses Maharashtra 209. 2012; Pull., Fl. Telangana 3: 1140. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 134. 2017; K.C.Mohan & Y.Mahesh, J. Global Biosci. 9(8): 7839. 2020. *Lectotype* (designated by Chorghe & Tiwari, 2021):—INDIA, *Wallich* 8767A (K [K000245990 digital image!]).

Iseilema venkateswarlui Satyavathi, J. Bombay Nat. Hist. Soc. 65: 666. 1969, *syn. nov. Lectotype* (designated by Drisya & Pradeep, 2019):—INDIA, *Satyavathi* IAG 4 (lecto: K [K000245995 digital image!]; isolecto: K [K000911770 digital image!, K000911771 digital image!, K000245994 digital image!]).

Figs. 130–133

Tufted annual, *ca.* 60 cm high, *culm* erect or geniculately ascending, sometimes rooting from lower nodes. *Node* glabrous, purplish; *internode* subterete, 3–11 cm long, glabrous, greenish with or without purple tinge. *Leaf sheath* folded and keeled, 2.5–3 cm long, chartaceous, both dorsal and ventral surface glabrous, greenish. *Leaf blade* narrowly ovate–linear, 7.5–8 × 3–4 mm, margins scabridulous, tubercle-based

hairy at base, abaxial (dorsal) surface scabridulous on midnerve at upper half, adaxial (ventral) surface scabridulous, tubercle-based hairy at collar and base (usually on margins), tubercle-based hairs hyaline, 2–3 mm long, apex acute, chartaceous, greenish. *Ligule* 0.8–1 mm long, hairy, jointed at base and basal portion membranous. *Inflorescence* false panicle interrupted by spathe and spatheole. *Raceme* comprises 4 involucral spikelets, 2 pedicelled spikelets and 1 sessile spikelet enclosed by a spatheole; *callus of the raceme* densely pilose forming an involucre, hairs hyaline, 0.1–2 mm long. *Spathe* often leafy with sheath and lamina, chartaceous, greenish; sheath 9–15 × 2–2.5 mm (when folded), margins entire and membranous, dorsally keeled, dorsal surface puberulent or glabrous, scabridulous on keel and tubercle-based hairy towards margins at upper 1/3rd , ventral surface glabrous or puberulent; balde 10–20 × 1–1.5 mm (when folded), flat or folded and keeled, keel scabridulous, margins scabrous–scabridulous, with few tubercle-based hairs seen towards mouth and collar, hairs hyaline, 1.5–2.5 mm long, dorsal surface scabridulous–puberulent, ventral surface puberulent. *Spatheole* elliptic, folded, 11–13 × 4–5 mm, margins entire, chartaceous, dorsally keeled, keel scabrous–scabridulous, dorsal surface puberulent or scabridulous, ventral surface glabrous, greenish, hyaline towards margins. *Peduncle* linear, salver shaped, 2–3 × 0.3–0.4 mm, laterally compressed, subterete, glabrous, scabridulous near apex, greenish. *Rachis internode* short, *ca.* 0.5 mm long, greenish, almost subequal with the pedicel of the involucral spikelet, pilose at apex, hairs hyaline, 0.5–1.5 mm long. *Involucral spikelet* male, pedicelled, narrowly ovate–elliptic, 5.5–6.5 × 1–1.5 mm, greenish, mostly with purple shade; *pedicel* as broad as

Fig. 130. Lectotype of *Iseilema anthephoroides* Hack. [*Wallich* 8767A (K000245990)] © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

long, 0.8–1 × 0.7–1 mm, jointed at base and forms an involucre. *Lower glume* narrowly ovate, 5.3–6 × 1–1.5 mm, margins entire, inflexed, infolded near apex (usually at upper 1/6th), keeled throughout, keel densely pilose (*ca.* at lower 7/8th), hairs hyaline, 1–2 mm long, keel scabridulous at apical region (at upper 1/8th), hairs minute, *ca.* 0.1 mm long, infolded and inflexed margins membranous and hyaline towards apex, apex acute–obtuse or muticous, coriaceous, dorsal surface vesicular and scabrous or scabridulous on infolded and inflexed marginal portion, hairs hyaline, 0.1–0.2 mm long, ventral surface glabrous, greenish, purplish dorsally. *Upper glume* narrowly ovate, 5–6 × 0.8–1 mm, cymbiform, margins entire, inflexed at lower 3/4th, infolded at upper 1/4th, inflexed and infolded margins membranous, apex obtuse, subcoriaceous, dorsal surface glabrous or sparsely puberulent, ventral surface glabrous, hyaline. *Lemma* and *Palea* absent or reduced. *Lodicules* 2, cuneate, 0.5–0.7 × 0.2–0.4 mm, hyaline. *Stamens* 3; filament hyaline; anthers 2.5–3.2 mm long, yellowish. *Sessile spikelet* bisexual, narrowly ovate–elliptic, 5–5.5 × 0.6–0.8 mm, lower broader portion and upper beak subequal or beak longer than basal portion, pale greenish. *Lower glume* ovate–narrowly ovate, 4.5–5.5 × 1–1.2 mm, margins inflexed at lower half, infolded at upper half, keeled throughout; keel pilose at lower half, scabridulous at upper half (usually on beak portion), tubercle-based hairy towards the middle of the keel and very few on beak keel, pilose hairs hyaline and 0.2–1 mm long, tubercle-based hairs hyaline, 1–2.5 mm long, infolded and inflexed margins scabrous–scabridulous, hairs 0.1–1 mm long, apex bifid, subcoriaceous–chartaceous, dorsal surface scabrous–scabridulous at upper 3/4th, hairs 0.1–0.5 mm long, ventral surface puberulent, greenish, 8–9-nerved. *Upper glume* narrowly ovate, 4.5–5.2 × 1–1.2 mm, margins entire, inflexed, apex acuminate–minutely aristate, subcoriaceous–chartaceous, dorsally keeled; keel scabrous on lower half (lower elliptic portion) and hairs 0.2－1 mm long, scabridulous on upper half (beak portion) and hairs *ca.* 0.1 mm long, dorsal surface of lower elliptic portion glabrous except on keel, scabridulous on upper beak portion, ventral surface puberulent, greenish, 3-nerved. *Lower lemma* ovate, 2–2.5 × 1–1.2 mm, margins entire, apex truncate and finely dissected or lobed, membranous, glabrous, hyaline. *Upper lemma* reduced to the hyaline base of the awn, *ca.* 4 × 0.2–

0.3 mm, not bilobed, but sometimes broad at apex. *Awn* geniculate, 18–25 mm long; column 9–12 mm long, twisted, scabridulous, dark brownish; bristle 8–13 mm long, scabridulous, pale brownish. *Paleas* absent or reduced. *Lodicules* reduced, triangular–linear, 2, *ca.* 0.2 × 0.1–0.2 mm, hyaline. *Ovary* elliptic, 0.8–1.5 × 0.3–0.4 mm, pale brownish; style 2, 2.5–3.5 mm long, hyaline; stigma 2, 6.5–7 mm long, plumose, purplish. *Pedicelled spikelet* 2, male, narrowly ovate, 5–5.5 × 0.7–1 mm, greenish, with or without purple tinge. *Pedicel* linear, salver shaped, 2.8–3.2 × *ca.* 0.1 mm, slender, dorsiventrally flattened, scabridulous or puberulent, hairs very minute, lateral margins scabrous at upper 1/3rd, hairs hyaline, 0.1—0.4 mm long, greenish. *Lower glume* narrowly ovate, 4.8–5 × 1–1.2 mm, margins inflexed at lower half, infolded at upper half and keeled at upper 3/4th, keel scabridulous and tuberculate, apex acute–acuminate, chartaceous, dorsal surface scabrous–scabridulous, puberulent and vesicular, ventral surface glabrous, greenish, 6-nerved. *Upper glume* narrowly ovate–elliptic, 4.5–4.8 × 1–1.2 mm, cymbiform, margins entire, narrowly inflexed at lower half, infolded at upper half, apex acuminate, chartaceous, glabrous, dorsally shallowly keeled and scabridulous near apex, greenish, 3-nerved. *Lemma* and *palea* absent or reduced. *Lodicules* 2, cuneate, 0.5–0.7 × 0.4–0.5 mm, hyaline. *Stamens* 3; filament hyaline; anthers 1.5–3 mm long, yellowish. *Caryopsis* ellipsoid, 1.8–2 × 0.5–0.6 mm, brownish, style persistent.

Flowering & Fruiting: September to March.

Distribution: Endemic to India. In India, it is distributed in Andhra Pradesh, Bihar, Daman and Diu, Dadra and Nagar Haveli, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh and Uttarakhand.

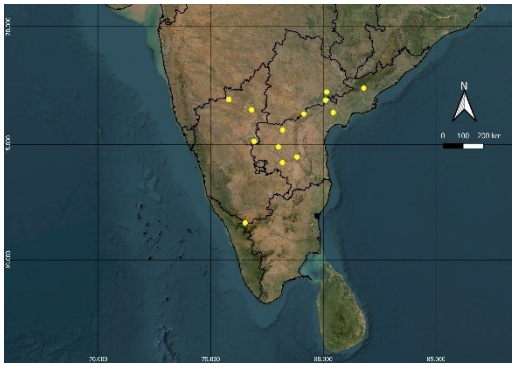

Fig. 131. Distribution of *Iseilema anthephoroides* Hack. in southern Peninsular India

Habitat: Open grasslands and margins of cultivated fields.

Specimens examined: INDIA. **Andhra Pradesh**, Anantapur district, Batrepalli, 14.02.2009, *B. Ravi Prasad Rao & P. Priyadarsini* 37066 (BSID); Tadpatri, 06.10.1981, *T. Pullaiah* 412 (MH); East Godavari district, Bhupathipalem, way to Maredumilli, 26.10.1994, *M. Mohanan* 102683 (BSID & MH); Guntur district, Larm Farm, Guntur, 10.10.2017, *V. Drisya* 157101 [CALI184895, CALI184896, CALI184897, CALI184898, CALI184899, CALI184900, CALI184901, CALI184902, CALI184903, CALI184904, CALI184905, CALI184906, CALI184907, CALI184908 & CALI184909] (CALI); Kadapa [Cuddapah] district, 20.10.1938, *DFO s.n.* (DD); Krishna district, Jaggayyapeta, 14.08.1907, *C.A. Barber* 8205 (FRC); Kurnool district, Hussainapuram, 26.12.2021, *V. Drisya* 169586 (CALI); Nandyal district, Nandyal Farm, 31.08.1936, *K.C. Jacob s.n.* (MH). **Karnataka**, Bellary district, Bellary, *s.d.*, *S.K. Jain* 31224 (CAL); Kupgal, 30.09.1958, *B.M. Wadhwa* 44908 (BSI). **Tamil Nadu**, Nilgiris district, Mudumalai, 07.03.2011, *J. Remya* 67116 (TBGT). **Telangana**, Khammam district, Koriguttalu, 19.10.1995, *R. Rajan* 106034; Mahbubnagar district, Maddimadugu, 25.09.2013, *L. Rasingam & M. Sankara Rao* 003798 (BSID).

Notes: *Iseilema anthephoroides* can be easily identified by the pedicel of the involucral spikelet, which is as broad as long and apparently forms an involucre. *Iseilema venkateswarlui* is found to be conspecific with *I. anthephoroides*. *I. venkateswarlui* is distinguished based on the relative length of involucral spikelets and central bisexual spikelet. This character is found to be variable and cannot be considered as a stable character to distinguish it from *I. anthephoroides*. The different racemes seen in same papulation of plants or sometimes in different racemes of the same plant shows variation in relative lengths of spikelets. The plants collected from Larm Farm in Guntur district (type locality of *I. venkateswarlui*) also shows the same type of variations, *ie*, central bisexual spikelet projecting beyond the tips of involucral spikelets as well as which is hidden by involucral spikelets are observed. Thus, *I. venkateswarlui* is treated here as a synonym of *I. anthephoroides*.

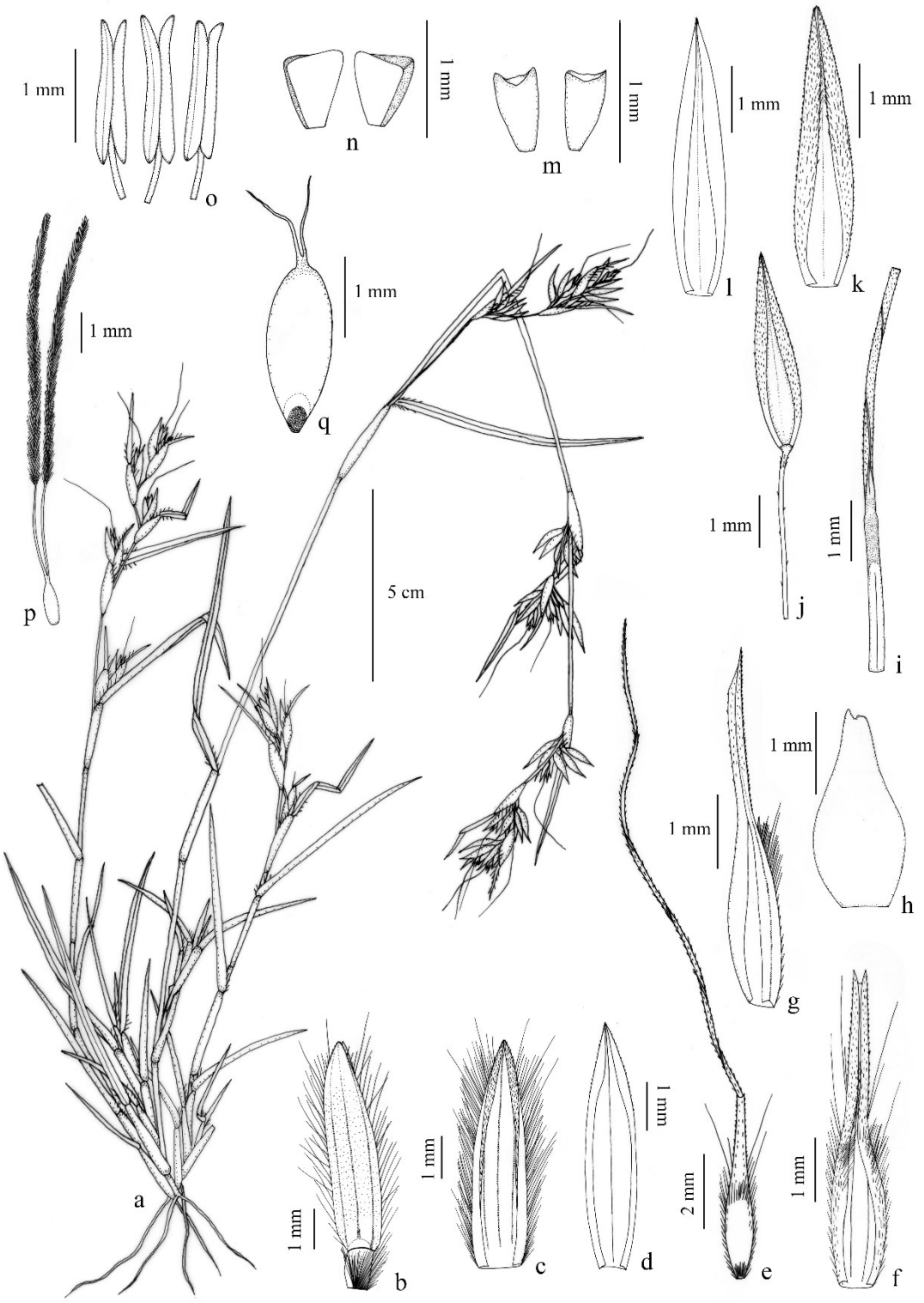

Fig. 132. *Iseilema anthephoroides* Hack.: **a.** Habit; **b.** Involucral spikelet; **c.** Lower glume; **d.** Upper glume (**b–d**: Involucral spikelet); **e.** Sessile spikelet; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Upper lemma (**e–i**: Sessile spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume (**j–l**: Pedicelled spikelet); **m & n.** Lodicules (**m**. Lodicules from pedicelled spikelet; **n**. Lodicules from involucral spikelet); **o.** Stamens; **p.** Gynoecium; **q.** Caryopsis (from *V. Drisya* 157101, drawn by V. Drisya).

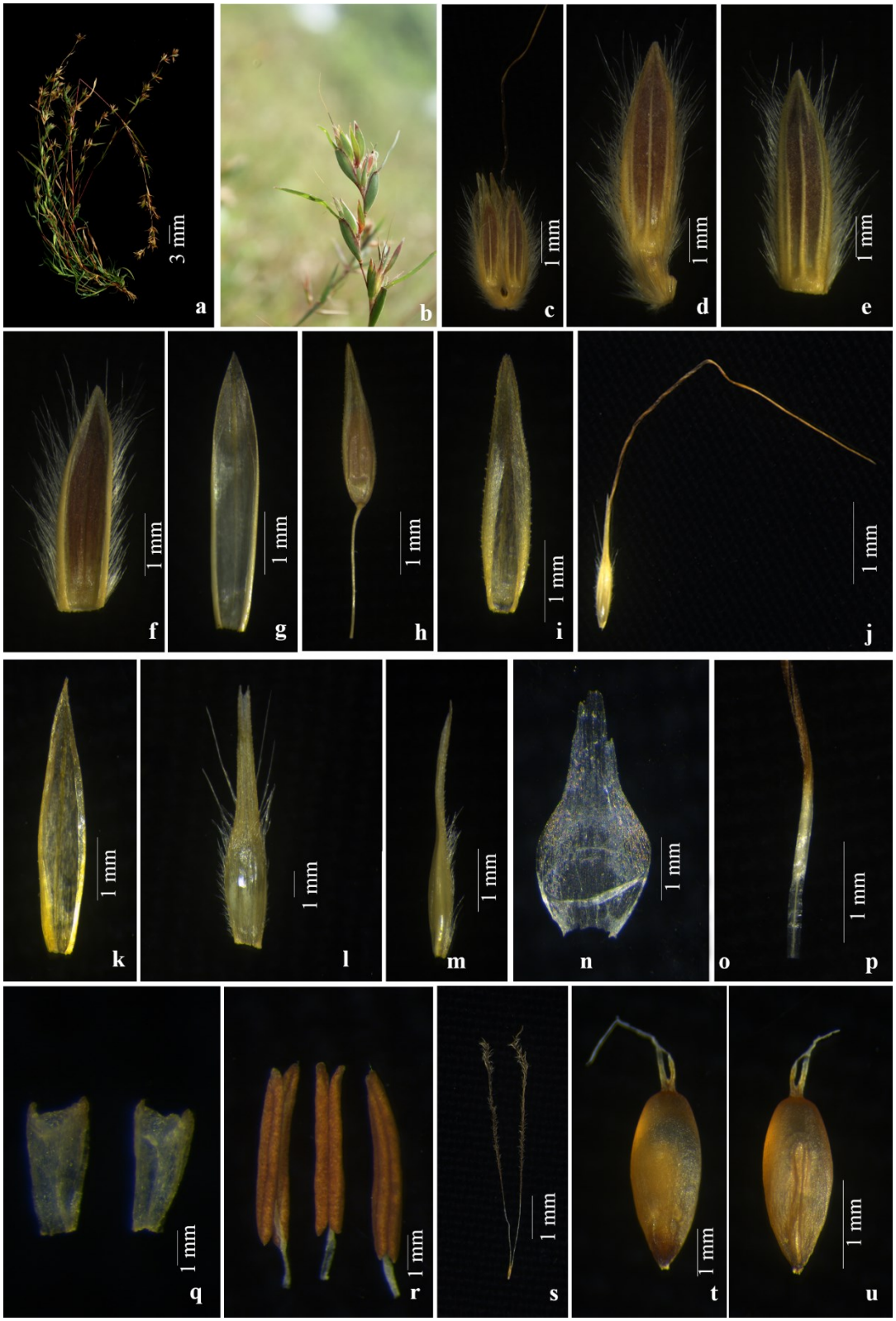

Fig. 133. *Iseilema anthephoroides* Hack.: **a.** Habit; **b.** Inflorescence; **c.** Single raceme; **d.** Involucral spikelet; **e.** Lower glume-dorsal view; **f.** Lower glume-ventral view; **g.** Upper glume (**d–g:** Involucral spikelet); **h.** Pedicelled spikelet; **i.** Lower glume; **j.** Upper glume (**h–j:** Pedicelled spikelet); **k.** Sessile spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Upper lemma (**k–o:** Sessile spikelet); **p.** Lodicules; **q.** Stamens; **r.** Gynoecium; **s.** Caryopsis-dorsal view; **t.** Caryopsis-ventral view.

2. Iseilema jainiana P.Umam. & P.Daniel, J. Bombay Nat. Hist. Soc. 98(3): 425. 2001. *Type*:—INDIA, **Tamil Nadu**, Tuticorin district, Gulf of Mannar coast, Kanyakumari–Thiruchendur highway, between Karaichuthu and Padakkapathu diversion, 26.01.1996, *P. Daniel & P. Umamaheswari* 107240 (holo: CAL!; iso: MH!).

Iseilema laxum Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 682. 1889, *non* Hack. ex Duthie 1888, *nom. illeg.*; Hook.f., Fl. Brit. India 7: 218. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1748. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 188. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 123. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1871. 1983; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 233. 1989; S.Moulik, Grasses Bamboos India 2: 236. 1997; Pull., Fl. Andhra Pradesh 3: 1213. 1997; Potdar *et al.*, Grasses Maharashtra 210. 2012; Pull., Fl. Telangana 3: 1141. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 134. 2017. *Iseilema hackelii* Shrestha & Gandhi, Harvard Pap. Bot. 13(2): 296. 2008; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 447. 2009; K.C.Mohan & Y.Mahesh, J. Global Biosci. 9(8): 7842. 2020. *Lectotype* (designated by Chorghe & Tiwari, 2021):—INDIA, *Wallich* 8767C (K [K000245988 digital image!]).

Iseilema laxum Hack. ex Duthie, Fodder Grass. N. Ind. 43. 1888, *p.p.*, excl. syn. *Iseilema prostratum* (L.) Anderss.

Figs. 134–137

Perennial, caespitose. *Culms* tufted, 20-60 cm tall, erect or geniculate, sometimes rooting from lower nodes. *Nodes* villous, purplish or brownish, hairs hyaline, 0.5–1.5 mm long, older nodes glabrous; *internodes* subterete 2–10 cm long, glabrous, greenish. *Leaf sheath* folded, keeled, 2.5–3.5 cm long, margins entire, chartaceous, membranous towards margins, dorsal surface glabrous or with few tubercle-based hairs towards apex, ventral surface glabrous, greenish and hyaline towards margin, tubercle-based hairs hyaline, 1.5–3 mm long. *Leaf blade* linear–lanceolate, 7–10 × 0.2–0.4 cm, base rounded, margins scabridulous and with or without few tubercle-based hairs towards mouth, apex acute–acuminate, chartaceous, dorsal surface

glabrous–puberulent, scabridulous on midvein, ventral surface glabrous–puberulent, greenish, hairs very minute and sometimes deciduous, tubercle-based hairs hyaline, 1.5–3 mm long. *Ligule* hairy, jointed at base, 0.5–0.8 mm long, hyaline. *Inflorescence* false panicle interrupted by spathe and spatheole. *Raceme* comprises four involucral spikelets, one sessile spikelet and two pedicelled spikelets enclosed by a spatheole; *callus of the raceme* densely pilose forming an involucre, hairs 0.1–2 mm long, hyaline. *Spathe* often leafy with sheath and lamina, chartaceous, greenish; sheath *ca.* 11 × 2 mm (when folded), dorsally keeled, margins entire and membranous, dorsal and ventral surface puberulent–scabridulous, or glabrous; balde flat or folded, 10–11 × 1–1.5 mm, keeled, keel scabridulous, margins scabrous–scabridulous, sometimes with few tubercle-based hairs seen towards mouth and collar, hairs hyaline, 1.5–2.5 mm long, dorsal and ventral surface scabridulous–puberulent. *Spatheole* narrowly elliptic, *ca.* 9 × 2 mm, folded, cymbiform, dorsally keeled, keel scabrous–scabridulous, margins entire, infolded, infolded margins hyaline and membranous, apex acuminate, chartaceous, dorsal surface scabridulous, ventral surface glabrous, greenish.

Fig. 134. Isotype of *Iseilema jainiana* P.Umam. & P.Daniel [*P. Daniel & P. Umamaheswari* 107240 (MH00001638)] © The Director, Botanical Survey of India.

Peduncle linear, salver shaped, 3–6 × *ca.* 0.2 mm, subterete, dorsi-ventrally compressed, scabridulous, glabrous or sparsely scabridulous near base, greenish. *Rachis internode* linear, 1.2–1.5 mm long, terete, dorsi-ventrally compressed, longer than the pedicel of the involucral spikelet, pilose on margins at upper half, greenish, hairs hyaline, 1.5–3 mm long. *Involucral spikelet* male, pedicelled, narrowly elliptic, 3.8–5 × 0.8–1 mm, greenish; *pedicel* linear, longer than broad, 1–1.2 mm long,

dorsiventrally flattened, glabrous, densely pilose at base on dorsal side, greenish, hairs hyaline, 1–1.8 mm long. *Lower glume* narrowly ovate, 3.5–4.8 × *ca.* 1.5 mm, spathiform, margins entire, inflexed at lower half, infolded and keeled at upper half, keel scabridulous towards apex, inflexed and infolded portion long ciliate at lower half or lower 2/3rd, hairs hyaline, 0.5–2 mm long, apex muticous, chartaceous, dorsal surface scabridulous, hairs usually on nerves and submarginal area, ventral surface glabrous, greenish, 7–9-nerved, rarely 11 nerves seen. *Upper glume* narrowly ovate or narrowly elliptic, 4.5–4.8 × 0.8–1 mm, margins entire, inflexed at lower 1/3rd, infolded at upper 2/3rd, apex acute, dorsal surface scabridulous, hairs minute, ventral surface glabrous, pale greenish–hyaline, 3-nerved, lateral nerves faint towards base. *Lower lemma* linear–lanceolate, 2.6–3.3 × 0.3–0.4 mm, apex acute–obtuse, sometimes lobed, membranous, dorsal surface glabrous–sparsely puberulent, hairs very minute, ventral surface glabrous, hyaline, sometimes absent or reduced. *Lower palea* absent. *Lodicules* cuneate, 2, *ca.* 0.5 × 0.3–0.5 mm, hyaline. *Stamens* 3; filament hyaline; anthers 1.5–3 mm long, yellowish. *Upper lemma* and *upper palea* absent or reduced. *Sessile spikelet* narrowly elliptic, 4–5 × *ca.* 0.5 mm, greenish. *Lower glume* narrowly ovate, 3.8–4.8 × *ca.* 1 mm, cymbiform, margins entire, inflexed at lower half, infolded and keeled at upper half, keel scabridulous and rarely with one or few tubercle-based hairs, tubercle-based hairs hyaline and *ca.* 2 mm long, apex bifid, subcoriaceous, dorsal surface scabridulous and glabrous towards base (usually glabrous at lower 1/3rd), ventral surface glabrous, greenish, 5–9-nerved. *Upper glume* oblanceolate, 4–4.8 × 1–1.3 mm, cymbiform, margins entire, inflexed at lower 3/4th, infolded at upper 1/4th, dorsally keeled at upper half, keel scabridulous, apex acuminate, subcoriaceous, dorsal surface scabridulous, hairs usually seen on upper 2/3rd and are usually concentrated on keel and subapical region, lower 1/3rd glabrous, ventral surface glabrous, greenish, 3-nerved. *Lower lemma* narrowly ovate, 2.5–2.7 × *ca.* 1 mm, margins entire, apex truncate–obtuse, or acute or shortly lobed, membranous, dorsal surface puberulent–glabrous, ventral surface glabrous, hyaline. *Lower palea* absent or reduced. *Upper lemma* reduced to the hyaline base of the awn, 2.5–2.8 mm long, apex mostly bilobed, sometimes lobes absent or may not be seen. *Awn* geniculate, *ca.* 1.7 cm long, scabridulous; column

ca. 9 mm long, twisted, scabridulous, dark brownish; bristle *ca.* 8 mm long, scabridulous, pale brownish. *Lodicules* 2, cuneate, 0.1–0.2 × 0.1–0.2 mm. *Ovary* elliptic, 0.5–1 × 0.2–0.4 mm; style 2, 1.5–2 mm long, hyaline; stigma 2, 5–6 mm long, plumose, purple. *Pedicelled spikelet* male, narrowly elliptic, 3.5–4.8 × *ca.* 0.5 mm, greenish. *Pedicel* linear, 2–2.2 mm long, slender, dorsi-ventrally compressed, pilose on lateral margins, hairs hyaline, 0.3–1.5 mm long, greenish. *Lower glume* ovate–narrowly ovate, 3.5–4.8 × 1–1.3 mm, margins inflexed at lower 1/3rd, infolded and keeled at upper 2/3rd, keel scabridulous, inflexed and infolded margins entire, apex acute, chartaceous, dorsal surface scabridulous, ventral surface glabrous, greenish, 5–12-nerved. *Upper glume* narrowly ovate, 4–4.8 × 1–1.2 mm, cymbiform, margins entire, inflexed at lower half, infolded at upper half, apex acute, chartaceous, dorsal surface very sparsely scabridulous–glabrous, hairs minute and usually seen towards apex, ventral surface glabrous, hyaline or pale greenish with green nerves, 3-nerved. *Lower lemma* narrowly ovate–linear, 1–2.8 × 0.2–0.4 mm, apex acute or lobed, membranous, glabrous, hyaline, sometimes reduced or absent. *Lower palea* absent. *Lodicules* 2, cuneate, 0.3–0.4 × 0.3–0.4 mm, hyaline. *Stamens* 3; filament hyaline; anthers *ca.* 2.3 mm long, yellowish. *Upper lemma* and *upper palea* absent or reduced. *Caryopsis* ellipsoid, *ca.* 2 × 0.7 mm, glabrous, brownish, style persistant.

Flowering & Fruiting: September to March.

Distribution: Indian Subcontinent to Myanmar. In India, it is distributed in Andhra Pradesh, Bihar, Delhi, Chhattisgarh, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal.

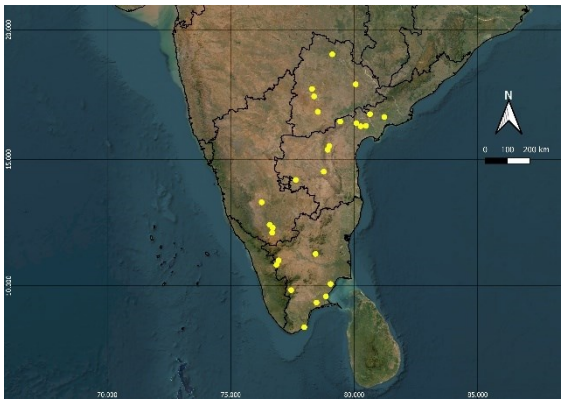

Fig. 135. Distribution of *Iseilema jainiana* P.Umam. & P.Daniel in southern Peninsular India

Habitat: Open grasslands and margins of cultivated fields.

Specimens examined: INDIA, **Andhra Pradesh**, Anantapur district, Gutturu, 07.11.2009, *B. Ravi Prasad Rao & P. Priyadarsini* 37158 (BSID); Guntur district, Dhulipalla, 11.10.2017, *V. Drisya* 157107 [CALI184871, CALI184872, CALI184873, CALI184874, CALI184875, CALI184876, CALI184877, CALI184878 & CALI184879]; Manasa Sarovaram Park, 10.10.2017, *V. Drisya* 157102 [CALI184951, CALI184952, CALI184953, CALI184954, CALI184955, CALI184956 & CALI184957]; *Ibid.*, 10.10.2017, *V. Drisya* 157103 [CALI184964, CALI184965 & CALI184966]; Phirangipuram, 12.10.2017, *V. Drisya* 157116 [CALI184958, CALI184959, CALI184960, CALI184961, CALI184962 & CALI184963] (CALI); Kadapa district, near Kadapa airport, 30.12.2019, *V. Drisya* 169505 [CALI184850, CALI184851, CALI184852, CALI184853, CALI184854, CALI184855, CALI184856, CALI184857, CALI184858, CALI184859, CALI184860, CALI184861, CALI184862, CALI184863, CALI184864, CALI184865, CALI184866, CALI184867; CALI184868, CALI184869 & CALI184870]; *Ibid.*, 25.12.2021, *V. Drisya* 169583; Ramireddy Kottalu, on the way to Narasareddy Palli, 30.12.2019, *V. Drisya* 169501 [CALI184880, CALI184881, CALI184882, CALI184883, CALI184884, CALI184885, CALI184886, CALI184887, CALI184888, CALI184889, CALI184890, CALI184891, CALI184892, CALI184893 & CALI184894]; Sivalapalli, 31.12.2019, *V. Drisya* 169506 [CALI184933, CALI184934, CALI184935, CALI184936, CALI184938, CALI184939, CALI184940, CALI184941 & CALI184942] (CALI); NTR district, Mylavaram, 04.08.1907, *C.A. Barber* 8158 (FRC); Palnadu district, Macherla, 11.10.2017, *V. Drisya* 157114 [CALI184943, CALI184944, CALI184945, CALI184946, CALI184947, CALI184948, CALI184949 & CALI184950] (CALI); Prakasam district, Giddalur, 21.01.2008, *B. Ravi Prasad Rao & B. Sadasivaiah* 30575 (BSID); West Godavari district, way to Kolleru Lake, 24.01.1958, *K. Subramanyam* 5112 (MH). **Karnataka**, Hassan district, Arsikere, 29.09.2015, *V. Drisya* 144225 [CALI184974, CALI184975, CALI184976, CALI184977, CALI184978 & CALI184979] (CALI); Mandya district, Below Kannambadi Dam [Krishna Raja Sagara Dam], Brindavan, 10.12.1940, *K.C. Jacob* 20137 (MH);

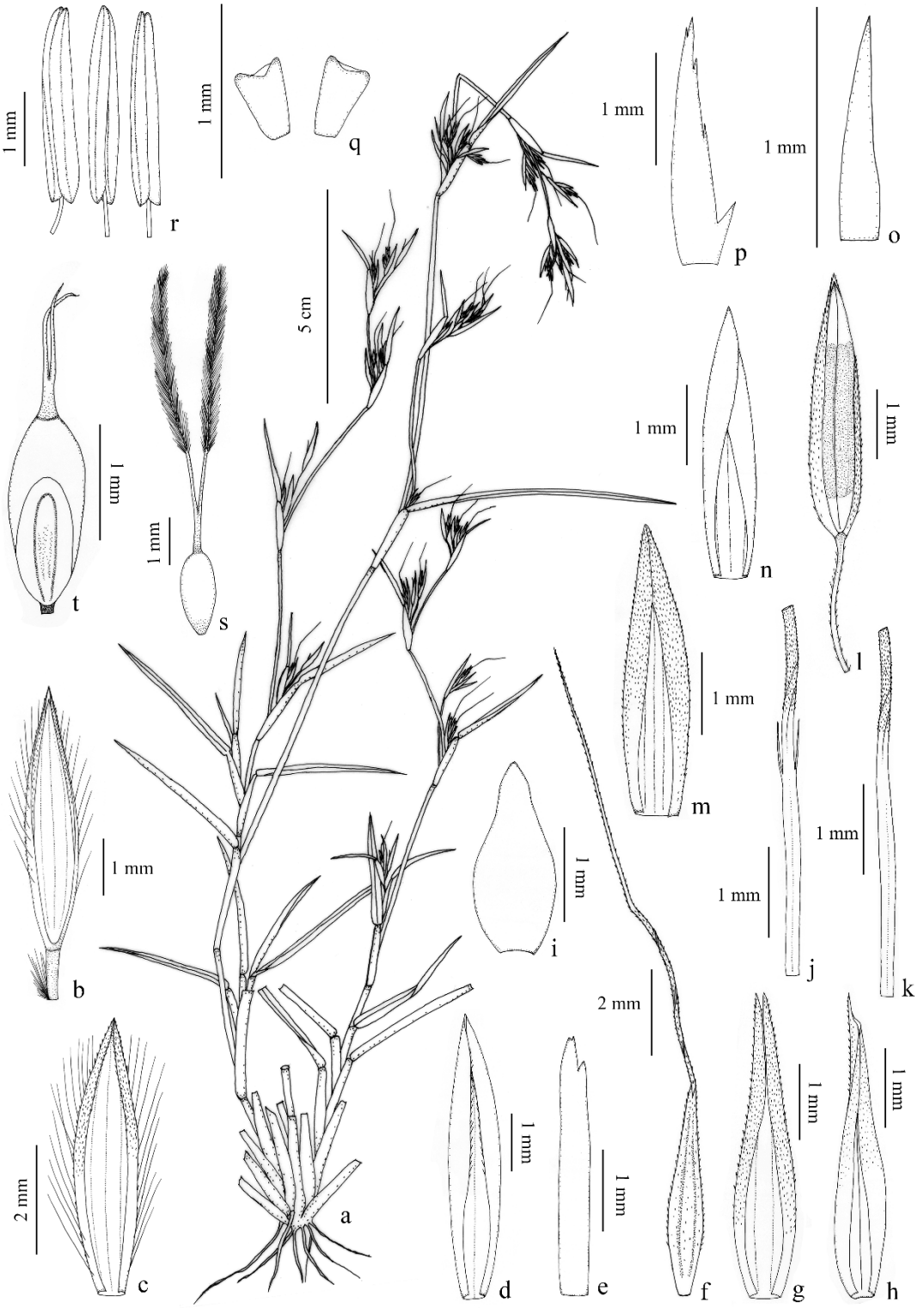

Fig. 136. *Iseilema jainiana* P.Umam. & P.Daniel: **a.** Habit; **b.** Involucral spikelet; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma (**b–e**: Involucral spikelet); **f.** Sessile spikelet; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j & k.** Upper lemma (variations: **j.** Bilobed upper lemma; **k.** Upper lemma without apical lobes) (**f–k**: Sessile spikelet); **l.** Pedicelled spikelet; **m.** Lower glume; **n.** Upper glume; **o & p.** Lower lemma (variations) (**l–p**: Pedicelled spikelet); **q**: Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis (from *V. Drisya* 169501, drawn by V. Drisya).

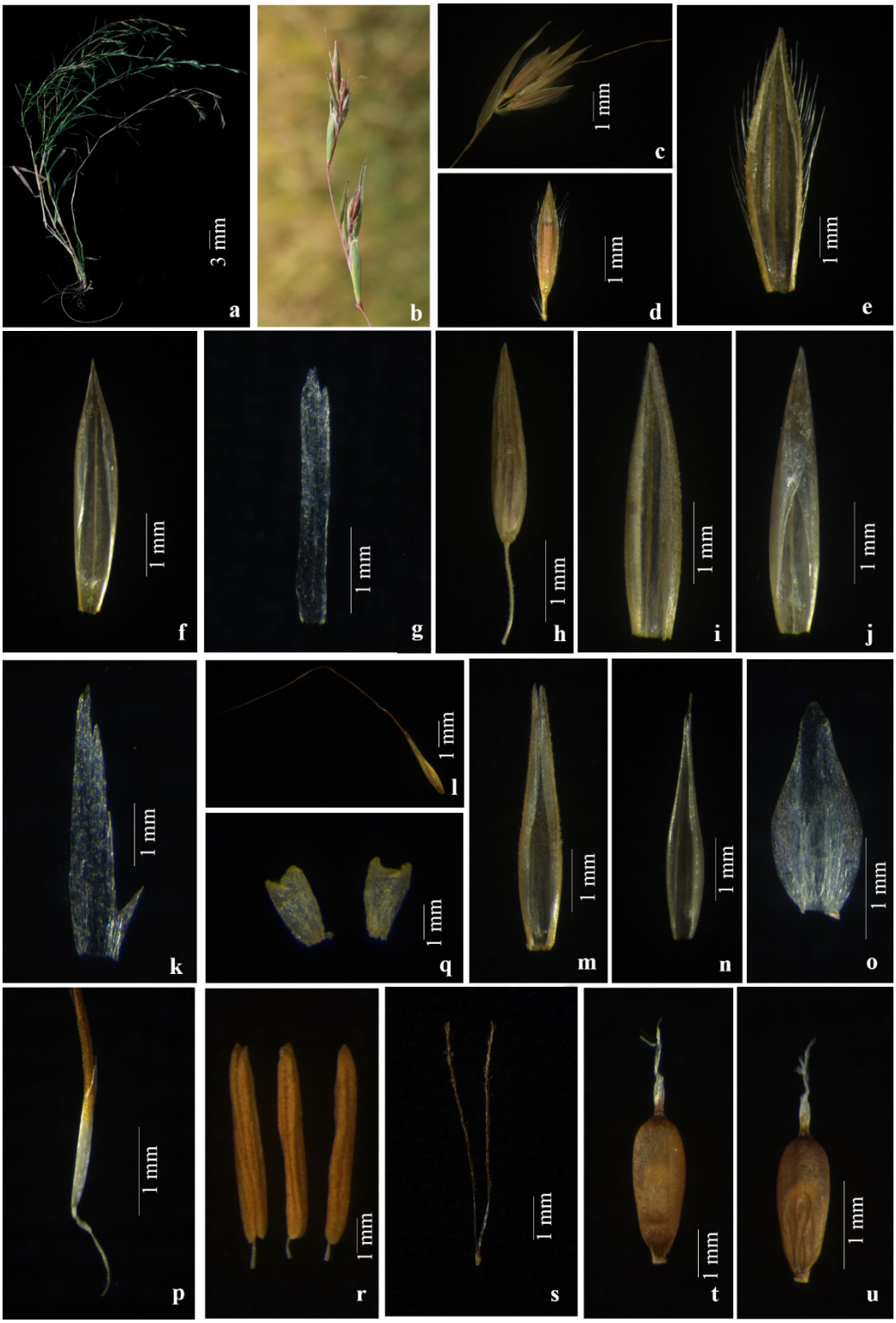

Fig. 137. *Iseilema jainiana* P.Umam. & P.Daniel: **a.** Habit; **b.** Inflorescence; **c.** Single raceme; **d.** Involucral spikelet; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma (**d–g:** Involucral spikelet); **h.** Pedicelled spikelet; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma (**h–k:** Pedicelled spikelet); **l.** Sessile spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Upper lemma (**l–p:** Sessile spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis-dorsal view; **u.** Caryopsis-ventral view.

Mysuru district, near Nanjangud, 28.09.2015, *V. Drisya* 144220 [CALI184967, CALI184968, CALI184969, CALI184970, CALI184971, CALI184972 & CALI184973] (CALI); Palace dairy farm, 17.11.1956, *B.D. Patil* 851 (DD). **Kerala**, Palakkad district, Walayar Dam site, 11.07.1963, *J. Joseph* 17105 (CAL & MH). **Tamil Nadu**, Coimbatore district, Agricultural College estate, CBE, 22.06.1957, *K. Subramanyam* 3522 (CAL & MH); Pudukkotai district, Avudaiyarkoil, 29.03.1985, *C. Arulappan* 391 (MH); Ramanathapuram district, Chithrangudi, 11.11.1989, *V. Balasubramaniam* 2136; Sozhandur, 26.02.1988, *V. Balasubramaniam* 1691 (MH); Tiruchirappalli district, way to Puliyancholai, 29.10.1958, *K.M. Sebastine* 7039 (CAL & MH); Virudhunagar district, Odapatti and Thotiluvampatti, Sathur, 29.01.2003, *K. Althaf Ahamed Kabeer* 116135 (MH). **Telangana**, Hyderabad district, Borabanda-Hitech city, 23.08.2007, *V. Sampath Kumar & K. Chandra* 000337 (BSID); Imarat Kancha, *s.d.*, *M.R. Saxena* 262 (DD); Khammam district, *s.loc.*, 22.10.1995, *R. Rajan* 106049 (BSID); Mahabubnagar district, Karkalpaadu Beat, Amangal R.F., 19.02.1996, *S.R. Srinivasan* 104549 (BSID); Mancherial district, Kawal Tiger Reserve, Thadlapet-Range, Mohammadabad-Beat, 27.10.2013, *P.S. Annamma* 003960 (BSID); Medak district, Pegarikutta East, Narsapur, 24.09.1958, *K.M. Sebastine* 6702 (MH); Warangal district, Pakhal, 02.03.1963, *A.N. Henry* 15977 (MH).

Additional specimens examined (from other than study area): INDIA, **Gujarat**, Vadodara district, Dabhoi, 03.11.2018, *V. Drisya* 171469 (CALI). **Madhya Pradesh,** Ujjain district, Vikram University Campus, 16.11.2017, Mushtaq Ahmed Khah & *V. Drisya* 171496 (CALI). **Maharashtra**, Kolhapur district, Kolhapur, 08.01.2017, *V. Drisya* 171410 [CALI184980, CALI184981, CALI184982, CALI184983, CALI184984 & CALI184985] (CALI).

Notes: The genus *Iseilema* was published by Andersson (1856) with four species *viz.*, *Iseilema prostratum* (L.) Andersson, *I. wightii* (Nees ex Steud.) Andersson, *I. arguta* (Nees ex Steud.) Andersson and *I. mitchellii* Andersson.

The species *I. prostratum* was published based on the Linnaean name *Andropogon prostratus* L. While transferring *Andropogon prostratus* to the genus

Iseilema, Andersson cited two more specimens *viz.*, *Wallich*, n. 8767, *Wight* n. 167. Later Hackel recognized that the specimens cited by Andersson (*Wallich*, n. 8767 and *Wight* n. 167) are of different elements and hence, described a new species *I. laxum* based on the specimens *Wallich* 8767B, 8767C and *Wight* 167[a] in the year 1889. Later, Gandhi and Shrestha (2008) published a new name, *I. hackelii* for *I. laxum* Hack. 1889 due to its later homonymy and due to the superfluous condition of *I. laxum* Hack. ex Duthiei 1888.

While describing *Iseilema jainiana* P.Umam. & P.Daniel, Umamaheswari and Daniel (2001) compared it with *Iseilema laxum* Hack. using quantitative characters such as size of spikelets, lower glumes, upper glumes, lemmas and caryopses as well as number of nerves in the lower glume of involucral spikelet and shape of upper glume of involucral spikelet.

The shape and number of nerves described for *I. jainiana* comes under the range of *I. hackelii* (=*I. laxum* Hack. 1889). While studying various specimens from different localities, it was observed that the number of nerves in lower glumes vary in number but that of upper glumes are somewhat constant. In many cases the nerves on glumes bifurcates towards apex or at upper half as well as some nerves are visible only after hydration. Due to these three reasons the number of nerves on glumes cannot be used as a reliable character for species delimitation in *Iseilema*. Apart from this, grasses shows remarkable size variations depending on various ecological conditions.

Iseilema hackelii (=*I. laxum* Hack. 1889) usually possess bilobed upper lemma in sessile bisexual spikelet, and these lobes are 0.1–0.5 mm long and delicate. But interestingly, the sessile bisexual spikelets of the plants collected (*V. Drisya* 157114) from a wetland in Macherla, Andhra Pradesh shows both bilobed upper lemma and non-bilobed upper lemma. Due to the delicate nature and smaller size, there are also chances for dehiscence or degeneration of such lobes. So, the presence or absence of such minute lobes on upper lemma alone cannot be relied as a good character for species delimitation in the genus *Iseilema*.

Hence, Iseilema hackelii Shrestha & Gandhi and *Iseilema jainiana* are treated here as conspecific following Kellogg *et al.* (2020). Because of having priority over *I.hackelii*, *I. jainiana* is taken here as the accepted name for this taxon.

3. Iseilema prostratum (L.) Andersson, Nova Acta Regiae Soc. Sci. Upsal., ser. 3(2): 251. 1856; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1747. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 188. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 123. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 233. 1989; S.Moulik, Grasses Bamboos India 2: 236. 1997; Pull., Fl. Andhra Pradesh 3: 1214. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 449. 2009; Potdar *et al.*, Grasses Maharashtra 213. 2012; Pull., Fl. Telangana 3: 1142. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 136. 2017; K.C.Mohan & Y.Mahesh, J. Global Biosci. 9(8): 7850. 2020. *Andropogon prostratus* L., Mant. Pl. 2: 304. 1771 ("*Andropogon prostratum*"). *Anthistiria prostrata* (L.) Willd., Sp. Pl. ed. 4., 4(2): 901. 1806. *Cymbopogon prostratus* (L.) Sweet, Hort. Brit. (ed. 2) 561. 1830. *Themeda prostrata* (L.) Roberty, Boissiera 100. 1960. *Iseilema laxum* Hack. ex Duthie, Fodder Grass. N. Ind. 43. 1888, *nom. superfl. Lectotype* (designated by Renvoize in Cafferty *et al.*, 2000): —— INDIA. (LINN [LINN-1211.8 digital image!]).

Anthistiria wightii Nees ex Steud., Syn. Pl. Glumac.1: 400. 1854. *Iseilema wightii* (Nees ex Steud.) Andersson, Nova Acta Regiae Soc. Sci. Upsal., ser. 3(2): 251. 1856; Hook.f., Fl. Brit. India 7: 218. 1897. *Lectotype* (designated here): ——INDIA, *s.d.*, *Wight* 1710 (lecto: K [K000245986 digital image!]; isolecto: E [E00174957 digital image!], P [P01942647 digital image]).

Iseilema kunhikannanii K.C.Mohan, Y.Mahesh & K.Prasad, Phytototaxa 434(1): 113. 2020, *syn. nov. Type*: ——INDIA, **Rajasthan**, Bundi district, Bundi forest division, Near Garrada village*, K. Chandra Mohan* 5126 (holo: CAL [*n.v.*]; iso: BSID [BSID0018685!, BSID0018686!], BSJO [*n.v.*]).

Figs. 138–142

Tufted annual or short-lived perennial. *Culm* erect or prostrate, geniculate, 15–80 cm high; *nodes* villous–glabrous, dark purplish, hairs hyaline, 0.1–1 mm long, lower nodes rooting; *internode* 2–18 cm long, glabrous, scabridulous and tubercle-based

hairy near apex, purplish–pale greenish, hairs hyaline, tubercle-based hairs 1–3 mm long, deciduous. *Leaf sheath* folded, keeled, 1.5–6 × 0.2–0.4 cm (when folded), chartaceous, dorsal surface scabridulous towards upper half, tubercle-based hairy on dorsal keel and submarginal nerves, ventral surface glabrous. *Leaf blade* linear–lanceolate, 8–30 × 0.2–0.3 cm, base rounded, margin scabridulous, apex acuminate, chartaceous, scabridulous and tubercle-based hairy towards base on both surface, tubercle-based hairs *ca*. 5 mm long. *Ligule* membranous, *ca*. 1.5 mm long, fimbriate at apex and sometimes looks like hairy. *Inflorescence* false panicle interrupted by spathe and spatheole, axillary and terminal. *Raceme* with 4 involucral spikelets, 1 or 2 sessile spikelets and their pedicelled attendants (2 or 3) enclosed by a spatheole. *Spatheole* narrowly elliptic, folded, 9–11 × 0.7–1 mm, margins infolded, apex aristate or sometimes leafy with reduced lamina, chartaceous, dorsal surface scabridulous, tubercle-based hairs on mid vein and submarginal veins, ventral surface glabrous, greenish; infolded portion of the margin membranous, dorsally scabridulous, hyaline. *Spathe* often leafy with sheath and lamina, 14–33 × 1.6–2 mm, same as spatheole. *Peduncle* slender, terete, 9–13 mm long, upper 1/3rd densely scabridulous, lower 2/3rd glabrous or very sparsely scabridulous, tubercle-based hairy near apex. *Rachis internode* linear, terete–subterete, dorsi-ventrally compressed, 1–1.5 × 0.2–0.3 mm, longer than pedicel of the involucral spikelet, margins and upper half of dorsal surface bulbous-based hairy, greenish, sometimes with purple shade, hairs hyaline, up to 2 mm long. *Involucral spikelets* 4, male, pedicelled, narrowly elliptic, 3.2–4 × *ca.* 0.8 mm, green or purple, tubercle-based hairy or tuberculate, callus glabrous; pedicel linear, flat, longer than broad, 0.8–1 × 0.2–0.3 mm, glabrous, dorsal surface pilose at base, hairs

Fig. 138. Lectotype of *Iseilema prostratum* (L.) Andersson [(LINN-1211.8)] © The Board of Trustees of Linnean Society, London. Reproduced with permission.

hyaline, 0.4–1.5 mm long. *Lower glume* narrowly ovate or narrowly elliptic, cymbiform, 3.2–4 × 0.8–1 mm, margins entire, inflexed at lower 2/3rd or lower half, infolded at upper 1/3rd or upper half, infolded margin keeled, keel scabrous, inflexed portion long ciliate, hairs hyaline, 1–1.5 mm long, apex muticous-mucronulate, chartaceous, dorsal surface scabridulous, keel and nerves tubercle-based hairy, hairs deciduous, ventral surface glabrous, pale greenish, 7–9-nerved; infolded portions scabridulous, bulbous based hairy at the point of folding, hairs up to 1.5 mm long, hyaline. *Upper glume* narrowly ovate or narrowly elliptic, 3–4 × 0.5–0.8 mm, cymbiform, margins entire, inflexed at lower half, infolded at upper half, infolded portion glabrous or scabridulous near apex, apex acute, chartaceous, dorsal surface glabrous at lower 2/3rd, scabridulous near apex or at upper 1/3rd, ventral surface glabrous, hyaline with green nerves, 3-nerved. *Lower lemma* narrowly elliptic or linear–lanceolate, 2–3 × 0.2–0.5 mm, apex acute–acuminate or lobed, membranous, glabrous, hyaline. *Lower palea* and upper floret absent or reduced. *Lodicules* 2, cuneate, 0.2–0.3 × *ca.* 0.3 mm, hyaline. *Stamens* 3; filament hyaline; anthers 2–3 × 0.4–0.5 mm, yellowish. *Sessile spikelet* 1 or 2, female or bisexual, narrowly elliptic, 3–3.5 × 0.5–0.9 mm, yellowish green with or without purple tinge, callus glabrous (of lower sessile spikelet) to densely pilose (of upper sessile spikeket). *Lower glume* narrowly ovate, 3–3.5 × 0.8–1 mm, margins entire, inflexed, keeled at upper 1/3rd or upper half, apex bifid, coriaceous–subcoriaceous, dorsal surface scabridulous at upper 2/3rd, lower 1/3rd glabrous, ventral surface glabrous, greenish, 4–7-nerved; keel scabrous–scabridulous and with or without tubercle-based hairs, hairs hyaline, *ca*. 2 mm long. *Upper glume* narrowly ovate, 3–3.5 × 0.8–1.5 mm, margins entire, inflexed, apex acuminate–aristate, dorsally keeled at upper 1/3rd , keel scabrous–scabridulous, subcoriaceous, dorsal surface scabridulous at upper 2/3rd, hairs concentrated towards keel, ventral surface glabrous, pale greenish, 3-nerved; arista hyaline sometimes with purple tinge, 0.3–0.5 mm long. *Lower lemma* narrowly ovate, 2–2.2 × *ca.* 0.9 mm, margins entire, apex obtuse or bifid, membranous, glabrous, hyaline. *Lower palea* absent or reduced. *Upper lemma* reduced to the hyaline base of the awn, linear, *ca.* 2.5 mm long, apex not bilobed but rarely minute lobes seen, membranous, glabrous. *Awn* geniculate, 12.5–15 mm long, scabridulous; column 6.5–8 mm long, twisted, scabridulous, dark brownish; bristle 6–7 mm long, scabridulous, pale brownish. *Upper palea* absent or reduced. *Lodicules* 2, cuneate, 0.3–0.4 × 0.2–0.3 mm, hyaline. *Stamens* not seen. *Ovary* elliptic or oblong, 0.5–0.7

× 0.3–0.4 mm, hyaline–pale brownish; *style* 2, 1–1.3 mm long, hyaline; *stigma* 2, feathery, 3–4 mm long, purplish. *Pedicelled spikelet* 2 or 3, male, narrowly elliptic, 3.5–4.5 × 0.5–0.8 mm, tubercle-based hairy, hairs deciduous, greenish with purple tinge; callus minutely pilose, hairs 0.1–0.5 mm long. *Pedicel* linear, dorsiventrally compressed, 1.8–2 × 0.1–0.2 mm, bulbous based hairy on margins at upper 2/3rd, lower portion glabrous or sparsely hairy; hairs 0.2–1.5 mm long, hyaline, longer hairs seen towards apex. *Lower glume* narrowly elliptic, 4–4.5 × 0.7–1 mm, margins infolded, keeled towards upper 1/3rd, keel scabrous–scabridulous, apex mucronulate–mucronate, chartaceous, dorsal surface scabrous–scabridulous, ventral surface glabrous, tubercle-based hairy on dorsal nerves and infolded margins, greenish–purplish, 7–9-nerved. *Upper glume* elliptic–narrowly elliptic, 3.8–4 × 0.6–1 mm, cymbiform, margins entire, inflexed at lower half, inflexed or infolded at upper half, apex acute–acuminate, chartaceous, dorsally keeled at upper half or upper 1/3rd, dorsal surface scabridulous upper 2/3rd and tuberculate or tubercle-based hairy at upper half or upper 2/3rd, tubercles or tubercle-based hairs seen on mid-nerve, lower 1/3rd glabrous, ventral surface glabrous, hyaline with green nerves, 3-nerved. *Lower lemma* narrowly elliptic or linear–lanceolate, 1.8–3.5 × 0.1–0.5 mm, apex acute–obtuse or lobed, membranous, glabrous, hyaline, sometimes absent. *Upper lemma* and *Paleas* absent or reduced. *Lodicules* 2, cuneate, *ca.* 0.3 × 0.2 mm, membranous, hyaline. *Stamens* 3; filament hyaline; anthers 2–3.5 × 0.4–0.5 mm, yellowish. *Caryopsis* ellipsoid, *ca.* 2 × 0.7–0.8 mm, glabrous, yellowish–pale brownish, sometimes with purple tinge, style persistent.

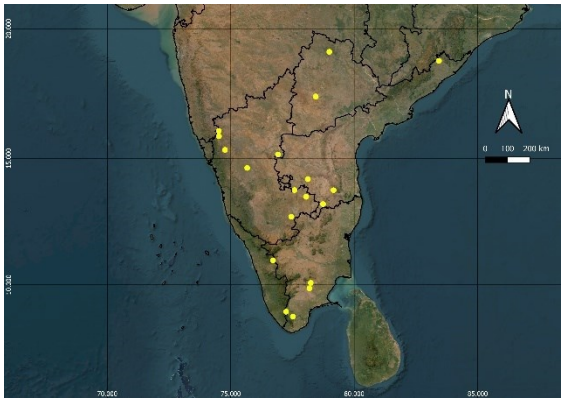

Fig. 139. Distribution of *Iseilema prostratum* (L.) Andersson in southern Peninsular India

Flowering & Fruiting: September to January.

Distribution: Indian Subcontinent to Indo-China. In India, it is distributed in Andhra Pradesh, Bihar, Chhattisgarh, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh.

Habitat: Open grasslands and margins of cultivated fields.

Specimens examined: INDIA, **Andhra Pradesh**, Anantapur district, Kadiri–Kalasamudram R.F., 19.11.1981, *N. Yesoda* 662 (MH); Chittoor district, Nerabylu, near forest rest house, 07.10.1974, *G.V. Subba Rao* 46024; Palamaner R.F., 07.10.1938, *K.C. Jacob* 458 (MH); Parvathipuram Manyam district, Salur, 12.09.1962, *N.P. Balakrishnan* A 1153 (CAL). **Karnataka**, Belgaum district, Belgaum, *s.d.*, *Ritchie* 876 (CAL); on way Belgaum to Kolhapur, 24.11.1962, *Sheshgiri Rao Rolla* 85082; *Ibid.*, 24.11.1962, *Sheshgiri Rao Rolla* 85083 (BSI); Bellary district, Bellary Fort, 01.01.2020, *V. Drisya* 169514 [CALI184913, CALI184914, CALI184915, CALI184916, CALI184917, CALI184918, CALI184919 & CALI184920]; *Ibid.*, 01.01.2020, *V. Drisya* 169517; Sirivaram, 01.01.2020, *V. Drisya* 169511 [CALI184921, CALI184922, CALI184923, CALI184924, CALI184925, CALI184926, CALI184927, CALI184928, CALI184929, CALI184930, CALI184931 & CALI184932] (CALI); Chikkaballapura district, Kotagal, 01.10.1958, *B.M. Wadhwa* 44965 (BSI); Chitradurga district, Swarnamukhi S.R., Hiriyur, 11.01.1976, *N.P. Singh* 142320 (BSI); Haveri district, Ranibennur [Ranebennuru], 30.11.1910, *R.K. Bhide s.n.* (BLAT); Uttara Kannada district, Haliyal, 30.11.1889, *W.A. Talbot* 2143 (CAL). **Tamil Nadu**, Kanyakumari district, Vazhukkuparai, Suchindram, Nagerkoil, 13.09.2003, *K. Althaf Ahamed Kabeer* 117114 (MH); Madurai district, near Alagar Koyil, 23.09.1957, *K. Subramanyam* 4357; Keeladi canal banks, near Silaiman, 10.02.2002, *K. Althaf Ahamed Kabeer* 113214 (MH); Tirunelveli district, Courtallam, on the way to Five Falls, 25.07.1957, *K. Subramanyam* 3813 (CAL & MH); Mukkudal road side, 29.01.2002, *K. Althaf Ahamed Kabeer* 113207 (MH); **Telangana**, Hyderabad district, Hyderabad, 00.00.1941, *M.R. Saxena* 253 (DD); Mancherial [old Adilabad] district, Kawal Tiger Reserve, Indhanpalli-Range, Jannaram-Forest Division, 26.10.2013, *P.S. Annamma, Alok Chorghe & Chandra Mohan* 3937 (BSID).

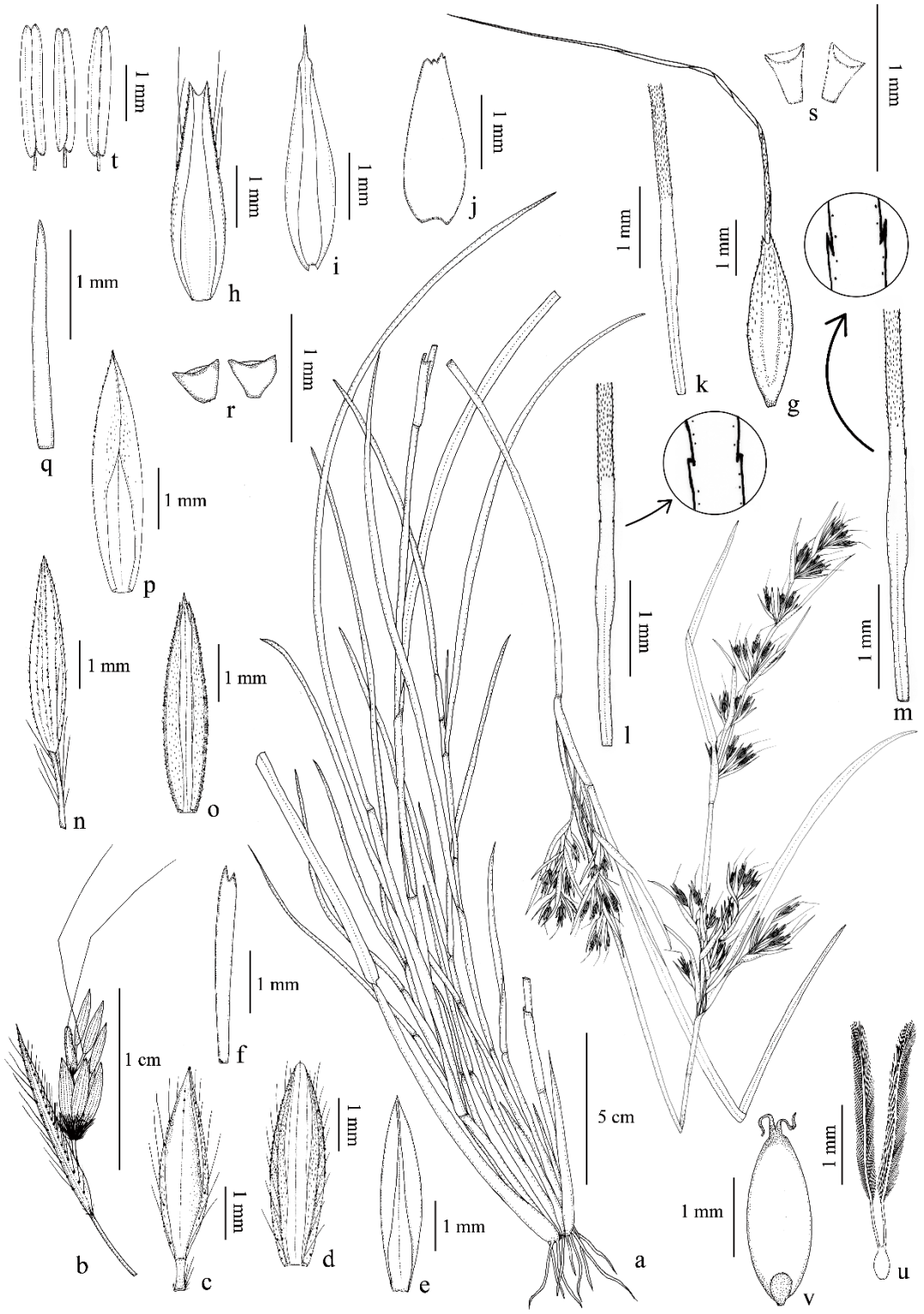

Fig. 140. *Iseilema prostratum* (L.) Andersson: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma (**c–f:** Involucral spikelet); **g.** Sessile spikelet; **h.** Lower glume; **i.** Upper glume; **j.** Lower lemma; **k, l & m.** Upper lemma (variations showing upper lemma with and without apical lobes) (**g–m:** Sessile spikelet); **n.** Pedicelled spikelet; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma (**n–q:** Pedicelled spikelet); **r & s.** Lodicules (**r.** from pedicelled spikelet; **s.** from sessile spikelet); **t.** Stamens; **u.** Gynoecium; **v.** Caryopsis (from *V. Drisya* 169514, drawn by V. Drisya).

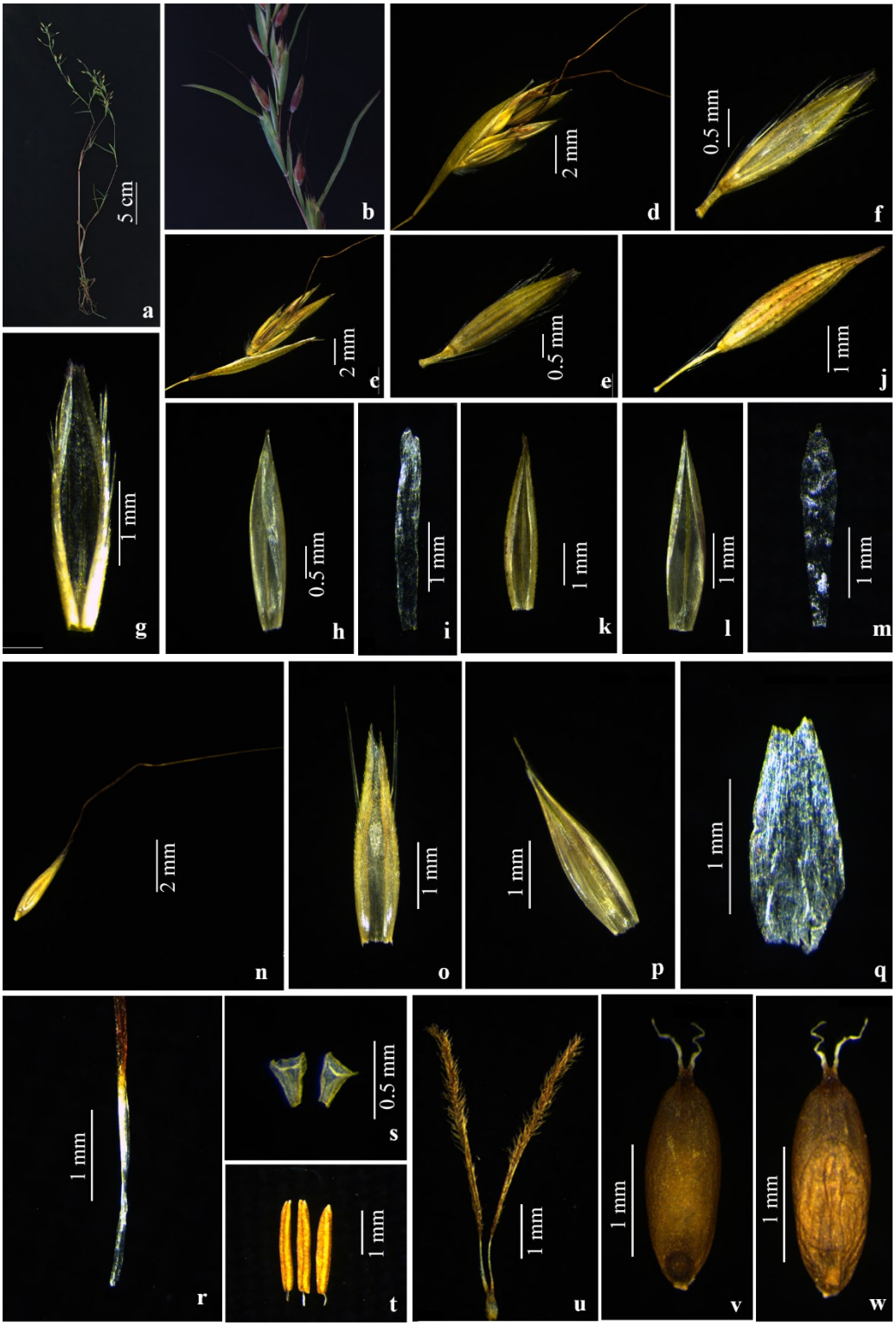

Fig. 141. *Iseilema prostratum* (L.) Andersson: **a.** Habit; **b.** Portion of inflorescence; **c & d.** Single raceme showing variation in number of spikelets; **e.** Involucral spikelet-dorsal view; **f.** Involucral spikelet-ventral view; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma (**e–i:** Involucral spikelet); **j.** Pedicelled spikelet; **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma (**j–m:** Pedicelled spikelet); **n.** Sessile spikelet; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma; **r.** Upper lemma (**n–r:** Sessile spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium; **v.** Caryopsis-dorsal view; **w.** Caryopsis-ventral view.

Notes: Chandra Mohan *et al.* (2020) while describing *Iseilema kunhikannanii* from Rajasthan, compared it with *I. holei* Haines presumably due to its erect habit. However, an examination of type specimens available at BSID revealed that certain characters are not in agreement with original description. The lower glume of involucral spikelets are 9-nerved, and upper glume of involucral spikelets are 3-nerved (as opposed to 5 and 1-nerved lower and upper glume of involucral spikelets respectively), a character unique to *I. prostratum*.

I. prostratum grows both as prostrate or decumbent herbs and as erect tufted herbs too. The erect specimens are represented in most of the Indian Herbaria, but were determined earlier as *Iseilema wightii*, which is now treated as a synonym of *Iseilema prostratum*. Apart from this, we could collect both the erect and prostrate (or decumbent) forms from different locations in Bellary district. The prostrate or decumbent form was collected from the bunds or margins of cultivated lands which are exposed to grazing as well as to different agriculture practices. The erect forms were collected from an area having more elevation than that of cultivated lands and having no grazing threats or agricultural practices.

Iseilema usually possess single bisexual sessile spikelet and two pedicelled spikelet in each single raceme apart from the four involucral spikelets. But here within a single population, we could observe some plants having two bisexual sessile spikelets and three pedicelled spikelets in each raceme as well as some plants having the typical racemes with one sessile and two pedicelled spikelets. Another interesting observation we made is the variation in the upper lemma of sessile spikelet. Some plants colleceted from the same population shows sessile spikelet with bilobed upper lemma while some shows entire upper lemma without lobes and some shows minutely hastate (or little broad near apex) upper lemma. This variation clearly indicates it as continuous. Since, these lobes are delicate and minute (0.1–0.3 mm long), there are chances of dehiscence and degeneration. So this character cannot be considered as good for species delimitation. Although it has least significance in species delimitation, ever since nobody noticed the presence of

bilobed upper lemma in *Iseilema*. This minute lobes are mere continuations of the hyaline upper lemma which are gradually dettached from the awn.

Interestingly, these spikelet number variations as well as variation in upper lemma (those with and without bilobes) are seen within the same population as well as in different populations. Both the population of erect plants collected from Bellary fort (*V. Drisya* 169514 & *V. Drisya* 169517) as well as population of prostrate or decumbent plants collected from cultivated lands in Sirivaram of Bellary district (*V. Drisya* 169511), shows this kind of spikelet number and upper lemma variations. The same pattern of having upper lemma with and without these minute lobes are also observed in *I. jainiana*.

Iseilema kunhikannanii cannot be distinguished from *I. prostratum* based on any good characters, hence it is reduced into the synonymy of *I. prostratum*.

Apart from this, Pullaiah included *Iseilema holei* in his Flora of Telangana vol.3 (2015) based on a specimen (*Alok Chorghe, Chandra Mohan & P.S. Annamma* 3937) deposited at BSID. But the critical examination of above mentioned specimen revealed that it is nothing but the erect form of *I. prostratum* only.

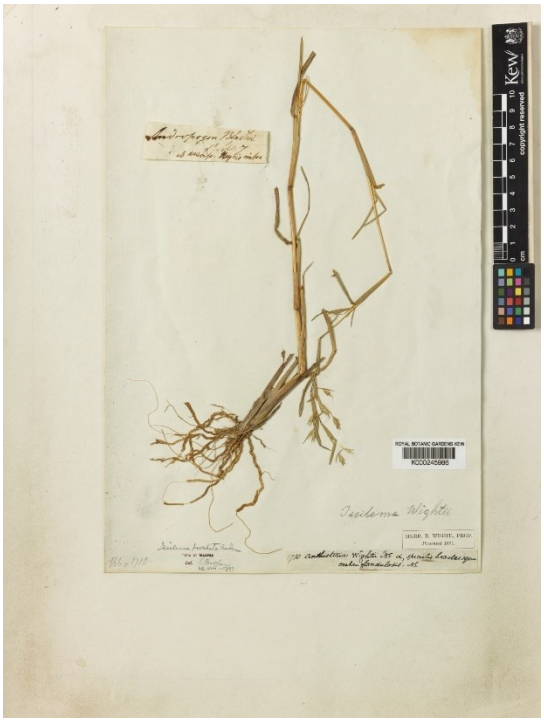

Fig. 142. Lectotype of *Anthistiria wightii* Nees ex Steud. [basionym of *Iseilema wightii* (Nees) Andersson] [*Wight* 1710 (K000245986)] © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

Notes on typification: *Iseilema prostratum* (L.) Andersson was based on the Linnaean *Andropogon prostratum* L. (Mantissa Plantarum 2, 1771). In the protologue Linnaeus cited "Habitat in India orientali. Koenig". The lectotype of this taxon was designated by Renvoize in Cafferty *et al.* (2000).

Chandramohan and Mahesh (2020) erroneously cited the specimen *Wight, R.*, 1710 at Kew Herbarium with barcode K000245986 as the type of *Iseilema prostratum* (L.) Andersson along with the synonym *I. wightii* (Nees) Andersson. But *Iseilema wightii* originally was a heterotypic synonym of *I. prostratum*. *I. prostratum* was based on a Linnaean specimen whereas *I. wightii* was based on Wight's, Wallich's, Heyne's, Royle's and Rottler's specimens. Also, authors were unaware about the earlier effective lectotypification of *I. prostratum* done by Renvoize in Cafferty *et al.* (2000). Thus, by citing the Wight's specimen '*Wight* 1710' as the type under *I. prostratum*, Chandramohan & Mahesh (*l.c.*) made an inapropriate citation.

However, in the protologue of *Anthistiria wightii*, which is the basionym of *I. wightii*, cited "*Anthistiria bladhi* Wight. Heyn. Rottl. Royle. Wallich.Cat.nr. 8770". So, all these elements constitute the syntypes. According to article 9.12 of Shenzhen Code (Turland *et al.* 2018), there needs selection of a single specimen as lectotype for the name *I. wightii*.

There is an earlier typification available for this taxon, made by Roberty (1960). In 1960, Roberty made a new combination by transferring *Iseilema* to *Themeda* and cited as "Typus: Wight 166! (Deccan)" under *Themeda prostrata* var. *wightii* Roberty. But this number 'Wight 166' is not available in any of the earlier protologue or literature associated with *Iseilema wightii*. Also, we were not able to trace Wight's specimen with collection number 166 in any of the Herbaria. Hence Roberty's treatment was not taken into consideration here.

In this context, the specimen '*Wight* 1710' was the only available syntype that agrees well with the protologue of *I. wightii*. Authors could trace a total of three sheets belonging to '*Wight* 1710' one each at K [K000245986], E [E00174957] and P [P01942647]. Among this syntypes, sheet at K [K000245986] being the well preserved specimen which agrees well with the protologue is designated here as the lectotype. Whereas its duplicates sheets available at E [E00174957] and P [P01942647] constitute the isolectotypes.

4. **Parahyparrhenia** A.Camus

Parahyparrhenia A.Camus, Bull. Mus. Natl. Hist. Nat. 2(22): 404. 1950; Clayton & Renvoize, Gen. Gram., Grasses World: 357. 1986; Watson & Dallwitz, Grass Gen. World: 689. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 312. 2015. *Type*: *Parahyparrhenia jaegeriana* A.Camus.

Annuals or perennials. *Ligule* membranous or hairy. *Inflorescence* a single or pair of racemes, terminal or axillary. *Lower homogamous spikelets* inconspicuous. *Upper sessile spikelet* bisexual, *lower glume* deeply grooved, *upper lemma* bilobed or bidentate with a geniculate awn. *Pedicelled spikelets* male or neuter.

Distribution: Senegal to Sudan, India and Thailand. About 7 species in the world; 2 in India and 1 in southern Peninsular India (Clayton & Renvoize, 1986; Watson & Dallwitz, 1992; Kellogg in Kubitzki, 2015; Kellogg *et al.*, 2020).

Habitat: Open savanna grassland, shallow pools on ironstone outcrops and hill slopes

Parahyparrhenia bellariensis (Hack.) Clayton, Kew. Bull. 27(3): 448. 1972; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 243. 1989; Pull., Fl. Andhra Pradesh 3: 1232. 1997; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 157. 2017. *Andropogon bellariensis* Hack., Flora 68(7): 123. 1885; Hook.f., Fl. Brit. India 7: 201. 1897. *Heteropogon bellariensis* (Hack.) C.E.C.Fisch. in Gamble, Fl. Madras 3: 1744. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 163. 1960. *Lectotype* (designated by Tiwari A.P., 2017):—INDIA, **Andhra Pradesh**, Anantapur district, Gooty-Fort-Hill, *Wight* 2321 (K [K000245932 digital image!]).

Figs. 143–145

Tufted perennial, 40–70 cm tall. *Leaf blade* linear–lanceolate, 5–50 × 0.1–0.5 mm, apex acuminate. *Inflorescence* terminal, solitary raceme with reduced spathe. *Spikelets* paired, one sessile and one pedicelled. *Rachis* jointed; *rachis internode* linear, *ca.* 3.5 × 0.2–0.3 mm, slender, dorsi-ventrally compressed, base and apex oblique, densely pilose on both margins, greenish, hairs hyaline, 0.4–1 mm long.

Upper spikelet pairs heterogamous. *Sessile spikelet* elliptic–narrowly elliptic, 6.5–7 × 0.6–0.8 mm, greenish; callus oblique, 1–1.2 mm long, densely pilose, hairs hyaline, 0.1–1 mm long. *Lower glume* narrowly ovate, 4.8–5 × 1–1.2 mm, cymbiform, dorsally grooved, margins entire, inflexed or incurved at lower half or lower 1/3rd, infolded at upper half or upper 2/3rd, infolded margins keeled, keel winged, wing margins scabridulous, apex truncate–acute, sometimes notched, chartaceous, dorsal surface sparsely scabridulous, ventral surface glabrous, greenish, 10-nerved. *Upper glume* narrowly ovate, 5.5–6 × 1.2–1.5 mm, cymbiform, margins ciliate, hairs hyaline, 0.1–0.3 mm long, inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, apex acuminate, chartaceous, dorsal surface puberulent, dorsally shallowly keeled near apex, keel scabridulous, ventral surface glabrous, greenish, 5-nerved. *Lower lemma* narrowly ovate, 4–4.2 × 0.5–0.8 mm, margins inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, infolded margins ciliate, hairs hyaline, 0.2–0.4 mm long, apex acute–obtuse, membranous, glabrous, hyaline, nerves not seen. Lower palea not seen. *Upper lemma* reduced to the hyaline base of the awn, *ca.* 4 mm long, apex shortly bilobed. *Awn* geniculate, 19–23 mm long, brownish; column twisted, 9–11 mm long, scabrous, dark brownish; bristle 10–12 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate, 1–1.5 × 0.4–0.6 mm, apex acute or obtuse, membranous, glabrous or puberulent, hyaline. *Lodicules* 2, cuneate, 0.4–0.6 × 0.3–0.5 mm. *Pedicelled spikelet* male, elliptic–narrowly elliptic, *ca.* 7.5 × 1 mm (including awn), greenish; callus 0.5–0.8 mm long, oblique, greenish, pilose at base

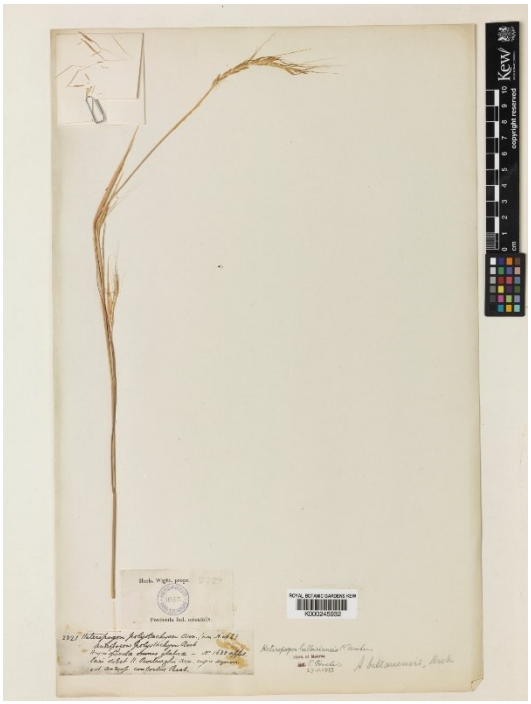

Fig. 143. Lectotype of *Parahyparrhenia bellariensis* (Hack.) Clayton [*Wight* 2321 (K000245932)] © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

and margins, hairs hyaline, 0.1–0.8 mm long. *Pedicel* linear, 3–3.5 × 0.1–0.2 mm, slender, dorsi-ventrally compressed, base and apex oblique, densely pilose on both margins, greenish, hairs hyaline, 0.4–1 mm long. *Lower glume* narrowly ovate, 6.5–7 × 1.5–1.8 mm, cymbiform, margins entire or sparsely ciliate, hairs 0.1–0.3 mm long, inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, keeled, keel winged, wing broad towards upper half of one side and at upper 3/4th of the other, wing margins scabridulous, apex acute, chartaceous, dorsal surface puberulent, ventral surface glabrous, greenish, 11-nerved. *Upper glume* narrowly ovate, 5.8–6 × 0.8–1 mm, cymbiform, margins ciliate, hairs 0.2–0.6 mm long, inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, apex acute, chartaceous, dorsal surface puberulent–sparsely puberulent, ventral surface glabrous, pale greenish, 5-nerved. *Lower lemma* narrowly ovate–oblong, *ca.* 4.5 × 1.2–1.5 mm, margins inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins ciliate, hairs 0.3–0.5 mm long, apex acute or obtuse, membranous, dorsal surface sparsely puberulent–glabrous, ventral surface glabrous, hyaline, 1-nerved. *Lower palea* not seen. *Upper lemma* narrowly ovate–oblong, 4–4.2 × 0.8–1 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.3–0.4 mm long, apex acute–obtuse, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 1-nerved. *Upper palea* ovate–narrowly ovate, 0.4–0.6 × 0.3–0.5 mm, apex bilobed, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.5–0.6 × 0.2–0.4 mm. *Stamens* 3; filaments hyaline; anthers *ca.* 3.5 mm long, yellowish.

Flowering & Fruiting: December to January.

Distribution: Endemic to southern Peninsular India. It is reported only from two localities so far, Gooty Fort Hill of Anantapur district and Gandikota Fort Hill of Kadapa district of Andhra Pradesh.

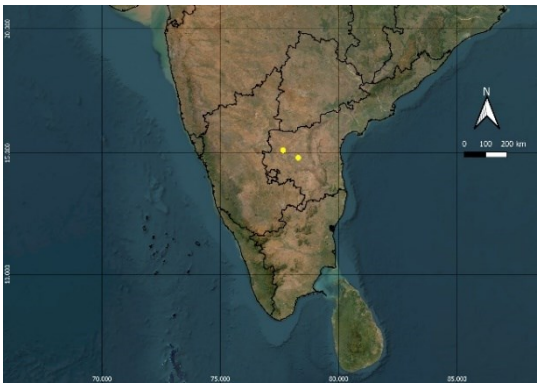

Fig. 144. Distribution of *Parahyparrhenia bellariensis* (Hack.) Clayton

Habitat: On hills and hill slopes.

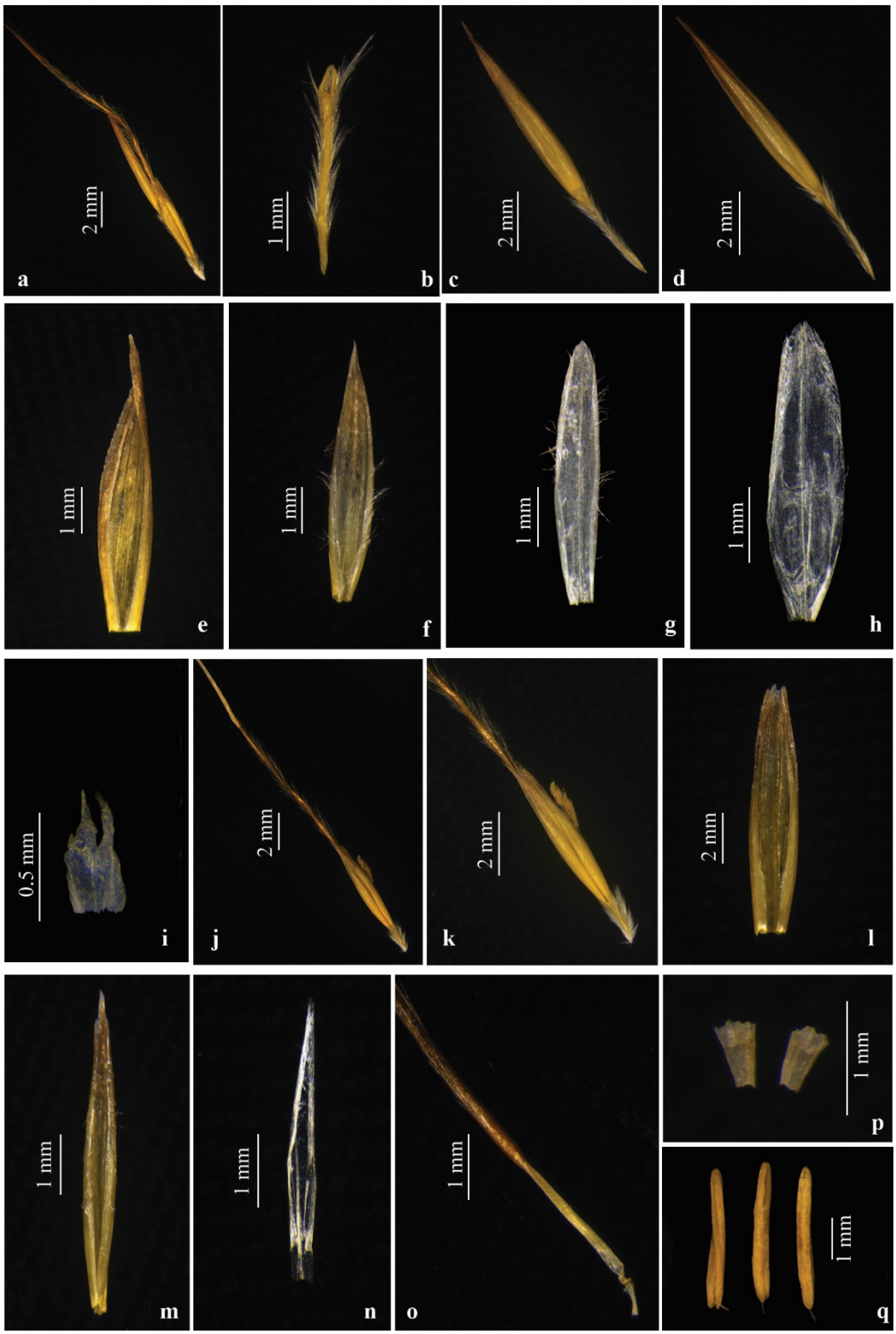

Fig. 145. *Parahyparrhenia bellariensis* (Hack.) Clayton: **a.** Spikelet pair; **b.** Rachis internode; **c.** Pedicelled spikelet-dorsal view; **d.** Pedicelled spikelet-ventral view; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma; **h.** Upper lemma; **i.** Upper palea (**c–i:** Pedicelled spikelet); **j & k.** Sessile spikelet; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma; **o.** Upper lemma (**j–o:** Sessile spikelet); **p.** Lodicules; **q.** Stamens.

Specimens examined: INDIA. **Andhra Pradesh**, Kadapa [Cuddapah] district, Gandikota Fort Hill, 21.12.2019, *Shahid Nawaz* GK-300; *Ibid.* 21.12.2019, *Shahid Nawaz* GK-301; *Ibid.* 21.12.2019, *Shahid Nawaz* GK-302; *Ibid.* 21.12.2019, *Shahid Nawaz* GK-303; *Ibid.* 21.12.2019, *Shahid Nawaz* GK-304; *Ibid.* 21.12.2019, *Shahid Nawaz* GK-305; *Ibid.* 21.12.2019, *Shahid Nawaz* GK-306 (BLAT).

Notes: This description was based on a herbarium specimen at BLAT herbarium (*Shahid Nawaz* GK-301). Author visited both the localities from where *Parahyparrhenia bellariensis* had been reported, but was unable to collect specimens from Gooty Fort Hill as well as from Gandikota Fort Hill.

5. **Pseudanthistiria** (Hack.) Hook.f.

Pseudanthistiria (Hack.) Hook.f., Fl. Brit. Ind. 7: 219. 1897; Clayton & Renvoize, Gen. Gram., Grasses World: 359. 1986; Watson & Dallwitz, Grass Gen. World: 779. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 312. 2015; Drisya & Pradeep, Rheedea 31(4): 236. 2021. *Andropogon* subg. *Hypogynium* sect. *Pseudanthistiria* Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 400. 1889. *Hypogynium* sect. *Pseudanthistiria* Roberty, Boissiera 9: 189. 1960. *Lectotype* (designated by Uniyal, 1984): *Pseudanthistiria heteroclita* (Roxb.) Hook.f.

Annual herbs, creeping or erect. *Leaf blade* narrowly ovate or narrowly elliptic to linear or lanceolate. *Ligule* membranous. *Inflorescence* terminal, false panicle interrupted by spathes and spatheoles, single raceme comprises 2 sessile and 3 pedicelled spikelets (arranged on a jointed rachis, with a basal pair of one sessile and one pedicelled spikelet and a terminal triad of one sessile and two pedicelled spikelets), which is enclosed by a spatheole. Spatheole often leafy, sometimes with developed sheath and lamina. *Rachis* jointed with two internodes. *Sessile spikelet* bisexual, elliptic to narrowly elliptic, awned, brownish; callus obtuse to slightly oblique; *upper lemma* reduced to the hyaline base of the awn; *upper palea* present, membranous; *lodicules* 2, cuneate; *stamens* 3, yellowish; *ovary* narrowly elliptic to oblong, *styles* 2, fused at the apex of ovary. *Pedicelled spikelets* male, elliptic to narrowly elliptic or lanceolate, greenish; *upper lemma* membranous, variable in

shape; *upper palea* absent or reduced. *Lower floret* usually absent both in the sessile and pedicelled spikelet. *Caryopsis* narrowly elliptic to oblong with persistent styles.

Distribution: Has two species distributed in Bangladesh, China, India to Thailand and Sri Lanka. All of them are represented in southern Peninsular India (Clayton & Renvoize 1986; Watson & Dallwitz 1992; Chen & Philips 2006; Drisya & Pradeep 2021).

Habitat: Species of open habitats, hill sides and disturbed ground.

Key to the species of *Pseudanthistiria* in India

1. Culms erect, robust; leaf blade adaxial surface is with evnly distributed tubercle-based hairs, abaxial surface throughout with sparse scabridulous hairs; sessile spikelet lower glume apex muticous and truncate .....1. ***P. heteroclita***

1. Culms decumbent, creeping below and rooting at the nodes, slender; leaf blade adaxial surface is with 1 or 2 tubercle-based hairs and are confined to the base, abaxial surface with scabridulous hairs only along midvein; sessile spikelet lower glume apex notched, muticous or truncate, if muticous and truncate then culms decumbent..... 2. ***P. umbellata***

1. Pseudanthistiria heteroclita (Roxb.) Hook.f., Fl. Brit. India 7: 219. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1749. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 203. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 124. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 252. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 179. 1991; S.Moulik, Grasses Bamboos India 1: 223. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 458. 2009; Potdar *et al.*, Grasses Maharashtra 232. 2012; T.S.Nayar *et al.*, Fl. Pl. W. Ghats, India 2: 1196. 2014; Drisya & Pradeep, Rheedea 31(4): 237. 2021. *Anthistiria heteroclita* Roxb., Fl. Ind. 1: 253. 1820. *Andropogon heteroclitus* (Roxb.) Nees, Fl. Afr. Austral. Ill. I: 115. 1841; Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 400. 1889, *p.p. Sorghum heteroclitum* (Roxb.) Kuntze, Revis. Gen. Pl. 2. 791. 1891, *p.p.*

Hypogynium heteroclitum (Roxb.) Roberty f. *heteroclitum* Roberty, Boissiera 9: 190. 1960, *p.p. Lectotype* (designated by Drisya & Pradeep, 2021):— Roxb. No. 1774 (Icones Roxburghianae).

Pseudanthistiria hispida Hook.f., Fl. Brit. India 7: 219. 1897. *Lectotype* **(**designated by Drisya & Pradeep, 2021): INDIA, **Madhya Pradesh,** By the stream near Khari, Khandwa district, 13.12.88, *J.F. Duthie* 8478 (lecto: K [K000245934 digital image!]; isolecto BM [BM000959812 digital image!], CAL [Accession number 532507!]). Other original material: K [K000245935 digital image!], CAL [Accession number 532506!], K [K000975016 digital image!].

Pseudanthistiria intermedia Birari & D'cruz, J. Bombay. Nat. Hist. Soc. 73(1): 192. 1976. *Type*:— INDIA, **Maharashtra**, Khandesh, Satpura (Toranmal) Range, 17. 11. 1968, *Rui D' Cruz* I-681 BC (holo: Herbarium of College of Agriculture, Pune [*n.v.*]; iso: BSI [*n.v.*]).

Figs. 146–149

Annual, erect, stout, branched herb, 7–120 cm tall, rooting from lower nodes. *Culm* erect, geniculate at base; *internode* 1–16 cm long, glabrous, pale yellowish with pink dots and streaks; *nodes* glabrous, dark pinkish–brownish. *Leaf sheath* 1.5–5 cm long, folded, rounded towards base, keeled towards apex, margin entire, chartaceous, dorsal surface scabrous or tubercle-based hairy at upper half or upper 1/3rd, hairs 0.8–3 mm long, hyaline, ventral surface glabrous, smooth, greenish. *Leaf blade* narrowly ovate–lanceolate, 20–150 × 2–5 mm, margin scabridulous, thicker than lamina, apex acute, chartaceous, adaxial surface scabridulous and sparsely tubercle-based hairy, abaxial surface tubercle-based hairy and sparsely scabridulous, hairs up to 2 mm long, greenish, 7-veined, midrib prominent, lateral veins distinct. *Ligule ca*. 1 mm long, apex ciliolate, truncate–obtuse, membranous, hyaline. *Inflorescence* terminal, false panicle interrupted by spathes and spatheoles; single raceme comprises 2 sessile and 3 pedicelled spikelets, which is subtended by a spatheole; flowering axis linear, 0.5–6 cm long, primary branch erect, further branches more or less flexuous, ventrally compressed, smooth to sparsely scabridulous, yellowish green, sometimes with purple tinge. *Spathe* encloses 6–9 racemes, narrowly elliptic, cymbiform, 1.5–2.5 × 0.2–0.3 cm, often leafy, keeled,

margin entire, apex acuminate, chartaceous, membranous towards margin, dorsal surface smooth to very sparsely scabridulous and tubercle-based hairy towards margin, hairs 2–3 mm long, hyaline, ventral surface glabrous, smooth, greenish, hyaline towards margin. *Spatheole* elliptic to narrowly elliptic, folded or cymbiform, 7–12 × 1–2 mm, dorsally keeled, margin entire, apex acuminate, chartaceous, membranous towards margin, dorsal surface glabrous except scabridulous keel and tubercle-based hairs towards margins, tubercle-based hairs 2–3 mm long, hyaline, ventral surface glabrous, smooth, greenish, hyaline towards margin. *Peduncle* linear, 2.5–4 mm long, broad at apex, ventrally compressed, flexuous, glabrous, smooth. *Rachis* jointed, lower internode linear, 1–1.5 mm long, scabrous to sparsely pilose at upper 3/4th, hairs 0.1–0.4 mm long, hyaline, lower 1/4 glabrous, pale greenish; upper internode similar to pedicel, linear, 0.8 mm long, ventrally compressed, dorsal surface densely pilose, hairs 0.4–0.8 mm long, hyaline to pale brownish, ventral surface glabrous, yellowish green. *Sessile spikelet* bisexual, elliptic to narrowly elliptic, 3–4.5 × 0.8–1 mm, pale greenish–brownish, sometimes with purple tinge; callus obtuse, densely pilose, hairs 0.5–1 mm long, hyaline–golden yellowish. *Lower glume* narrowly ovate–oblong, 2.8–4 × 0.8–1 mm, base truncate, margins incurved, entire, shallowly keeled towards apex, apex muticous and truncate, chartaceous–coriaceous, dorsal surface shallowly depressed, densely scabrous–scabridulous, hairs up to 0.3 mm long, hyaline, ventral surface glabrous, pale greenish–brownish, 9-veined, veins greenish–hyaline, usually prominent on upper half. *Upper glume* narrowly ovate, cymbiform,

Fig. 146. Lectotype of *Pseudanthistiria heteroclita* (Roxb.) Hook.f.: Drawing in Icones Roxburghianae no. 1774 (K) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

2–3.5 × *ca.* 0.5 mm, base obtuse, margins entire, membranous, lower half inflexed, upper half infolded, apex obtuse–truncate, sometimes notched, chartaceous–coriaceous, dorsally keeled and humped, 2-grooved in between the veins, dorsal surface glabrous except keel, keel scabrous–scabridulous, ventral surface glabrous, hyaline, 3-veined. *Lower floret* absent. *Upper lemma* reduced to the hyaline base of the awn, linear, 4–5 mm long, glabrous, smooth distally and margin scabridulous towards apex, pale brownish. *Awn* geniculate, 1.3–3 cm long, scabridulous; column slightly twisted, 7–12 mm long, dark brownish; bristle 8–11 mm long, pale or golden brownish. *Upper palea* narrowly ovate or narrowly elliptic, 0.9–1 × 0.4–0.5 mm, base truncate, apex acute, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 1 × 0.3–0.4 mm, hyaline. *Stamens* 3; filament glabrous, hyaline; anthers 1–2 mm long, yellowish. *Ovary* narrowly elliptic–oblong, 0.8–0.9 × 0.2–0.3 mm, glabrous, pale yellowish–hyaline; *Style* 2, *ca.* 1.2 mm long, glabrous, hyaline, fused at the apex of ovary; *Stigma* 2, plumose, *ca.* 2 mm long, purplish. *Pedicelled spikelet* male, elliptic to narrowly elliptic, 4–5.5 × 0.4–0.8 mm, green, often with purple tinge; callus linear, 0.3–0.5 mm long, broader than pedicel, glabrous, very sparsely pilose at base, hairs minute. *Pedicel* linear, *ca.* 1 mm long, slender, ventrally compressed, dorsal side pilose, hairs 0.5–1 mm long, hyaline to pale brownish, ventral side glabrous, pale greenish–hyaline. *Lower glume* narrowly ovate, *ca.* 5 × 0.6 mm, base truncate, margins infolded at lower half, keeled and ciliate at upper half, hyaline, membranous, keel scabrous–scabridulous, apex acuminate, chartaceous to subcoriaceous, dorsal surface scabridulous, few tubercle-based hairs towards lateral keels, ventral surface glabrous, greenish, nearly 11-veined, veins faint. *Upper glume* narrowly ovate to narrowly elliptic, cymbiform, *ca.* 4.5 × 0.4 mm, base truncate, margins inflexed at lower half, infolded at upper half, ciliate towards apex, apex acute–acuminate, chartaceous to subcoriaceous, dorsal surface glabrous except sparsely scabridulous hairs on veins, ventral surface glabrous, hyaline, 3-veined. *Lower floret* absent. *Upper lemma* narrowly ovate to narrowly elliptic, 0.5–1.5 × 0.4–0.5 mm, base truncate, apex acute, membranous, glabrous, hyaline. *Upper palea* absent. *Lodicules* 2, cuneate, *ca.* 0.5 × 0.4 mm, apex broad,

truncate, hyaline. *Stamens* 3; filaments hyaline; anthers 2–3 mm long, yellowish. *Caryopsis* oblong, 1.5–2 × 0.4–0.6 mm, ventrally 2-channelled, styles persistent.

Flowering & Fruiting: September to January.

Distribution: India to Bangladesh. In India, it is distributed in Bihar, Daman & Diu, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu and West Bengal.

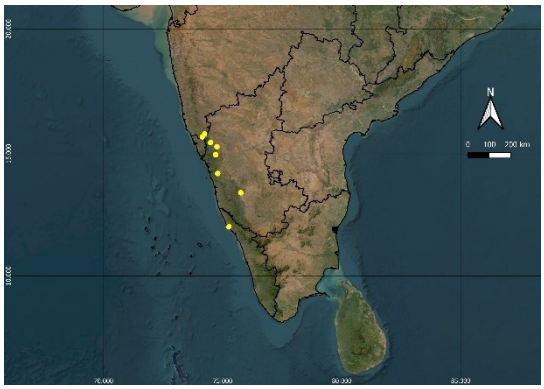

Fig. 147. Distribution of *Pseudanthistiria heteroclita* (Roxb.) Hook.f. in southern Peninsular India

Habitat: Open grasslands.

Specimens examined: INDIA, **Karnataka,** Belgaum district, Londa, 03.11.1902, *G.A. Gammie* 15863 (BSI); near Gunji, 28.10.1978, *Cecil J. Saldanha & P. Prakash* 3705 (CAL); Sada, 04.11.2006, *Arun M. Chandore* 118 (SUK); Chikamagalur district, Baba Budangiri, 23.10.1964, *R.S. Raghavan* 103835 (BSI); Shivamogga [Shimoga] district, near Jog Falls, cultivation fields, 16.11.1997, *P.V. Prasanna* 176734 (BSI); Uttara Kannada district, Siddapur, Balicop forest, 19.11.1957, *S.K. Jain* 29806 (BSI); Yellapura [Yellapur], 00.11.1939, *IFC s.n.* (DD); *s.loc.*, 10.11.1889, *W.A. Talbot* 2096 (BLAT); *s.loc.*, *s.d.*, *s.coll.* 1522 (BSI). **Kerala,** Kannur district, Madayippara, near fort, 04.10.2011, *C. Pramod* 126821 (CALI); *Ibid.*, 18.11.2015, *Rinku J. Desai* 1738 (BARO); *Ibid.*, 14.11.2018, *V. Drisya* 157870 [CALI184737, CALI184738, CALI184739, CALI184740, CALI184741, CALI184742 & CALI184743] (CALI). **Malabar & Concan**, *s.loc.*, *s.d.*, *Stocks, Law &c. s.n.* (CAL).

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Kolhapur district, Shivaji University Campus, 14.01.2017, *V. Drisya* 171419 [CALI184734, CALI184735 & CALI184736]; Tillari, 08.01.2017, *V. Drisya* 171401 [CALI184733]; Panhala Fort, 13.01.2017, *V. Drisya* 171415 (CALI); Sindhudurg district, Amboli village, 12.11.2016, *Shinoj & V. Drisya* 176675; on the way to Amboli, 12.11.2016, *Shinoj & V. Drisya* 176677 (CALI).

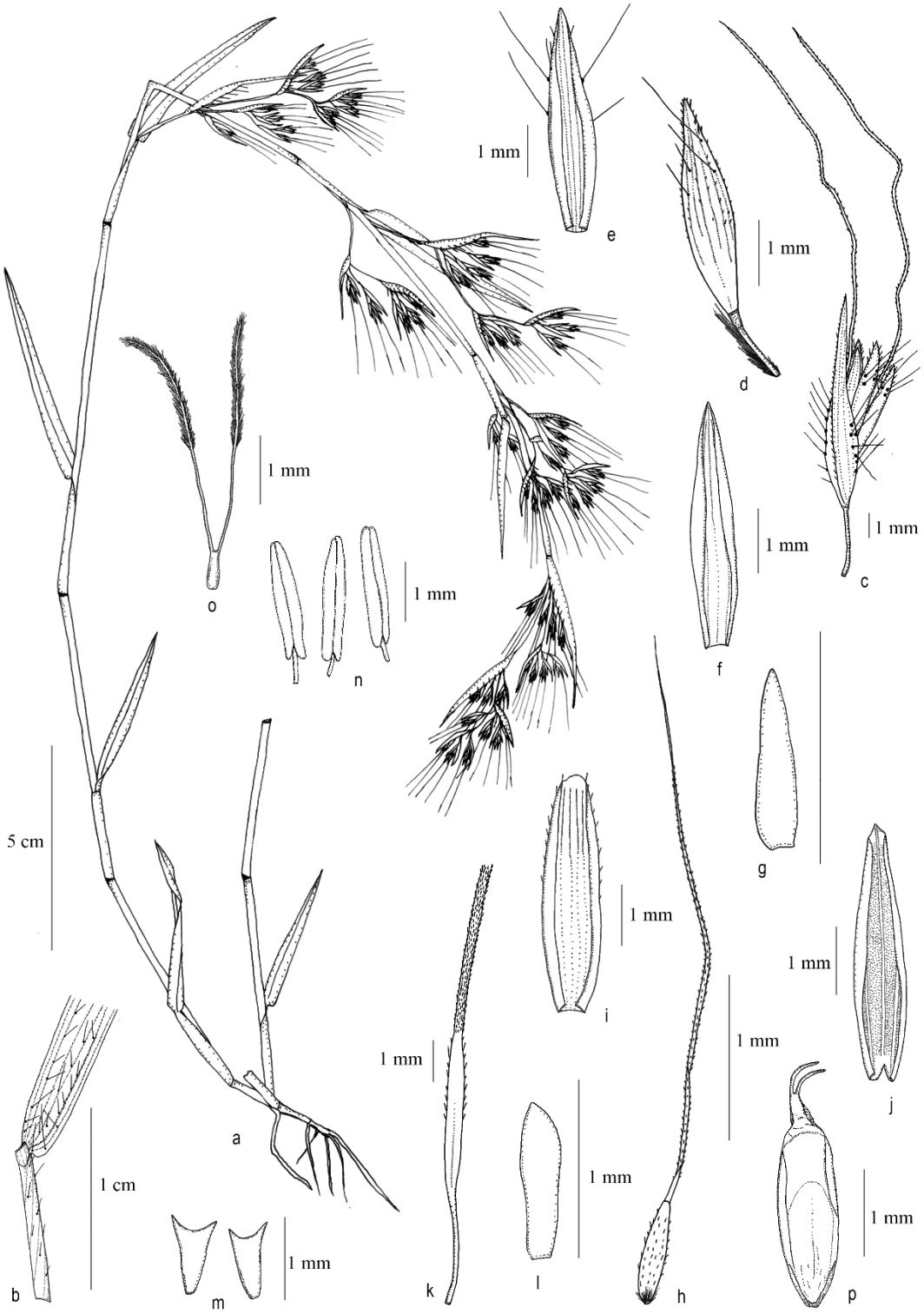

Fig. 148. *Pseudanthistiria heteroclita* (Roxb.) Hook.f.: **a.** Habit; **b.** Junction of the leaf sheath and blade; **c.** Single raceme; **d.** Pedicelled spikelet; **e.** Lower glume-ventral view; **f.** Upper glume-ventral view; **g.** Lemma (**d–g:** Pedicelled spikelet); **h.** Sessile spikelet; **i.** Lower glume-ventral view; **j.** Upper glume-ventral view; **k.** Lemma; **l.** Palea (**h–l:** Sessile spikelet); **m.** Lodicules; **n.** Stamens; **o.** Gynoecium; **p.** Caryopsis-ventral view (from *V. Drisya* 157870, drawn by V. Drisya).

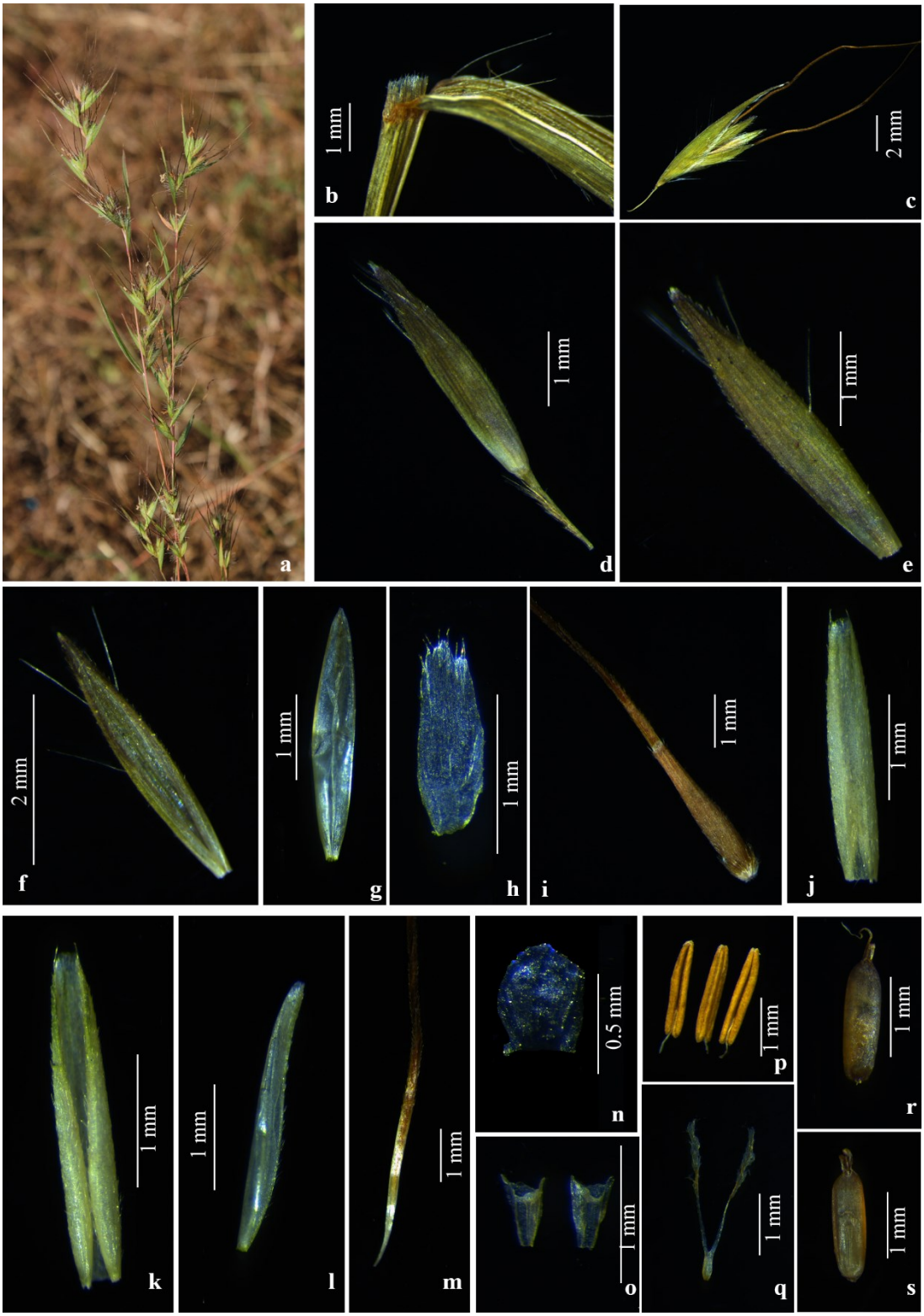

Fig. 149. *Pseudanthistiria heteroclita* (Roxb.) Hook.f.: **a.** Habit; **b.** Ligule; **c.** Single raceme; **d.** Pedicelled spikelet; **e.** Lower glume-dorsal view; **f.** Lower glume-ventral view; **g.** Upper glume; **h.** Upper lemma (**d–h:** Pedicelled spikelet); **i.** Sessile spikelet; **j.** Lower glume-dorsal view; **k.** Lower glume-ventral view; **l.** Upper glume; **m.** Upper lemma; **n.** Upper palea (**i–n:** Sessile spikelet); **o.** Lodicules; **p.** Stamens; **q.** Gynoecium; **r.** Caryopsis-dorsal view; **s.** Caryopsis-ventral view.

Notes: This species can be easily distinguished from *Pseudanthistiria umbellata* by the presence of prominent tubercle-based hairs on leaf sheaths and blades, and a muticous to truncate apex of the lower glume of the sessile spikelet, in combination with its robust erect habit (Drisya & Pradeep 2021).

Notes on typification: *Anthistiria heteroclita* was originally described by Roxburgh (1820) in his *Flora Indica* although he did not cite any specimen, but mentioned it as "a native of newly made pasture land in the vicinity of Calcutta". Hooker (1897), when recircumscribing *A. heteroclita* as *Pseudanthistiria heteroclita*, added the statement 'I have seen no Bengal specimens, but the excellent figure in Roxburgh's "Icones Pictae" leaves no doubt in my mind as to its being of the same species as the Western plant, only more copiously ciliate'. In this, he also provided reference to the type collection as 'Bengal; pastures near Calcutta, Roxburgh & The Concan and Canara, Law, Thomson, &c'. While searching for Roxburgh's drawing, the authors could trace it (with no. 1774) from Library, Art and Archives at the Royal Botanic Gardens, Kew, where most of the illustrations made by Roxburgh for "Flora Indica" were deposited. Though Nees von Esenbeck (1841) already provided a reference to the illustration, by citing the basionym as "*Anthistiria heteroclita* Roxb. Fl. Ind. Or. I.p. 249. ed. Car. et. Wall. p. 253. n. 4. Tab. Pict. n. 1774", it cannot be considered as a typification because he simultaneously cited several other elements. However, the citation of Hance 9667 in Tropicos as "Type-Protolog" is apparently an error, and probably based on Chen & Phillips (2006). Hence, we here designate the illustration (No. 1774) by Roxburgh as the lectotype for the name *Anthistiria heteroclita* (Drisya & Pradeep 2021).

Hooker (1897) while describing the species *Pseudanthistiria hispida,* provided reference to the collection "The Concan, Stocks, Law, Dalzell & c. Central Provinces; Khandwa, Duthie (No. 8478)". After a thorough search for the original material, the authors could trace six herbarium sheets that were originally mentioned by Hooker (1897) in the protologue. Three sheets of Duthie with collection number 8478 were found, one each at BM (BM000959812 digital image!), CAL (Accession number 532507!) and K (K000245934 digital image!). Two more sheets of original

material were found at K, one belonging to Dalzell's collection (K000975016 digital image!) while the other sheet (K000245935 digital image!) bears the label of "Herb. Ind. Or. Hook. Fil & Thomson", with Concan as the collection locality and Stocks & Law as collectors. Aside from this label, the second sheet also bears a stamp "Herbarium Hookerianum 1867", clearly indicating it as part of the original material used by Hooker. Apart from this, a duplicate sheet of Stocks and Law was also found at CAL (Accession number 532506). All these available sheets constitute the syntypes. According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), there need to be a selection of a single specimen as lectotype. Hence, Duthie 8478 (K000245934 digital image!) being a well preserved specimen agreeing with the protologue is selected here as the lectotype, with BM000959812 and CAL (Accession number 532507) as isolectotypes (Drisya & Pradeep 2021).

2. Pseudanthistiria umbellata (Hack.) Hook.f., Fl. Brit. India 7: 220. 1897; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1749. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 204. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 124. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 252. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 181. 1991; S.Moulik, Grasses Bamboos India 1: 225. 1997; Pull., Fl. Andhra Pradesh 3: 1243. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 459. 2009; Potdar *et al.*, Grasses Maharashtra 232. 2012; T.S.Nayar *et al.*, Fl. Pl. W. Ghats, India 2: 1196. 2014; Drisya & Pradeep, Rheedea 31(4): 241. 2021. *Andropogon umbellatus* Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 401. 1889. *Sorghum umbellatum* (Hack.) Kuntze, Revis. Gen. Pl. 2. 792. 1891. *Hypogynium heteroclitum* (Hack.) Roberty f. *umbellatum* Roberty, Boissiera 9: 190. 1960. *Lectotype* (designated here):— SRI LANKA [CEYLON], *s.d.*, *Thwaites* 963 (lecto: P [P00740707 digital image!]; isolecto: BM [BM000959813 digital image!, BM000959814 digital image!], BR [BR0000006885847 digital image!], K [K000245936/K000975015 digital image!], MEL [MEL19172 digital image!], W [W18890064970 digital image!, W18890098348 digital image!, W19160027408 digital image!]).

Pseudanthistiria burmanica Hook.f., Fl. Brit. India 7: 220. 1897. *Lectotype* **(**First-step designated by Bor, 1960: 203; second-step designated by Drisya & Pradeep, 2021): MYANMAR [BURMA], **Pegu**, *s.d., S. Kurz 2755* (K [K000245937 digital image!]; isolecto: K [K000246129 digital image!], CAL [CAL0000002053!]).

Anthistiria heteroclita sensu Thwaites, Enum. Pl. Zeyl. 366. 1864. *non* Roxb. 1820.

Figs. 150–154

Annual, creeping, decumbent, slender, 45–65 cm tall, rooting from lower nodes. *Culm* geniculate or straight; *internodes* 1–13 cm long, glabrous, purplish; *node* glabrous, dark purplish. *Leaf sheath* rounded to shallowly keeled, 1.5–2.5 cm long, margin entire, chartaceous, dorsal surface glabrous or tubercle-based hairy towards apex, hairs hyaline, 0.5–2 mm long, ventral surface glabrous, smooth, greenish. *Leaf blade* narrowly ovate–lanceolate, 1.5–5 × 0.3–1.2 cm, base obtuse–rounded, margin scabridulous, apex acute–acuminate, chartaceous, adaxial surface scabridulous, very few (1 or 2) tubercle-based hairs towards base, abaxial surface glabrous to tubercle-based hairy with scabridulous midvein, greenish, 5–9-veined. *Ligule ca*. 0.5 mm long, apex truncate, fimbriate, membranous, hyaline. *Inflorescence* terminal, false panicle interrupted by spathes and spatheoles; raceme more or less flexuous, comprises 2 sessile and 3 pedicelled spikelets, which is subtented by a spatheole; flowering axis linear, 1–5 cm long, subterete, ventrally compressed, smooth–scabridulous at upper 1/4th, greenish–purplish. *Spathe* encloses 3–10 racemes, narrowly elliptic, cymbiform, 15–30 × 3–3.5 mm (1.5–2 mm wide when folded), often leafy, dorsally keeled, margin entire, apex acuminate, chartaceous, dorsal surface scabridulous towards apex, tubercle-based hairy at middle portion towards margin, hairs 1–2 mm long, hyaline, ventral surface glabrous, smooth, greenish with purplish tinge, hyaline towards margin. *Spatheole* narrowly elliptic, cymbiform, 10–12 × 2.5–3 mm (*ca.* 1.5 mm wide when folded), folded, dorsally keeled, base cuneate, margin membranous, hyaline, entire, apex acuminate–aristate, chartaceous, dorsal surface glabrous, tubercle-based hairy at middle portion towards margin, hairs 2.5–3 mm long, hyaline, keel scabridulous, ventral surface glabrous, smooth, greenish. *Peduncle* linear, 2.5–4.5 mm long, ventrally compressed, dorsal surface and margins scabridulous. *Rachis* jointed, rachis internode 2; lower internode linear,

2 mm long, scabridulous at upper 2/3rd, sparsely pilose at apex, hairs hyaline, up to 0.5 mm long, greenish; upper internode linear, *ca.* 1.5 mm long, ventrally compressed, densely pilose on dorsal surface, hairs 0.5–1 mm long, hyaline to pale brownish, more towards apex, pale greenish. *Sessile spikelet* 2, bisexual, narrowly ovate–elliptic, 3.5–4 × 0.5–0.8 mm, pale greenish–brownish; callus obtuse, slightly oblique, densely pilose, hairs 0.1–1 mm long, hyaline to pale brownish. *Lower glume* narrowlly ovate–oblong, 3.4–3.5 × *ca.* 1 mm, base truncate, margin entire, inflexed at lower half, infolded and keeled at upper half, keel scabridulous, apex muticous, truncate–notched; chartaceous–coriaceous, dorsal surface scabridulous on veins, ventral surface glabrous, pale greenish–brownish, 9–10-nerved, veins usually prominent at upper 1/3rd. *Upper glume* narrowly ovate, cymbiform, *ca.* 3.5 × 0.8 mm, base obtuse, margins entire, membranous, lower half inflexed, upper half infolded or inflexed; apex mucronate, chartaceous–coriaceous, dorsally keeled and two channelled, dorsal surface glabrous except scabridulous keel (upper half) and sub apical region, ventral surface glabrous, hyaline with green tinge, 3-veined. *Lower floret* absent. *Upper lemma* reduced to the hyaline base of the awn, 4–4.5 mm long, glabrous. *Awn ca.* 2.4 cm long, geniculate, brownish, scabridulous; column *ca.* 10 mm long, slightly twisted, dark brownish; bristle 9–11 mm long, pale brownish. *Upper palea* variable in shape, *ca.* 1 × 0.5 mm, base truncate, apex obtuse–rounded, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, 0.4–0.6 × 0.2–0.3 mm, hyaline. *Stamens* 3; filament, glabrous, hyaline;

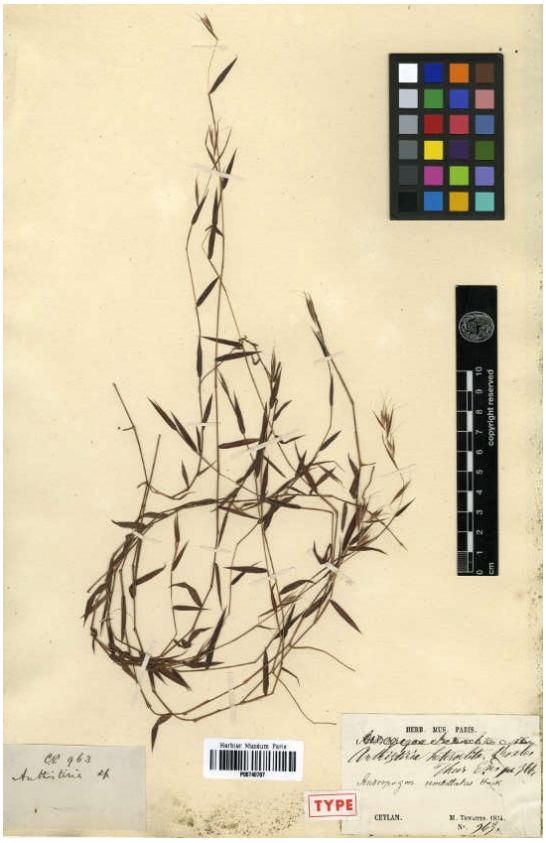

Fig. 150. Lectotype of *Pseudanthistiria umbellata* (Hack.) Hook.f. [*Thwaites* 963 (P00740707)] © The Board of Trustees of Muséum National d'Histoire Naturelle, Paris (France). Reproduced with permission.

anthers 3, 1.8–2 mm long, yellowish. *Ovary* narrowly elliptic–oblong, 0.5–1.5 × 0.3–0.5 mm, glabrous, hyaline to pale yellowish; *Style* 2, 1.3–1.5 mm long, fused at the apex of ovary, glabrous, hyaline; *Stigma* 2, plumose, 1.5–3 mm long, purplish. *Pedicelled spikelet* 3, male, narrowly elliptic, 5–5.5 × 0.5–0.8 mm, greenish; callus obtuse–linear, *ca.* 0.5 × 0.2–0.3 mm long, broader than pedicel, dorsiventrally flattened, glabrous, few very minute hairs towards the pedicel. *Pedicel* linear, 1–1.5 mm long, slender, dorsiventrally compressed, dorsal side pilose, hairs 0.5–1 mm long, hyaline to pale brownish, ventral side glabrous, pale greenish to pale yellowish. *Lower glume* narrowly ovate, 4.8–5.5 × 0.8–1 mm, base truncate, margins at lower 1/3rd inflexed, upper 2/3rd infolded, keeled and ciliate, infolded margins and keel scabridulous, apex acuminate, chartaceous to subcoriaceous, dorsal surface sparsely scabridulous, hairs seen at upper 2/3rd on veins and sub apical region, lower 1/3rd glabrous, ventral surface glabrous, greenish, 7–10-veined. *Upper glume* narrowly ovate to narrowly elliptic, cymbiform, 3.8–4.1 × *ca.* 1 mm, base truncate, margins inflexed at lower half, infolded at upper half, infolded margins ciliate, apex acute, chartaceous to subcoriaceous, dorsal surface scabridulous on veins at upper half, ventral surface glabrous, hyaline, 3-veined, veins greenish. *Lower floret* absent. *Upper lemma* variable in shape, 0.8–2 × 0.3–0.5 mm, base truncate, apex acute, membranous, glabrous, hyaline. *Upper palea* absent. *Lodicules* 2, cuneate or triangular, *ca.* 0.5 × 0.4 mm, apex broad, truncate, hyaline. *Stamens* 3; filament glabrous, hyaline; anthers 2–2.8 mm long, yellowish. *Caryopsis* elliptic–oblong, *ca.* 2.5 × 0.8 mm, ventrally 2-channelled, styles persistent.

Flowering & Fruiting: September to January.

Distribution: Peninsular India, Sri Lanka, South Myanmar to Thailand. In India, it is distributed in Karnataka, Kerala, Maharashtra, Odisha and

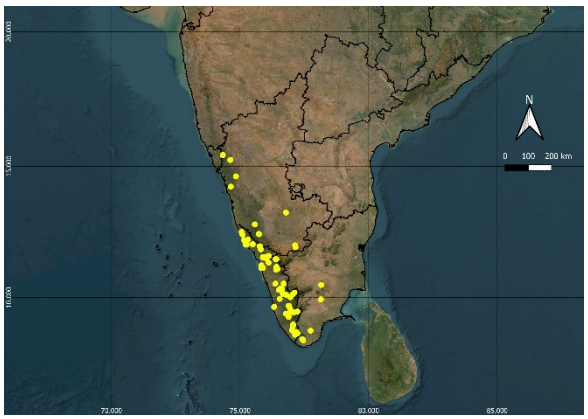

Fig. 151. Distribution of *Pseudanthistiria umbellata* (Hack.) Hook.f. in southern Peninsular India

Tamil Nadu.

Habitat: Open areas, hills sides and roadsides.

Specimens examined: INDIA, **Karnataka,** Chamarajanagar district, BRT (Biligiri Ranganatha Swamy Temple) Wildlife Sanctuary, 21.12.2016, *Alok Chorghe* 206421; *Ibid.*, Doddasampige gate, 21.12.2016, *J. Jayanthi* 206557 (BSI); Dakshina Kannada district, Gundia R.F., 26.11.1927, *s.coll. s.n.* (MH); Kodagu district, Coorg, 26.10.2016, *Nikhil Krishna & V. Drisya* 176774 (CALI); Madikery, 21.11.1958, *G.S. Puri* 45833; *Ibid.*, *G.S. Puri* 45853 (BSI); *Ibid.*; 07.10.2010, *J. Remya* 69559 (TBGT); Shivamogga [Shimoga] district, Nagare, 13.01.1979, *B.R. Ramesh, K.R. Keshava Murthy & P. Prakash* 5668 (CAL); Uttara Kannada district, Anmod to Castle Rock, 14.11.1970, *M.R. Almeida* 1482; Dandeli, 25.12.1955, *P.V. Bole* 1454 (BLAT); Sirsi, 10.11.1950, *J. Fernandez* 1782 (BLAT). **Kerala,** Alappuzha district, Thiruvizha, *s.d*., *C.N. Sunil* 1673 (CALI); Ernakulam district, Mamalakkandam, 19.12.2016, *Shinoj & V. Drisya* 176761; Mayiladumkunnu, near Bhoothathankettu, 14.12.2018, *V. Drisya*; Shoolamudi, 14.12.2016, *Shinoj & V. Drisya* 176683 (CALI); Vettilapara forest, cochin, 07.12.1952, *J. Fernandez* 11 (BLAT); Idukki district, Adimali Ghat road side, 15.12.2018, *V. Drisya* 170140 (CALI); Eravikulam National Park, Rajamala, 08.04.1998, *S.D. Biju* 36731 (TBGT); *Ibid.*, Lakkam Kurisumala top, 01.01.2019, *V. Drisya* 168739 (CALI); Munnar, 13.11.1980, *P.V. Sreekumar* 68443 (BSID); Periyar Wildlife Sanctuary, Vallakkadavu, 30.12.1993, *Jomy Augustine* 12725 (TBGT); Vagamon, 15.10.2015, *V. Drisya & A.K. Pradeep* 144242; Vagamon-Kurisumala, 26.10.2017, *V. Drisya* 157141; *Ibid.*, 26.10.2017, *V. Drisya* 157150; *Ibid.*, 01.12.2019, *V. Drisya* 170189; *Ibid.*, 01.12.2019, *V. Drisya* 170193 (CALI); Kannur district, Aaralam, 27.11.2016, *Shinoj* & *V. Drisya* 176745 (CALI); Chengalayi, 22.12.1980, *R. Ansari* 69979 (CAL & MH); Madayippara, slopes towards Vengara, 28.11.2012, *C. Pramod* 290360; Ezhimala, Kurisumala, 12.11.2017, *V. Drisya* 157716; Kunnaru, 12.11.2017, *V. Drisya* 157718; Peringome, 14.11.2018, *V. Drisya* 157859; Madayippara, on the way to Pazhayangadi, 14.11.2018, *V. Drisya* 157871 [CALI184747, CALI184748 & CALI184749] (CALI); Kasaragod district, Cherkala, 25.12.2016, *V. Drisya* 176672;

Ibid., 02.11.2017, *V. Drisya* 157198; Periya, 25.12.2016, *V. Drisya* 176619; *Ibid.*, 25.12.2016, *V. Drisya* 176620; *Ibid.*, 02.11.2017, *V. Drisya* 157194; Pilicode, Karipath, 24.12.2016, *V. Drisya* 176601; *Ibid.*, 24.12.2016, *V. Drisya* 176602; Veethukunnu, near Pilicode, 24.12.2016, *V. Drisya* 176612; (CALI); Kollam district, *s.loc.*, 24.11.1893, *M.A. Lawson* 137 (CAL); Kulathupuzha, Elderslie Estate, Road, Thenmala range, 20.12.1975, *K.N. Subramanian* 5781 (FRC); Kumaramperur R.F., 13.11.1976; *M. Chandrabose* 49031 (CAL & MH); Chandanakkunnu, Thenmala, 21.12.2019, *V. Drisya* 170199 (CALI); Kottayam district, Pulluparai–Peermade, 24.11.1967, *K. Vivekananthan* 29335 (CAL & MH); Kozhikode district, Chippilithodu, Wayanad Ghat road side, 05.12.2016, *V. Drisya* 176732; Kakkadampoyil, 20.11.2019, *V. Drisya* 176232; Kakkayam, near Dam, on the way to Oorakuzhi waterfalls, 28.12.2017, *V. Drisya* 157804; Kakkayam, Ghat road side, 28.12.2017, *V. Drisya* 157806; Kakkayam, Ambalappara grassland, 30.11.2018, *V. Drisya* 157884; Kanjirakadavu, 08.12.2016, *V. Drisya* 176736; Pokkunnumala, near Nanminda, 23.11.2019, *V. Drisya* 176240; *Ibid.*, 23.11.2019, *V. Drisya* 176244 (CALI); Malappuram district, Kadalundi, 02.05.1978, *Mercy Jacob* 24164; Calicut University Campus, 08.03.1978, *M.I. Razia* 29877; *Ibid*., 08.03.1978, *B.I. Kochumary* 23407; *Ibid*.,12.01.1983, *Shanthi K. Nair* 2029; *Ibid.*, 09.11.1981, *K. Kutty Sankar* 182; *Ibid*., 03.09.1981, *T. Beena Joseph* 145; *Ibid.*, 20.11.1981, *Egy T. Paul* 141; *Ibid*., 02.12.1981, *P. Manimohan* 105; *Ibid*., 06.02.1982, *K. Susha* 147, *Ibid.*, 02.02.1983, *V.T. Nandakumar* 1099; *Ibid*., 03.03.1983, *E.K. Sumathi* 2316; *Ibid*., 01.10.1986, *T.G. Jaisonlal* 4357; *Ibid.,* 30.11.1986, *Sreenivasan Ettammal* 2732; *Ibid.*, 07.12.1986, *V. Usha* 3115; *Ibid.*, 10.11.2015, *V. Drisya* 144288; C.U. Botanical Garden, 07.11.2000, *S. Jayasree* 74347; *Ibid.*, 22.10.2009, *P.I. Jattisha* 127345; *Ibid.*, 14.12.2019, *V. Drisya* 176279; *Ibid.*, 12.11.2020, *V. Drisya* 169527 [CALI184744, CALI184745 & CALI184746]; *Ibid.*, 31.12.2020, *V. Drisya* 169540 (CALI); Palakkad district, Kottopadam, Thiruvizhamkunnu, Mannarghat, 20.12.1972, *K.N. Subramanian* 4618 (FRC); Nelliyampathy, 11.12.2016, *Shinoj & V. Drisya* 176751; Silent valley, W. boundary near Walaghat, 23.11.1982, *Sathish Kumar* 10773 (CALI); Sirendhri Camp Shed, 06.11.2012, *J. Remya* 74588 (TBGT); Pathanamthitta district, Pamba Forest Range, near Ezhukuman, Udumpara,

18.11.2017, *V. Drisya* 157742 (CALI); Pamba, Kozhikannu area, 13.12.1983, *K.N. Subramanian* 9972 (FRC); Sabarimala, 23.12.1980, *P.V. Sreekumar* 69445 (BSID); *Ibid.*, 18.01.2016, *V.S. Hareesh & V. Drisya* 176654 (CALI); Thrissur district, near Charpa Falls, in between Athirappilly & Vazhachal, 12.12.2019, *V. Drisya* 176276 (CALI); Peringalkuthu–Sholayar forest, 25.11.1982, *K. Ramamurthy* 75536 (CAL & MH); Peringalkuthu, near Dam site on the western side, 19.12.1984, *K.N. Subramanian* 10794 (FRC); Peechi, Karadippara, 22.09.1987, *N. Sasidharan* 4646; Vazhachal, 12.12.2019, *V. Drisya* 176273 (CALI); Thiruvananthapuram district, Agasthyamala, Pongalappara, 15.03.2016, *Shinoj & V. Drisya* 176667; Chippanchira, near TBGRI quarters, 02.02.2017, *V. Drisya* 176646 (CALI); Kottur R.F., 21.02.1979, *M. Mohanan* 59338 (CAL & MH); TBGRI Garden site, 23.11.1984, *K.C. Koshy* 400; Bonaccord, 22.12.1988, *N. Mohanan* 7911; Chemungi, 18.05.1993, *N. Mohanan* 10895; Nedumangaud, Peringamala, 29.11.1996, *P.S. Jothish* 27848 (TBGT); Wayanad district, Chandanathode, 00.11.1937, *N.L. Bor* 9178; *Ibid.*, 00.11.1938, *N.L. Bor* 8444 (DD); Mandhanmala, near Navodaya School, Pookode Lake, 15.01.2017, *Nikhil Krishna & V. Drisya* 171451 (CALI); Manikunnumala, 10.11.2000, *M.K. Ratheesh Narayanan* 2158; *s.loc*., *s.d*., *s.coll*. 1597 (CALI); *s.loc.*, 22.11.2015, *Rinku J. Desai* 1781 (BARO). **Tamil Nadu**, Dindigul district, Ayyalur, 21.01.1942, *Indian Forest College Student s.n.* (DD); Kanyakumari district, Injikadadu to Asambu, 05.12.2005, *K. Althaf Ahamed Kabeer* 118724; Keeriparai to Maramalai, 01.12.2005, *K. Althaf Ahamed Kabeer* 118642 (MH); Madurai district, Hospital valley, 21.01.1988, *V. Lakshmanan* 87662 (BSID); Nilgiris district, Devala, 00.11.1884, *J.S. Gamble* 15578 (CAL); Tirunelveli [Tinnevelly] district, Naterikal, 13.02.1913, *D. Hooper & M.S. Ramaswami* 38577 (CAL); Nadugani, 07.11.2012, *J. Remya* 75418 (TBGT).

Notes: *Pseudanthistiria burmanica,* as circumscribed by Hooker (1897), is described based on specimens collected at high elevations. It shows continuous variation with regard to leaf shape and pubescence and nature of racemes, making it not easily separable from *P. umbellata*. Hence *P. burmanica* is treated here as a synonym of *P. umbellata* (Drisya & Pradeep 2021).

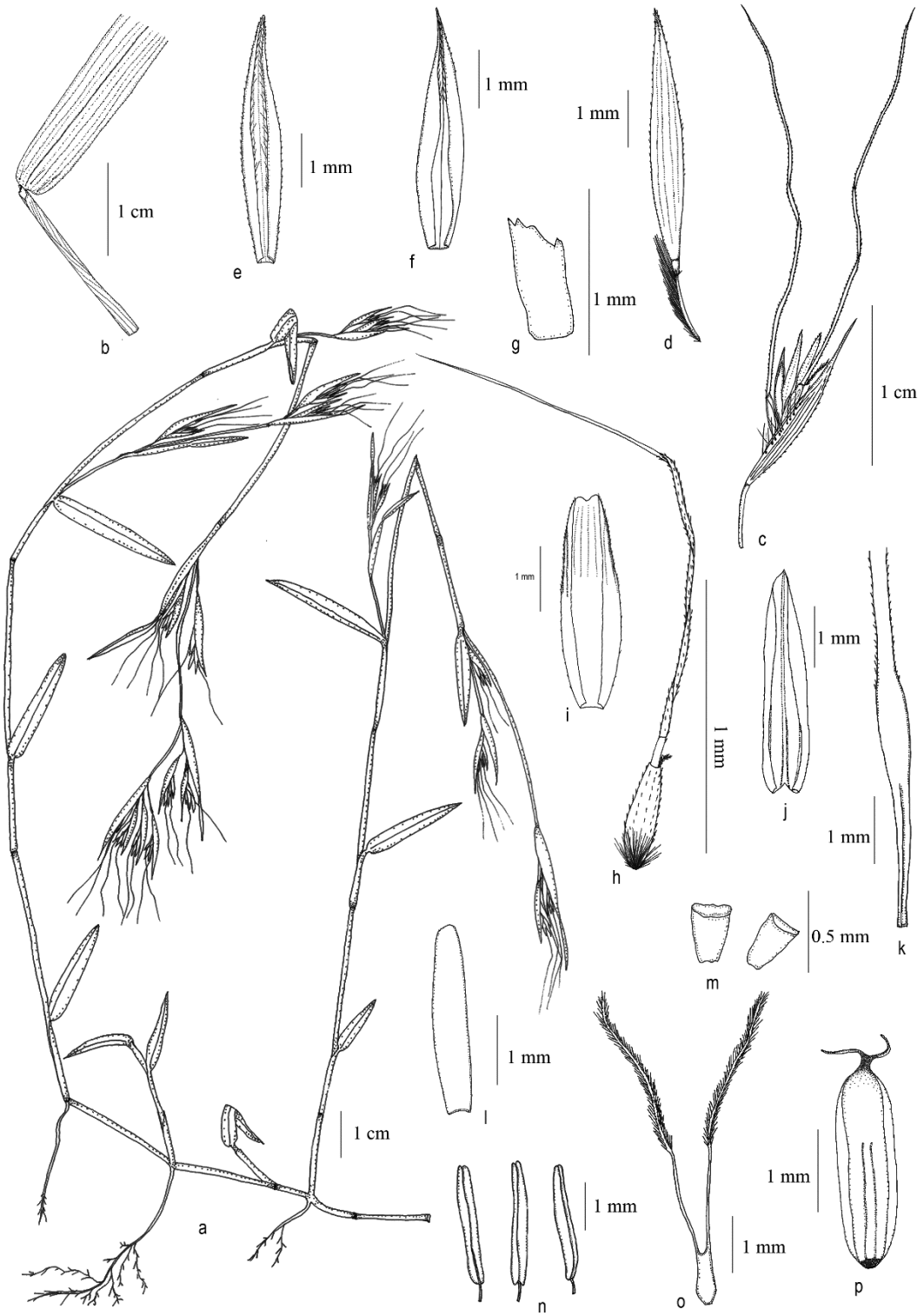

Fig. 152. *Pseudanthistiria umbellata* (Hack.) Hook.f.: **a.** Habit; **b.** Junction of the leaf sheath and blade; **c.** Single raceme; **d.** Pedicelled spikelet; **e.** Lower glume-ventral view; **f.** Upper glume-ventral view; **g.** Lemma (**d–g:** Pedicelled spikelet); **h.** Sessile spikelet; **i.** Lower glume-ventral view; **j.** Upper glume-ventral view; **k.** Lemma; **l.** Palea (**h–l:** Sessile spikelet); **m.** Lodicules; **n.** Stamens; **o.** Gynoecium; **p.** Caryopsis-ventral view (from *V. Drisya* 169527, drawn by V. Drisya).

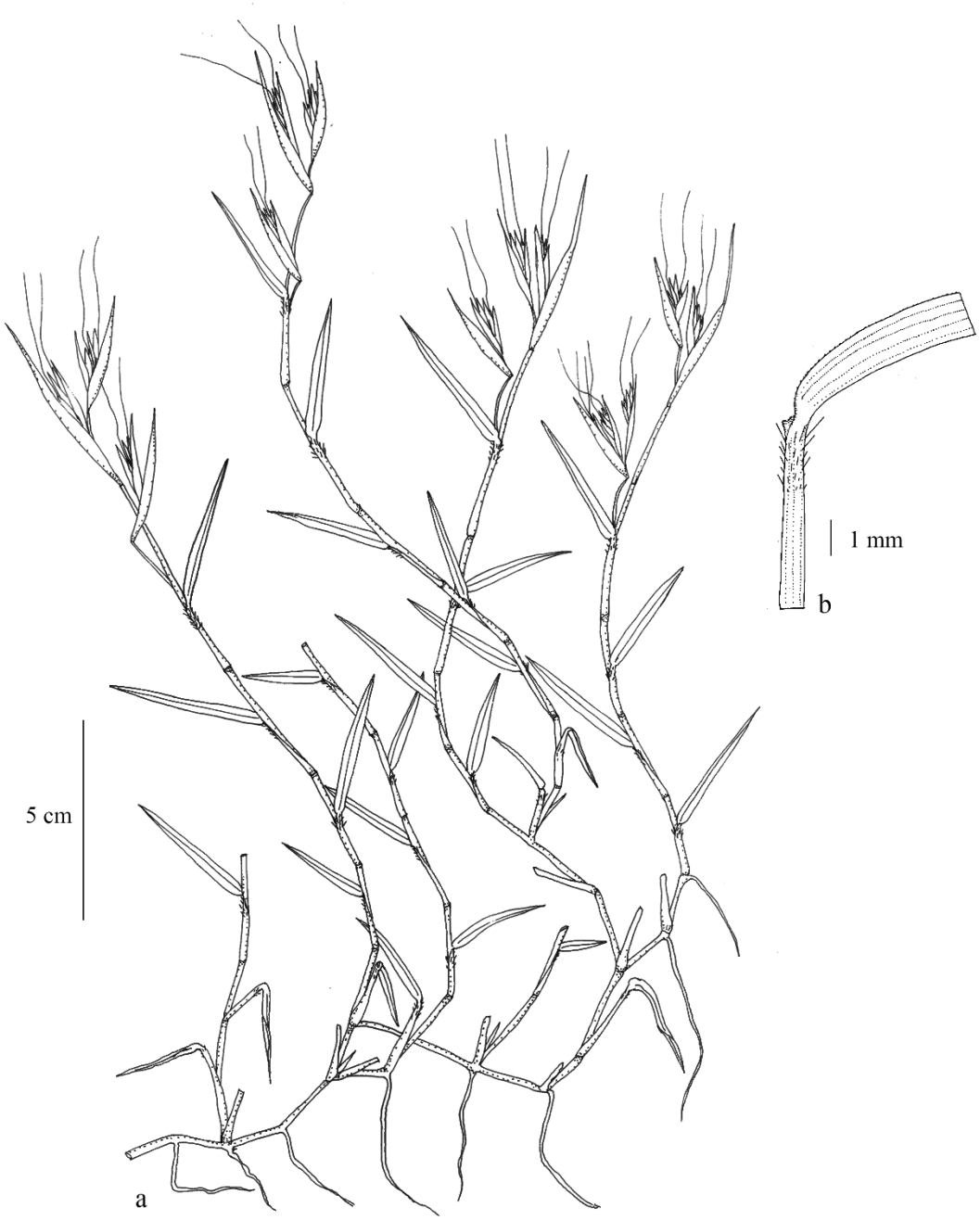

Fig. 153. *Pseudanthistiria umbellata* (Hack.) Hook.f. showing variation in habit and leaf sheath indumentum: **a.** Habit; **b.** Indumentum on leaf sheath apex (from *V. Drisya* 157150, drawn by V. Drisya).

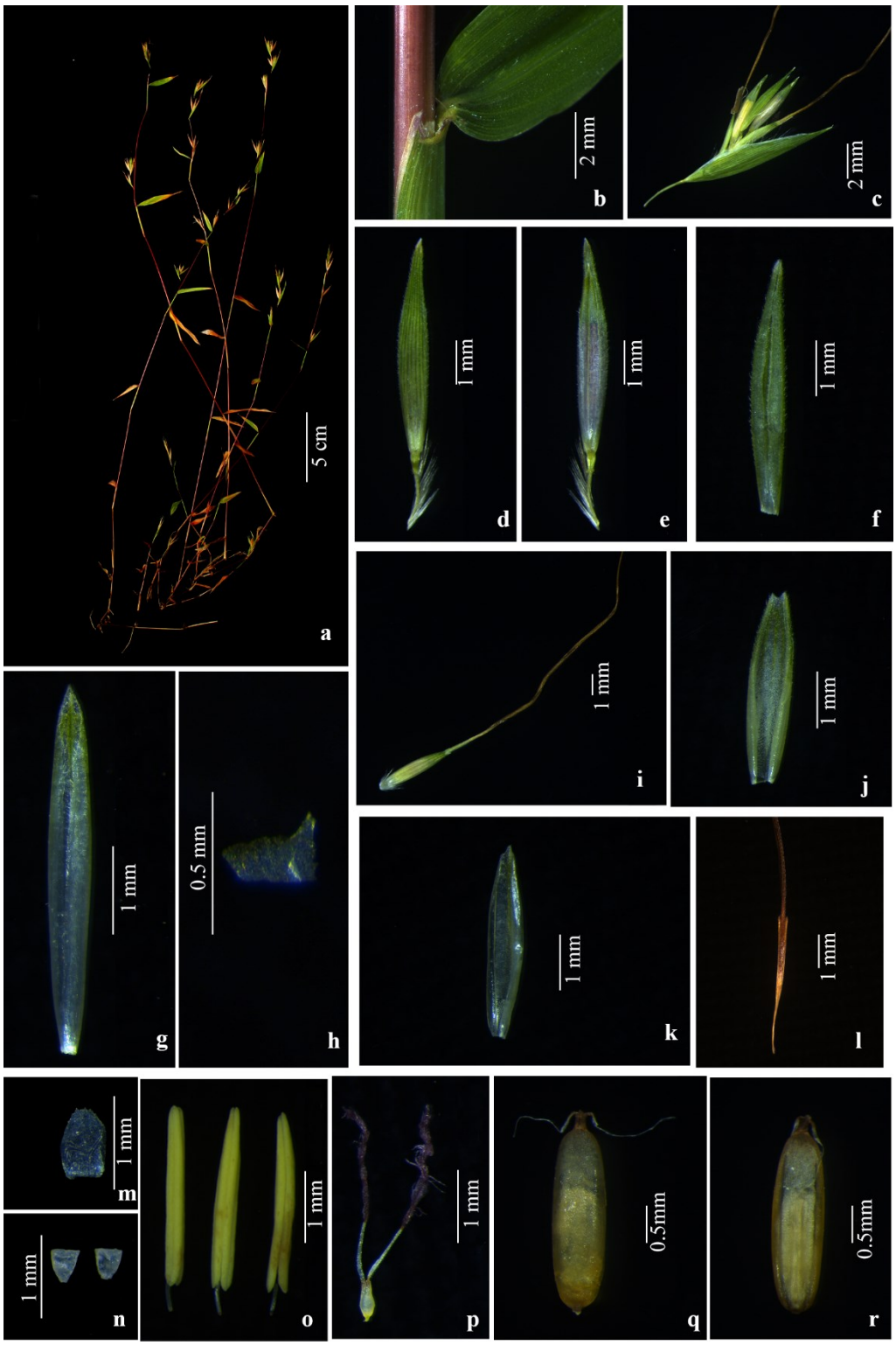

Fig. 154. *Pseudanthistiria umbellata* (Hack.) Hook.f.: **a.** Habit; **b.** Leaf blade base & sheath apex with ligule; **c.** Single raceme; **d.** Pedicelled spikelet-dorsal view; **e.** Pedicelled spikelet-ventral view; **f.** Lower glume; **g.** Upper glume; **h.** Upper lemma (**d–h:** Pedicelled spikelet); **i.** Sessile spikelet; **j.** Lower glume; **k.** Upper glume; **l.** Upper lemma; **m.** Upper palea (**i–m:** Sessile spikelet); **n.** Lodicules; **o.** Stamens; **p.** Gynoecium; **q.** Caryopsis-dorsal view; **r.** Caryopsis-ventral view.

Notes on Typification: When Hooker (1897: 220) described *Pseudanthistiria burmanica,* he only cited "Pegu" and "Kurz" in the protologue, referring to the locality and the collector's name, respectively. Bor (1960: 203) mentioned the type is at Kew with the collection number 2755. While searching for the type specimen of *P. burmanica*, the authors found two sheets at K (K000246129 digital image!, K000245937 digital image!) and one sheet at CAL (CAL0000002053!) collected from Pegu by Kurz with the same collection number 2755, as mentioned by Bor (1960: 203). The CAL sheet is also accompanied by a note stating it to be an isotype. As Hooker (1897) did not mention any holotype or isotypes but only type locality and collector's name, these three sheets, K000246129, K000245937 and CAL0000002053, constitute the syntypes. Among these, K000245937 is selected here as the lectotype, since the other two sheets are mixed collections and bear parts of some other plant affixed to the same sheet (Drisya & Pradeep 2021).

Hooker (1897) elevated the status of Hackel's *Andropogon* section Pseudanthistiria to a genus, *Pseudanthistiria* (Hack.) Hook.f., and transferred *Andropogon umbellatus* Hack. into the genus *Pseudanthistiria*. While describing *P. umbellata*, Hooker did not cite any material, instead cited "Deccan Peninsula, Wight; Cochin, Johnstone. Ceylon, Gardner, & c.". Whereas, Hackel cited a Ceylon plant number 'C.P. 963' while describing *Andropogon umbellatus* Hack. It was clear from Hackel's (1889) treatment that his species *Andropogon umbellatus* was originally based on Thwaites's *Anthistiria heteroclita* (not of Roxburgh, 1820). Actually, Thwaites misunderstood his specimen and applied the name *Anthistiria heteroclitus* Roxb. for his entirely different specimen, 'C.P. 963'. Later, Hackel transferred *Anthistiria heteroclita* as understood by Thwaites into the genus *Andropogon* and validated Thwaites's *Anthistiria heteroclita* by providing a new specific epithet '*umbellatus*' and cited the same specimen (C.P. 963) as cited by Thwaites (1864).

While searching the specimens belonging to 'C.P. 963', author could trace 9 sheets, one sheet at herbarium P [P00740707 digital image!]; two sheets at BM [BM000959813, BM000959814 digital image!], one sheet at BR

[BR0000006885847 digital image!]; one sheet at K [K000245936/K000975015 digital image!]; one sheet at MEL [MEL19172 digital image!] and three sheets at W [W18890064970, W18890098348, W19160027408 digital image!]). The herbarium sheet at P, simply bears a 'type' label. All these 9 sheets with the same collection number 'C.P. 963' constitutes the syntypes. According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), there needs selection of a single specimen as lectotype. Hence, P00740707 at P being a well preserved specimen agreeing with the protologue, is selected here as the lectotype. Whereas, all other specimens BM000959813, BM000959814, BR0000006885847, K000245936, K000975015, MEL19172, W18890064970, W18890098348 and W19160027408 are selected here as the isolectotypes.

6. **Themeda** Forssk.

Themeda Forssk., Fl. Aegypt.-Arab. 178. 1775; Clayton & Renvoize, Gen. Gram., Grasses World: 360. 1986; Watson & Dallwitz, Grass Gen. World: 940. 1992; E.A.Kellogg in Kubitzki, Fam. Gen. Vasc. Pl. 13: 310. 2015; Veldkamp, Blumea 61: 31. 2016. *Type*: *Themeda triandra* Forssk.

Anthistiria L.f., Nov. Gram. Gen. 35. 1779; Hook.f., Fl. Brit. India 7: 210. 1897.

Perobachne J.Presl, Reliq. Haenk. 1(4–5): 348, t. 48. 1830.

Androscepia Brongn., Voy. Monde, Phan. 77. 1829 [1831].

Annuals or perennials, mostly caespitose. *Ligule* membranous, or a fringed membrane or absent. *Inflorescence* a false panicle interrupted by spathe and spatheoles; *single raceme* comprises four involucral male spikelets, one or two bisexual sessile spikelets and two or three male pedicelled spikelets. *Sessile spikelet* brownish; callus oblique, mostly pungent sometimes obtuse; upper lemma awned, *awn* twisted and geniculate.

Distribution: Old World tropics and subtropics, mainly in Asia, Australia and Warm Africa. About 29 species in the world; 20 in India and 8 in southern Peninsular India (Clayton & Renvoize, 1986; Watson & Dallwitz, 1992; Kellogg in Kubitzki, 2015; Kellogg *et al.*, 2020).

Habitat: Species of open savanna, hill slopes, shola grasslands and dry open areas.

Key to the species of *Themeda* in southern Peninsular India

1. Sessile spikelet more than 1 in a raceme **2**
1. Sessile spikelet 1 in a raceme **3**
2. Lower glume of sessile spikelet dorsally grooved ..... 7. ***T. tremula***
2. Lower glume of sessile spikelet not dorsally grooved ..... 3. ***T. mooneyi***
3. Panicle decompound **4**
3. Panicle simple, lax **5**
4. Callus hairs of sessile spikelet brownish .....6. ***T. sabarimalayana***
4. Callus hairs of sessile spikelet white .....1. ***T. cymbaria***
5. Tubercle-based hairs present on leaves; pairs of involucral spikelets inserted more or less at the same level **6**
5. Tubercle-based hairs absent on leaves; pairs of involucral spikelets inserted at different level, otherwise at same level then the sessile spikelet scabridulous only at upper 1/3rd **7**
6. Panicles loose .....2. ***T. laxa***
6. Panicles more or less congested ..... 5. ***T. quadrivalvis***
7. Sessile spikelets densely covered throughout with 1–3 mm long rufous hairs ....4. ***T. palakkadensis***
7. Sessile spikelets scabridulous at upper 1/3rd, not covered with rufous hairs ....8. ***T. triandra***

1. Themeda cymbaria Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 668. 1889; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1746. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 251. 1960; N.P.Singh *et al.*, Bull.

Bot. Surv. India 18(1−4): 126. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1908. 1983; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 268. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 196. 1991; S.Moulik, Grasses Bamboos India 2: 231. 1997; K.M.Matthew, Fl. Palni Hills 3: 1598. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 478. 2009; Potdar *et al.*, Grasses Maharashtra 269. 2012. *Lectotype* (designated by Chorghe *et al*., 2021):—— SRI LANKA (CEYLON), *Thwaites* 3257 (W1916-0028232 digital image!).

Anthistiria cymbaria Roxb., Fl. Ind. 1: 255. 1820, *nom. superfl.* excl. syn. *Andropogon cymbarius* L., Mant. Pl. 2: 303. 1771 (as 'cymbarium'); Hook.f., Fl. Brit. India 7: 215. 1897.

Figs. 155–158

Tufted perennials, tussock forming, 150–250 cm tall; *node* sparsely scabridulous–glabrous, sometimes glaucous, purplish or brownish; *internode* terete, 10–40 cm long, glabrous or sparsely scabridulous near apex. *Leaf sheath* 9.5–20 cm long, dorsally shallowly keeled, margins entire or scabrous towards apex, subcoriaceous, dorsal surface glabrous or scabrous towards apex, ventral surfaces glabrous, scabrous hairs hyaline, upto 4 mm long, greenish; *leaf blade* linear–lanceolate, 35–90 × 0.5–0.8 cm, base attenuate, margins scabrous–scabridulous, apex acuminate, subcoriaceous, abaxial surface scabridulous, adaxial surface scabrous mainly on nerves, greenish. *Ligule* 1–1.5 mm long, membranous, fimbriate at apex, pale brownish. *Inflorescence* a false panicle interrupted by spathe and spatheole, terminal, lax; raceme comprises 4 involucral spikelets, 1 sessile spikelet and 2 pedicelled spikelet. *Spathe* often leafy with or without reduced lamina, more or or less similar to spatheole. *Spatheole* elliptic–narrowly elliptic, folded or cymbiform, *ca.* 10 × 2–2.5 mm, margins entire, apex acuminate, chartaceous, membranous towards margins, dorsally keeled, dorsal surface scabridulous, ventral surface glabrous, greenish. *Peduncle* slender, terete, 2.5–3 mm long, scabridulous, greenish. *Joint of rachis* (or *rachis internode*) linear, 0.6–0.8 mm long, margins scabrous–scabridulous, hairs hyaline, 0.1–0.3 mm long, oblique at apex, subcrustaceous. *Involucral spikelets* arranged in pairs at different levels, narrowly elliptic, 5–5.5 ×

ca. 0.8 mm, greenish; *florets* 2, lower floret empty, upper floret male. *Lower glume* narrowly ovate, 4.5–5 × 0.8–1 mm, cymbiform, margins entire, infolded, keeled at upper half or upper 3/4th, keel scabridulous, otherwise one margin infolded with the other infolded, keeled and winged throughout, apex acute–acuminate, chartaceous, dorsal surface puberulent–sparsely scabridulous with few tubercle-based hairs towards winged margin, ventral surface glabrous, greenish, 10-nerved. *Upper glume* narrowly ovate–elliptic, *ca.* 4.5 × 1 mm, cymbiform, margins inflexed at lower half or lower 1/4th, infolded and keeled at upper half or upper 3/4th, infolded margins ciliate, hairs 0.1–0.2 mm long, keel sparsely scabridulous, apex acute–shortly aristate, chartaceous, dorsal surface sparsely puberulent, ventral surface glabrous, greenish, 3-nerved. *Lower lemma* narrowly ovate–elliptic, *ca.* 3 × 0.8–1 mm, cymbiform, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.1–0.3 mm long, apex obtuse–rounded and ciliolate, membranous, glabrous, hyaline, 1-nerved. *Lower palea* absent or reduced. *Upper lemma* narrowly elliptic–linear, *ca.* 1.5 × 0.3–0.5 mm, margins ciliolate at upper 1/3rd, apex obtuse and ciliolate, membranous, glabrous or dorsal surface puberulent, hyaline. *Upper palea* narrowly ovate or linear–lanceolate, 1.3–1.5 × 0.2–0.4 mm, margins entire or ciliolate near apex, apex obtuse or lobed and ciliolate, membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 0.3–0.4 × 0.1–0.2 mm. *Stamens* 3; anthers 1.5–1.8 mm long, yellowish. *Sessile spikelet* bisexual, narrowly elliptic, *ca.* 4 × 0.5 mm, yellowish brown, callus minutely oblique, densely

Fig. 155. Lectotype of *Themeda cymbaria* Hack. (*Thwaites* 3257 [W1916-0028232]) © The Board of Trustees of Natural History Museum, Vienna. Reproduced with permission.

pilose, hairs hyaline, 0.2–1.5 mm long. *Lower glume* narrowly ovate, *ca.* 3.5 × 0.8–1 mm, margins entire, incurved, narrowly infolded and keeled towards apex, apex truncate, sometimes notched, subcoriaceous, dorsal surface scabrous–scabridulous, ventral surface glabrous–puberulent, yellowish brown, 9-nerved. *Upper glume* narrowly ovate, 3.5–4 × *ca.* 1 mm, cymbiform, margins inflexed, entire at lower half, ciliate at upper half, hairs hyaline, 0.1–0.2 mm long, apex acuminate or cuspidate, subcoriaceous, dorsally keeled with two lateral channels, keel wide, dorsal surface scabridulous on keel, ventral surface glabrous–puberulent, yellowish brown, 3-nerved. *Lower lemma* narrowly ovate, 3.8–4 × *ca.* 0.8 mm, margins inflexed or infolded, ciliate towards upper half, hairs *ca.* 0.1 mm long, apex obtuse and ciliolate, membranous, glabrous, hyaline. *Lower palea* reduced or absent. *Upper lemma* reduced to the hyaline base of the awn, *ca.* 2.5 mm long, bilobed at apex. *Awn* geniculate, 12–13 mm long, brownish; column twisted, *ca.* 7 mm long, scabridulous; bristle *ca.* 5 mm long, scabridulous. *Upper palea* narrowly ovate or oblong, 0.5–0.7 × 0.4–0.5 mm, apex acute or bilobed and ciliolate, membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 0.4–0.6 × 0.3–0.6 mm. *Stamens* 3; anthers *ca.* 1.8 mm long, yellowish. *Ovary* oblong, 0.5–1 × 0.2–0.4 mm; *style* 2, 0.5–0.8 mm long; stigma 2, plumose, 2–2.5 mm long, purple. *Pedicelled spikelet* narrowly ovate–elliptic, 4.5–5.8 × *ca.* 0.5 mm, greenish; *florets 2,* lower floret empty, upper floret male. *Pedicel* linear, 1–1.8 mm long, dorsiventrally flattened, greenish, scabrous–scabridulous, hairs hyaline, 0.1–0.4 mm long. *Lower glume* narrowly ovate, 4–5 × 1–1.2 mm, cymbiform, margins entire, inflexed, infolded near apex, infolded margin minutely keeled, or one margin infolded, keeled and winged throughout, wing broad towards base (*ca.* at lower 1/3rd) and narrow towards apex (*ca.* at upper 2/3rd), apex acute–acuminate, chartaceous, dorsally shallowly keeled near apex, dorsal surface scabridulous, ventral surface glabrous, greenish, 10–12-nerved. *Upper glume* narrowly ovate, 4.2–4.5 × 0.8–1 mm, cymbiform, margins inflexed, ciliate at upper half, hairs 0.1–0.3 mm long, apex acuminate, chartaceous, dorsal surface sparsely puberulent, ventral surface glabrous, dorsally shallowly keeled near apex, keel scabridulous, greenish, 3-nerved. *Lower lemma* narrowly ovate–elliptic, 3–3.2 × 0.8–1 mm, cymbiform, margins inflexed at lower 1/3rd or

lower half, infolded at upper 2/3rd or upper half, infolded margins ciliolate, apex obtuse and ciliolate, membranous, glabrous, hyaline, 1-nerved. *Lower palea* reduced or absent. *Upper lemma* narrowly obovate, *ca.* 2.5 × 0.3–0.6 mm, margins entire or ciliolate towards apex, inflexed, apex obtuse or bilobed with a minute central arista, membranous, glabrous, hyaline. *Upper palea* oblong or lanceolate, 0.7–0.9 × *ca.* 0.3 mm, apex bilobed, sparsely ciliolate or not on lobes, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 0.5 × 0.2–0.3 mm. *Stamens* 3; anthers 2.5–2.8 mm long, yellowish. *Caryopsis* not seen.

Notes: Paleas in the florets is often found to be highly reduced or even absent.

Flowering & Fruiting: October to February.

Distribution: India and Sri Lanka. In India, it is distributed in Goa, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu.

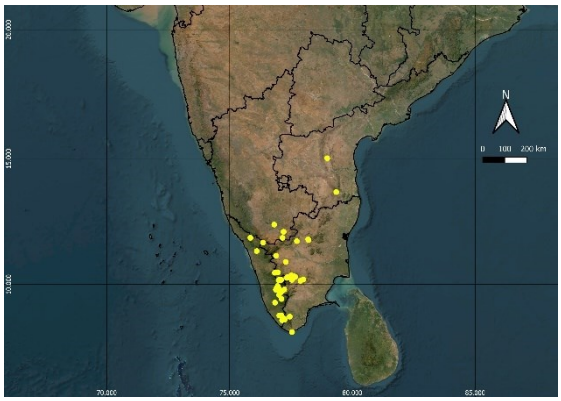

Fig. 156. Distribution of *Themeda cymbaria* Hack. in southern Peninsular India

Habitat: Common in hill slopes, forest margins and sometimes as a forest undergrowth.

Specimens examined: INDIA, **Andhra Pradesh**, Kadapa district, Mallelamma temple, 26.12.2007, *B. Ravi Prasad Rao & B. Sadasivaiah* 30527 (BSID); Tirupati district, Tirumalai, 09.03.1957, *S.K. Wagh* 5578 (BLAT). **Karnataka**, Chamarajanagar district, BRT Hill Tiger Reserve (BRT Wildlife Sanctuary), 22.12.2016, *Alok Chorghe* 206422; *Ibid.*, Burude–Gundal, 04.09.2015, *J. Jayanthi* 202921; *Ibid.*, Gumane betta, 03.04.2015, *J. Jayanthi* 202846 (BSI). **Kerala**, Idukki district, Anamudi Shola, on the way to Idlimotta, 02.01.2019, *V. Drisya* 168770; Arippara, near Kulamavu, 25.03.2016, *V. Drisya* 150722; Chelachuvadu, Ghat roadside, 20.07.2016, *V. Drisya* 150742; Cheri, near Kulamavu, 26.03.2016, *V. Drisya* 150717; Kalvary Mount kurisumala, 27.10.2017, *V. Drisya* 157157; Eravikulam National Park, Lakkam kurisumala, on the way to Lakkam kudi, 01.01.2019, *V. Drisya* 168745; *Ibid.*, near Thookkupalam, Lakkam Falls, 06.02.2018, *V. Drisya* 157827 [CALI184825 & CALI184826]; *Ibid.*,

Kudimala, near Lakkam Kudi, 06.02.2018, *V. Drisya* 157825 [CALI184827 & CALI184828]; Keerithodu, Ghat roadside, 20.07.2016, *V. Drisya* 150744 (CALI); Kozhimala R.F., site I, 04.11.1956, *B.D. Patil* 827 (CAL & DD); Mattuchola, 04.01.2019, *V. Drisya* 168800; near Attikulam, Ghat road side, 20.07.2016, *V. Drisya* 150743; on the way to Mattuchola top, 04.01.2019, *V. Drisya* 168792 (CALI); on the way to Vallakkadavu-Periyar, 08.07.1981, *P.V. Sreekumar* 70456 (BSID); Painavu, Microwave Power Hill, 27.10.2017, *V. Drisya* 157164; Para, on the way to Arippara, near Kulamavu, 25.03.2016, *V. Drisya* 150721 (CALI); Peermade [Peerumedu], 18.02.1957, *G.S. Puri* 15351 (BSI); Ramakkalmedu, 19.07.2016, *V. Drisya* 150740 (CALI); Kozhikode district, Kakkadampoyil, 20.11.2019, *V. Drisya* 176236 (CALI); Pathanamthitta district, Chengara, 05.02.1934, *H.G. Champion* 1134 (DD); Ponnambalamedu, 04.07.1981, *P.V. Sreekumar* 69500 (BSID); Thiruvananthapuram district, Agasthyamala, Athirumala, 16.05.1988, *N. Mohanan* 9818 (TBGT); *Ibid.*, 14.03.2016, *Shinoj & V. Drisya* 176665; *Ibid.*, near camp shed, 20.12.2018, *V. Drisya* 168726 (CALI); *Ibid.*, Attayar, 04.02.1988, *N. Mohanan* 8920 (TBGT); *Ibid.*, Grassland between Attayar and Athirumala, 20.12.2018, *V. Drisya* 168729; *Ibid.*, Pongalappara, 15.03.2016, *Shinoj & V. Drisya* 176666 (CALI); Bonacaud, 17.01.1997, *A. Nazarudeen* 27486 (TBGT); Kottur, 11.02.1981, *P. Farooqui* 243 (FRC); Palode, Garden site [TBGRI], 10.10.1984, *K.C. Koshy & N. Mohanan* 638 (TBGT); Ponmudi, 05.01.1957, *B.K. Nayar & party* 44919 (LWG); Vattappara, 17.02.1957, *G.S. Puri* 15195 (BSI); Wayanad district, Muthanga Wildlife Sanctuary, 28.09.2015, *V. Drisya* 144216 (CALI). **Tamil Nadu**, Coimbatore district, Top slip, 18.11.1937, *N.L. Bor s.n.* (DD); Upper Aliyar, 24.01.2004, *K. Althaf Ahamed Kabeer* 117722 (MH); Dindigul district, Kodaikanal, 28.10.1956, *B.D. Patil* 703 (DD); *Ibid.*, Attuvampatti, CIMAP surrounding, 01.03.2002, *K. Althaf Ahamed Kabeer* 113293 (MH); *Ibid.*, Dolphin's Nose to Vellakevi, 03.11.1985, *K.M. Matthew & N. Rajendren* 42548; *Ibid.*, Vellakevi–Kumbakkarai path, 03.11.1985, *K.M. Matthew & N. Rajendren* 42615; Kilanavayal–Manjampatti hill track, 05.02.1986, *K.M. Matthew & N. Rajendren* 44032; Kukkal, below rest house, 03.10.1990, *K.M. Matthew* 54505; Palamalai–Iruttaru, 20.02.1986, *K.M. Matthew* 44175; Palamalai–

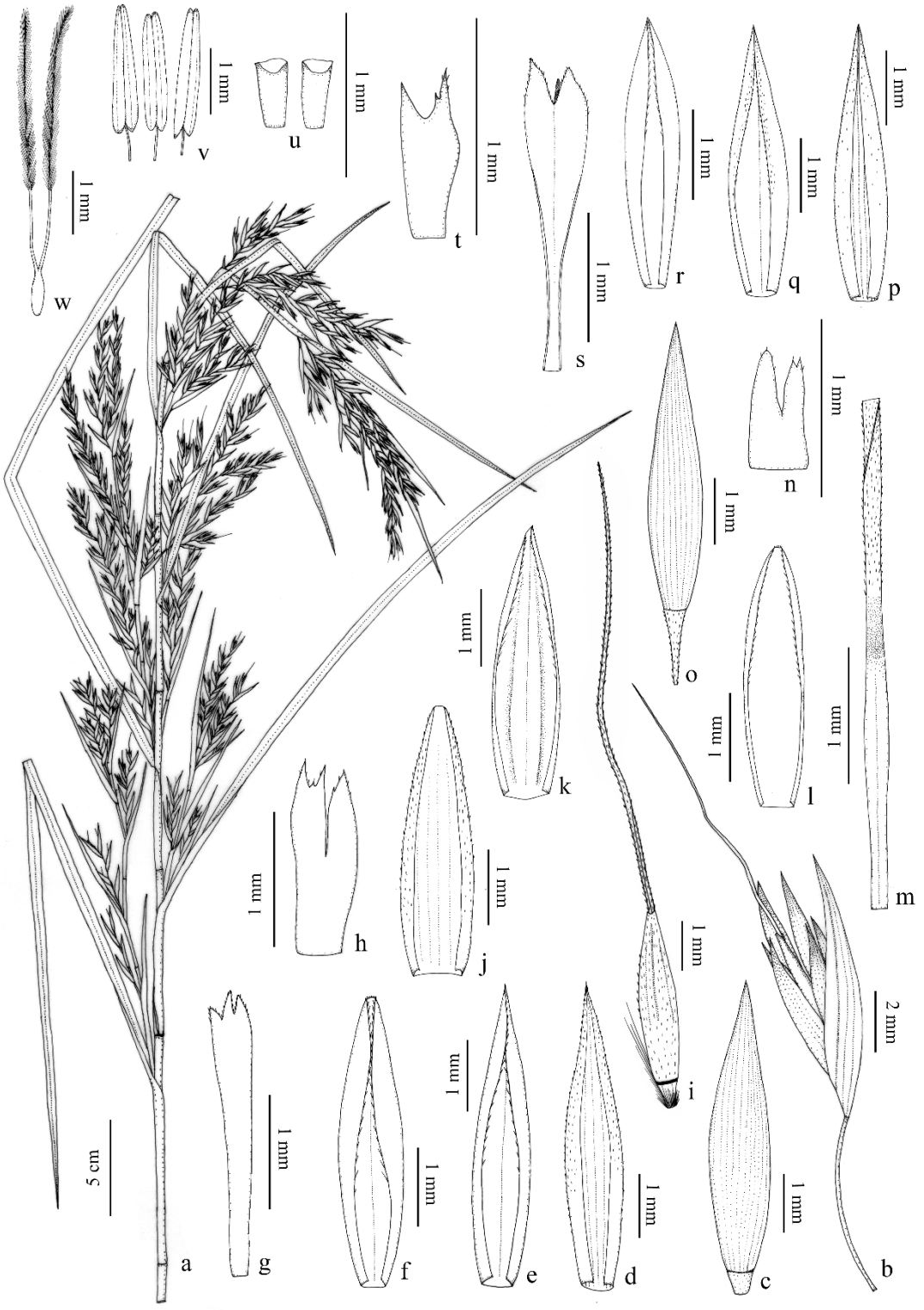

Fig. 157. *Themeda cymbaria* Hack.: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Upper lemma; **h.** Upper palea (**d–h**: Involucral spikelet); **i.** Sessile spikelet; **j.** Lower glume; **k.** Upper glume; **l.** Lower lemma; **m.** Upper lemma; **n.** Upper palea (**i–n**: Sessile spikelet); **o.** Pedicelled spikelet; **p.** Lower glume; **q.** Upper glume; **r.** Lower lemma; **s.** Upper lemma; **t.** Upper palea (**o–t**: Pedicelled spikelet); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium (from *V. Drisya* 157827, drawn by V. Drisya).

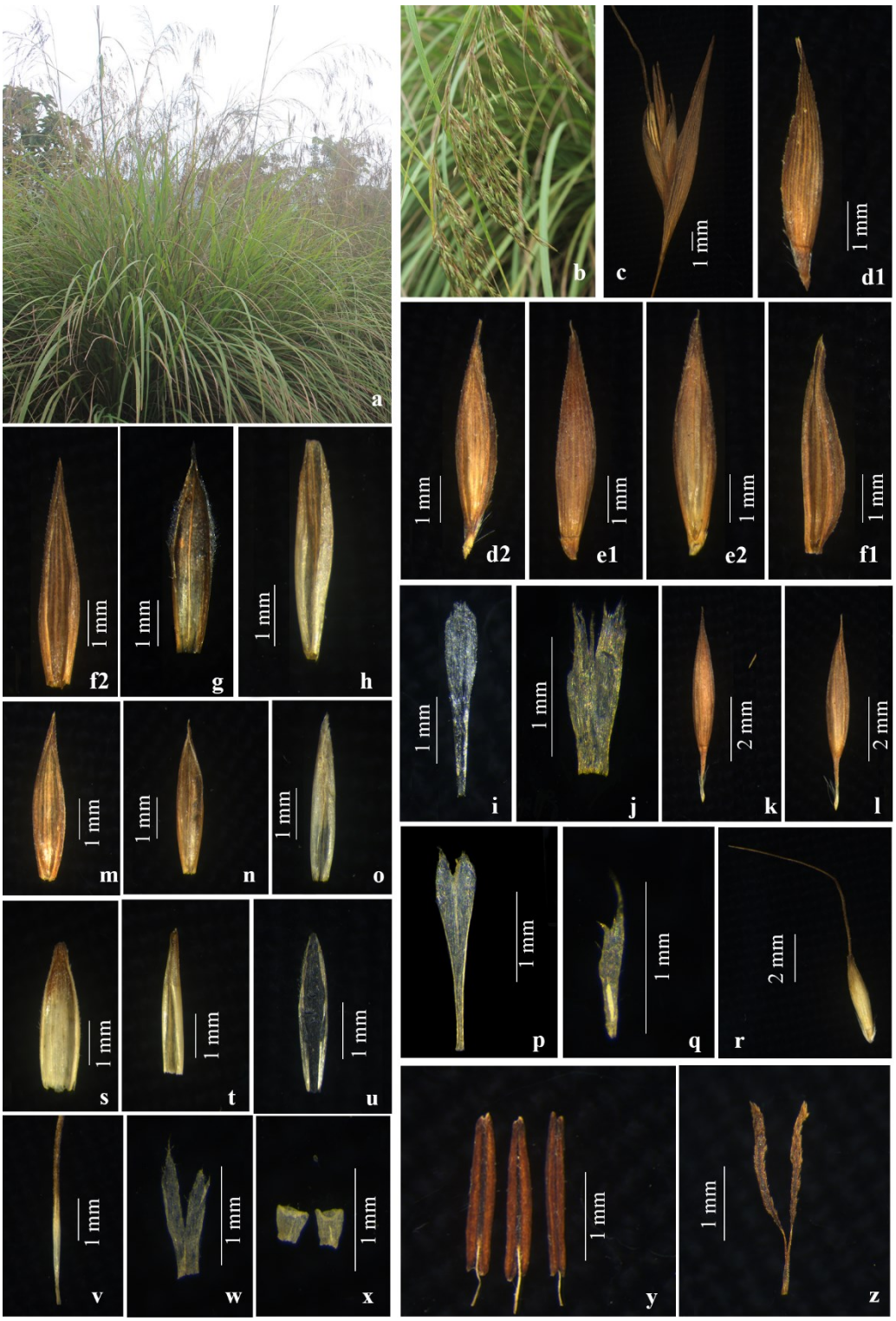

Fig. 158. *Themeda cymbaria* Hack.: **a.** Habit; **b.** Portion of Inflorescence; **c.** Single raceme; **d1 & d2.** Involucral spikelet with wings (**d1.** Dorsal view; **d2.** Ventral view); **e1 & e2.** Involucral spikelet without wings (**e1:** dorsal view; **e2:** ventral view); **f1 & f2.** Lower glume (showing variation in wings); **g.** Upper glume; **h.** Lower lemma; **i.** Upper lemma; **j.** Upper palea (**d1–j:** Involucral spikelet); **k.** Pedicelled spikelet-dorsal view; **l.** Pedicelled spikelet-ventral view; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma; **p.** Upper lemma; **q.** Upper palea (**k–q:** Pedicelled spikelet); **r.** Sessile spikelet; **s.** Lower glume; **t.** Upper glume; **u.** Lower lemma; **v.** Upper lemma; **w.** Upper palea (**r–w:** Sessile spikelet); **x.** Lodicules; **y.** Stamens; **z.** Gynoecium.

Machur path, 03.12.1987, *K.M. Matthew* 51888; Palni Hills, Palni ghat road, 05.07.1986, *K.M. Matthew & N. Rajendren* 45697; *Ibid.*, Pannaikkadu, Perumpallam Jeep road, 12.04.1987, *K.M. Matthew* 49214; Perumalmalai foot hills, 21.07.1984, *K.M. Matthew* 40284; Shempaganur–Periakulam path, 02.06.1984, *S.J. Britto* 40278; Sirumalai, 06.11.1958, *J. Pallithanam* 3699; *Ibid.*, 26.08.1959, *J. Pallithanam* 4925; Thandikudi ghat road, 19.03.1985, *K.M. Matthew* 41087 (RHT); Thandikudi Hills, Seetharam Odai, 03.12.1989, *K. Ravikumar* 92337 (BSID); Vadakavunchi, 14.08.1987, *K.M. Matthew & K.T. Mathew* 50176 (RHT); Kanyakumari district, Kanyakumari [Cape Comorin], 02.11.1956, *B.D. Patil* 753 (DD); *Ibid.*, 26.11.2005, *K. Althaf Ahamed Kabeer* 118585 (MH); Salem district, Yercaud, Opposite to Orchidarium, 04.08.2000, *K.M. Matthew* 62034 (RHT); *Ibid.*, Sanyasimalai R.F., 17.09.1965, *K.N. Subramanian* 1983 (FRC); Tirunelveli district, Ambasamudram taluk, Kannikketti–Kowthalaior (Periapil mittai), 02.01.1978, *K.M. Matthew* 15827 (RHT).

2. Themeda laxa (Andersson) A.Camus, Bull. Mus. Hist. Nat. 26: 423. 1920; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1746. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 251. 1960; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1908. 1983; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 268. 1989; S.Moulik, Grasses Bamboos India 2: 231. 1997; Pull., Fl. Andhra Pradesh 3: 1264. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 479. 2009; Potdar *et al.*, Grasses Maharashtra 269. 2012; Pull., Fl. Telangana 3: 1182. 2015. *Anthistiria laxa* Andersson in Nov. Act. Sci. Upsal. 3, 2: 243. 1856; Hook.f., Fl. Brit. India 7: 213. 1897. *Themeda forskalii* var. *laxa* (Andersson) Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 663. 1889. *Themeda triandra* var. *laxa* (Andersson) Noltie, Edinburgh J. Bot. 56(3): 402. 2000. *Lectotype* (designated by Chorghe *et al*., 2021):—— NEPAL, *Wallich* Cat. No. 8775 (K [K001131606 digital image!]).

Figs. 159–162

Tufted perennials; *culms* erect, 30–200 cm tall; *nodes* glabrous; *internodes* 3–15 cm long. *Leaf sheath* 2–7 cm long, dorsally keeled, keel puberulent–sparsely scabridulous, margins entire, chartaceous, membranous towards margin, dorsal surface puberulent, ventral surface glabrous, greenish, hyaline towards margin. *Leaf blade* linear–lanceolate, 6–25 × 0.2–0.6 cm, base obtuse–rounded, margins

scabridulous, apex acuminate, chartaceous, abaxial surface puberulent, adaxial surface scabridulous–puberulent, tubercle-based hairy, tubercle-based hairs hyaline, 1–4 mm long, greenish. *Ligule* 1–3 mm long, membranous, hyaline–pale brownish. *Inflorescence* leafy, false panicle interrupted by spathe and spatheole. *Spathe* leafy, 25–40 × 3–4 mm. Spatheole folded or cymbiform, dorsally keeled, 17.5–20 × *ca.* 2 mm, margins entire, apex acuminate, keel and dorsal surface scabridulous–puberulent, ventral surface glabrous, chartaceous, membranous towards margins, greenish. *Peduncle* linear, terete, *ca.* I mm long, puberulent, greenish. *Joint of rachis* linear, oblique at apex, 1–1.2 mm long, dorsiventrally compressed, coriaceous, glabrous–very sparsely scabridulous. *Involucral spikelets* 4, arranged in pairs at same level, narrowly elliptic, 6–6.5 × 0.8–1 mm, greenish. *Lower glume* narrowly ovate, cymbiform, 5.2–5.5 × 0.8–1 mm, margins sparsely ciliate towards apex, inflexed or infolded, keeled, keel scabridulous, winged at one margin or not, wing margin scabrous–scabridulous, hairs upto 0.3 mm long; apex acuminate, chartaceous, dorsal surface scabridulous–puberulent, tubercle-based hairy, tubercle-based hairs hyaline, 1–1.5 mm long, ventral surface puberulent, greenish, 8–9-nerved. *Upper glume* narrowly ovate, cymbiform, 5.5–5.8 × *ca.* 0.8 mm, margins inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins ciliate, hairs 0.1–0.5 mm long, apex acute–acuminate, chartaceous, dorsal surface puberulent, ventral surface glabrous, pale greenish, 3-nerved. *Lower lemma* narrowly elliptic, 3.8–4.2 × *ca.* 0.8 mm, margins sparsely ciliate, hairs 0.1–0.3 mm long, inflexed or infolded at lower 1/3rd, infolded

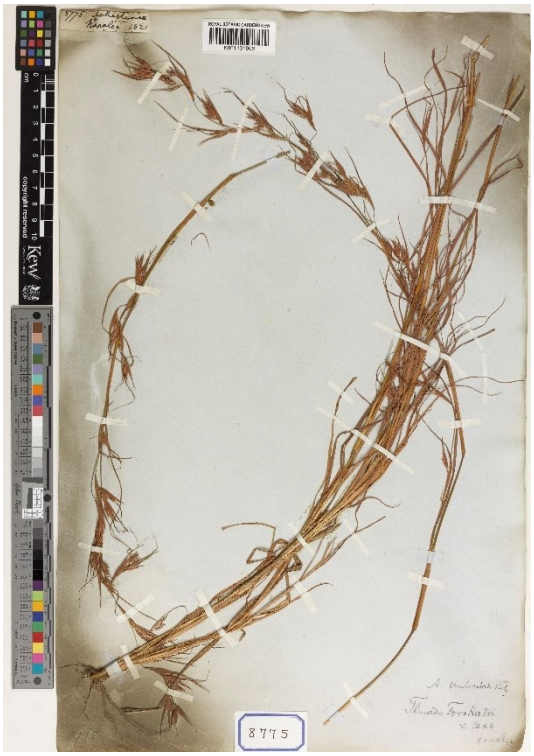

Fig. 159. Lectotype of *Themeda laxa* (Andersson) A.Camus (*Wallich* Cat. No. 8775 [K001131606]) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

at upper 2/3rd, apex obtuse, membranous, glabrous, hyaline, 1-nerved. *Lodicules* 2, cuneate, 0.5–0.6 × 0.2–0.4 mm. *Stamens* 3; anthers 1.5–1.8 mm long, yellowish. *Sessile spikelet* narrowly elliptic, 5.5–6 × 0.5–0.8 mm, pale brownish–brownish; callus pungent, rufous brown hairy, hairs 0.1–2 mm long. *Lower glume* ovate–narrowly ovate, cymbiform, 3.8–4 × 1–1.2 mm, margins entire, inflexed or incurved, apex truncate, coriaceous, dorsal surface scabrous–scabridulous at upper 1/4th, glabrous at lower 3/4th, ventral surface glabrous, brownish, 10-nerved. *Upper glume* narrowly ovate, cymbiform, 3.8–4 × 1–1.2 mm, margins inflexed or incurved at lower half, infolded at upper half, infolded margins ciliate, hairs 0.1–0.3 mm long, apex obtuse, coriaceous, dorsally keeled, keel broad with two lateral channels and scabridulous at upper 1/3rd, ventral surface glabrous, brownish, 3-nerved, midnerve prominent. *Lower lemma* narrowly ovate, 2.8–3 × *ca.* 0.8 mm, margins ciliolate, inflexed at lower 1/3rd, inflexed or infolded at upper 2/3rd, apex obtuse, membranous, dorsal surface sparsely scabridulous, ventral surface glabrous, hyaline. *Upper lemma* reduced to the hyaline base of the awn, 3–3.5 mm long. *Awn* geniculate, *ca.* 3.5 cm long, brownish; column 16–17 mm long, twisted, scabridulous; bristle 17–18 mm long, scabridulous. *Upper palea* oblong or lanceolate, 1–1.2 × 0.2–0.3 mm, margins entire, apex acute or bilobed, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 1 × 0.3–0.5 mm. *Stamens* 3; anthers *ca.* 2 mm long, yellowish. *Ovary* elliptic–narrowly elliptic, 1–1.2 × 0.2–0.3 mm, pale brownish; *style* 2, jonted at base, 2–2.2 mm long; *stigma* 2, plumose, 2.5–3 mm long, purple. *Pedicelled spikelet* 2, narrowly elliptic, 5–5.5 × 0.4–0.5 mm, greenish, empty or male. *Pedicel* linear–clavate, 1–1.2 mm long, dorsiventrally flattened, glabrous, greenish. *Lower glume* narrowly ovate, cymbiform, 5.2–5.5 × 0.8–1 mm, margins inflexed or infolded at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins ciliate, apex acuminate, chartaceous, dorsally keeled, keel and dorsal surface scabridulous, ventral surface scabridulous–puberulent, greenish, 11-nerved. *Upper glume* narrowly ovate, cymbiform, 3.8–4 × 0.8–1 mm, margins inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins ciliate, hairs 0.1–0.3 mm long, apex acute–acuminate, chartaceous–membranous, dorsally shallowly keeled towards apex, keel and dorsal surface scabridulous,

ventral surface glabrous, pale greenish–hyaline, 3-nerved. *Lower lemma* present or absent, narrowly elliptic, 3–4 × 0.7–1.2 mm, margins sparsely ciliate at upper half, inflexed or infolded at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, apex obtuse, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* and paleas reduced or absent. *Caryopsis* not seen.

Flowering & Fruiting: August to January.

Distribution: Indian Subcontinent to Myanmar. In India, it is distributed in Andaman Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan and Tamil Nadu.

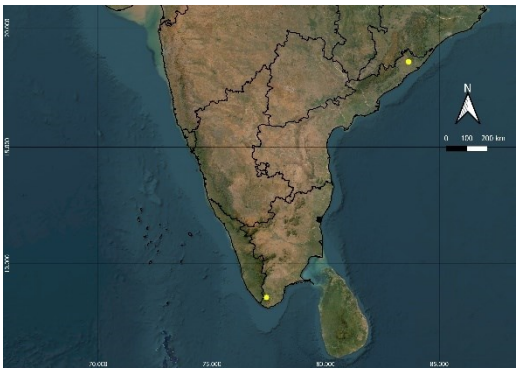

Fig. 160. Distribution of *Themeda laxa* (Andersson) A.Camus in southern Peninsular India

Habitat: Found growing along hill slopes and marshy areas, not very common.

Specimen examined: INDIA, **Andhra Pradesh**, 'Rampa district', Palakonda, 01.10.1920, *V. Narayanaswami* 380 (MH). **Tamil Nadu**, Kanyakumari district, Kodayar to Mancholai, 20.12.2005, *K. Althaf Ahamed Kabeer* 119639 (MH).

Additional specimens examined (from other than study area): INDIA, **Maharashtra**, Kolhapur district, Tillari, 08.01.2017, *V. Drisya* 171448 (CALI). **Odisha**, Kalahandi district, Karlapat Wildlife Sanctuary, Jacum, 02.11.2012, *Alok Chorghe* 2445; Mayurbhaj district, Similipal Biosphere Reserve, Hatigarh, 29.09.2011, *Alok Chorghe* 2352 (BSID).

Notes: *Themeda laxa* is not very common in southern Peninsular India and author was not able to collect it from the study area. The description in the present treatment was based on southern Peninsular Indian specimens available at MH herbarium as well as author's own collection from Maharashtra.

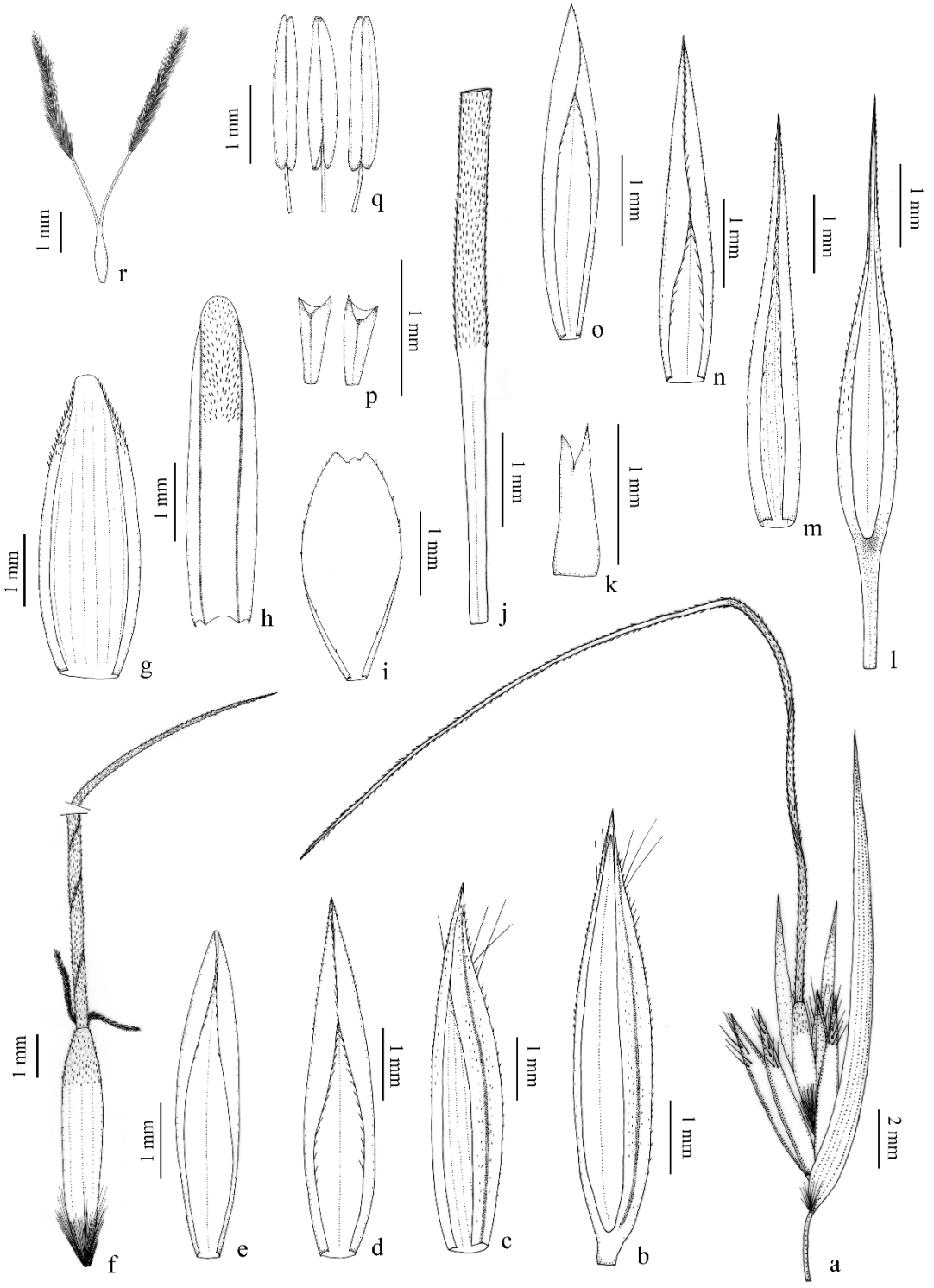

Fig. 161. *Themeda laxa* (Andersson) A.Camus: **a.** Single raceme; **b.** Involucral spikelet; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma (**b–e**: Involucral spikelet); **f.** Sessile spikelet; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma; **j.** Upper lemma; **k.** Upper palea (**f–k**: Sessile spikelet); **l.** Pedicelled spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma (**l–o**: Pedicelled spikelet); **p.** Lodicules; **q.** Stamens; **r.** Gynoecium (from *V. Drisya* 171448, drawn by V. Drisya).

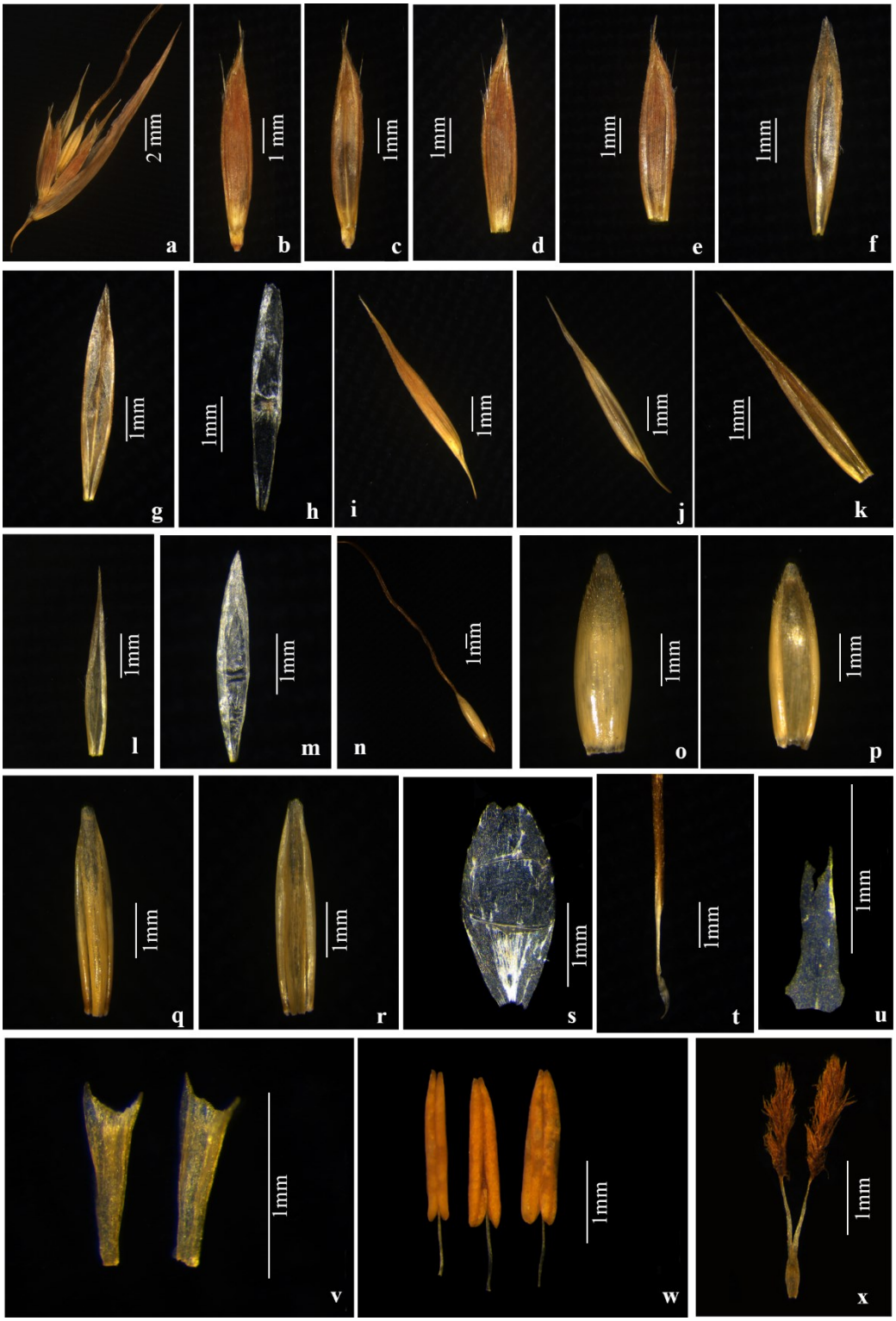

Fig. 162. *Themeda laxa* (Andersson) A.Camus: **a.** Single raceme; **b.** Involucral spikelet-dorsal view; **c.** Involucral spikelet-ventral view; **d.** Lower glume-dorsal view; **e.** Lower glume-ventral view; **f.** Upper glume-dorsal view; **g.** Upper glume-ventral view; **h.** Lower lemma (**b–h:** Involucral spikelet); **i.** Pedicelled spikelet-dorsal view; **j.** Pedicelled spikelet-ventral view; **k.** Lower glume; **l.** Upper glume; **m.** Lower lemma (**i–m:** Pedicelled spikelet); **n.** Sessile spikelet; **o.** Lower glume-dorsal view; **p.** Lower glume-ventral view; **q.** Upper glume-dorsal view; **r.** Upper glume-ventral view; **s.** Lower lemma; **t.** Upper lemma; **u.** Upper palea (**n–u:** Sessile spikelet); **v.** Lodicules; **w.** Stamens; **x.** Gynoecium.

3. Themeda mooneyi Bor, Kew Bull. 6(3): 451. 1951; Bor, Grasses Burma, Ceylon, India & Pakistan 252. 1960; Karthik *et al.*, Fl. Ind. Enum. Monocot. 268. 1989; S.Moulik, Grasses Bamboos India 2: 231. 1997. *Type*:—— INDIA, **Orissa**, near Pottangi, Koraput Dist., 10.10.1950, *H.F. Mooneyi* 4064 (holo: K [K000245982 digital image!]; iso: DD!).

Figs. 163–167

Tufted perennials; *culms* erect or geniculate, 80–150 cm tall; *node* scabrous, purplish, hairs 0.2–2 mm long; *internode* terete, 4–15 cm long, glabrous, scabridulous or puberulent near nodes. *Leaf sheath* 5–9 cm long, dorsally keeled, margins entire, chartaceous, membranous on margins, dorsal surface scabridulous–puberulent, ventral surface glabrous, greenish, purplish near margins; *leaf blade* narrowly ovate to linear–lanceolate, 20–25 × 0.3–0.6 cm, base rounded, margins scabridulous, apex acuminate, chartaceous, dorsal surface scabridulous–puberulent, ventral surface scabridulous to puberulent with tubercle-based hairs at the base and on submargins towards base, greenish, tubercle-based hairs 3–8 mm long. *Ligule* membranous, 1–2 mm long, highly dissected at apex and sometimes looks like hairy, hyaline–pale brownish. *Inflorescence* a false panicle interrupted by spathe and spatheole; *racemes* loosely arranged, not congested, long excerted from the spatheoles, comprises 4 involucral spikelets, 2–3 sessile spikelets and 3–4 pedicelled spikelets. *Spathe* often leafy with or without reduced lamina. *Spatheole* reduced, 3–6 cm long, dorsally keeled towards apex, keel scabridulous. *Peduncle* linear, 4–6 cm long, slender, terete or subterete, glabrous–very sparsely scabridulous, greenish. *Joint of rachis* oblique, 2–2.5 mm long, dorsally compressed, coriaceous–crustaceous, both the margins and base rufous brown hairy, hairs 0.5–2 mm long, pale greenish. *Involucral spikelets* male, arranged in pairs at different levels, elliptic, 14–15 × 1–2 mm, dorsally tubercle-based hairy, greenish with purple shade. *Lower glume* narrowly ovate, 13.5–14 × *ca.* 2 mm, cymbiform, margins entire, infolded, keeled, keel winged throughout, wing margins entire at lower 1/4th, scabridulous at upper 3/4th, otherwise one margin infolded and not keeled and winged with the other infolded, keeled and winged throughout, apex acuminate, chartaceous, dorsal surface scabridulous–puberulent and tubercle-based hairy, tubercle-based hairs 1–2

mm long, ventral surface scabridulous, greenish, 12-nerved. *Upper glume* narrowly ovate, 8.5–9 × 1.8–2 mm, cymbiform, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margins ciliate, hairs 0.2–0.4 mm long, apex acute–obtuse, membranous–chartaceous, dorsal surface puberulent, ventral surface glabrous, pale greenish–hyaline, 3-nerved. *Lower lemma* narrowly elliptic–lanceolate, *ca.* 7.5 × 1.5–1.8 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.3–0.4 mm long, apex acute, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* linear–lanceolate, *ca.* 7 × 0.5 mm, margins entire, inflexed or incurved at lower half, infolded at upper half, apex acute, membranous, glabrous, hyaline, 1-nerved. *Upper palea* narrowly elliptic or lanceolate, 4.8–5 × *ca.* 0.8 mm, margins entire or sparsely ciliolate, apex obtuse–rounded, membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 0.4–0.5 × 0.2–0.3 mm. *Stamens* 3; anthers *ca.* 5 mm long, yellowish. *Sessile spikelet* bisexual, narrowly elliptic, 6.5–7.5 × 1–1.2 mm, scabridulous throughout, brownish; callus oblique, slightly pungent, densely rufous brown hairy, hairs 0.5–3 mm long. *Lower glume* narrowly ovate, *ca.* 6 × 2.5–2.8 mm, cymbiform, margins entire, inflexed or incurved, apex obtuse and scabridulous, coriaceous, dorsal surface scabridulous throughout and scabrous near apex, ventral surface glabrous, pale greenish–brownish, 10-nerved, nerves inconspicuous. *Upper glume* narrowly ovate–elliptic, *ca.* 6 × 1.5–1. 8 mm, cymbiform, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, hairs 0.1–0.3 mm long, apex acute and scabridulous, chartaceous, dorsally keeled with two lateral channels, keel wide,

Fig. 163. Holotype of *Themeda mooneyi* Bor (*H.F. Mooneyi* 4064 [K000245982]) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

dorsal surface scabridulous on keel, ventral surface scabridulous, pale greenish, 3-nerved. *Lower lemma* ovate, *ca.* 5 × 1.5 mm, margins inflexed or infolded at lower half, ciliolate at upper half or upper 2/3rd, hairs 0.1–0.3 mm long, apex obtuse–rounded and ciliolate, membranous, glabrous or dorsal surface puberulent, hyaline. *Lower palea* reduced or absent. *Upper lemma* reduced to the hyaline base of the awn, 4.5–5 mm long, shortly bilobed at apex. *Awn* geniculate, 31–33 mm long, brownish; column twisted, 18–19 mm long, scabridulous, dark brownish; bristle 13–14 mm long, scabridulous, pale brownish. *Upper palea* narrowly ovate or lanceolate, *ca.* 3 × 0.6–0.8 mm, margins sparsely ciliate at upper half, apex acute–obtuse, membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 1–1.2 × 0.3–0.8 mm. *Stamens* 3; anthers 3–3.2 mm long, yellowish or purplish. *Ovary* elliptic–oblong, 0.8–1 × 0.3–0.4 mm, pale brownish; *style* 2, jointed at base, 1.5–1.8 mm long; *stigma* 2, plumose, 3–3.5 mm long, purplish. *Pedicelled spikelet* male, narrowly elliptic, *ca.* 11.5 × 1–1.2 mm, greenish with purple shade. *Callus* elongated, linear, thickened towards apex, 1.5–2 × 0.3–0.4 mm, dorsiventrally flattened, glabrous, scabridulous towards base, hairs pale brownish, 0.1–0.3 mm long, greenish. *Pedicel* linear, 2–3 × 0.3–0.4 mm, dorsiventrally flattened, margins rufous brown hairy, hairs 0.3–5 mm long, greenish. *Lower glume* narrowly ovate, *ca.* 11.5 × 1.8 mm, cymbiform, margins entire, one margin infolded and keeled, keel winged throughout, wing margin scabridulous; other margin inflexed at lower 2/3rd or 3/4th, infolded at upper 1/3rd or 1/4th, infolded margins keeled, keel scabridulous, apex acuminate, chartaceous, dorsal surface scabridulous–sparsely scabridulous, ventral surface scabridulous, greenish, 9–13-nerved. *Upper glume* narrowly ovate, *ca.* 8 × 1.5 mm, cymbiform, margins inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins ciliate, hairs 0.2–0.4 mm long, apex acuminate, chartaceous, both dorsal and ventral surfaces scabridulous–puberulent, scabridulous hairs prominent towards upper half, dorsally shallowly keeled near apex, keel scabridulous, pale greenish–hyaline, 3-nerved. *Lower lemma* narrowly ovate or elliptic, *ca.* 7.5 × 1.5–1.8 mm, cymbiform, margins inflexed at lower 1/3rd or 1/4th, infolded at upper 2/3rd or 3/4th, infolded margins ciliate, hairs 0.2–0.4 mm long, apex acute–acuminate, membranous, dorsal surface

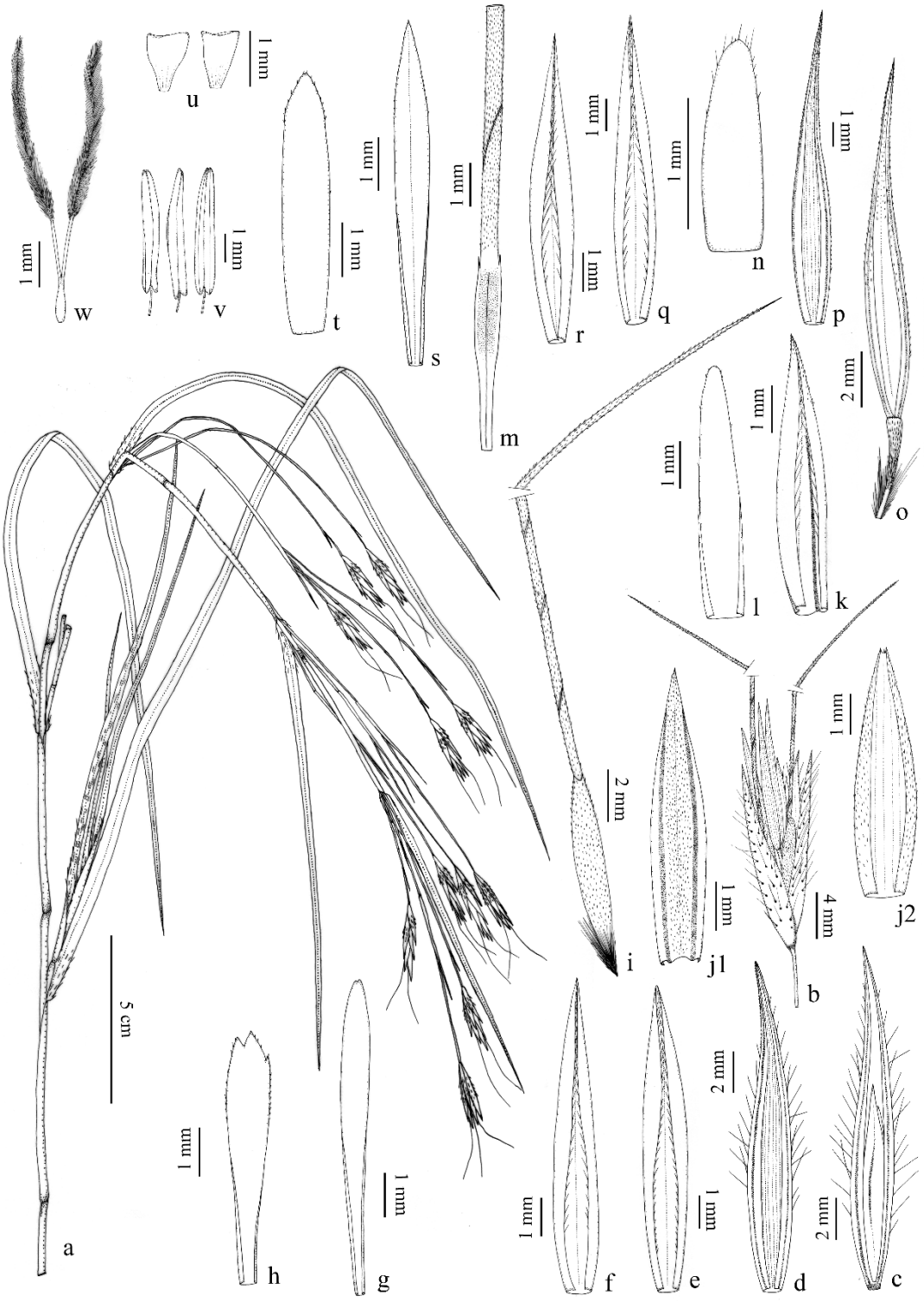

Fig. 164. *Themeda mooneyi* Bor: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Upper lemma; **h.** Upper palea (**c–h**: Involucral spikelet); **i.** Sessile spikelet; **j1.** Lower glume-dorsal view; **j2.** Lower glume-ventral view; **k.** Upper glume; **l.** Lower lemma; **m.** Upper lemma; **n.** Upper palea (**i–n**: Sessile spikelet); **o.** Pedicelled spikelet; **p.** Lower glume; **q.** Upper glume; **r.** Lower lemma; **s.** Upper lemma; **t.** Upper palea (**o–t**: Pedicelled spikelet); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium (from *V. Drisya* 157132, drawn by V. Drisya).

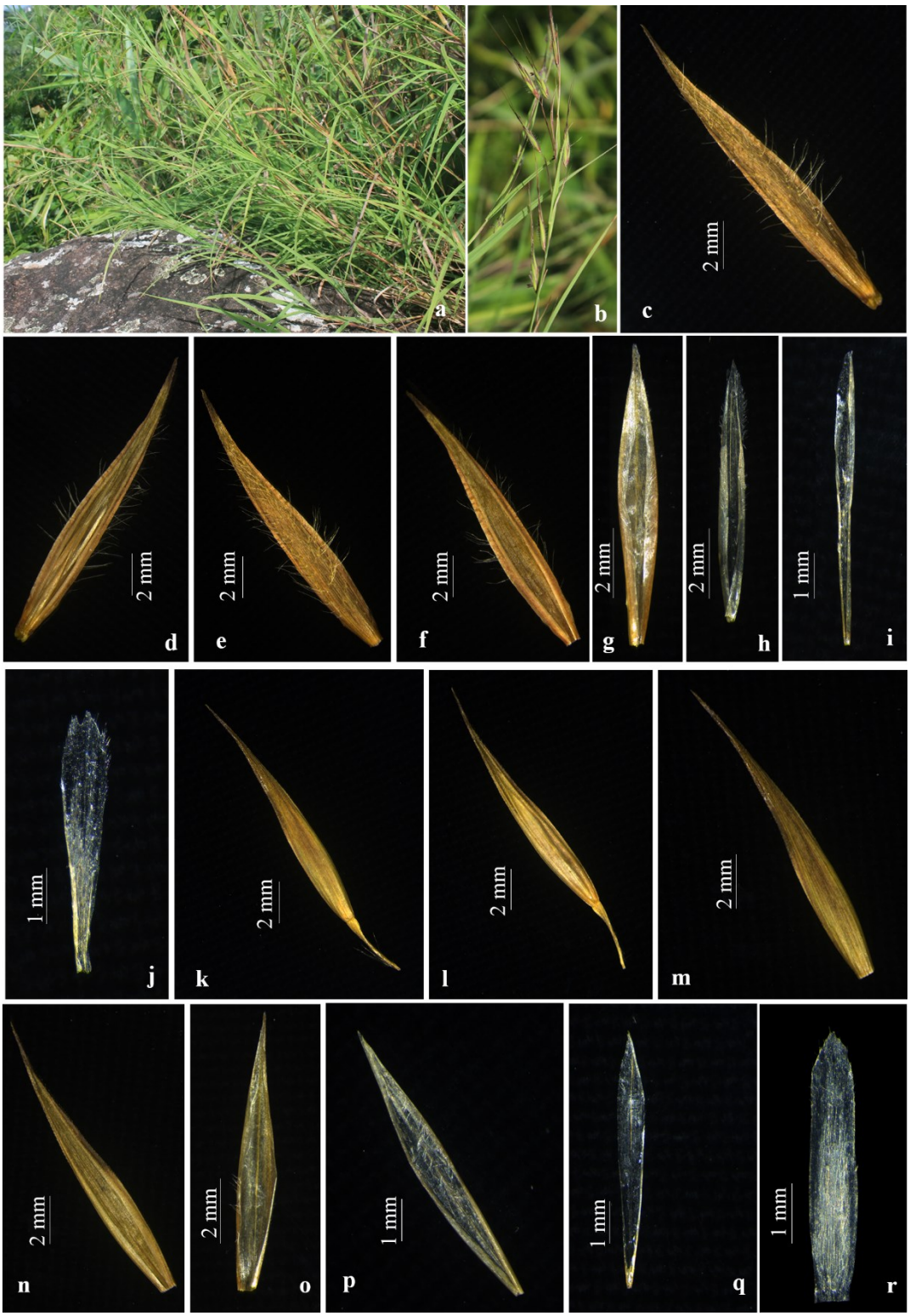

Fig. 165. *Themeda mooneyi* Bor: **a.** Habit; **b.** Portion of Inflorescence showing racemes; **c.** Involucral spikelet-dorsal view; **d.** Involucral spikelet-ventral view; **e.** Lower glume-dorsal view; **f.** Lower glume-ventral view; **g.** Upper glume; **h.** Lower lemma; **i.** Upper lemma; **j.** Upper palea (**c–j:** Involucral spikelet); **k.** Pedicelled spikelet-dorsal view; **l.** Pedicelled spikelet-ventral view; **m.** Lower glume-dorsal view; **n.** Lower glume-ventral view; **o.** Upper glume; **p.** Lower lemma; **q.** Upper lemma; **r.** Upper palea (**k–r:** Pedicelled spikelet).

Fig. 166. *Themeda mooneyi* Bor: **a.** Sessile spikelet; **b.** Lower glume-dorsal view; **c.** Lower glume-ventral view; **d.** Upper glume-dorsal view; **e.** Upper glume-ventral view; **f.** Lower lemma; **g.** Upper lemma; **h.** Upper palea (**a–h:** Sessile spikelet); **i.** Lodicules; **j.** Stamens; **k.** Gynoecium.

puberulent, ventral surface glabrous, hyaline, 1-nerved. *Lower palea* reduced or absent. *Upper lemma* linear–lanceolate, 6–7 × 0.5–0.6 mm, margins entire, inflexed or infolded towards base, apex acute, membranous, glabrous, hyaline, 1-nerved. *Upper palea* narrowly elliptic or lanceolate, 4.8–5 × 0.6–0.8 mm, margins ciliolate at upper half, apex obtuse–rounded and ciliolate, membranous, glabrous or puberulent, hyaline. *Lodicules* 2, cuneate, 0.6–0.8 × 0.3–0.5 mm. *Stamens* 3; anthers 4–4.5 mm long, yellowish or purplish. *Caryopsis* not seen.

Flowering & Fruiting: October to December.

Distribution: Endemic to Peninsular India. It is distributed in Andhra Pradesh and Odisha.

Habitat: Hill slopes.

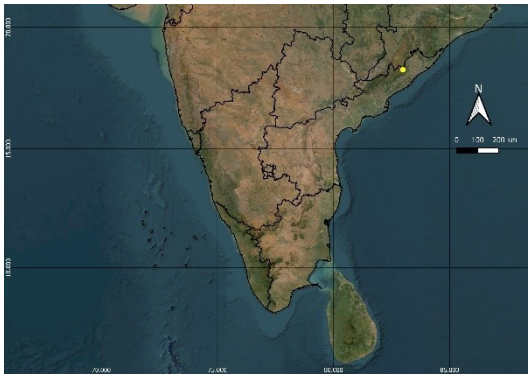

Fig. 167. Distribution of *Themeda mooneyi* Bor in southern Peninsular India

Specimens examined: INDIA, **Andhra Pradesh**, Visakhapatanam district, Araku Valley, Galikonda Hill, near Janamguda, 16.10.2017, *V. Drisya* 157132 [CALI184793, CALI184794, CALI184795, CALI184796, CALI184797, CALI184798, CALI184799, CALI184800, CALI184801, CALI184802, CALI184803, CALI184804, CALI184805, CALI184806, CALI184807 & CALI184808] (CALI).

Additional specimens examined (from other than study area): INDIA, **Odisha** [Orissa], Koraput district, Rasili Hill, 21.11.2017, *Alok Chorghe* 206436 (BSI).

4. Themeda palakkadensis Chorghe, K.Prasad & Lakshmin., Taiwania 64(3): 231. 2019. *Type*:—— INDIA. **Kerala**, Palakkad district, Elivai Malai, 12.11.2016, *K. Prasad* 8485 (holo: CAL [CAL0000033967 digital image!]; iso: BSI [BSI 0000001616 digital image!], CAL [CAL0000033968 digital image!]).

Figs. 168–171

Perennial, erect, tussock forming, culm tillers prominent. *Culm* 40–150 cm high, branched, 2–5 branches from each node; nodes glabrous, deep purplish, younger nodes glaucous or puberulous; internode terete, 2–14 cm long, glabrous, purplish–yellowish green. *Leaf sheath* keeled, rounded at base, 2–15 cm long, chartaceous, membranous towards margin, dorsal surface papillose–scabridulous, sparsely hirsute, ventral surface very sparsely hirsute–glabrous, hairs very small, greenish with purple tinge towards base; margin entire, hyaline–purplish. *Leaf blade* oblong–linear, 3–45 × 0.5–1.5 cm, flat, base rounded–truncate, margin scabrous–scabridulous, apex acuminate, chartaceous, adaxial surface densely scabrous–

scabridulous (young leaves sparsely hirsute at base), abaxial surface densely scabrous–scabridulous or sparsely hirsute, *ca*. 7–14-nerved, midrib prominent; *ligule* ovate, 3–4 mm long, apex ciliate, membranous, pale brownish; *collar* strigose, brownish, hairs hyaline, minute. *Inflorescence* terminal, false panicle comprises numerous racemes interrupted by spathes and spatheoles. *Raceme* comprises four involucral spikelets, two pedicelled and one sessile spikelet which is subtended by a spatheole. *Spathe* leafy, 4–8 cm long. *Spatheole* narrowly ovate or narrowly elliptic, 20–25 × 3–4 mm, cymbiform or folded, apex acuminate, chartaceous, dorsal surface papillose–scabridulous, very sparsely hirsute, ventral surface scabrous–scabridulous, sparsely hirsute towards base, greenish; margin entire, membranous, hyaline–purplish or pale brownish. *Peduncle* 1–1.5 mm long, densely hirsute–scabrous, yellowish green, hairs hyaline, 0.1–0.5 mm long. *Joint of rachis* triangular, 1–1.2 × *ca.* 0.8 mm, dorsiventrally compressed. *Involucral spikelets* paired, inserted at different levels (with 0.5–0.8 mm distance), elliptic–narrowly elliptic, 10–11 × *ca.* 2 mm; *callus* obtuse, puberulous, hairs hyaline, very minute; *floret* 2, lower floret epaleate and empty, upper floret male. *Lower glume* elliptic–narrowly elliptic, 10–11 × *ca.* 2 mm, margins inflexed, infolded towards apex, inflexed and infolded margins scabridulous, one margin keeled and winged throughout, wing hyaline, wing margin scabridulous, the other margin narrowly winged towards apex, rarely winged throughout, then wing narrower than that of other marginapex acute–acuminate,

Fig. 168. Holotype of *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin. (CAL [CAL0000033967]) © The Director, Botanical Survey of India.

chartaceous, dorsal surface sparsely scabridulous, ventral surface scabridulous–sparsely scabridulous, greenish, hyaline or pale brownish towards margin, *ca*. 16-nerved. *Upper glume* narrowly elliptic, 9–11 × 1–1.5 mm, margins inflexed, winged at upper 3/4th, wing margin hyaline and ciliate, apex acute–acuminate, chartaceous–membranous, greenish–yellowish green, dorsal surface scabrous on middle nerve towards apex and scabridulous along either side of the middle nerve, ventral surface glabrous, 3-nerved. *Lower lemma* narrowly elliptic, 6–10 × 0.8–1 mm, margins inflexed, infolded towards upper half, infoldeded margin and apex ciliate, hairs very short, apex obtuse, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* linear–lanceolate, 3.5–6.5 × 0.1–0.3 mm, membranous, glabrous, hyaline. *Upper palea* narrowly elliptic–linear, 1–4.5 × 0.1–0.5 mm, margin and apex ciliate, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 1 mm long. *Stamens* 3, 5–8 mm long; filament short, 1–3 mm long, hyaline; anther 4–5 mm long, yellowish. *Sessile spikelet* bisexual, narrowly elliptic or narrowly obovate or oblong, 10–11 × *ca.* 2 mm, brownish, covered with dense golden brownish–rufous brown pilose hairs, hairs 1–3 mm long; *callus* oblique, pungent; floret 2, lower floret empty and epaleate, upper floret bisexual. *Lower glume* ovate–cymbiform, 6–6.5 × 2–3 mm, margins inflexed, entire, scabridulous at upper 1/6th, apex obtuse–truncate or shallowly notched, coriaceous, dorsal surface densely pilose, hairs golden brownish–rufous brown, upto 3 mm long, glabrous or sparsely scabridulous at upper 1/6th; ventral surface sparsely villous–glabrous, hairs hyaline, caducous, often glaucous, pilose at upper 1/6th, hairs rusty brownish, upto 0.5–1 mm long; brownish, 8–13-nerved. *Upper glume* narrowly ovate–cymbiform, *ca.* 7 × 1–1.5 mm, deeply 2-chanelled, margins inflexed, pale yellowish, ciliate at upper half; apex notched and ciliate, coriaceous, chartaceous on either sides of the channels, dorsal surface densely pilose at lower 5/6th, hairs brownish, 1–3 mm long, sparsely scabrous–scabridulous at upper 1/6th mostly towards margins, ventral surface pilose at upper 1/6th, then hairs extends upto half of the length mainly in between the channels, hairs golden brownish, 0.1–1 mm long, lower half scabrous–sparsely villous, often glaucous, hairs pale brownish–hyaline, 0.2–0.5 mm long, sparsely pilose–glabrous on either sides of the channels; golden brownish. *Lower lemma* ovate–elliptic, 5–5.5

× 1.5–2 mm, margin densely ciliate at upper 1/4, hairs purplish, sparsely ciliate and hairs hyaline at lower 3/4, hairs 0.1–0.7 mm long, apex obtuse–truncate, membranous, dorsal surface sparsely scabrous–scabridulous, hairs purplish–pale brownish, ventral surface glabrous, hyaline. *Upper lemma* reduced to hyaline base of the awn, 1–1.5 mm long; *awn* geniculate, 7–7.5 cm long, twisted, scabridulous, brownish. *Upper palea* linear–lanceolate, 2.5–3 × 0.5–0.8 mm, apex acute–bifid or trifid, membranous, glabrous, or sparsely ciliate on margins towards apex, hyaline. *Lodicules* 2, cuneate, 1.5–2 × 0.5–0.8 mm, membranous, glabrous, hyaline with a brownish tinge on center. *Stamens* 3, 4.5–5.5 mm long; filament 2–2.5 mm long, hyaline; anthers 3–3.2 mm long, yellowish. *Stigma* 2, plumose, 2–4 mm long, purplish; *style* 2, 2–3.5 mm long, hyaline; *ovary* narrowly ovate or narrowly elliptic, 1.5–3.5 × 0.5–0.8 mm. *Pedicelled spikelet* 2 in a raceme, male or empty, narrowly elliptic, 10–11.5 × 1–1.5 mm; *callus* obtuse, puberulous, hairs pale yellowish, minute; floret 2. *Pedicel* linear, broader towards apex, 1.5–2 mm long, base hollow, scabrous, hairs pale yellowish, up to 0.5 mm long. *Lower glume* narrowly elliptic or narrowly ovate, 8–10 × 1–2 mm, margins inflexed, infolded towards apex, hyaline, entire, inflexed and infolded margins scabridulous–sparsely scabridulous, keeled, apex acuminate, chartaceous, dorsal surface sparsely scabridulous, hairs seen mainly on veins, ventral surface glabrous, greenish, hyaline or pale brownish towards margin, 10–15-nerved; marginal keel winged throughout, wing hyaline, membranous, wing margin scabridulous (both the margins are winged in one pedicelled spikelet, but only one margin is winged in the other pedicelled spikelet). *Upper glume* narrowly ovate–narrowly elliptic, *ca.* 9 × 1–1.5 mm, cymbiform, margins inflexed, upper 5/6th ciliate, upper half narrowly infolded and narrowly winged, wing membranous, apex acuminate, chartaceous, dorsal surface very sparsely scabridulous, narrowly keeled towards apex, keel scabrous, ventral surface at upper 1/4th scabridulous, lower 3/4th glabrous, hyaline, 4-nerved. *Lower lemma* oblong–lanceolate, 6–8.5 × 0.8–1 mm, margins incurved, ciliate towards apex, apex obtuse and narrowly fimbriate, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* linear or lanceolate, 2–5.5 × *ca.* 0.3 mm, apex acute or shortly lobed, membranous, glabrous, hyaline. *Upper palea* lanceolate–linear, 1–2 × *ca.* 0.3 mm,

apex acute or notched, membranous, glabrous, hyaline. *Lodicules* 2, cuneate, *ca.* 1 × 0.5 mm. *Stamens* 3, 3–5.5 mm long; filament short, 0.5–1.5 mm long, hyaline; anthers 2–4.5 mm long, yellowish. *Caryopsis* oblong–obovate, 5–6 × *ca.* 1 mm, brownish, ventral surface 2-grooved at lower half, stigma persistent.

Notes: While describing this species, Chorghe *et al.* (2019), noticed only one floret each in pedicelled and involucral spikelets, as opposed to two in our collections.

Flowering & Fruiting: October to January.

Distribution: Endemic to southern Peninsular India. It is distributed in Kerala only.

Habitat: Hill slopes, ghat sides and forest margins.

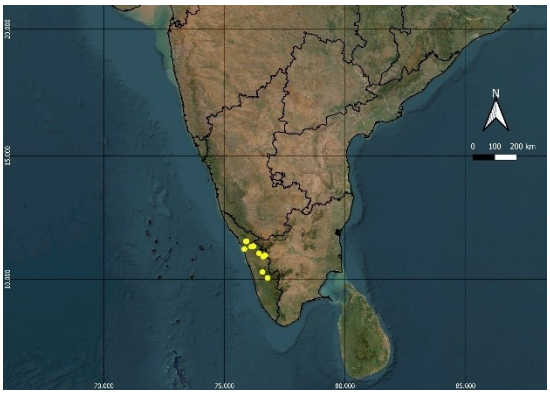

Fig. 169. Distribution of *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.

Specimens examined: INDIA, **Kerala**,
Idukki district, Adimali Ghat, in between Neriamangalam and Cheeyappara Waterfalls, 15.12.2018, *V. Drisya* 168715 (CALI); Kozhikode district, Kakkadampoyil, 19.10.2016, *V. Drisya* 150798; *Ibid.*, 20.11.2019, *V. Drisya* 176224; *Ibid.*, 20.11.2019, *V. Drisya* 176233; Kakkayam, 19.10.2016, *Nikhil Krishna & V. Drisya* 176769; Ghat road side, 28.12.2017, *V. Drisya* 157794; *Ibid.*, on the way to Search, 28.12.2017, *V. Drisya* 157799 [CALI184836, CALI184837, CALI184838, CALI184839 & CALI184840]; *Ibid.*, 30.11.2018, *V. Drisya* 157887 [CALI184829, CALI184830, CALI184831, CALI184832, CALI184833, CALI184834 & CALI184835]; Pokkunnumala, near Nanminda, 26.10.2016, *V. Drisya* 150763; *Ibid.*, 23.11.2019, *V. Drisya* 176242 (CALI); Malappuram district, Nilambur, Adyanpara, 12.02.2016, *Shinoj & V. Drisya* 150728 (CALI); Palakkad district, Elivai Malai, 12.11.2016, *K. Prasad* 8463; *Ibid.*, 12.11.2016, *K. Prasad* 8465; *Ibid.*, 12.11.2016, *K. Prasad* 8479 (BSID); *Ibid.*, 12.11.2016, *K. Prasad* 8480 (BSI & BSID); *Ibid.*, 12.11.2016, *K. Prasad* 8482; *Ibid.*, 12.11.2016, *K. Prasad* 8484 (BSID); Silent Valley, Aruvanpara, 25.12.1996, *S. Anil Kumar* 33607 (TBGT);

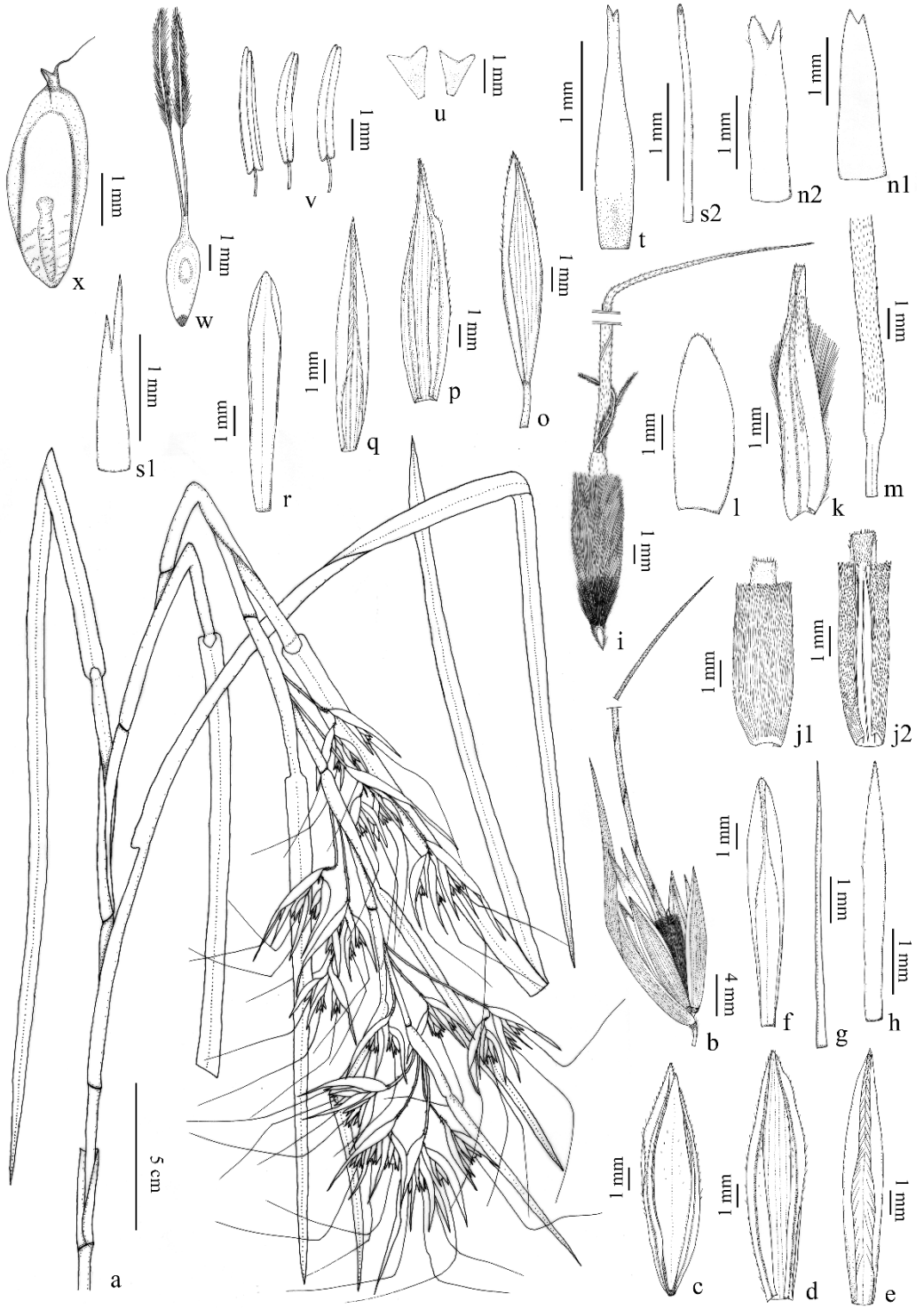

Fig. 170. *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Upper lemma; **h.** Upper palea (**c–h**: Involucral spikelet); **i.** Sessile spikelet; **j1.** Lower glume-dorsal view; **j2.** Lower glume-ventral view; **k.** Upper glume; **l.** Lower lemma; **m.** Upper lemma; **n1 & n2.** Upper palea-variations (**i–n**: Sessile spikelet); **o.** Pedicelled spikelet; **p.** Lower glume; **q.** Upper glume; **r.** Lower lemma; **s.** Upper lemma; **t.** Upper palea (**o–t**: Pedicelled spikelet); **u.** Lodicules; **v.** Stamens; **w.** Gynoecium; **x.** Caryopsis (from *V. Drisya* 168715, drawn by V. Drisya).

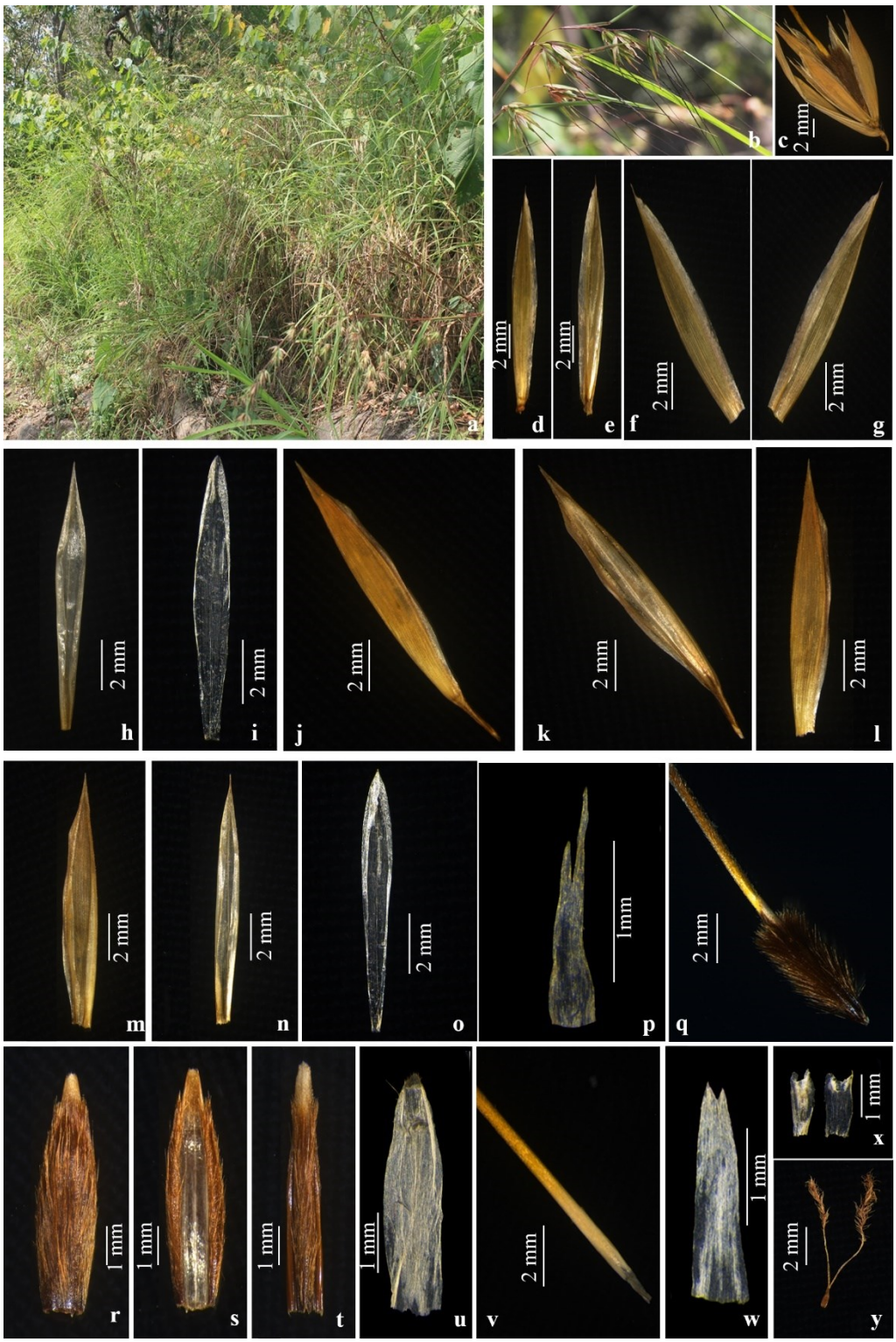

Fig. 171. *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.: **a.** Habit; **b.** Portion of inflorescence; **c.** Single raceme; **d.** Involucral spikelet-dorsal view; **e.** Involucral spikelet-ventral view; **f.** Lower glume-dorsal view; **g.** Lower glume-ventral view; **h.** Upper glume; **i.** Lower lemma (**d–i:** Involucral spikelet); **j.** Pedicelled spikelet-dorsal view; **k.** Pedicelled spikelet-ventral view; **l.** Lower glume-dorsal view; **m.** Lower glume-ventral view; **n.** Upper glume; **o.** Lower lemma; **p.** Upper lemma (**j–p:** Pedicelled spikelet); **q.** Sessile spikelet; **r.** Lower glume-dorsal view; **s.** Lower glume-ventral view; **t.** Upper glume; **u.** Lower lemma; **v.** Upper lemma; **w.** Upper palea (**q–w:** Sessile spikelet); **x.** Lodicules; **y.** Gynoecium.

Thrissur district, near Charpa Falls, in between Athirappilly & Vazhachal, 12.12.2019, *V. Drisya* 176278 (CALI). **Tamil Nadu**, Coimbatore district, Velliangiri Hill, 30.09.2016, *A.K. Pradeep & V. Drisya* 150706; *Ibid.*, 30.09.2016, *A.K. Pradeep & V. Drisya* 150710 (CALI).

5. Themeda quadrivalvis (L.) Kuntze, Revis. Gen. Pl. 2: 794. 1891; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1746. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 252. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 126. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 268. 1989; S.Moulik, Grasses Bamboos India 2: 231. 1997; Pull., Fl. Andhra Pradesh 3: 1264. 1997; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 481. 2009; Potdar *et al.*, Grasses Maharashtra 273. 2012; Pull., Fl. Telangana 3: 1182. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 187. 2017. *Andropogon quadrivalvis* L., Syst. Veg. (eds. 13): 758. 1774. *Anthistiria ciliata* L.f., Suppl. Pl. 113. 1781 *nom. nud.*, *nom. illeg.*, *superfl.*; Retz. Observ. Bot. 3: 11. 1783; Hook.f., Fl. Brit. India 7: 213. 1897. *Themeda ciliata* (L.f.) Hack. ex Duthie, Fodder Grasses N. India 43. 1888, *pro syn. Lectotype* (designated by Cope in Cafferty *et al.*, 2000):—— INDIA. (LINN-1211.5 digital image!).

Andropogon nutans L., Mant. 2: 303. 1771; *non* Sp. Pl.: 1045. 1753. *nom. illeg., hom. Type*: Habitat H.U; not traceable.

Anthistiria scandens Roxb., Fl. Ind. 1: 253. 1820. *Lectotype* (designated here):—— Roxb. No. 1773 (Icones Roxburghianae).

Themeda ciliata Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 664. 1889. *nom. illeg. hom. Lectotype* (designated here):——UNITED STATES, **Indiana**, Bourbon, 12.04.1847, *Boivin* 985 (P [P03219670 digital image!]).

Themeda helferi sensu M.Anil Kumar *et al.*, Rheedea 28(1): 57. 2018 *non* Hack. 1889.

Figs. 172–178

Annuals; *culms* erect or geniculate, 60–200 cm tall; *node* glabrous, purplish or brownish; *internode* terete, 6–16 cm long, glabrous. *Leaf sheath* 2.5–7 cm long, keeled, margins entire, chartaceous, membranous on margins, dorsal surface glabrous, puberulent near apex with few tubercle-based hairs, ventral surface

Fig. 172. Lectotype of *Themeda quadrivalvis* (L.) Kuntze (LINN-1211.5) © The Board of Trustees of Linnean Society, London. Reproduced with permission.

glabrous, greenish. *Leaf blade* linear–lanceolate, 5–30 × 0.3–0.8 cm, base rounded, margins scabridulous and sparsely tubercle-based hairy, tubercle-based hairs 2–4 mm long, apex acute–acuminate, chartaceous, dorsal surface scabridulous or scabrous on nerves, ventral surfaces scabridulous, greenish. *Ligule ca.* 1.5 mm long, membranous, fimbriate at apex, hyaline–pale brownish. *Inflorescence* a false panicle with congested clusters of racemes, interrupted by spathe and spatheole; *raceme* comprises 4 involucral spikelets, 1 sessile spikelet and 2 pedicelled spikelets. *Spathe* often leafy with sheath and lamina, similar to leaves with prominent tubercle-based hairs. *Spatheole* elliptic, folded or cymbiform, 18–19 × 3–4 mm, margins entire, apex acuminate, chartaceous, membranous towards margins, dorsally keeled, keel scabridulous, dorsal surface puberulent, ventral surface glabrous, greenish, hyaline towards margins. *Peduncle* linear, 2.2–2.8 mm long, dorsi-ventrally flattened, glabrous, puberulent near apex, greenish. *Joint of rachis* short, linear, 0.6–0.8 × 0.2–0.3 mm, subterete, apex oblique, crustaceous, sparsely scabridulous–glabrous. *Involucral spikelets* male or empty, arranged in pairs at more or less same level, narrowly elliptic, *ca.* 5 × 0.8–1 mm, dorsally tubercle-based hairy, greenish. *Lower glume* narrowly ovate, 4.8–5 × *ca.* 1 mm, cymbiform, margins entire or one margin entire at lower 2/3rd and ciliate at upper 1/3rd, hairs hyaline, 0.1–0.3 mm long, either both the margins infolded and keeled, keel minutely winged, or one margin infolded, keeled and broadly winged with the other inflexed and keeled towards apex only, wing margins scabridulous, apex acuminate, chartaceous, dorsal surface puberulent with tubercle-based hairs at upper half, tubercle-based hairs 2.5–3 mm long, ventral

surface glabrous, greenish, 10-nerved. *Upper glume* narrowly ovate–elliptic, 4.8–5 × *ca.* 1 mm, cymbiform, margins ciliate, inflexed at lower lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, hairs 0.3–0.5 mm long, apex acuminate, chartaceous, dorsal surface puberulent or glabrous, ventral surface glabrous, greenish, 3-nerved. *Lower lemma* narrowly elliptic–lanceolate, 3.2–4 × 0.5–0.8 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.1–0.5 mm long, apex acute–obtuse, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* reduced, linear, 1.5–2 × 0.1–0.2 mm, margins entire, apex acute, membranous, glabrous, hyaline. *Paleas* absent or reduced. *Lodicules* 2, cuneate or triangular, *ca.* 0.8 × 0.3–0.4 mm, sometimes with long apical appendage, appendage *ca.* 2 mm long. *Stamens* 3; anthers 1–1.5 mm long, yellowish. *Sessile spikelet* bisexual, elliptic, 5–5.5 × *ca.* 1 mm, scabridulous at upper 1/3rd or throughout, brownish; callus oblique, slightly pungent, densely rufous brown hairy, hairs 0.1–1.5 mm long. *Lower glume* narrowly ovate–elliptic, cymbiform, 4–4.5 × *ca.* 1.2 mm, margins entire, inflexed or incurved, apex obtuse–truncate and entire, coriaceous, dorsal surface scabridulous at upper 1/3rd or throughout, ventral surface glabrous, brownish, 9-nerved, nerves inconspicuous. *Upper glume* narrowly ovate, *ca.* 4.2 × 1–1.2 mm, cymbiform, margins entire, inflexed or infolded, apex obtuse and entire, coriaceous, dorsally keeled with two lateral channels, keel wide, dorsal surface scabridulous at upper 1/3rd, ventral surface glabrous, brownish, nerves inconspicuous, only midnerve prominent. *Lower lemma* ovate, 3–3.5 × 0.8–1 mm, margins inflexed or infolded, sparsely ciliate–entire, hairs *ca.* 0.1 mm long, apex acute or shortly lobed, membranous, glabrous, hyaline. *Lower palea* reduced or absent. *Upper lemma* reduced to the hyaline base of the awn, 2.5–3 mm long. *Awn* geniculate, 36–38 mm long, brownish; column twisted, 18–19 mm long, scabridulous, dark brownish; bristle 18–19 mm long, scabridulous, pale brownish. *Upper palea* reduced or absent. *Lodicules* 2, cuneate or triangular, *ca.* 1 × 0.3–0.4 mm. *Stamens* 3; anthers 1–2 mm long, yellowish. *Ovary* narrowly elliptic, 1.5–1.8 × 0.2–0.4 mm; *style* 2, jointed at base, 1.5–1.8 mm long; *stigma* 2, plumose, 4–5 mm long, purple. *Pedicelled spikelet* male, narrowly elliptic, *ca.* 5 × 0.6 mm, greenish. *Pedicel* linear, 1.8–2 × *ca.* 0.2 mm long, dorsiventrally compressed, dorsally

sparsely pilose at base, hairs brownish, 1.5–2 mm long, greenish. *Lower glume* narrowly ovate, *ca.* 5 × 1–1.2 mm, cymbiform, margins entire, one margin inflexed at lower 1/3rd and infolded at upper 2/3rd, other margin inflexed and infolded near apex only, infolded margins keeled, keel scabridulous, apex acuminate, chartaceous, dorsal surface scabridulous or puberulent, ventral surface glabrous, greenish, 12–14-nerved. *Upper glume* narrowly ovate–elliptic, *ca.* 4.5 × 1–1.2 mm, cymbiform, margins inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, infolded margins ciliate, hairs 0.4–6 mm long, apex acuminate, chartaceous, dorsal surface puberulent, ventral surface glabrous, dorsally shallowly keeled, keel scabridulous near apex, pale greenish, 3-nerved. *Lower lemma* elliptic, *ca.* 3.2 × 0.8–1 mm, margins inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, infolded margins ciliate, hairs 0.1–0.3 mm long, apex obtuse–rounded, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* and *paleas* reduced or absent. *Lodicules* 2, cuneate, 0.2–0.5 × 0.1–0.4 mm. *Stamens* 3; anthers 1–1.5 mm long, yellowish. *Caryopsis* ellipsoid or oblong, 2.8–3 × *ca.* 0.5 mm, brownish, style persistent.

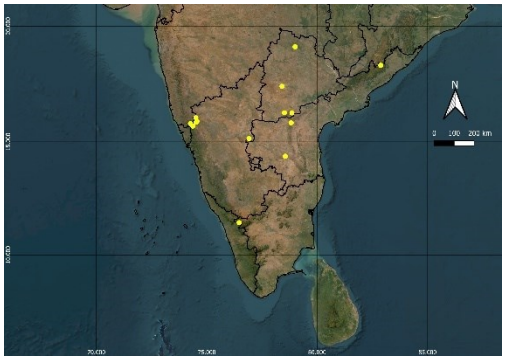

Fig. 173. Distribution of *Themeda quadrivalvis* (L.) Kuntze in southern Peninsular India

Flowering & Fruiting: September to December.

Distribution: Indian Subcontinent to North Thailand. In India, it is distributed in Andaman & Nicobar Islands, Andhra Pradesh, Bihar, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Odisha, Rajasthan, Sikkim, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand and West Bengal.

Habitat: Hill slopes, road sides and in open grasslands.

Notes: Anil Kumar *et al.* (2018) reported *Themeda helferi* from Andhra Pradesh as a new record for India. They differentiated *T. helferi* from *T. quadrivalvis* mainly based on dwarf habit and indumentum on sessile spikelet (as scabridulous

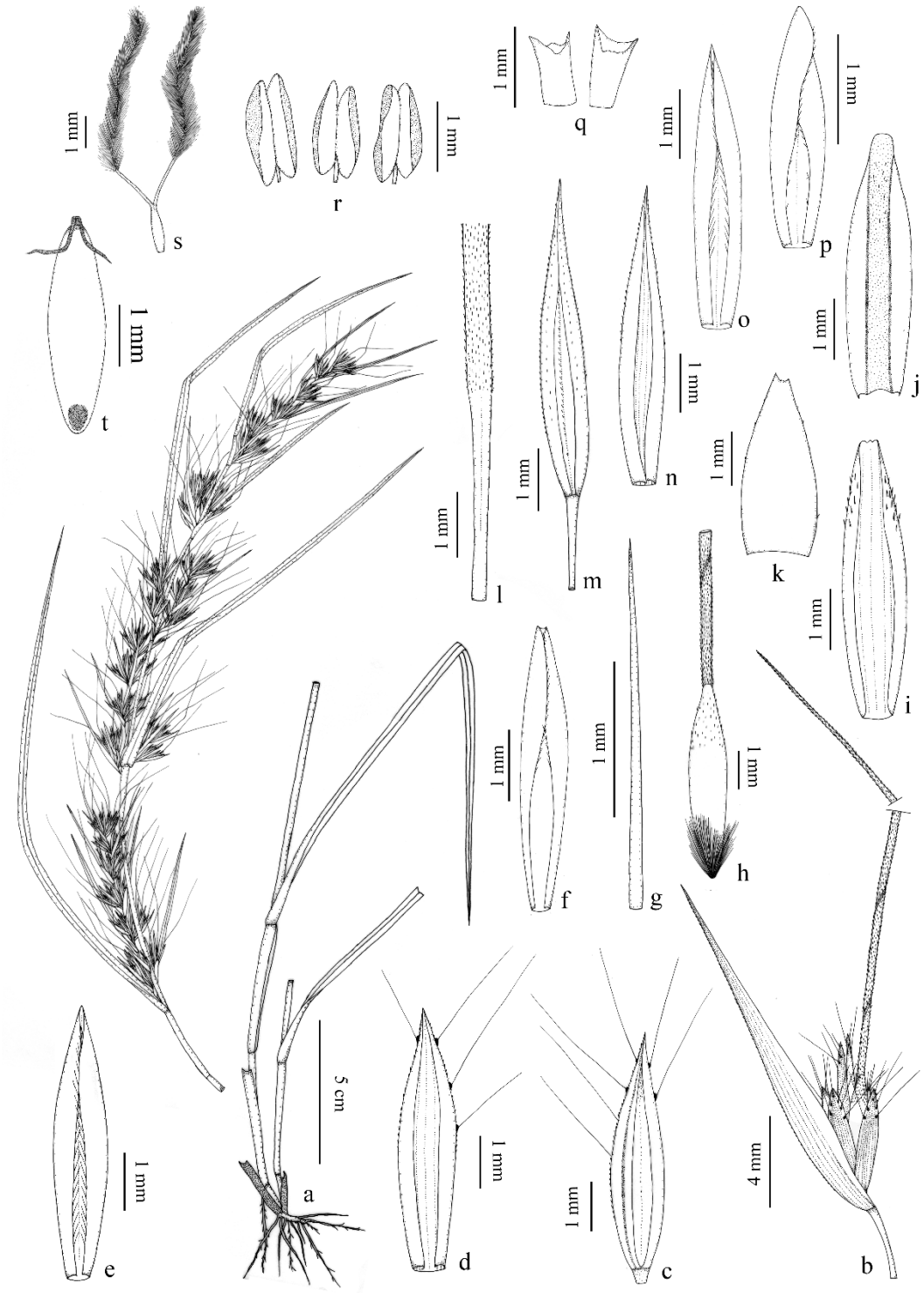

Fig. 174. *Themeda quadrivalvis* (L.) Kuntze: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Upper lemma (**c–g**: Involucral spikelet); **h.** Sessile spikelet; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Upper lemma (**h–l**: Sessile spikelet); **m.** Pedicelled spikelet; **n.** Lower glume; **o.** Upper glume; **p.** Lower lemma (**m–p**: Pedicelled spikelet); **q.** Lodicules; **r.** Stamens; **s.** Gynoecium; **t.** Caryopsis (from *V. Drisya* 169520, drawn by V. Drisya).

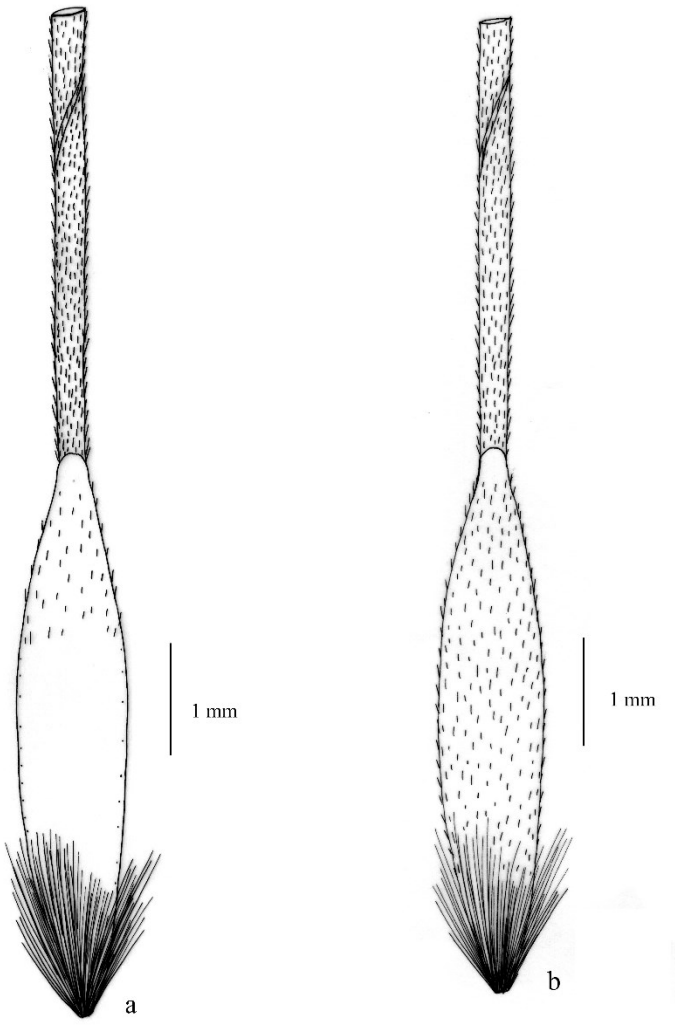

Fig. 175. *Themeda quadrivalvis* (L.) Kuntze: **a & b.** Sessile spikelets showing variation in indumentum (from *V. Drisya* 169520, drawn by V. Drisya).

throughout the dorsal surface in *T. helferi*). *Themeda quadrivalvis* usually possess sessile spikelets with scabridulous hairs only at upper 1/3rd as seen in *T. triandra*. But in some population of *T. quadrivalvis*, we could observe both the plants having sessile spikelets with scabridulous hairs at upper 1/3rd as well as the sessile spikelets with scabridulous hairs throughout, but the plants with sessile spikelets having scabridulous hairs at upper 1/3rd were predominant in such populations. Moreover, the height of *T. quadrivalvis* is found to be highly variable. Both dwarf plants as well as moderately tall (upto 200 cm) plants were noticed in *T. quadrivalvis*. Hence *T. helferi* as understood by Anil Kumar *et al*. (2018) belongs to *T. quadrivalvis* (L.) Kuntze.

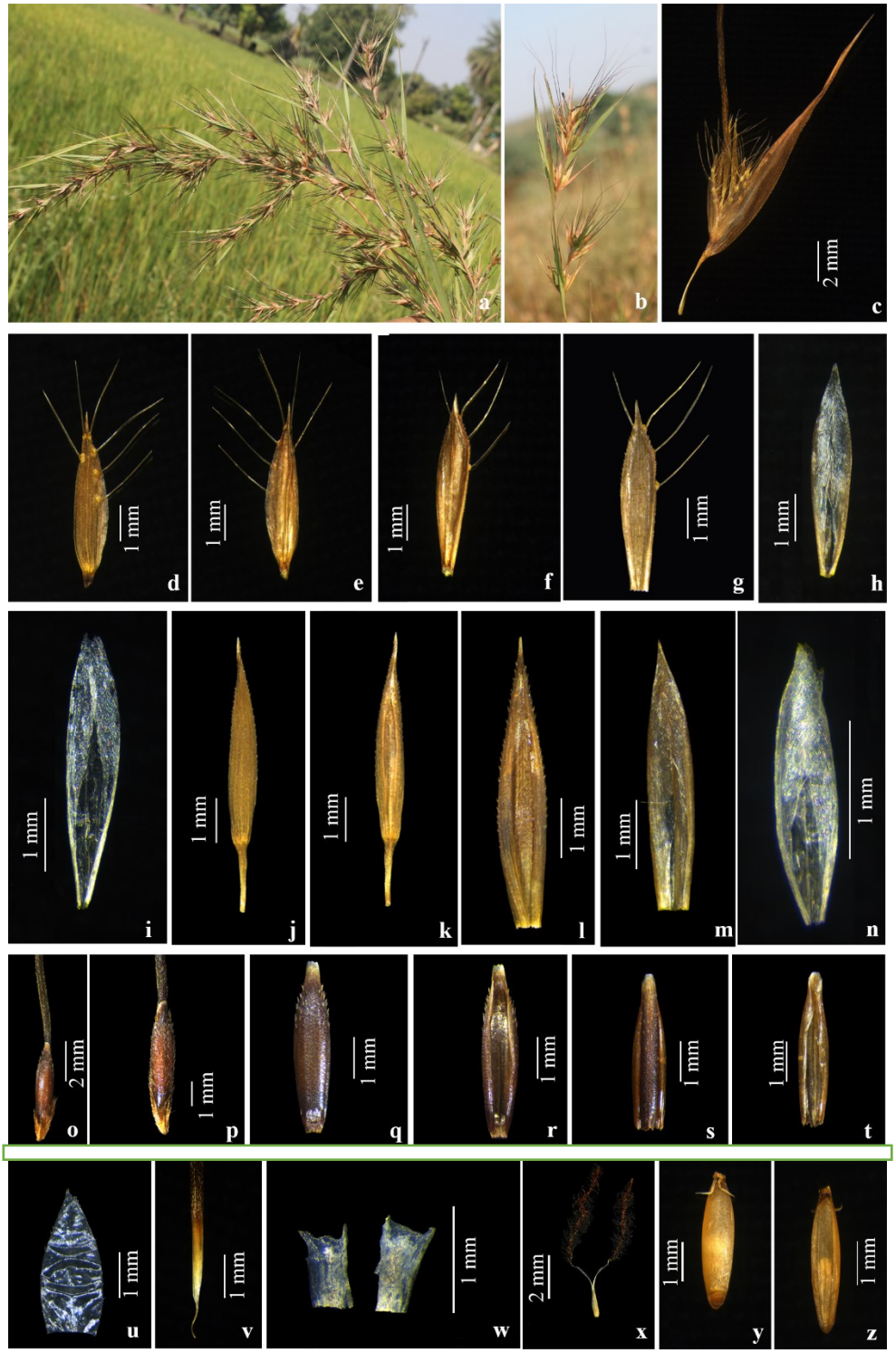

Fig. 176. *Themeda quadrivalvis* (L.) Kuntze: **a.** Habit; **b.** Portion of Inflorescence; **c.** Single raceme; **d**. Involucral spikelet-dorsal view; **e & f.** Involucral spikelet-ventral view showing variation in wings; **g.** Lower glume; **h.** Upper glume; **i.** Lower lemma (**d–i:** Involucral spikelet); **j.** Pedicelled spikelet-dorsal view; **k.** Pedicelled spikelet-ventral view; **l.** Lower glume; **m.** Upper glume; **n.** Lower lemma (**j–n:** Pedicelled spikelet); **o & p.** Sessile spikelet showing variation in indumentum (**o:** scabridulous at upper 1/3rd; **p:** scabridulous throughout); **q.** Lower glume-dorsal view; **r.** Lower glume-ventral view; **s.** Upper glume-dorsal view; **t.** Upper glume-ventral view; **u.** Lower lemma; **v.** Upper lemma (**o–v:** Sessile spikelet); **w.** Lodicules; **x.** Gynoecium; **y.** Caryopsis-dorsal view; **z.** Caryopsis-ventral view.

Specimens examined: INDIA, **Andhra Pradesh**, Chittoor district, Seshachalam Biosphere Reserve, Kumaradara Valley, 14.02.2014, *P.V. Prasanna & M. Sankara Rao* 003836 (BSID); Prakasam district, Rollapenta, 09.12.2012, *L. Rasingam & M. Sankara Rao* 010166 (BSID); Visakhapatanam district, Araku Valley, Foot hills of Galikonda, 16.10.2017, *V. Drisya* 157134 (CALI). **Karnataka**, Belgaum district, Belgaum Fort, 03.01.2020, *V. Drisya* 169519 (CALI); Jamboti, 17.02.2010, *Arun M. Chandore* 1329 (SUK); Kanbargi, 03.01.2020, *V. Drisya* 169520 (CALI); Sutagatti, 04.11.1957, *S.D. Mahajan* 24986 (BSI); Bellary district, Bellary, 00.00.1826, *J.S. Gamble s.n.* (DD). **Tamil Nadu**, Nilgiris district, Gudalur, Baram, Choondi, 'O' Valley, 25.02.2018, *V. Drisya* 157841 (CALI). **Telangana**, Hyderabad district, Hyderabad, 00.00.1941, *M.R. Saxena* 210 (DD); Mahbubnagar district, Lingal, Padmanapally, 15.12.2014, *L. Rasingam & M. Sankara Rao* 004764; Mallelatheertham , 28.11.1999, *S.R. Srinivasan* 111412 (BSID); Mancherial district, Kawal Tiger Reserve, Birsaipet-Range, Gandigopalpur-Beat, 26.10.2013, *P.S. Annamma* 003983 (BSID).

Additional specimens examined (from other than study area): INDIA, **Gujarat**, Panchmahal district, Kabutarkhana Pavilion, 02.11.2018, *V. Drisya* 171462; Dhanpuri, 02.11.2018, *V. Drisya* 171464 (CALI). **Madhya Pradesh**, Ujjain district, Kolping, Maksi, 07.11.2017, *V. Drisya* 171432 [CALI184818]; Vikram University Campus, 06.11.2017, *V. Drisya* 157704 [CALI184819, CALI184820, CALI184821 & CALI184822] (CALI). **Maharashtra**, Kolhapur district, Kolhapur, 08.01.2017, *V. Drisya* 171411; Panhala Fort, 10.11.2016, *Shinoj & V. Drisya* 176674; Shivaji University Campus, 14.01.2017, *V. Drisya* 171421 [CALI184823 & CALI184824]; Tillari, 08.01.2017, *V. Drisya* 171449 (CALI).

Notes on typification: *Anthistiria ciliata* L.f. was described in 1781 by citing "habitat in India" as well as by providing a reference to two names, '*Andropogon quadrivalve*. Syst. Veg. ed.13. p.758' and '*Andropogon nutans*. Mant. Plant. p.303'. *Andropogon quadrivalvis* is a Linnean name published in 1774. Whereas the name *Andropogon nutans* was first appeared in Species Plantarum (1753), which is a synonym of *Sorghastrum nutans* (L.) Nash. However, *Andropogon nutans* L. in

Mantissa Plantarum (1771) is an entirely different species from that of the previous one (ie, as in Sp. Pl. 1753, lectotype LINN-1211.3), and the latter actually belongs to *Themeda*. So, the usage of the name *Andropogon nutans* L. in Mant. Pl. 1771 is misapplied, later homonym and illegitimate.

Thus, *Anthistiria ciliata* L.f (1781) is a *nomen nudum* as well as a nomenclaturally superfluous name. Later, Hackel (1889) validly published this name as *Themeda ciliata* (L.f.) Hack. by citing '*Andropogon nutans* Linn. Mant. 2, p.303 non Spec. Pl.". Incidentaly, Hackel's new name '*Themeda ciliata*' was published by Duthie (1888) prior to that of Hackel's publication in 1889, again as a synonym of *Anthistiria ciliata* L.f. without knowing the purpose of a new name by Hackel. Thus, Duthie's early publication made Hackel's new name '*Themeda ciliata*' as illegitimate.

Fig. 177. Lectotype of *Anthistiria scandens* Roxb. Drawing in Icones Roxburghianae no. 1773 (K) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

While publishing *Themeda ciliata*, Hackel cited many elements "India Orient.: Nepal (Royle 244); Himalaya ad viam versus Gosham Sthan (Wall. 8764 D); Bengalia (Roxb.); Griff. 6803 sine I. sp.; in distr. Tschanda (Duthie); Malabar, Concan, Beliar (HOOK.f. et Thoms.); ins. Mauritius (Sieb.47); Bourbon (Boivin 985); terra capensis? (inventa tantum in foeno ex urbe Capstadt advecto)". Among these syntypes cited by Hackel, authors could trace only two sheets 'Mauritius (*Sieber* 47)' with barcode P03219683 and 'Bourbon (*Boivin* 985)' with barcode P03219670 in herbarium P. The two Wallichian sheets of *Themeda quadrivalvis* are also located at Herbarium E, but they are in doubt about the collection number. The sheet with barcode E00697644 contains a

handwritten annotation "*Wallich* 8764" but not certain that it is 8764 D or not. But the sheet also contains one *T. triandra* and one *T. quadrivalvis* specimens. Whereas on the other sheet with barcode E00697689, has a label with collection number as *Wallich* 8764 E, but it also contains elements of *T. triandra* and *T. quadrivalvis*. Moreover, one Griffith's sheet containing *T. quadrivalvis* were also traced at E (barcode E00697649) but the collection number is '*Griffith* 6808' which is slightly different from that mentioned as 'Griffith *6803*' in protologue.

From the available syntypes of *T. ciliata*, there needs selection of a single specimen as lectotype in accordance with article 9.12 of the Shenzhen Code (Turland *et al*. 2018). Hence, 'Bourbon (*Boivin* 985)' [P03219670 digital image!] being a well preserved specimen agreeing with the protologue is selected here as the lectotype. Whereas, 'Mauritius (Sieber 47)' [P03219683 digital image!] remains as other original material.

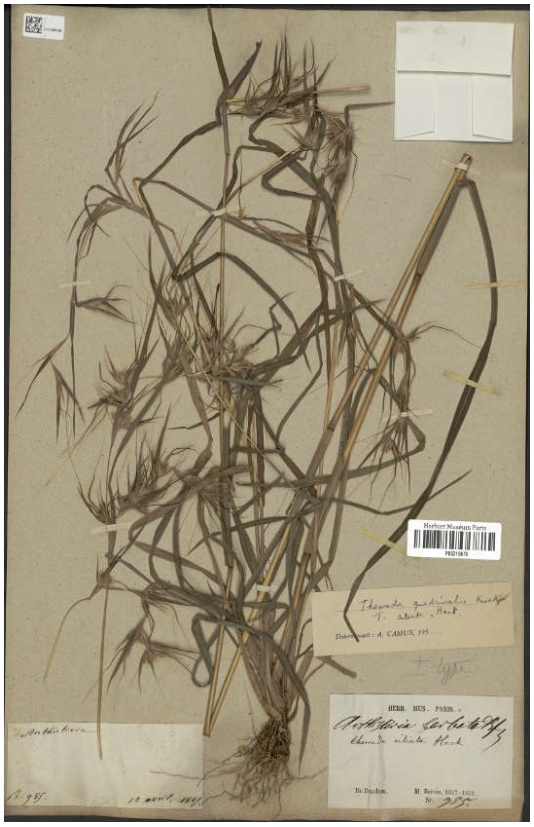

Fig. 178. Lectotype of *Themeda ciliata* Hack. (*Boivin* 985 [P03219670]) © The Board of Trustees of Muséum National d'Histoire Naturelle, Paris (France).

The name *Anthistiria scandens* Roxb. was initially published in *Hortus Bengalensis* (1814) by Roxburgh. Later he provided detailed description in his *Flora Indica* (1820). Here he also mentioned that it is a 'native of Bengal'. But while searching the specimen for *Anthistiria scandens*, authors failed to trace original materials by Roxburgh. In this context, authors selected the illustration of *A. scandens* by Roxburgh for his *Flora Indica* as the lectotype.

6. Themeda sabarimalayana Sreek. & V.J.Nair, Bull. Bot. Surv. India 29(1–4): 127. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 198. 1991; K.M.Matthew, Fl.

Palni Hills 3: 1599. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 482. 2009. *Type*:—— INDIA. **Kerala**, Pathanamthitta district, on the way to Sabarimala, 23.12.1980, *P.V. Sreekumar* 69433 (holo: CAL!; iso: K [K000245984 digital image!], MH!).

Figs. 179–182

Tufted perennials, tussock forming; *culms* erect, 50–250 cm tall; *node* glabrous, purplish or brownish; *internode* 8–20 cm long, glabrous or puberulent towards apex. *Leaf sheath* 5–25 cm long, dorsally keeled, margins entire, coriaceous, dorsal surface puberulent–glabrous, ventral surface glabrous, greenish; *leaf blade* linear–lanceolate, 15–95 × 0.5–1.3 cm, base rounded, margins scabridulous, apex acuminate, coriaceous, both abaxial and adaxial surfaces scabridulous and puberulent, greenish. *Ligule* 4–10 mm long, membranous, fimbriate at apex, pale brownish. *Inflorescence* a false panicle interrupted by spathe and spatheole, panicle lax, often drooping; *raceme* comprises 4 involucral spikelets, 1 sessile spikelet and 2 pedicelled spikelet. *Spathe* often leafy with or without reduced lamina, more or or less similar to spatheole. *Spatheole* narrowly elliptic, cymbiform, 15–22 × 2–3.5 mm, margins entire, infolded or inflexed, apex acuminate, chartaceous, membranous towards margins, dorsally keeled, dorsal surface scabridulous–puberulent and scabrous on submargins towards base, hairs 0.5–1.5 mm long, ventral surface glabrous, greenish. *Peduncle* slender, terete, 1–3.2 mm long, scabrous–scabridulous towards apex, greenish, hairs 0.1–2 mm long. *Joint of rachis* short, triqueterous, oblique, 0.5–0.6 mm long, crustaceous, rufous brown hairy at base, hairs 0.1–1 mm long. *Involucral spikelets* 4, male, arranged in pairs at almost same level, narrowly elliptic, 6.5–7 × *ca.* 0.8 mm, greenish. *Lower glume* narrowly ovate, 6–6.2 × 1.2–1.5 mm, margins entire, both the margins inflexed or infolded and infolded near apex with short keels or one margin inflexed or infolded with the other infolded and keeled, keel winged throughout, wing margin scabridulous, apex acute–acuminate, chartaceous, dorsal surface scabridulous–puberulent with few tubercle-based hairs, ventral surface glabrous, greenish, 11-nerved. *Upper glume* narrowly ovate, cymbiform, 6.5–7 × 1.2–1.5 mm, margins inflexed at lower 1/3rd or 1/4th, inflexed or infolded at upper 2/3rd or 3/4th, ciliate at upper 3/4th, hairs 0.4–1 mm long, apex acute–acuminate, chartaceous, dorsal surface puberulent or scabridulous, ventral

surface glabrous, dorsally shallowly keeled, keel scabridulous, greenish, 3-nerved. *Lower lemma* narrowly elliptic, *ca.* 6 × 0.8–1 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, ciliate at upper half or upper 2/3rd, hairs 0.3–0.5 mm long, margins ciliate or not towards apex, apex acute–obtuse, membranous, dorsal surface puberulent, ventral surface glabrous, hyaline, 1-nerved. *Lower palea* narrowly ovate or lanceolate, 1.5–1.8 × 0.5–0.8 mm, apex bilobed, sometimes lobes more than two, membranous, glabrous, hyaline. *Upper lemma* reduced, linear, 1–1.5 × 0.1–0.2 mm, membranous, glabrous, hyaline. Upper palea absent. *Lodicules* 2, cuneate or triangular, 0.5–0.6 × 0.3–0.5 mm. *Stamens* 3; anthers 2.5–3 mm long, yellowish. *Sessile spikelet* bisexual, narrowly elliptic, 7.5–8 × 0.5–0.8 mm, scabridulous throughout, brownish; callus oblique, densely rufous brown hairy, hairs 0.1–3 mm long. *Lower glume* narrowly ovate, cymbiform, 6–6.5 × 1.8–2 mm, margins entire, incurved, laterally shallowly keeled at upper 1/4th, keel scabrous–scabridulous, apex truncate–notched, scabridulous; coriaceous, dorsal surface scabridulous, ventral surface glabrous, brownish, 7–9-nerved. *Upper glume* narrowly ovate, cymbiform, 6–6.5 × 1–1.2 mm, margins incurved, ciliate at upper 3/4th, hairs hyaline, upto 1 mm long, apex acuminate, coriaceous, dorsally keeled with two lateral channels, keel wide, dorsal surface scabridulous on keel, ventral surface puberulent, hairs prominent towards apex, brownish, 5-nerved. *Lower lemma* narrowly ovate–elliptic, 4–4.5 × 1–1.2 mm, margins inflexed or infolded at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.3–0.4 mm long, apex notched and scabridulous, membranous, dorsal surface scabridulous at upper 1/4th, glabrous at lower 3/4th, ventral surface glabrous, hyaline. *Upper lemma* reduced to the hyaline base of the awn, 3–4 mm long. *Awn* geniculate, 35–38 mm long, brownish; column twisted, 20–22 mm long,

Fig. 179. Isotype of *Themeda sabarimalayana* Sreek. & V.J.Nair (*P.V. Sreekumar* 69433 [K000245984]) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

scabridulous; bristle 15–16 mm long, scabridulous. *Upper palea* reduced, lanceolate, 1.8–2 × 0.3–0.4 mm, apex lobed, membranous, glabrous, margins lobed or not, sparsely ciliolate or not near apex, hyaline. *Lodicules* 2, cuneate or triangular, 0.8–1 × 0.3–0.5 mm. *Stamens* 3; anthers 1.5–2 mm long, yellowish. *Ovary* oblong, 0.8–1 × 0.3–0.4 mm; *style* 2, jointed at base, 1.5–2 mm long; *stigma* 2, plumose, *ca.* 2 mm long, purple. *Pedicelled spikelet* male or empty, narrowly ovate, 7.5–8 × *ca.* 0.8 mm, greenish. *Pedicel* linear, 2.2–2.5 mm long, dorsiventrally flattened, greenish, scabrous on both both surfaces, hairs brownish. *Lower glume* narrowly ovate, *ca.* 7.5 × 1.2–1.5 mm, margins entire, inflexed or incurved, infolded and shallowly keeled at upper 1/4th or near apex, keel scabridulous, apex acuminate, chartaceous, dorsal and ventral surfaces scabridulous, greenish, *ca.* 14-nerved. *Upper glume* narrowly ovate, cymbiform, 6.8–7 × 1.2–1.5 mm, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, hairs 0.5–0.8 mm long, apex acuminate, chartaceous, dorsal surface scabridulous, ventral surface glabrous, dorsally shallowly keeled near apex, keel scabrous–scabridulous, pale greenish, 3–4-nerved. *Lower lemma* narrowly ovate–lanceolate, 5.8–6 × 0.8–1 mm, margins inflexed at lower 1/3rd, infolded and ciliate at upper 2/3rd, apex acute–obtuse and scabridulous, membranous, dorsal surface scabridulous, ventral surface glabrous, pale greenish–hyaline, 1-nerved. *Upper lemma* elliptic or oblong, 1.5–2 × 0.4–0.5 mm, margins entire or sparsely ciliolate, apex bilobed or sometimes lobes more than two, membranous, glabrous, hyaline. *Paleas* absent. *Lodicules* 2, cuneate, 0.5–0.6 × 0.3–0.5 mm. *Stamens* 3; anthers 2.8–3 mm long, yellowish. *Caryopsis* not seen.

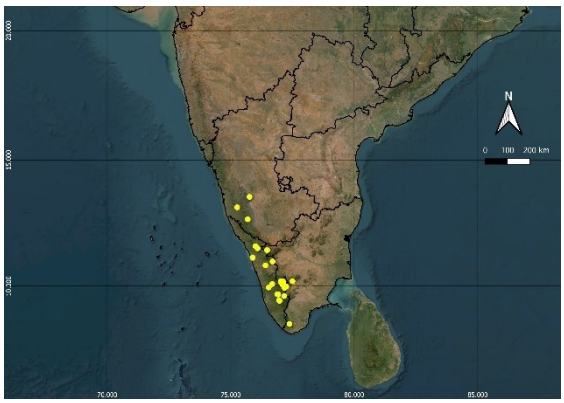

Fig. 180. Distribution of *Themeda sabarimalayana* Sreek. & V.J.Nair

Flowering & Fruiting: October to December.

Distribution: Endemic to southern Peninsular India. Distributed only in Karnataka, Kerala and Tamil Nadu.

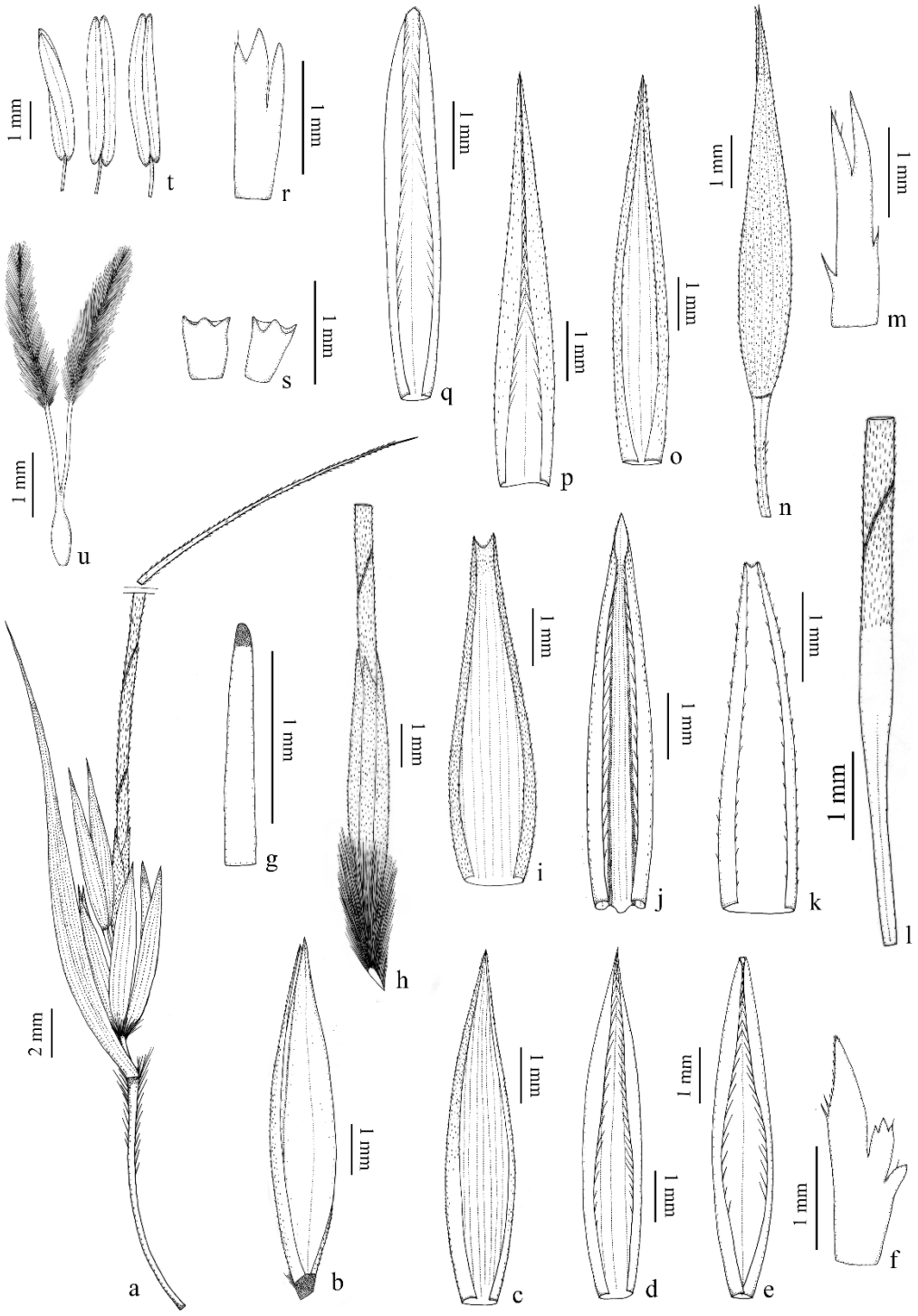

Fig. 181. *Themeda sabarimalayana* Sreek. & V.J.Nair: **a.** Single raceme; **b.** Involucral spikelet; **c.** Lower glume; **d.** Upper glume; **e.** Lower lemma; **f.** Lower palea; **g.** Upper lemma (**b–g**: Involucral spikelet); **h.** Sessile spikelet; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Upper lemma; **m.** Upper palea (**h–m**: Sessile spikelet); **n.** Pedicelled spikelet; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma; **r.** Upper lemma (**n–r**: Pedicelled spikelet); **s.** Lodicules; **t.** Stamens; **u.** Gynoecium (from *V. Drisya* 157743, drawn by V. Drisya).

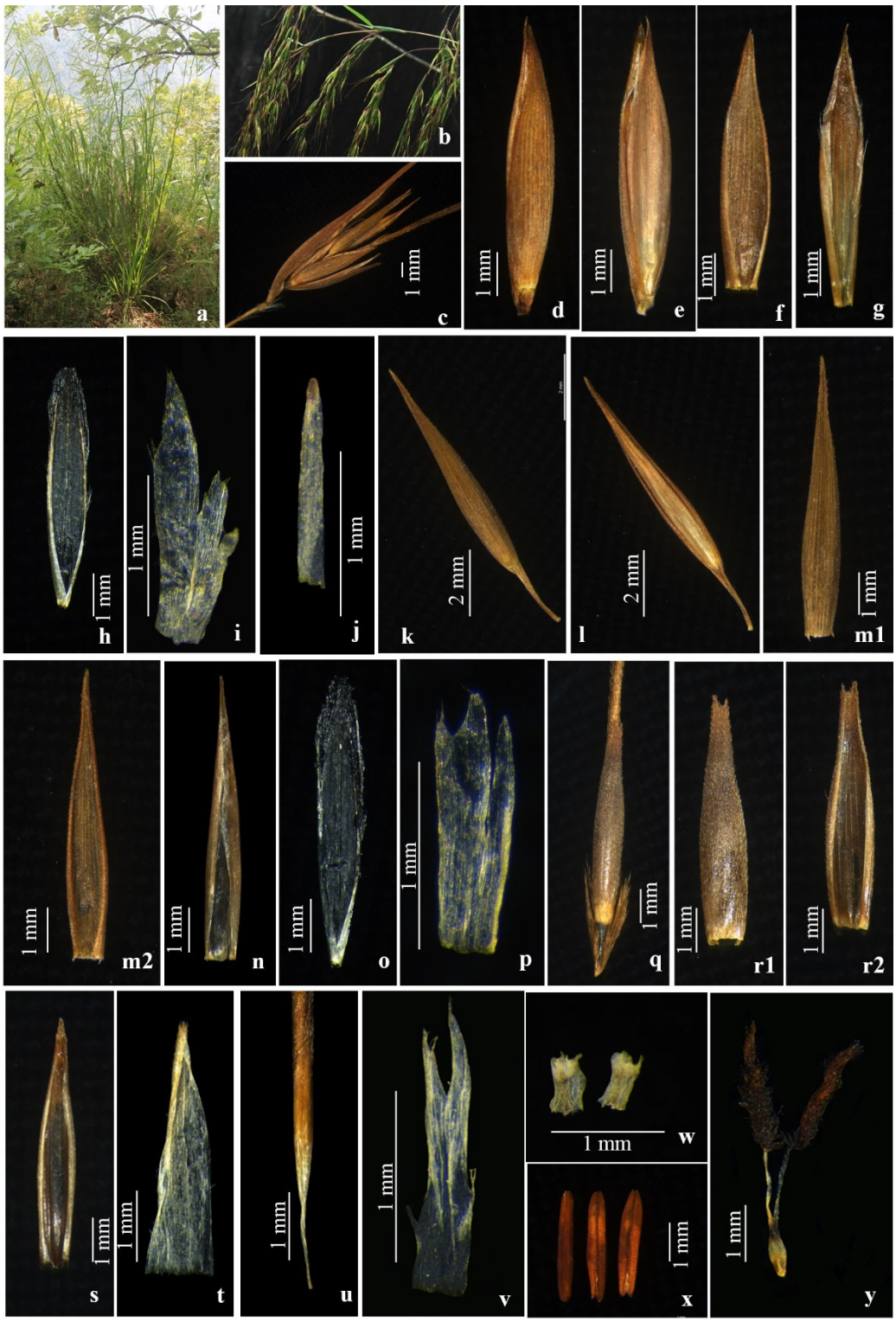

Fig. 182. *Themeda sabarimalayana* Sreek. & V.J.Nair: **a.** Habit; **b.** Portion of Inflorescence; **c.** Single raceme; **d**. Involucral spikelet-dorsal view; **e.** Involucral spikelet-ventral view; **f.** Lower glume; **g.** Upper glume; **h.** Lower lemma; **i.** Lower palea; **j.** Upper lemma (**d–j:** Involucral spikelet); **k.** Pedicelled spikelet-dorsal view; **l.** Pedicelled spikelet-ventral view; **m1.** Lower glume-dorsal view; **m2.** Lower glume-ventral view; **n.** Upper glume; **o.** Lower lemma; **p.** Upper lemma (**k–p:** Pedicelled spikelet); **q.** Sessile spikelet; **r1.** Lower glume-dorsal view; **r2.** Lower glume-ventral view; **s.** Upper glume; **t.** Lower lemma; **u.** Upper lemma; **v.** Upper palea (**q–v:** Sessile spikelet); **w.** Lodicules; **x.** Stamens; **y.** Gynoecium.

Habitat: On hill slopes and forest margins.

Specimens examined: INDIA, **Karnataka**, Chikmagalur district, Baba Budangiri, Kemmanagundi trekking path, 03.03.2016, *V. Drisya* 176726; Kudremukh, 11.10.2016, *E.R. Archana & V. Drisya* 176770 (CALI); Kodagu district, Pushpagiri Wildlife Sanctuary, Kumara Parvatha, 03.01.2017, *Alok Chorghe* 206446 (BSI). **Kerala**, Ernakulam district, Shoolamudi, 14.12.2016, *Shinoj & V. Drisya* 176679 (CALI); Idukki district, Eravikulam National Park, Lakkam, Lakkam kurisumala, 01.01.2019, *V. Drisya* 168742; *Ibid.*, Lakkam kurisumala, on the way to Lakkam kudi, 01.01.2019, *V. Drisya* 168746; near Thookkupalam, 06.02.2018, *V. Drisya* 157824; *Ibid.*, 06.02.2018, *V. Drisya* 157826; *Ibid.*, Panthavaaram, near Lakkam Waterfalls, 06.02.2018, *V. Drisya* 157828 (CALI); *Ibid.*, Rajamala, road to information centre, 12.11.1997, *S.D. Biju* 36732 (TBGT); Mathikettan Shola National Park, 22.07.2016, *V. Drisya* 150753; *Ibid.*, Gimmikkadu, 22.07.2016, *V. Drisya* 150749; *Ibid.*, Vattappara, 22.07.2016, *V. Drisya* 150750; Mattuppetty, 21.07.2016, *V. Drisya* 150747; Munnar, on the way to Devikulam, 08.04.2016, *Shinoj & V. Drisya* 176662; *Ibid.*, Devikulam, near KFRI Nursery, 08.04.2016, *Shinoj & V. Drisya* 176663; (CALI); Thekkadi, 23.11.2015, *Rinku J. Desai* 1821 (BARO); Vagamon Kurisumala, 01.12.2019, *V. Drisya* 170194; Vagamon meadows, 01.12.2019, *V. Drisya* 170178 (CALI); Kozhikode district, Kakkayam, Ambalappara Grassland, 30.11.2018, *V. Drisya* 157883 (CALI); Malappuram district, Calicut University Botanical Garden (introduced), 05.02.2021, *V. Drisya* 169572; Nadukani, 12.02.2016, *Shinoj & V. Drisya* 150729 (CALI); Pathanamthitta district, Pamba Range, Udumpara, near Ezhukuman, 18.11.2017, *V. Drisya* 157743 [CALI184841 & CALI184842] (CALI); Wayanad district, Chembra, 30.12.2015, *V. Drisya* 176706; Kurichiar mala, 31.12.2015, *V. Drisya* 176710 (CALI). **Tamil Nadu**, Coimbatore district, Velliangiri Hills, 11.01.2004, *K. Althaf Ahamed Kabeer* 117260 (MH); Dindigul district, Palni Hills, Samakkadu (Palamalai road), 11.01.1987, *K.M. Matthew* 48246 (RHT); Kanyakumari district, Muthukulivayal, after Upper Kothayar Dam, 09.12.2021, *K.K. Jeomol & V. Drisya* 169579 (CALI); Nilgiris district, Gudalur, Baram, Choondi, 'O' Valley, 25.02.2018, *V. Drisya* 157842 (CALI).

7. Themeda tremula (Nees ex Steud.) Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 667. 1889; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1746. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 254. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 126. 1976; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 269. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 198. 1991; S.Moulik, Grasses Bamboos India 2: 233. 1997; Pull., Fl. Andhra Pradesh 3: 1265. 1997; K.M.Matthew, Fl. Palni Hills 3: 1599. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 482. 2009; Potdar *et al.*, Grasses Maharashtra 275. 2012. *Anthistiria tremula* Nees ex Steud., Syn. Pl. Glumac. 1: 401. 1855; Hook.f., Fl. Brit. India 7: 214. 1897. *Androscepia tremula* (Nees ex Steud.) Andersson, Nova Acta Regiae Soc. Sci. Upsal., ser. 3, vol. 2: 247. 1856. *Lectoype*: (designated by Chorghe *et al*., 2021):—— 'CEYLON'. Wallich Cat. No. 8765 (K [K001131585 digital image!]).

Anthistiria thwaitesii Hook.f., Fl. Brit. India 7: 215. 1897. *Themeda thwaitesii* (Hook.f.) A.Camus, Bull. Mus. Natl. Hist. Nat. 26: 424. 1920. *Lectotype* (designated here):——SRI LANKA (CEYLON). *Thwaites*, C.P. 961 (BR [BR0000006884925 digital image!]).

Figs. 183–187

Tufted annuals or perennials; *culms* erect or geniculate, 60–150 cm tall; *node* glabrous, purplish; *internode* terete–subterete, 5–20 cm long, glabrous. *Leaf sheath* 3–4 cm long, keeled, margins entire, chartaceous, membranous on margins, dorsal surface puberulent, ventral surface glabrous, greenish, sometimes purplish towards margins; *leaf blade* linear–lanceolate, 18–23 × 0.4–0.7 cm, base rounded, margins scabridulous, apex acuminate, chartaceous, abaxial surface scabridulous, adaxial surface scabridulous and tubercle-based hairy, tubercle-based hairs 3–5 mm long, greenish. *Ligule ca.* 0.5 mm long, membranous, fimbriate at apex, hyaline–pale brownish. *Inflorescence* a false panicle with congested clusters of racemes, interrupted by spathe and spatheole; *raceme* comprises 4 involucral spikelets, 2 sessile spikelets and 3 pedicelled spikelets. *Spathe* often leafy with or without reduced lamina, tubercle-based hairy and puberulent, more or less similar to spatheole. *Spatheole* elliptic–narrowly elliptic, cymbiform, folded, *ca.* 12 × 2–2.5 mm, margins entire, apex acuminate, chartaceous, membranous towards margins,

dorsally keeled, keel scabridulous, dorsal surface puberulent–glabrous, with or without tubercle-based hairs, tubercle-based hairs 1–3.5 mm long, ventral surface glabrous, greenish, hyaline towards margins. *Peduncle* terete–subterete, 1–1.8 mm long, glabrous, greenish. *Joint of rachis* triquetrous, short, oblique, 0.4–0.6 × 0.3–0.4 mm, crustaceous, glabrous, pilose on lateral margins, hairs rufous brown, 0.5–1.2 mm long. *Involucral spikelets* male, arranged in pairs at different levels, narrowly elliptic, *ca.* 6.5 × 1–1.2 mm, dorsally tubercle-based hairy, greenish. *Lower glume* narrowly ovate, cymbiform, *ca.* 6 × 1–1.2 mm, margins entire, either both margins infolded, keeled and winged throughout or one margin infolded, keeled and winged with the other one inflexed only, wing margins scabridulous, apex acute–acuminate, chartaceous, dorsal surface puberulent and tubercle-based hairy throughout, tubercle-based hairs 0.5–4 mm long, ventral surface glabrous, greenish, 9–10-nerved, nerves inconspicuous. *Upper glume* narrowly ovate–elliptic, cymbiform, *ca.* 6 × 1.2–1.5 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.3–0.4 mm long, apex acute–acuminate, chartaceous, dorsal surface puberulent or glabrous, ventral surface glabrous, greenish, 3-nerved. *Lower lemma* narrowly elliptic–lanceolate, *ca.* 5.5 × 0.8–1 mm, margins inflexed or incurved at lower 1/3rd, infolded at upper 2/3rd, infolded margins sparsely ciliate, hairs 0.2–0.4 mm long, apex obtuse and ciliolate, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* and *paleas* absent or reduced. *Lodicules* 2, cuneate or triangular, 0.3–0.4 × 0.2–0.3 mm. *Stamens* 3; anthers 3.2–3.5 mm long, yellowish. *Sessile spikelet*

Fig. 183. Lectotype of *Themeda tremula* (Nees) Hack. (*Wallich* Cat. No. 8765 [K001131585]) © The Board of Trustees for The Royal Botanic Gardens, Kew. Reproduced with permission.

bisexual, elliptic or narrowly elliptic, *ca.* 3.5 × 0.5 mm, scabridulous throughout, brownish; callus oblique, slightly pungent, densely rufous brown hairy, hairs 0.3–0.8 mm long. *Lower glume* narrowly ovate, cymbiform, 2.5–3 × 0.8–1 mm, dorsally grooved, margins entire, inflexed or incurved, apex obtuse–truncate and scabridulous, coriaceous, dorsal surface scabrous–scabridulous, ventral surface glabrous, brownish, 7–8-nerved. *Upper glume* narrowly ovate, cymbiform, 2.8–3 × 1–1.2 mm, margins entire, inflexed or infolded, apex mucronate, coriaceous, dorsally keeled with two lateral channels, keel wide, dorsal surface scabrous–scabridulous throughout on keel, ventral surface glabrous, brownish, 3-nerved. *Lower lemma* narrowly ovate–elliptic, *ca.* 2 × 0.6 mm, margins inflexed or infolded, ciliate, hairs *ca.* 0.1 mm long, apex acute–obtuse, membranous, glabrous, hyaline. *Upper lemma* reduced to the hyaline base of the awn, 2–2.5 mm long, not bilobed. *Awn* geniculate, 28–29 mm long, brownish; column twisted, *ca.* 14 mm long, scabridulous, dark brownish; bristle 14–15 mm long, scabridulous, pale brownish. *Paleas* reduced or absent. *Lodicules* 2, cuneate or triangular, *ca.* 0.8 × 0.3–0.4 mm. *Stamens* 3; anthers 1.5–1.8 mm long, yellowish. *Ovary* oblong or elliptic, 0.6–1 × 0.3–0.4 mm; *style* 2, jointed at base, *ca.* 0.5 mm long; *stigma* 2, plumose, 3–3.5 mm long, purplish. *Pedicelled spikelet* male, narrowly elliptic, 4.5–5.2 × 0.6–0.8 mm, greenish; *florets* 2, lower floret male, upper floret reduced. *Pedicel* linear, thickened towards apex, 0.8–1 mm long, dorsiventrally compressed, greenish, scabridulous throughout, pilose at base on margins, hairs 0.3–0.4 mm long. *Lower glume* narrowly ovate, cymbiform, 4.5–5 × 0.8–1 mm, margins entire, inflexed or infolded and shallowly keeled near apex, apex acute–acuminate, chartaceous, dorsal surface tubercle-based hairy on upper half, scabridulous near apex, tubercle-based hairs upto 0.5 mm long and seen more towards margins, ventral surface glabrous, greenish, 11-nerved. *Upper glume* narrowly ovate, cymbiform, 5–5.5 × 1–1.2 mm, margins ciliate, inflexed or infolded, hairs 0.3–0.5 mm long, apex acuminate, chartaceous, dorsal surface glabrous except keel, ventral surface glabrous, dorsally shallowly keeled near apex, keel scabridulous, greenish, 3-nerved. *Lower lemma* elliptic–narrowly elliptic, *ca.* 4 × 0.6–0.8 mm, margins inflexed or infolded, at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, margins ciliate at upper half or

upper 2/3rd, hairs 0.2–0.4 mm long, apex obtuse, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* and *paleas* reduced or absent. *Lodicules* 2, cuneate, 0.3–0.4 × 0.2–0.3 mm. *Stamens* 3; anthers 3–3.2 mm long, yellowish. *Caryopsis* narrowly elliptic, 2–2.2 × 0.3–0.4 mm, brownish, stigma persistent.

Flowering & Fruiting: October to December.

Distribution: India to Bangladesh and Sri Lanka. In India, it is distributed in Andhra Pradesh, Bihar, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Meghalaya, Rajasthan, Tamil Nadu and Uttar Pradesh.

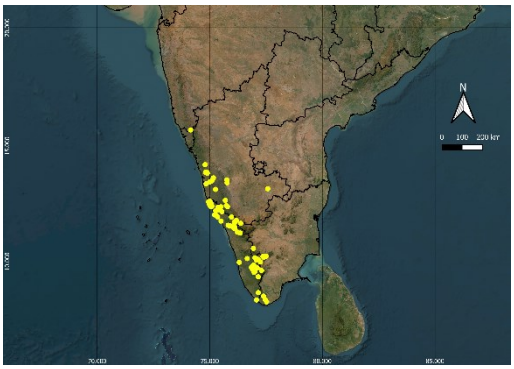

Fig. 184. Distribution of *Themeda tremula* (Nees ex Steud.) Hack. in southern Peninsular India

Habitat: Open grasslands, hill slopes, road cuttings and lateritic plateaus.

Specimens examined: INDIA, **Karnataka**, Belagavi [Belgaum] district, Sada, 04.11.2006, *Arun M. Chandore* 117 (SUK); Chikmagalur district, Baba Budangiri, Kemmanagundi Park, 03.03.2016, *V. Drisya* 176725; *Ibid.*, on the way to Manikyadhara, 03.03.2016, *V. Drisya* 176718; *Ibid.*, Kemmanagundi, 03.03.2016, *V. Drisya* 176723; Kudremukh, 11.10.2016, *E.R. Archana & V. Drisya* 176771 (CALI); Kodagu district, Kodagu [Coorg], 28.01.1951, *S.K. Jain & R.C. Bharadwaja s.n.* (DD); *Ibid.*, 26.10.2016, *Nikhil Krishna & V. Drisya* 176773 (CALI); Pushpagiri Wildlife Sanctuary, Mandalpatti, 30.12.2016, *Alok Chorghe* 206423; Talakaveri [Talacauvery], 20.02.1963, *A.S. Rao* 85754 (BSI); *Ibid.*, *Eucalyptus* plantation area, 26.10.1963, *A.S. Rao* 95114 (CAL); 'Watekolly area on the way to Makut from Mercara' [Madikeri], 'south Kanara', 13.03.1960, *R.S. Rao* 61312 (BSI); Shivamogga [Shimoga] district, Agumbe, 29.12.2016, *P. Soumya & V. Drisya* 176671 (CALI); *Ibid.*, Doddagudda, 08.02.1961, *R.S. Raghavan* 69518; *Ibid.*, Megarvalli, 31.10.1960, *R.S. Raghavan* 68015; *Ibid.*, Min-hole, 02.11.1960, *R.S. Raghavan* 68073 (BSI); Kodachadri, 09.09.2015, *V. Drisya* 144205 (CALI); Udupi district, Kolluru, 30.12.1938, *S.R. Raju* 6327 (MH); Mookambika Wildlife Sanctuary, Manmanhara Plateau, 19.12.2007, *P.G. Diwakar & R.Kr. Singh* 193723;

Ibid., Meghan Valley, 20.12.2007, *P.G. Diwakar & R.Kr. Singh* 193737 (BSI); on the way to Hebri, 09.09.2015, *V. Drisya* 144203 (CALI); Uttara Kannada [North Kanara] district, Jog Falls, 01.05.1939, *N.L. Bor* 11341 (DD); *Ibid.*, 16.01.1950, *J. Fernandez* 842 (BLAT); *Ibid.*, 07.05.1956, *G.S. Puri* 2100 (BSI). **Kerala**, Ernakulam district, Mayiladumkunnu, near Bhoothathankettu, 14.12.2018, *V. Drisya* 168712; *Ibid.*, 14.12.2018, *V. Drisya* 170137; Shoolamudi, 14.12.2016, *Shinoj & V. Drisya* 176681; *Ibid.*, 14.12.2016, *Shinoj & V. Drisya* 176684; *Ibid.*, Variyam, 14.12.2016, *Shinoj & V. Drisya* 176687 (CALI); Idukki district, Cheri, near Kulamavu, 26.03.2016, *V. Drisya*, 150719; Cheri forest, near Kulamavu, 26.03.2016, *V. Drisya* 150716 (CALI); Eravikulam National Park, 25.08.1980, *P.V. Sreekumar* 67783 (BSID); *Ibid.*, 23.11.2015, *Rinku J. Desai* 1814 (BARO); *Ibid.*, Nemmakkad, 19.02.1997, *S.D. Biju* 35683; *Ibid.*, Rajamala, 09.05.1997, *S.D. Biju* 35145 (TBGT); Kattadikunnu, 10.12.2019, *K.K. Jeomol & V. Drisya* 176269; Kuttikkanam, on the way to Thrisanku Hill, 17.10.2015, *V. Drisya & A.K. Pradeep* 144255; Mathikettan Shola National Park, 22.07.2016, *V. Drisya* 150752; *Ibid.*, Gimmikkadu, 22.07.2016, *V. Drisya* 150748; Mattuchola, 04.01.2019, *V. Drisya* 168799 (CALI); Meenmutty, 28.12.1983, *A.G. Pandurangan* 62563 (CAL); Munnar, 13.01.1957, *B.K. Nayar & party* 45216 (LWG); *Ibid.*, 12.11.1980, *P.V. Sreekumar* 68428 (MH); *Ibid.*, 13.07.1981, *P.V. Sreekumar* 70500 (BSID); *Ibid.*, 21.07.2016, *V. Drisya* 150745; on the way to Mattuchola top, 04.01.2019, *V. Drisya* 168791; *Ibid.*, 04.01.2019, *V. Drisya* 170106 (CALI); Painavu, Microwave Station Hill, 08.11.1981, *V.S. Raju* 71216 (CAL); *Ibid.*, Microwave Power Hill, 27.10.2017, *V. Drisya* 157161; Panjalimedu, 17.10.2015, *V. Drisya & A.K. Pradeep* 144261 (CALI); Peermade [Peerumedu], 18.02.1957, *G.S. Puri* 15342; *Ibid.*, 18.02.1957, *G.S. Puri* 15356 (BSI); Kuttikkanam, 28.11.1996, *N. Ravi & N. Mohanan* 24792 (TBGT); Vagamon, 05.12.2019, *A.K. Pradeep & V. Drisya* 176267; *Ibid.*, on the way to Pullikkanam, 15.10.2015, *V. Drisya & A.K. Pradeep* 144241; Vagamon Kurisumala, 01.12.2019, *V. Drisya* 170181; *Ibid.*, 01.12.2019, *V. Drisya* 170190; Vagamon meadows, 26.10.2017, *V. Drisya* 157152; *Ibid.*, 01.12.2019, *V. Drisya* 170180 (CALI); Vallakkadavu, 14.07.1983, *K.N. Subramanian* 9975 (FRC); Kannur district, Chooral, 17.10.2019, *V. Drisya* 170169; Eenthodu, near Pappinissery, 30.12.2016, *V. Drisya* 176640; Ezhimala, 28.11.2016, *Shinoj & V. Drisya* 176750; Kunnaru, on the way to Ezhimala kurisumala, 12.11.2017, *V. Drisya* 157717;

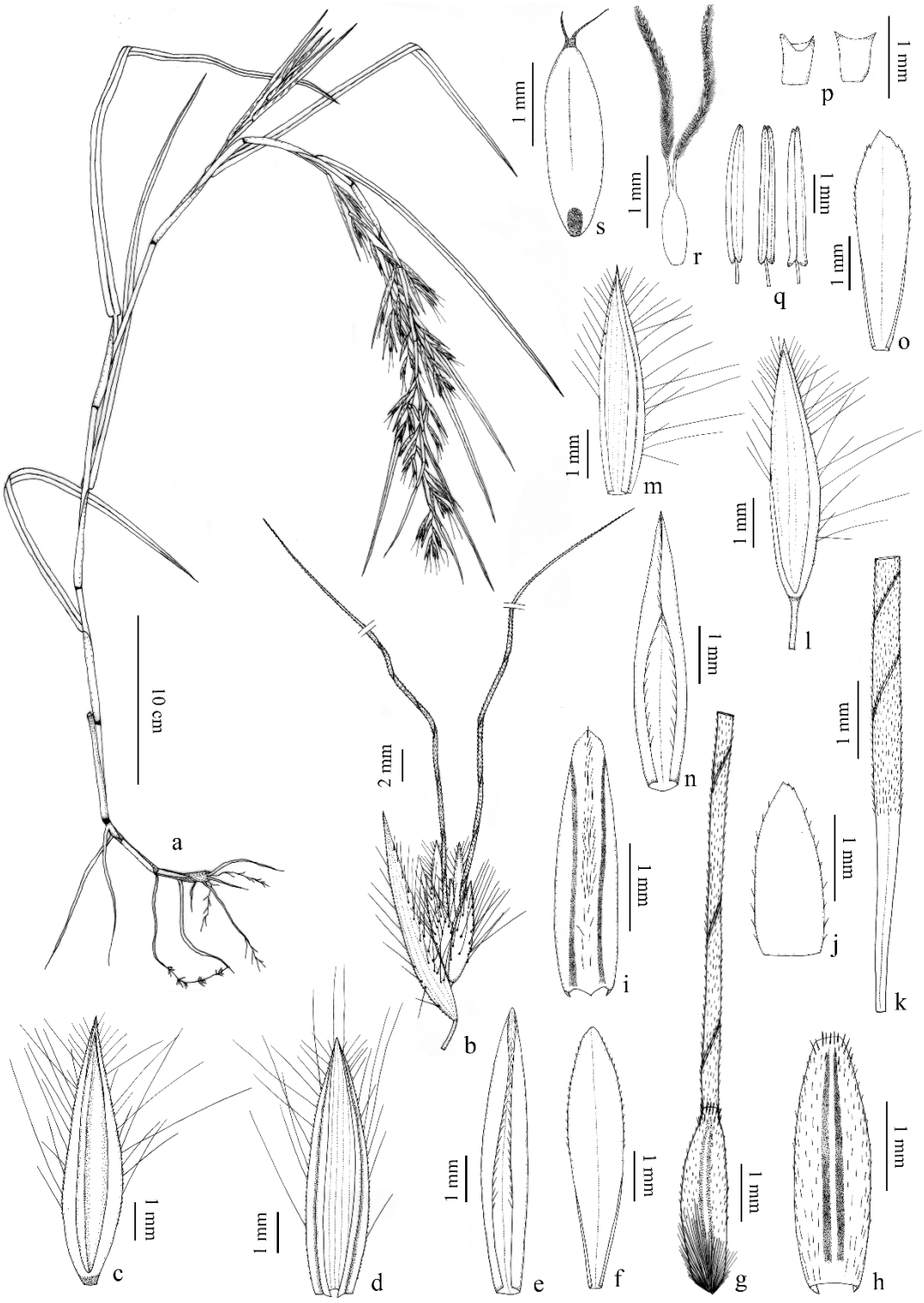

Fig. 185. *Themeda tremula* (Nees) Hack.: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma (**c–f**: Involucral spikelet); **g.** Sessile spikelet; **h.** Lower glume; **i.** Upper glume; **j.** Lower lemma; **k.** Upper lemma (**h–k**: Sessile spikelet); **l.** Pedicelled spikelet; **m.** Lower glume; **n.** Upper glume; **o.** Lower lemma (**l–o**: Pedicelled spikelet); **p.** Lodicules; **q.** Stamens; **r.** Gynoecium; **s.** Caryopsis (from *V. Drisya* 157858, drawn by V. Drisya).

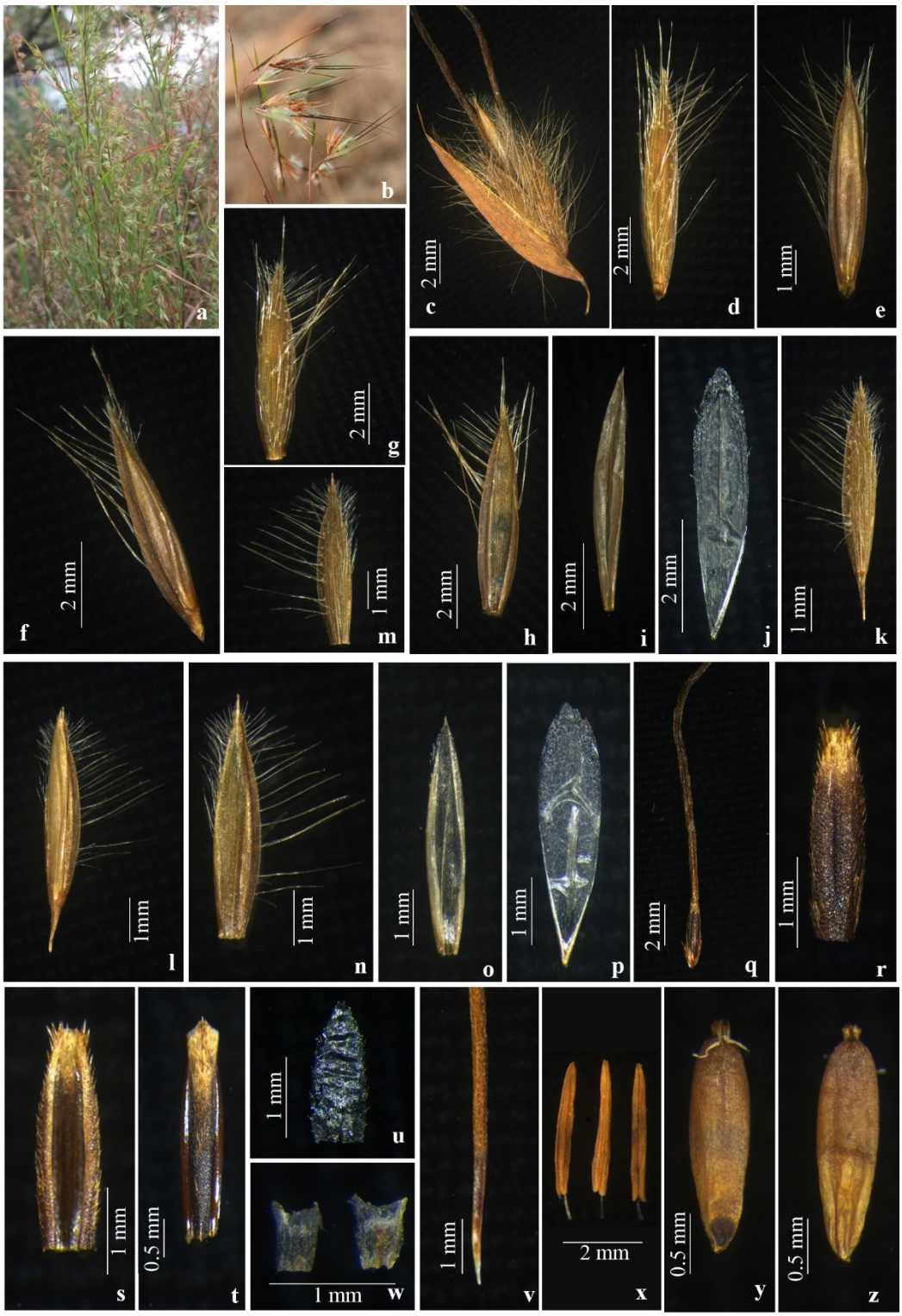

Fig. 186. *Themeda tremula* (Nees) Hack.: **a.** Habit; **b.** Portion of Inflorescence; **c.** Single raceme; **d.** Involucral spikelet-dorsal view; **e & f.** Involucral spikelet-ventral view showing variation in marginal wings; **g.** Lower glume-dorsal view; **h.** Lower glume-ventral view; **i.** Upper glume; **j.** Lower lemma (**d–j:** Involucral spikelet); **k.** Pedicelled spikelet-dorsal view; **l.** Pedicelled spikelet-ventral view; **m.** Lower glume-dorsal view; **n.** Lower glume-ventral view; **o.** Upper glume; **p.** Lower lemma (**k–p:** Pedicelled spikelet); **q.** Sessile spikelet; **r.** Lower glume-dorsal view; **s.** Lower glume-ventral view; **t.** Upper glume; **u.** Lower lemma; **v.** Upper lemma (**q–v:** Sessile spikelet); **w.** Lodicules; **x.** Stamens; **y.** Caryopsis-dorsal view; **z.** Caryopsis-ventral view.

Madayippara, near College, 31.10.2017, *V. Drisya* 157167; Paithalmala, 19.09.2015, *V. Drisya* 144209; Peringome, 14.11.2018, *V. Drisya* 157858 [CALI184815, CALI184816 & CALI184817] (CALI); Thalassery, 25.01.1951, *S.K. Jain & R.C. Bharadwaja s.n.* (DD); *Ibid.*, 13.12.1996, *N. Ravi & N. Mohanan* 33754 (TBGT); Kasaragod district, Bekal Fort, 12.12.1996, *N. Ravi & N. Mohanan* 33729; *Ibid.*, 12.12.1996, *N. Ravi* 33731 (TBGT); Chattanchal, 02.11.2017, *V. Drisya* 157186; Cherkala, 02.11.2017, *V. Drisya* 157197 (CALI); Kasaragod, 16.10.1981, *P.V. Sreekumar* 70590 (BSID); Kumbla, 11.11.2018, *V. Drisya* 157846 (CALI); Paramba, 15.12.1997, *N. Ravi & T. Shaju* 36917 (TBGT); Periya, road side, 25.12.2016, *V. Drisya* 176622; *Ibid.*, 02.11.2017, *V. Drisya* 157189; Puthige, 23.01.2020, *V. Drisya* 169524 (CALI); Kozhikode district, Kakkayam, Ambalappara Grassland, 30.11.2018, *V. Drisya* 157881; *Ibid.*, on the way to Search, near Dam site, 28.12.2017, *V. Drisya* 157795; *Ibid.*, 30.11.2018, *V. Drisya* 157890; Peruvannamoozhi, near Kanjirakadavu, 08.12.2016, *V. Drisya* 176737; Olichuchattam, 09.12.2018, *Nikhil Krishna & V. Drisya* 170145; on the way to Olichuchattam, 24.12.2019, *V. Drisya* 169570; Thusharagiri, 30.03.2016, *K.P. Smisha & V. Drisya* 176664 (CALI); Malappuram district, Nilambur, 08.01.1942, *Indian Forest College Student s.n.*; *Ibid.*, Amarambalam, 28.12.1957, *Sethi & Negi* 25961 (DD); Pathanamthitta district, Anathode, 10.11.1975, *K. Vivekananthan* 46596 (CAL); Wayanad district, Chandanathode, 06.01.1942, *M.A.K. Khalil s.n.* (DD); Chembra, 12.10.2012, *J. Remya* 74513; *Ibid.*, 12.10.2012, *J. Remya* 74514 (TBGT); *Ibid.*, near Lake, 30.12.2015, *V. Drisya* 176705; Kurichiar mala, 31.12.2015, *V. Drisya* 176709 (CALI); Muthanga forest range, Mavanhalla reserve forest, Muthappan Kolly area, 09.12.1987, *N. Venkatasubramanian* 13606 (FRC); Pakshipathalam, 06.10.2010, *J. Remya* 69541; *Ibid.*, 06.10.2010, *J. Remya* 69600 (TBGT); Pulppally, 16.10.2016. *Shimi Cherian & V. Drisya* 176660 (CALI). **Tamil Nadu**, Coimbatore district, Anaimalai, Konalar Bungalow, 02.10.1984, *K.M. Matthew* 18311 (RHT); Dindigul district, Kodaikanal, 16.09.1956, *J. Pallithanam* 2201; *Ibid.*, Berijam slopes, 09.08.1984, *K.M. Matthew* 40778; *Ibid.*, Berijam to Vembadi (Geranium plantation), 07.08.1984, *K.M. Matthew* 40662; Palni Hills, Kodaikanal–Berijam road by Mathikettan shola, 06.12.1986, *K.M. Matthew & M. Charles* 47759; Mannavanur sheep farm, 28.08.1987, *K.M. Matthew* 50448; Shembaganur–Kodai Levinge path, 09.07.1986, *K.M. Matthew & N. Rajendran* 45773 (RHT); Kanyakumari district, Injikadavu to Asambu, 05.12.2005, *K. Althaf*

Ahamed Kabeer 118714 (MH); Muthukulivayal, Upper Kothayar Dam, 09.12.2021, *K.K. Jeomol & V. Drisya* 169580 (CALI); Theni district, Meghamalai, Maharaja Mettu, 11.01.1986, *K. Ravi Kumar* 2943 (CAL).

Notes on typification: Hooker (1897) described *Anthistiria thwaitesii* Hook.f. as a new species allied to *Anthistiria tremula* Nees ex Steud. He distinguished *A. thwaitesii* from *A. tremula* in having larger and less hairy fascicles of spikes. Moreover, Hooker simultaneously cited the specimen "Ceylon, *Thwaites* (C.P. 961 in part)" under *A. thwaitesii* as well as "Ceylon, Walker, *Thwaites* (C.P.961 in part)" under *Anthistiria tremula*.

Fig. 187. Lectotype of *Anthistiria thwaitesii* Hook.f. (*Thwaites* C.P. 961 [BR0000006884925]) © The Board of Trustees for Meise Botanic Garden, Belgium.

Later in 1920, A. Camus transferred *Anthistiria thwaitesii* to *Themeda* and made a new combination *T. thwaitesii* (Hook.f.) A.Camus. But in this treatment, Camus erroneously cited the specimen "Ceylon (*Thwaites*, C.P. no. 691, *p.p.*)" instead of C.P. 961.

While searching the original materials of *Anthistiria thwaitesii* with collection number 'C.P. 961', authors could trace 3 sheets, one each at herbaria BR (BR0000006884925), CAL (CAL00 00002335) and K (K000245969). Authors are not sure about which one among (BR, CAL & K sheets) Hooker selected for *A. thwaitesii* and which one for *A. tremula*, since all of them are more or less similar and belongs to the currently accepted *T. tremula* (Nees ex Steud.) Hack. According to article 9.12 of the Shenzhen Code (Turland *et al*. 2018), one sheet has to be selected as the lectotype. Hence, the specimen at BR (BR0000006884925) bearing an isotype label by

'Herbier du Jardin botanique de TEtat BRUXELLES' is taken here to serve as the lectotype of *A. thwaitesii*.

8. Themeda triandra Forssk., Fl. Aegypt.- Arab.: 178. 1775; C.E.C.Fisch. in Gamble, Fl. Madras 3: 1746. 1934; Bor, Grasses Burma, Ceylon, India & Pakistan 254. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 126. 1976; Britto & K.M.Matthew, Fl. Tamil Nadu Carnatic 3(2): 1908. 1983; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 269. 1989; Sreek. & V.J.Nair, Fl. Kerala - Grasses 202. 1991; S.Moulik, Grasses Bamboos India 2: 234. 1997; Pull., Fl. Andhra Pradesh 3: 1265. 1997; K.M.Matthew, Fl. Palni Hills 3: 1600. 1999; Kabeer & V.J.Nair, Fl. Tamil Nadu: Grasses 483. 2009; Potdar *et al.*, Grasses Maharashtra 278. 2012; Pull., Fl. Telangana 3: 1182. 2015; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 187. 2017. *Themeda polygama* J.F.Gmel., Syst. Nat. 2: 149. 1791, *nom. illeg, superfl.*
Anthistiria forskalii Kunth, Révis. Gramin. 1: 162. 1829, *nom. illeg. superfl.*
Type:—— "Hadie. Arab." [*n.v.*] (destroyed).
Anthistiria imberbis Retz., Observ. Bot. 3: 11. 1783; Hook.f., Fl. Brit. India 7: 211. 1897. *Themeda imberbis* (Retz.) T.Cooke, Fl. Bombay 2: 993. 1908. *Type*:—— South Africa, Caput bonae Spei, *Sparrman s.n.* (LD [LD1241177 digital image!]).
Themeda forskalii Hack ex Duthie, Fodder Grasses N. India 43. 1888, *nom. illeg., superfl.*
Themeda forskalii Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle, Monogr. Phan. 6: 659. 1889, *nom. illeg, superfl.*

Figs. 188–190

Tufted perennials; *culms* erect or geniculate, 30–250 cm tall; *node* glabrous, purplish or brownish; *internode* terete–subterete, 10–25 cm long, glabrous. *Leaf sheath* 3–10 cm long, keeled, margins entire, chartaceous, membranous towards margins, both dorsal and ventral surfaces glabrous, greenish, pale brownish or purplish towards margins; *leaf blade* narrowly ovate to linear–lanceolate, 8–40 × 0.3–1 cm, base rounded–cordate, margins scabridulous, apex acuminate, chartaceous, both abaxial and adaxial surfaces sparsely scabridulous, greenish. *Ligule* 2–2.5 mm long, membranous, fimbriate at apex, hyaline–pale brownish. *Inflorescence* a false panicle

with congested clusters of racemes, interrupted by spathe and spatheole; *raceme* comprises 4 involucral spikelets, 1 sessile spikelet and 2 pedicelled spikelets. *Spathe* often leafy with or without reduced lamina, more or or less similar to spatheole; sheath folded, dorsally keeled, dorsal surface scabridulous, with or without tubercle-based hairs towards apex near to margins and pilose hairs towards margins near base, ventral surface glabrous, tubercle-based hairs 2–2.5 mm long; blade reduced if present, abaxial surface scabridulous–sparsely scabridulous, adaxial surface scabridulous. *Spatheole* narrowly ovate, folded, *ca.* 20 × 3–5 mm, margins entire, apex acuminate, chartaceous, membranous towards margins, dorsally keeled, keel scabridulous, dorsal surface sparsely puberulent and with or without pilose hairs at base or at margins near to base, hairs 0.1–1.5 mm long, ventral surface glabrous, greenish, hyaline towards margins. *Peduncle* short, terete, 1–1.2 mm long, scabrous–pilose, greenish, hairs 0.1–1 mm long. *Joint of rachis* short, oblique, 0.6–0.8 mm long, crustaceous, sparsely scabridulous–glabrous. *Involucral spikelets* male, arranged in pairs at more or less same level, elliptic–narrowly elliptic, *ca.* 10 × 2 mm, dorsally tubercle-based hairy, greenish. *Lower glume* narrowly ovate–elliptic, cymbiform, 8.5–9.5 × 1.8–2.5 mm, margins entire at lower 2/3rd, scabridulous at upper 1/3rd, infolded and keeled, keel winged throughout, wing margins scabridulous, otherwise one margin infolded while the other infolded, keeled and winged throughout, apex acute–acuminate, chartaceous, dorsal surface puberulent with tubercle-based hairs at upper half, tubercle-based hairs 2–4 mm long, ventral surface glabrous, greenish, 13–15-nerved. *Upper glume* narrowly ovate or narrowly elliptic, cymbiform, 7.5–8.5 × 0.8–1.2 mm, margins inflexed at lower lower 1/3rd, infolded at upper 2/3rd, infolded margins ciliate, hairs 0.5–0.8 mm long, apex acute, chartaceous, dorsal surface puberulent, ventral surface glabrous, greenish, 3-nerved, midnerve prominent. *Lower lemma* narrowly elliptic–lanceolate, 7–8 × 1.2–1.5 mm, margins inflexed at lower 1/3rd, infolded at upper 2/3rd, infolded margins sparsely ciliate, hairs 0.1–0.3 mm long, apex acute–obtuse, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* reduced, narrowly elliptic–linear, 1–1.5 × 0.3–0.4 mm, margins entire or very sparsely ciliolate, apex minutely lobed, membranous, glabrous, hyaline. *Paleas* absent or reduced. *Lodicules* 2, cuneate or triangular, 1–

1.5 × 0.4–0.6 mm. *Stamens* 3; anthers *ca.* 3.8 mm long, yellowish or purplish. *Sessile spikelet* bisexual, narrowly elliptic, 8.5–9 × *ca.* 1 mm, scabridulous at upper 1/3rd, brownish; callus oblique, pungent, densely rufous brown hairy, hairs 0.1–4 mm long. *Lower glume* narrowly ovate, cymbiform, 6.5–7 × 2–2.5 mm, margins entire, incurved, inflexed towards apex, apex truncate and scabridulous, coriaceous, dorsal surface glabrous at lower 2/3rd, scabridulous at upper 1/3rd, ventral surface glabrous or scabridulous at upper 1/3rd, brownish, 11–12-nerved. *Upper glume* narrowly ovate, cymbiform, 6.5–7 × 1.5–1.8 mm, margins inflexed at lower 1/3rd, inflexed or infolded and ciliate at upper 2/3rd, hairs hyaline, 0.3–0.5 mm long, apex obtuse–rounded and puberulent, coriaceous, dorsally keeled with two lateral channels, keel wide, dorsal surface scabridulous at upper 1/3rd, ventral surface glabrous, brownish, nerves inconspicuous. *Lower lemma* ovate–elliptic, 4.5–5 × 1.8–2 mm, margins inflexed or infolded, ciliate, hairs 0.1–0.2 mm long, apex acute, membranous, dorsal surface scabridulous, ventral surface glabrous, hyaline. *Lower palea* reduced or absent. *Upper lemma* reduced to the hyaline base of the awn, 4–5 mm long. *Awn* geniculate, 38–40 mm long, brownish; column twisted, 23–24 mm long, scabridulous; bristle 15–16 mm long, scabridulous. *Upper palea* narrowly ovate, 2.2–2.5 × 0.8–1 mm, margins entire, apex acute or notched, membranous, glabrous, hyaline. *Lodicules* 2, cuneate or triangular, 1–2 × 0.5–0.8 mm. *Stamens* 3; anthers 2.5–4.5 mm long, yellowish. *Ovary* ellipsoid or oblong, 1.5–1.8 × 0.3–0.4 mm; *style* 2, jointed at base, 2.5–3 mm long; *stigma* 2, plumose, *ca.* 3.5 mm long, purple. *Pedicelled spikelet* male, narrowly elliptic, *ca.* 10.5 × 0.8–1 mm, greenish. *Pedicel* linear, thickened towards apex, 1.5–1.8 × 0.2–0.4 mm long, ventrally compressed, greenish, sparsely scabridulous. *Lower glume* narrowly ovate, cymbiform, 10–10.5 × 1.8–2 mm, margins inflexed, infolded and shallowly keeled near apex, ciliate at upper 2/3rd, hairs 0.2–0.3 mm long, keel scabridulous, apex acuminate, chartaceous, dorsal surface puberulent, ventral surface glabrous, greenish, *ca.* 13-nerved. *Upper glume* narrowly ovate, cymbiform, 9–9.5 × 1.5–1.8 mm, margins inflexed at lower 1/4th, infolded at upper 3/4th, infolded margins ciliate, hairs 0.1–1 mm long, apex acute–acuminate, chartaceous, dorsal surface puberulent, ventral surface glabrous, dorsally shallowly keeled near apex, keel scabridulous,

greenish, 3-nerved. *Lower lemma* narrowly elliptic, 7.8–8 × 1.5–1.8 mm, margins inflexed at lower 1/3rd or lower half, infolded at upper 2/3rd or upper half, infolded margins ciliolate, apex acuminate, membranous, glabrous, hyaline, 1-nerved. *Upper lemma* and *paleas* reduced or absent. *Lodicules* 2, cuneate, 1–1.2 × 0.4–0.6 mm. *Stamens* 3; anthers 2.5–3 mm long, yellowish. *Caryopsis* ellipsoid, 4–4.5 × *ca.* 0.8 mm, styles persistent.

Flowering & Fruiting: October to December.

Distribution: Africa, Tropical and Subtropical Asia to Australia. In India, it is distributed in Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Punjab, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh. Common in southern Peninsular India.

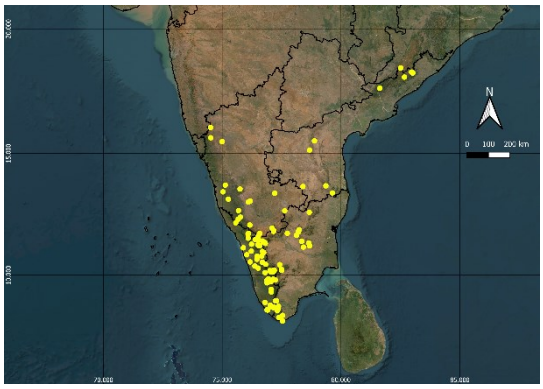

Fig. 188. Distribution of *Themeda triandra* Forssk. in southern Peninsular India

Habitat: Hill slopes and road sides.

Specimens examined: INDIA, **Andhra Pradesh**, Chittoor district, Horsley Hills, northern slope, 10.11.2000, *G.V.S. Murthy* 111062; Kailasanathakona, 21.10.2009, *B. Ravi Prasad Rao & P. Priyadarsini* 37126 (BSID); East Godavary district, Maredumilli, Valamuru, 23.12.1993, *M. Mohanan* 100858 (MH); Kurnool district, Ahobilum, 26.10.2006, *B. Ravi Prasad Rao & B. Sadasivaiah* 29314 (BSID); Prakasam district, G B WLS, Isukagundalu, 08.02.2016, *J. Swamy & L. Rasingam* 007591(BSID); Tirupati district, Thirumala, Satralu, 31.12.2012, *P.V. Prasanna & M. Sankara Rao* 010334 (BSID); Visakhapatanam district, Araku Valley, Galikonda, 15.10.2017, *V. Drisya* 157124; *Ibid.*, Galikonda Hill, 16.10.2017, *V. Drisya* 157136; *Ibid.*, foot hills of Galikonda, 16.10.2017, *V. Drisya* 157138; *Ibid.*, Getuvalasa, 15.10.2017, *V. Drisya* 157122; *Ibid.*, Sunkarametta, 15.10.2017, *V.*

Drisya 157129; *Ibid.*, I.T.D.A. Paderu Botanical Garden, Padmapuram, 16.10.2017, *V. Drisya* 157131 (CALI); near Bondruguda, 09.10.1964, *G.V. Subbarao* 21517 (MH). **Karnataka**, Belagavi [Belgaum] district, Khanapura [Khanapur], 07.11.2006, *Arun M. Chandore* 157 (SUK); Sutagatti, *s.d.*, *S.D. Mahajan* 28643 (BSI); Chamarajanagar district, Bandipur, forest area, 18.11.1956, *S.C. Agarwal* 902 (DD); Bedaguli, Chathurakallubetta, 18.04.1962, *A.S. Rao* 80068 (CAL); BRT Wildlife Sanctuary, Honnematti Coffee Estate, 11.10.2013, *J. Jayanthi* 194718; *Ibid.*, Seematti forest camp, 02.04.2015, *J. Jayanthi* 202833 (BSI); Gopalaswamy Hills, 30.09.2015, *V. Drisya* 144234 (CALI); Chikmagalur district, Kemmanagundi, 03.03.2016, *V. Drisya* 176721; Kudremukh, 11.10.2016, *E.R. Archana & V. Drisya* 176772 (CALI); Dharwad [Dharwar] district, *s.loc.*, 25.09.1956, *R.M. Patil* 4745 (BSI); Hassan district, Hassan, 29.09.2015, *V. Drisya* 144222; near Koravangala, 29.09.2015, *V. Drisya* 144223 (CALI); Kodagu district, Kodagu [Coorg], 28.01.1951, *S.K. Jain & R.C. Bharadwaja s.n.* (DD); Kottamudi on the other side of river Kaveri [Cauvery] at Napoklu, 05.10.1961, *A.S Rao* 74948; Nagarhole, 01.03.1963, *A.S. Rao* 86630; Pushpagiri Wildlife Sanctuary, Mandalpatti, 31.12.2016, *Alok Chorghe* 206425 (BSI); Shivamogga [Shimoga] district, Kavaledurga, 02.10.1962, *R. Sundara Raghavan* 82924 (BSI); Tumakuru district, Devarayanadurga, Navaligunda plantation, 19.09.1974, *N.P. Singh* 133164 (BSI). **Kerala**, Ernakulam district, Mamalakkandam, 19.12.2016, *Shinoj & V. Drisya* 176763 (CALI); Vettilapara forest, Cochin, 07.12.1952, *J. Fernandez* 15 (BLAT); Idukki district, Anamudi Shola National Park, on the way to Idlimotta, 02.01.2019, *V. Drisya* 168756; *Ibid.*, near Idlimotta, on the way to top, 02.01.2019, *V. Drisya* 168774; Cheri, near Kulamavu, 26.03.2016, *V. Drisya* 150718; Kalvary Mount kurisumala, 27.10.2017, *V. Drisya* 157158 (CALI); Eravikulam National Park, 26.08.1980, *P.V. Sreekumar* 67792 (BSID); *Ibid.*, near Kudimala, on the way to Lakkam Kudi, 06.02.2018, *V. Drisya* 157822; *Ibid.*, near Lakkam Kudi, 06.02.2018, *V. Drisya* 157821; *Ibid.*, near Thookupalam, Lakkam Falls, 06.02.2018, *V. Drisya* 157829; *Ibid.*, on the way to Turner's Valley, 05.01.2019, *V. Drisya* 170120; Mattuchola, 04.01.2019, *V. Drisya* 170104; Nedumkandam, 19.07.2016, *V. Drisya*

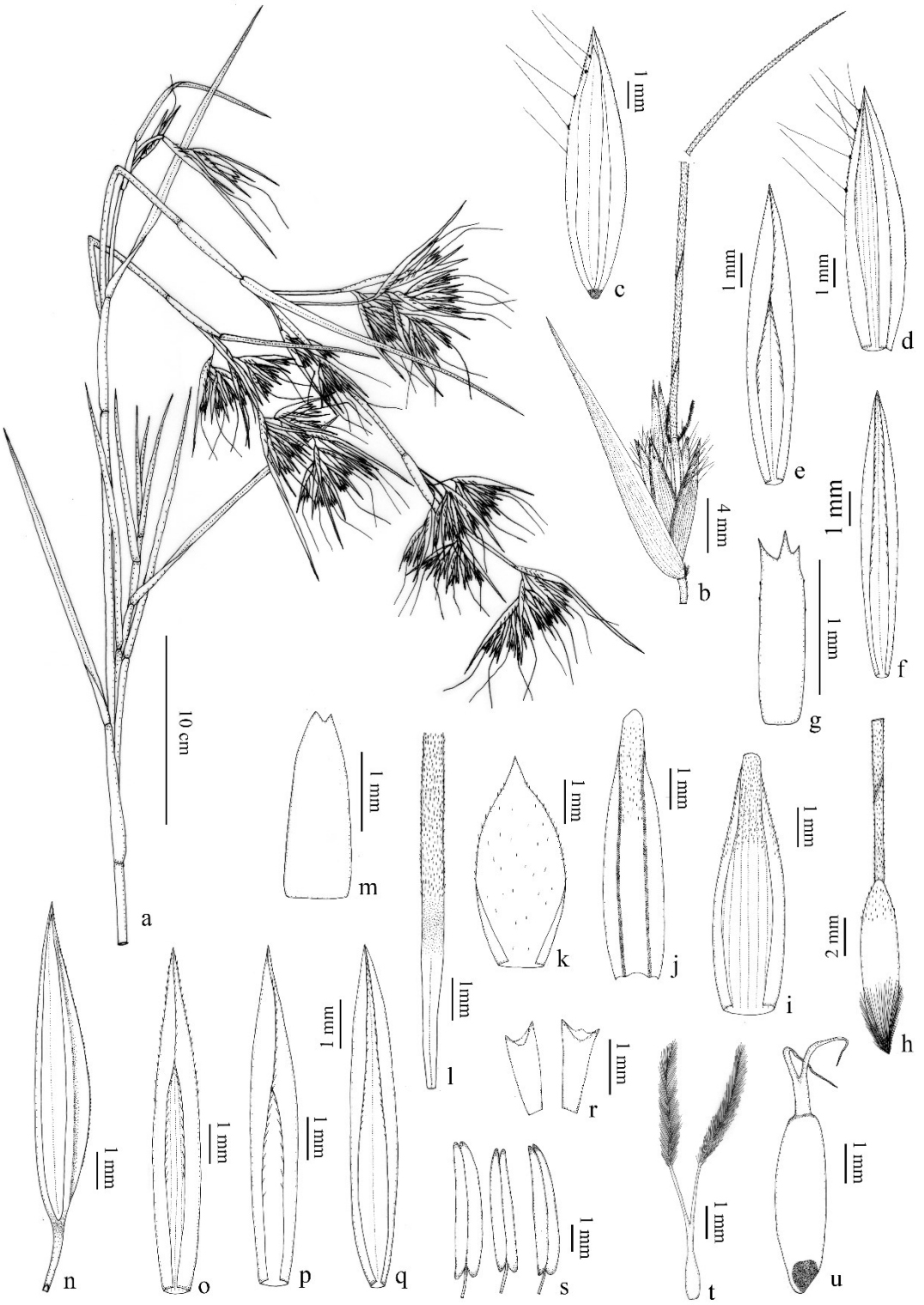

Fig. 189. *Themeda triandra* Forssk.: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet; **d.** Lower glume; **e.** Upper glume; **f.** Lower lemma; **g.** Upper lemma (**c–g**: Involucral spikelet); **h.** Sessile spikelet; **i.** Lower glume; **j.** Upper glume; **k.** Lower lemma; **l.** Upper lemma; **m.** Upper palea (**h–m**: Sessile spikelet); **n.** Pedicelled spikelet; **o.** Lower glume; **p.** Upper glume; **q.** Lower lemma (**n–q**: Pedicelled spikelet); **r.** Lodicules; **s.** Stamens; **t.** Gynoecium; **u.** Caryopsis (from *V. Drisya & A.K. Pradeep* 157747, drawn by V. Drisya).

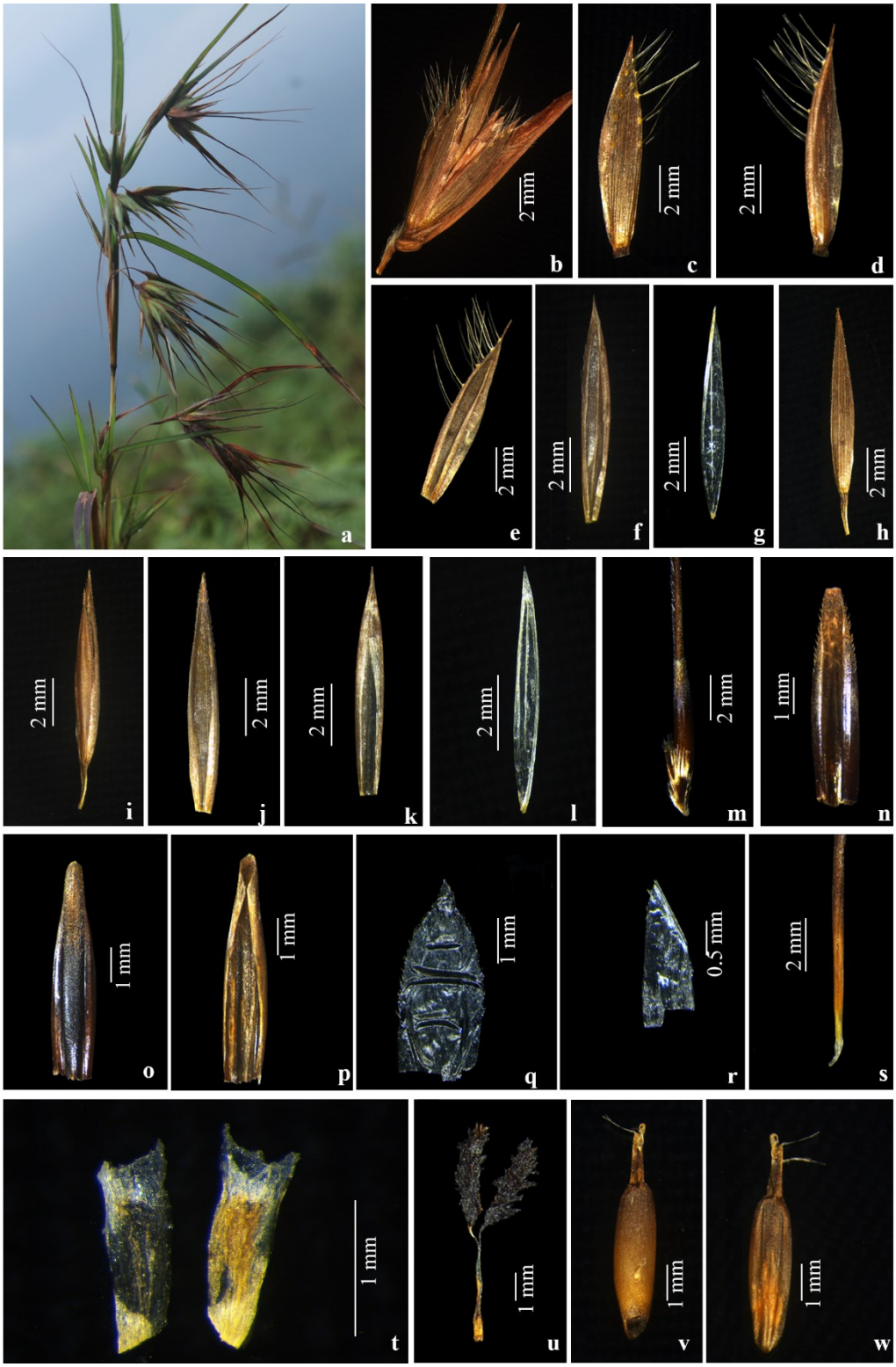

Fig. 190. *Themeda triandra* Forssk.: **a.** Habit; **b.** Single raceme; **c.** Involucral spikelet-dorsal view; **d.** Involucral spikelet-ventral view; **e.** Lower glume; **f.** Upper glume; **g.** Lower lemma (**c–g:** Involucral spikelet); **h.** Pedicelled spikelet-dorsal view; **i.** Pedicelled spikelet-ventral view; **j.** Lower glume; **k.** Upper glume; **l.** Lower lemma (**h–l:** Pedicelled spikelet); **m.** Sessile spikelet; **n.** Lower glume; **o.** Upper glume-dorsal view; **p.** Upper glume-ventral view; **q.** Lower lemma; **r.** Lower palea; **s.** Upper lemma (**m–s:** Sessile spikelet); **t.** Lodicules; **u.** Gynoecium; **v.** Caryopsis-dorsal view; **w.** Caryopsis-ventral view.

150741; on the way to Mattuchola top, 04.01.2019, *V. Drisya* 168793; Painavu, Microwave Power Hill, 27.10.2017, *V. Drisya* 157159; *Ibid.*, 27.10.2017, *V. Drisya* 157163; Perumala, Bramaram view point, near Kulachivayalkudi, 03.01.2019, *V. Drisya* 168781; *Ibid.*, on the way to Nakkupettikudi, 03.01.2019, *V. Drisya* 168784; Ramakkalmedu, 19.07.2016, *V. Drisya* 150734; *Ibid.*, 19.07.2016, *V. Drisya* 150735; *Ibid.*, 19.07.2016, *V. Drisya* 150737; *Ibid.*, 19.07.2016, *V. Drisya* 150738; Thoppippala, 17.10.2015, *V. Drisya & A.K. Pradeep* 144263; Vagamon meadows, 26.10.2017, *V. Drisya* 157153; Vagamon kurisumala, 26.10.2017, *V. Drisya* 157146 (CALI); Kannur district, Paithalmala, 19.09.2015, *V. Drisya* 144208 (CALI); Kollam district, Ithikkara, 15.11.2017, *V. Drisya* 157735 [CALI184846, CALI184847, CALI184848 & CALI184849] (CALI); *s.loc.*, 29.08.1983, *K. Satheesh Kumar* 57 (TBGT); Malappuram district, Calicut University Botanical Garden (introduced), 19.02.2021, *V. Drisya* 169573; Kuttippuram, near railway station, 23.11.2017, *V. Drisya & A.K. Pradeep* 157747 [CALI184843, CALI184844 & CALI184845]; Manathumangalam, near Perinthalmanna, 03.12.2016, *V. Drisya* 144299; *Ibid.*, 03.12.2016, *V. Drisya* 150702 (CALI); Nilambur, 08.01.1942, *Indian Forest College Student s.n.*; *Ibid.*, 21.01.1942, *Indian Forest College Student s.n.* (DD); Palakkad district, Manappulli, 03.01.2016, *V. Drisya* 171483; Nelliyampathy, 05.12.2015, *V. Drisya* 150790; *Ibid.*, Ghat road side, 10.12.2022, *V. Drisya* 169600; *Ibid.*, Manpara, 11.12.2016, *Shinoj & V. Drisya* 176753; Padur, road side, 05.12.2018, *V. Drisya* 157897 (CALI); Pathanamthitta district, Moozhiyar, near pipeline, 07.07.1981, *P.V. Sreekumar* 70444; Pamba, 23.12.1980, *P.V. Sreekumar* 69434 (BSID); Thriveni, 22.12.1994, *A.G. Pandurangan & M. Raveendran* 12732 (TBGT); Thiruvananthapuram district, Bonacaud, 22.12.1988, *N. Mohanan* 7959; Chettachal, 22.07.1996, *A. Nazarudeen* 27458 (TBGT); Kariavattom, 21.03.1980, *P.V. Sreekumar* 67125 (BSID); Kariavattom campus, 10.11.2015, *V. Drisya* 150780 (CALI); Meenmutty, 06.11.1990, *N. Mohanan* 10118 (TBGT); Palode, 13.05.1958, *G.S. Puri* 37331 (BSI); *Ibid.*, Garden site [TBGRI], 10.10.1984, *K.C. Koshy* 639; *Ibid.*, 19.10.1984, *C. Sathish Kumar* 442A (TBGT); Sreekaryam, 22.03.1980, *P.V. Sreekumar* 67132 (BSID); Thrissur district, Kodali, 10.02.2019, *V. Drisya* 170159; Muthuvara, Puzhakkal Padam, 13.01.2018, *V. Drisya* 157810 (CALI); Wayanad

district, Chandanathodu, 13.02.1978, *V.S. Ramachandran* 53943 (CAL); *Ibid.*, 22.11.1983, *K.N. Subramanian* 9870 (FRC); Chembra, 30.12.2015, *V. Drisya* 176703 (CALI); Wayanad, 24.11.1939, *N.S. Kaikini s.n.* (DD); *s.dist.*, Adilampara, 21.02.1957, *G.S. Puri* 15741 (BSI); *s.dist.*, 'Travancore', *s.d.*, *V. Narayanaswami* 741; *Ibid.*, *s.d.*, *V. Narayanaswami* 196; *Ibid.*, *s.d.*, *V. Narayanaswami* 1203 (CAL). **Tamil Nadu**, Coimbatore district, Siruvani, 07.12.1956, *K. Subramanyam* 1648; Thunakkadavu [Tunakadavu], Mount Stouert, 27.10.1961, *J. Joseph* 13338; Velliangiri Hills, 18.02.1957, *K.M. Sebastine* 2369 (CAL); Dindigul district, Kodaikanal, 28.10.1956, *P.C. Nanda* 695 (DD); Puthur–Kavalappatty footpath, 25.08.1986, *K.M. Matthew* 46666; Palamalai, Hill behind bungalow, 02.12.1987, *K.M. Matthew* 51772; Palni foot hills, 06.11.1987, *K.M. Matthew & K.T. Mathew* 51193; Palni ghat road, below Kombaikkadu, 13.12.1989, *K.T. Mathew, S. Perianayagam & S. Sebastian* 53810 (RHT); Kanyakumari district, Kanyakumari [Cape Comorin], 02.11.1956, *B.D. Patil* 755 (DD); Lower Kothayar, Vazhukkalpara, 20.07.2016, *Shinoj & V. Drisya* 150756; Nagercoil, near Mambazhathuraiyar reservoir, 29.10.2015, *V. Drisya* 144271 (CALI); Krishnagiri district, Thally Hills, Devarbetta, Nakka Vanga, 10.09.1978, *K.M. Matthew & N. Venugopal* 17331 (RHT); Nilgiris district, Coonoor, 00.06.1883, *J.S. Gamble* 11804 (CAL); *Ibid.*, Jagathala, Wheat research station, 01.06.2005, *K. Althaf Ahamed Kabeer* 118549; Devala, Kariya shola, 19.07.2003, *K. Althaf Ahamed Kabeer* 116217; *Ibid.*, 20.7.2003, *K. Althaf Ahamed Kabeer* 116228; Gudalur, Chundi to Barwood, 26.05.2005, *K. Althaf Ahamed Kabeer* 117973 (MH); *Ibid.*, Kozhipalam, near Irumbupalam, 25.02.2018, *V. Drisya* 157836 (CALI); Gottacombai [Kottaicombai], 23.10.1956, *K. Subramanyam* 1085 (CAL); Hulical Droog, 27.08.1957, *K.M. Sebastine* 4123 (CAL); Kargudi, 29.10.1972, *K. Vivekananthan* 43108 (MH); Mudumalai, 20.07.1960, *K. Subramanyam* 10491 (CAL); Mukurthy National Park, Upper Bhavani to No.1 Dam, 19.09.2008, *K. Althaf Ahamed Kabeer* 121998 (MH); *Ibid.*, Bangitapal, 24.12.2018, *S. Resmi & V. Drisya* 176212; *Ibid.*, Korakundah Range, 24.12.2018, *S. Resmi & V. Drisya* 176213; (CALI); Nilgiri mountains [Nilgherris], 09.09.1870, *C.B. Clarke* 10526 (CAL); Ootty, 18.01.1951, *S.K. Jain & R.C. Bharadwaja* 22741 (DD); *Ibid.*, Needle view Point, on the way to

Pykara, 24.02.2018, *V. Drisya* 157839; *Ibid.*, 24.02.2018, *V. Drisya* 157840 (CALI); Salem district, Kollis, Solakkadu, above Pongal Koil shola, 11.11.1976, *K.M. Matthew* 4699 (RHT); Yercaud, 10.12.2017, *Nikhil Krishna & V. Drisya* 157767 (CALI); *Ibid.*, Kaveri peak, 04.11.1968, *D.B. Deb* 31253 (CAL); *Ibid.*, Louis villa, 21.09.1976, *D.I. Arockiasamy* 4067 (RHT); *Ibid.*, Sanyasimalai R.F., 17.09.1965, *K.N. Subramanian* 1986 (FRC); Tenkasi district, Courtallam, 00.12.1932, *V. Ramaswami* 523 (RHT); Tiruchirapally district, Chengattu patti top, 28.10.1958, *K.M. Sebastine* 7035 (CAL); Pachaimalai, Puthur, 21.03.1978, *Rajendran* 12633 (RHT); Tirunelveli district, Courtallam, near bus stand, 17.12.1957, *K. Subramanyam* 4973; Kuthiraivetti, 31.08.1963, *A.N. Henry* 17402; On the way to Five falls, 25.07.1957, *K. Subramanyam* 3827; Papanasam, near power house, 06.07.1959, *K.M. Sebastine* 8347; way to Naterikal, 22.09.1967, *E. Vajravelu* 29264 (CAL); Vellore district, Yelagiri Hills, down ghat road, 15.12.1999, *K.M. Matthew* 70572 (RHT).

Additional specimens examined (from other than study area): INDIA, '**Peninsula Indiae Orientalis**', *s.d.*, *Wight* 1709 (CAL). **Maharashtra**, Kolhapur district, on the way to Tillari, 08.01.2017, *V. Drisya* 171429; Tillari, 08.01.2017, *V. Drisya* 171406 (CALI).

Excluded taxa

1. *Ischaemum lisboae* Hook.f., Fl. Brit. India 7: 133. 1897; Bor, Grasses Burma, Ceylon, India & Pakistan 182. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 122. 1976; Karthik. *et al.,* Fl. Ind. Enum. Monocot. 232. 1989; S.Moulik, Grasses Bamboos India 2: 301. 1997. *Type*:—— North Canara, *Lisboa s.n.* (K [K000245696 digital image!]).

2. *Sehima ischaemoides* Forssk., Fl. Aegypt.-Arab. 178. 1775; Bor, Grasses Burma, Ceylon, India & Pakistan 218. 1960; N.P.Singh *et al.*, Bull. Bot. Surv. India 18(1−4): 125. 1976; Karthik. *et al.,* Fl. Ind. Enum. Monocot. 258. 1989; S.Moulik, Grasses Bamboos India 2: 301. 1997; Potdar *et al*., Grasses Maharashtra 247. 2012; B.R.P.Rao *et al.*, Grasses Arid Zone Penins. India 172. 2017. *Type*:—— "Yemen in montibus ad Hadie" [*n.v.*] (destroyed).

3. *Themeda arundinacea* (Roxb.) A.Camus in Lecomte *et al.*, Fl. Indo-Chine 7: 363. 1922; Bor, Grasses Burma, Ceylon, India & Pakistan 250. 1960; Karthik. *et al.,* Fl. Ind. Enum. Monocot. 268. 1989; S.Moulik, Grasses Bamboos India 2: 230. 1997; Pull., Fl. Andhra Pradesh 3: 1264. 1997. *Anthistiria arundinacea* Roxb., Fl. Ind. 1: 256. 1820. *Type*:—— "A native of Bengal". Sheet not traceable.

CHAPTER 6

Discussion on Comparative Morphology

A taxonomic revision on the two subtribes Ischaeminae and Anthistiriinae (Poaceae) is presented here. The result obtained during this study is discussed below.

Habit and Habitat

Members of Poaceae are either annuals or perennials and are seen in all kinds of habitats. Southern Peninsular Indian members of Anthistiriinae are mostly perennials (*Agenium*, *Heteropogon*, *Parahyparrhenia* and *Themeda*). Whereas, *Iseilema* may be annual or perennial. *Pseudanthistia* is the other annual member of this subtribe. *Parahyparrhenia* is represented by a single species *P. bellariensis* in southern Peninsular India. It is usually found growing in granitic hills or hill slopes and are reported only from two locations in Andhra Pradesh. All other genera are seen in all kinds of habitats including high altitude grasslands, forest margins, lowland grasslands and paddy fields. Among the 6 genera of Anthistiriinae, the genus *Heteropogon* has a wider distribution. They are caespitose (*Heteropogon*, *Parahyparrhenia*, *Agenium*) or tufted or geniculately ascending (*Iseilema*, *Pseudanthistiria heteroclita*) or as decumbent or creeping (*Pseudanthistiria umbellata*) or as robust forms (*Themeda*).

Southern Peninsular Indian members of Ischaeminae are mostly annuals but some of them are perennials. *Thelepogon* and most of the species of *Ischaemum* are annuals. But few species of *Ischaemum* are perennials. The genus *Sehima* is represented by two species in southern Peninsular India, of which, *S. nervosa* is perennial whereas *Sehima sulcata* is annual. The other genus *Apluda* grows mostly as annuals but sometimes they are found as perennials. Many members of this subtribe grows as erect and tufted (*Sehima*, *Thelepogon*, *Apluda*, few species of *Ischaemum* such as *I. rugosum, I. barbatum*, *I. molle*, *I. travancorense*, *I. rangacharianum*) or as decumbent or as stoloniferous or creeping (*I. ciliare*, *I.*

muticum, *I. timorense*, *I. semisagittatum*). *Apluda* and few species in *Ischaemum* such as *I. molle*, *I. barbatum*, *I. semisagittatum*, *I. pushpangadanii*, *I. rugosum*, *I. cannanorensis* and *I. travancorense* produce stilt roots from lower nodes. This stilt roots are rarely seen in *I. rangacharianum*. Habitat is important and useful in easy identification of many species of Ischaeminae. The monotypic *Thelepogon* as well as *Ischaemum afrum* are mainly seen in black cotton soil. Whereas *I. polystachyum* inhabits riversides or rock crevices in rivers. *I. molle* and *I. rugosum* are usually found in paddy fields or areas adjacent to such locations. *I. molle* also grows in hilly grasslands or hill sides. *I. pushpangadanii* is seen mainly associated with small rocky areas along river banks. *Ischaemum cannanorensis* was found profusely growing mainly in lateritic plateaus whereas *I. travancorense* was found to occur in backwaters in Alleppey, Kollam and Kottayam. *I. commutatum* was collected only from the high altitude grass lands or high altitude forest margins. *I. barbatum* is also habitat specific, which prefers wet or marshy areas. Likewise, *I. muticum* is found in sandy soils or wet areas near to water bodies in Alappuzha district.

Leaf sheath and leaf blade

Leaf sheath has less taxonomic importance in both Ischaeminae and Anthistiriinae since it is almost similar in all taxa. In some cases, the pubescence on the leaf sheath shows variation. Whereas leaf blades have role in identification or separation of few taxa to some extent. In some cases, leaf shape and leaf base are important (*I. semisagittatum*, *I. pushpangadanii*). In *Thelepogon elegans*, *Ischaemum ciliare* and *Ischaemum rangacharianum* the leaf blades are undulate or sinuate; whereas in all the other species of *Ischaemum* leaf blades are straight without any undulations. Leaf margins are also important in the case of *I. rangacharianum* and *I. commutatum* which are entire. While the leaf margins of *I. muticum* is entire but scabridulous towards apex and all the remaining southern Peninsular Indian species of *Ischaemum* the leaf margins are scabridulous.

Ligule

Ligule is usually thin, brownish or white membrane in all the southern Peninsular Indian members of Anthistiriinae. While in case of Ischaeminae, all the genera except *Sehima* possess membranous ligule, in *Sehima* the ligule is hairy.

Inflorescence

The inflorescence pattern among the genera of both Ischaeminae and Anthistiriinae varies considerably. However, it is unique in certain genera. The Anthistiriinae members such as *Agenium*, *Heteropogon* and *Parahyparrhenia* have same kind of raceme; that is a single raceme with lower homogamous spikelet pairs and upper heterogamous spikelet pairs. Lower homogamous spikelet pairs are fewer in number in *Parahyparrhenia* and *Agenium* as compared to that of *Heteropogon*. Whereas the other three genera of this subtribe, such as *Iseilema*, *Pseudanthistiria* and *Themeda* forms false panicles with spathe and spatheoles. Though these three are treated under the broad term false panicle, each of the genera are peculiar with its infloresecence or number or arrangement of spikelets along the floral axis. The genus *Iseilema* was characterized by the presence of four involucral spikelets and one or two sessile spikelet along with two or three pedicelled spikelet within a single raceme. The involucral spikelets are pedicelled here in the case of *Iseilema*. Whereas the single raceme of *Themeda* is characterized by the presence of four involucral spikelets as in the case of *Iseilema*, but the difference is involucral spikelets here is sessile not pedicelled as in case of *Iseilema*. Apart from this four involucral spikelets, *Themeda* also possess one or two sessile spikelets and two or three pedicelled spikelets. The involucral and pedicelled spikelets are male and sessile spikelets are bisexual in both of the genera. But in *Pseudanthistiria*, single raceme comprises 2 sessile and 3 pedicelled spikelets which are arranged on a jointed rachis, with a basal pair of one sessile and one pedicelled spikelet and a terminal triad of one sessile and two pedicelled spikelets. Involucral spikelets are absent in *Pseudanthistiria*.

In Ischaeminae, false panicle interrupted by spathe and spatheoles are seen only in the monotypic *Apluda mutica*. Here, the raceme comprises two pedicelled and one sessile spikelet encircled by a boat-shaped spatheole. Sessile spikelet is bisexual, with bulbous callus and out of the two pedicelled spikelets, one is reduced to a scale and the other is fertile and male. But in case of *Ischaemum*, inflorescence is usually a paired or digitate raceme or rarely a solitary raceme. The spikelets are

arranged as dissimilar pairs; one is sessile and the other is pedicelled. Sessile spikelets are always bisexual whereas pedicelled spikelets are either male (eg: *I. cannanorensis*, *I. commutatum*) or bisexual (eg: *I. afrum*, *I. barbatum*, *I. ciliare*, *I. molle*, *I. muticum*, *I. polystachyum*, *I. pushpangadanii*, *I. rangacharianum*, *I. rugosum*, *I. semisagittatum*, *I. timorense*, *I. travancorense*). In case of *I. impressum* and *I. kingii*, both male and empty pedicelled spikelets were observed. The other genus *Sehima* is characterised by a solitary terminal raceme with many paired sessile and pedicelled spikelets. Here also the sessile spikelets are bisexual and pedicelled spikelets are either male or sterile. Inflorescence is a digitate raceme in *Thelepogon*. Usually, 2 to many racemes are seen in *Thelepogon* but very rarely it may be reduced to a single raceme due to adverse conditions. Here also the spikelets are paired with a bisexual sessile spikelet and a reduced pedicelled spikelet, but the difference is that the pedicelled spikelets are always represented by a reduced pedicel.

Rachis internode

Rachis internode or joint of rachis has less taxonomic importance in case of subtribe Anthistiriinae. But it is important in case of Ischaeminae. The two southern Peninsular Indian species of *Sehima* are separated mainly using rachis internode character. In *Sehima nervosa*, the rachis internode is pilose on both the margins. Whereas in *Sehima sulcata*, it is pilose on one margin. Rachis internode is prominently seen in all other members of the subtribe Ischaeminae and shows variation in indumentum and length (**Figs. 191 & 192**).

Involucral spikelets

Involucral spikelets are seen only in the two genera, *Iseilema* and *Themeda* of the subtribe Anthistiriinae. The genus *Iseilema* is characterized by four pedicelled involucral spikelets whereas, *Themeda* by four sessile involucral spikelets. In *Themeda*, these involucral spikelets are arranged in pairs either at same level (as in *T. laxa*, *T. quadrivalvis*, *T. sabarimalayana* and *T. triandra*) or at different levels (as in *T. cymbaria*, *T. mooneyi*, *T. palakkadensis* and *T. tremula*). Likewise, the nature of the pedicel of involucral spikelet is important in separating the species within

Iseilema. In *Iseilema anthephoroides*, the pedicels of involucral spikelets are as broad as long whereas in *I. jainiana* and *I. prostratum* the pedicels of involucral spikelets are longer than broad (**Fig. 193**).

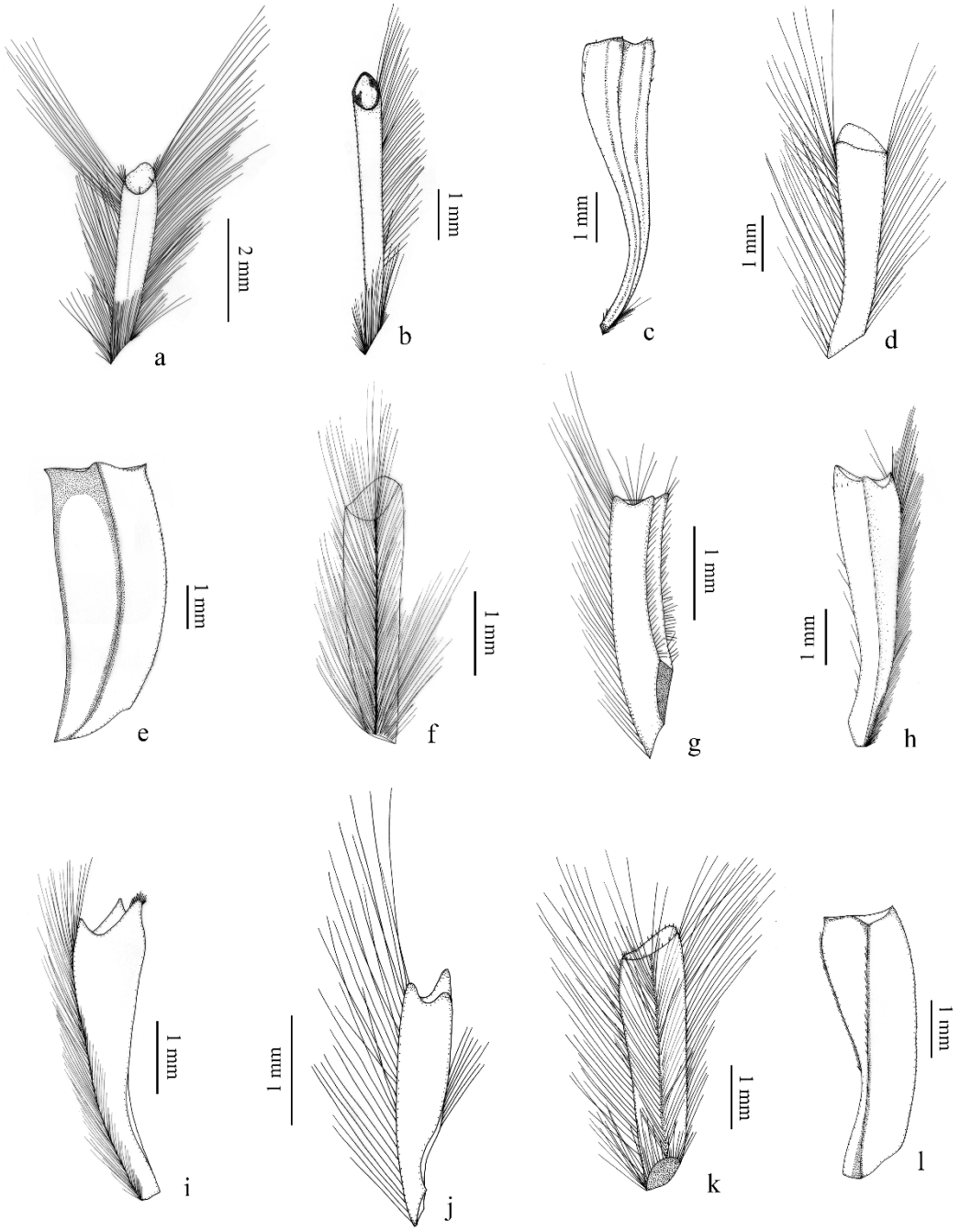

Fig. 191. Rachis internode: **a.** *Sehima nervosa* (Rottler) Stapf; **b.** *Sehima sulcata* (Hack.) A.Camus; **c.** *Thelepogon elegans* Roth ex Roem. & Schult.; **d.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **e.** *Ischaemum barbatum* Retz.; **f.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **g.** *Ischaemum ciliare* Retz.; **h.** *Ischaemum commutatum* Hack.; **i.** *Ischaemum impressum* Hack.; **j.** *Ischaemum kingii* Hook.f.; **k.** *Ischaemum molle* Hook.f.; **l.** *Ischaemum muticum* L.

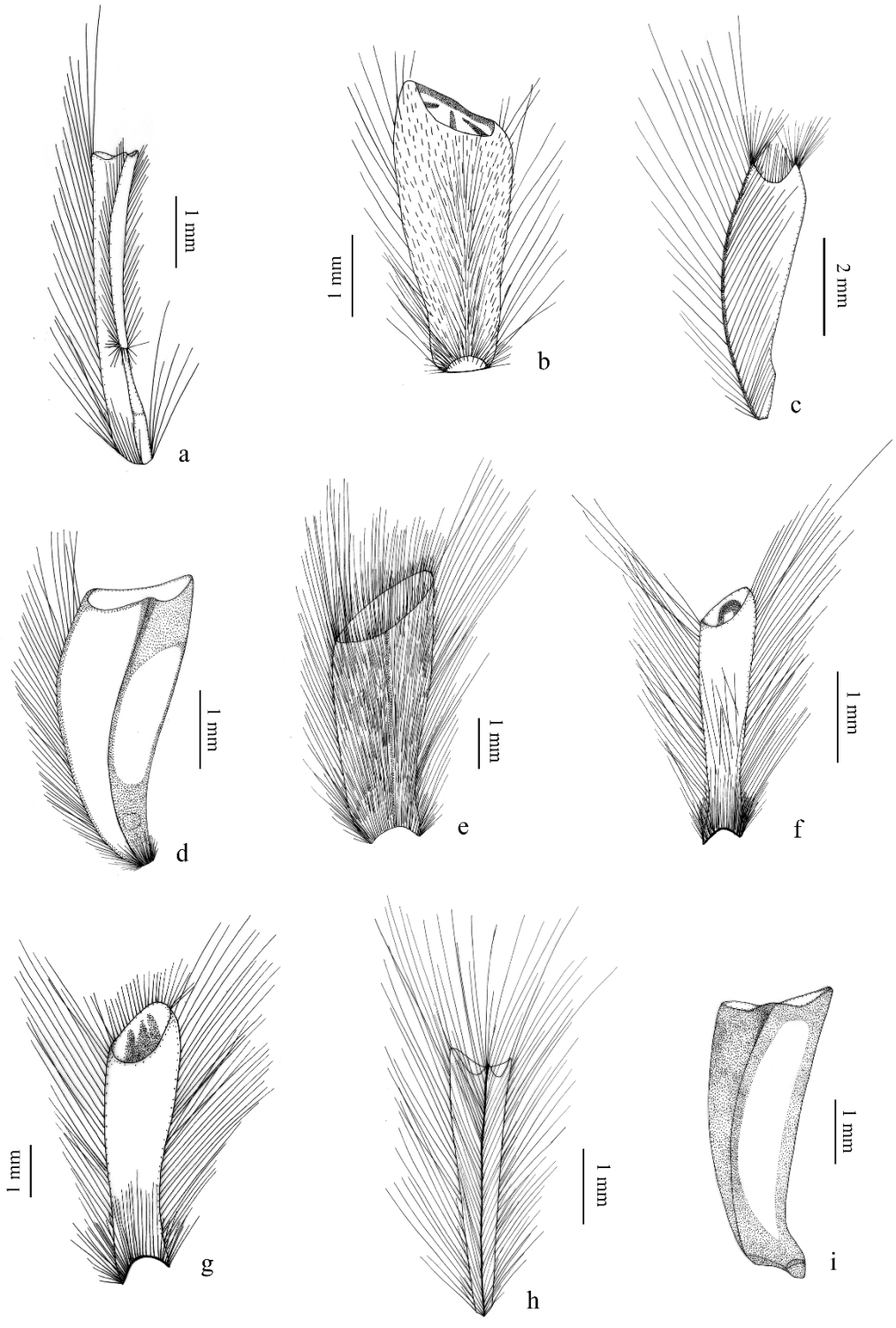

Fig. 192. Rachis internode: **a.** *Ischaemum polystachyum* J.Presl; **b.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **c.** *Ischaemum rangacharianum* C.E.C.Fisch.; **d.** *Ischaemum rugosum* Salisb.; **e–g.** *Ischaemum semisagittatum* Roxb.; **h.** *Ischaemum timorense* Kunth; **i.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.

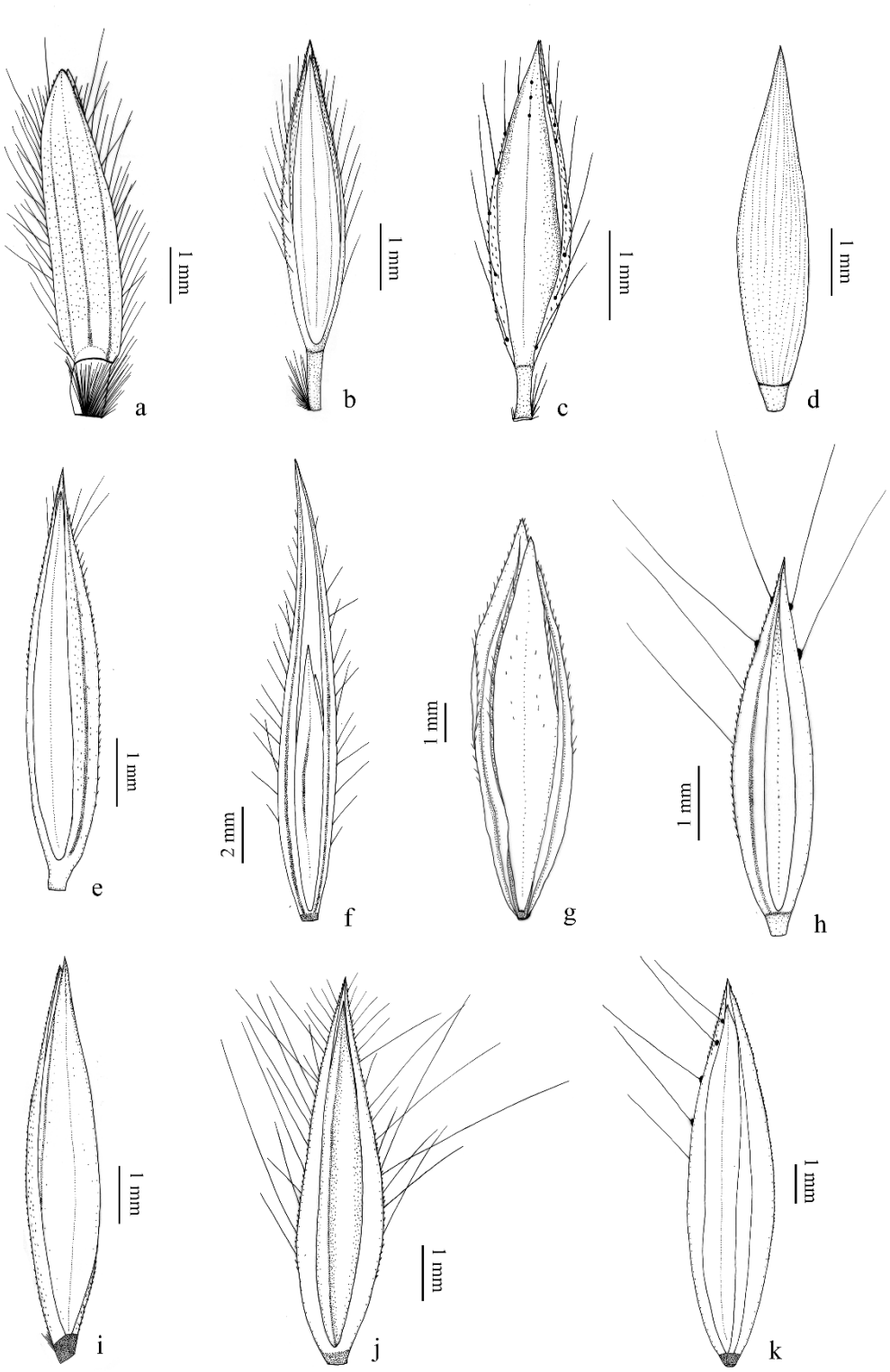

Fig. 193. Involucral spikelets: **a.** *Iseilema anthephoroides* Hack.; **b**. *Iseilema jainiana* P.Umam. & P.Daniel; **c.** *Iseilema prostratum* (L.) Andersson; **d.** *Themeda cymbaria* Hack.; **e.** *Themeda laxa* (Andersson) A.Camus; **f.** *Themeda mooneyi* Bor; **g.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **h.** *Themeda quadrivalvis* (L.) Kuntze; **i.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **j.** *Themeda tremula* (Nees) Hack.; **k.** *Themeda triandra* Forssk.

Sessile spikelets

Sessile spikelets (here sessile spikelets of upper heterogamous pair in *Agenium* and *Heteropogon*) in southern Peninsular Indian Anthistiriinae were more or less similar in their external appearance except in case of *Parahyparrhenia*. In *Parahyparrhenia bellariensis*, the sessile spikelet is chartaceous in nature with greenish colour and never be brownish. But in case of the remaining genera such as *Agenium*, *Heteropogon*, *Iseilema*, *Pseudanthistiria* and *Themeda*, the sessile spikelets are coriaceous to subcoriaceous. The colour of sessile spikelet is brownish in case of *Agenium*, *Heteropogon* and *Themeda*, whereas pale greenish to brownish in case of *Pseudanthistiria* and greenish in *Iseilema*. Among southern Peninsular Indian species of *Themeda*, *Themeda palakkadensis* is the only species with sessile spikelet having dense rufous brown hairs throughout, whereas all other species (*T. cymbaria*, *T. laxa*, *T. mooneyi*, *T. quadrivalvis*, *T. sabarimalayana*, *T. tremula* and *T. triandra*) are not covered throughout with dense rufous hairs in sessile spikelet.

In the subtribe Ischaeminae, sessile spikelet shows variation in indumentum, ornamentation and size even within species. Hence, the entire sessile spikelet is not used to compare species within this subtribe (**Figs. 194–198**).

Pedicelled spikelets

Almost all taxa of Ischaeminae and Anthistiriinae had pedicelled spikelets that were similar in some way. They are usually awnless but exceptions are there such as pedicelled spikelets with well-developed awn or pedicelled spikelets with reduced awn are also occasionally found (discussed under upper lemma of pedicelled spikelet). In some species of these subtribes, pedicelled spikelets may be reduced or absent. In *Apluda mutica*, one pedicelled spikelet is reduced and represented by a scale, whereas in *Thelepogon elegans*, pedicelled spikelet was reduced and represented by a pedicel. Similarly, some species of *Ischaemum* exhibits both developed and reduced pedicelled spikelets (*I. rugosum*). In a few species of *Ischaemum*, the pedicelled spikelets are more or less similar to the sessile spikelets (*I. timorense*). The characters of pedicelled spikelets play a significant role in segregating species in *Iseilema*. The pedicelled spikelets of *I. prostratum* and *I. anthephoroides* were more or less tuberculate or tubercle-based hairy, whereas in *I. jainiana* pedicelled spikelets are devoid of tubercles or tubercle-based hairs (**Figs. 196, 197, 199 & 200**).

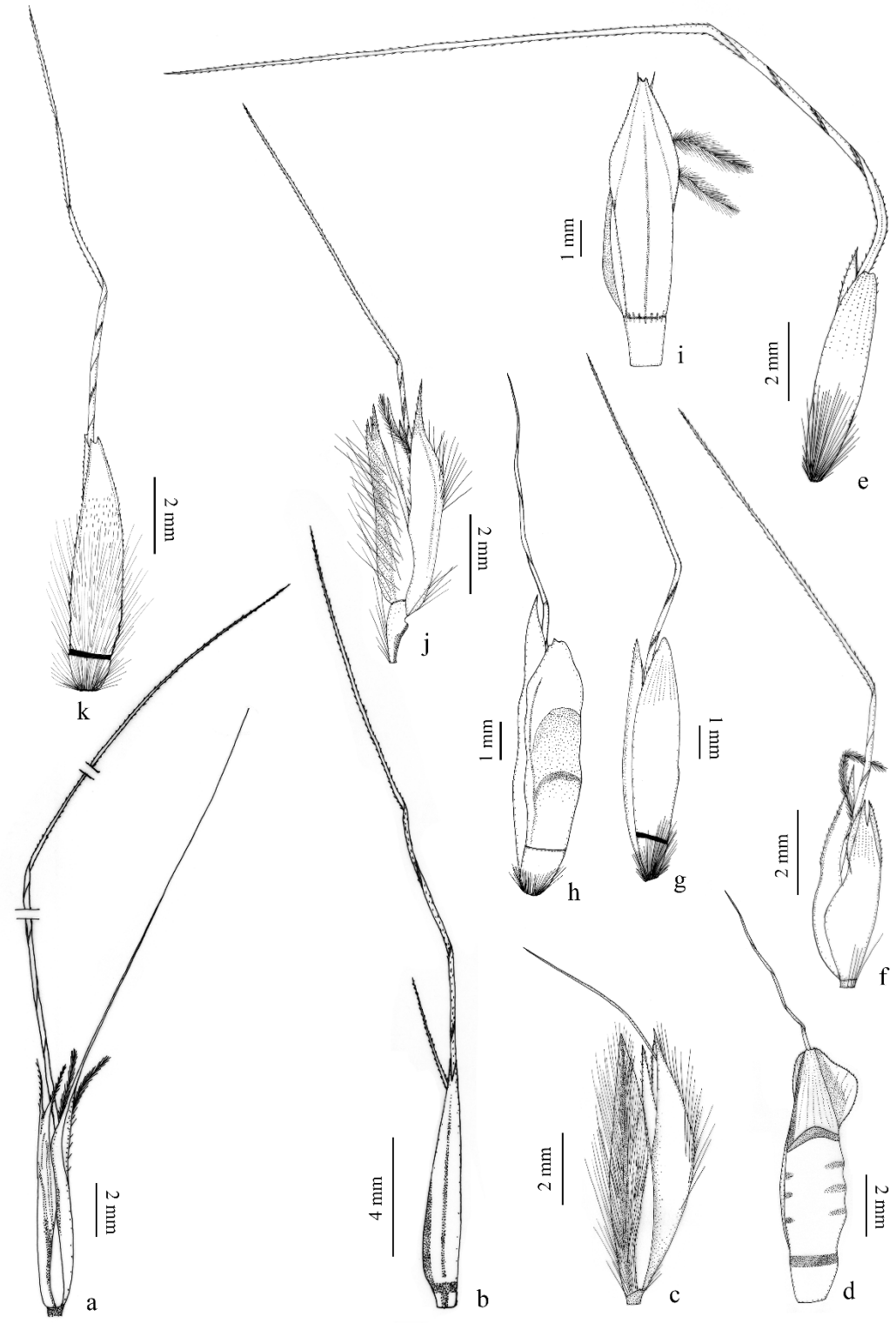

Fig. 194. Sessile spikelet: **a.** *Sehima nervosa* (Rottler) Stapf; **b.** *Sehima sulcata* (Hack.) A.Camus; **c.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **d.** *Ischaemum barbatum* Retz.; **e.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **f.** *Ischaemum ciliare* Retz.; **g.** *Ischaemum commutatum* Hack.; **h.** *Ischaemum impressum* Hack.; **i.** *Ischaemum muticum* L.; **j.** *Ischaemum polystachyum* J.Presl; **k.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj.

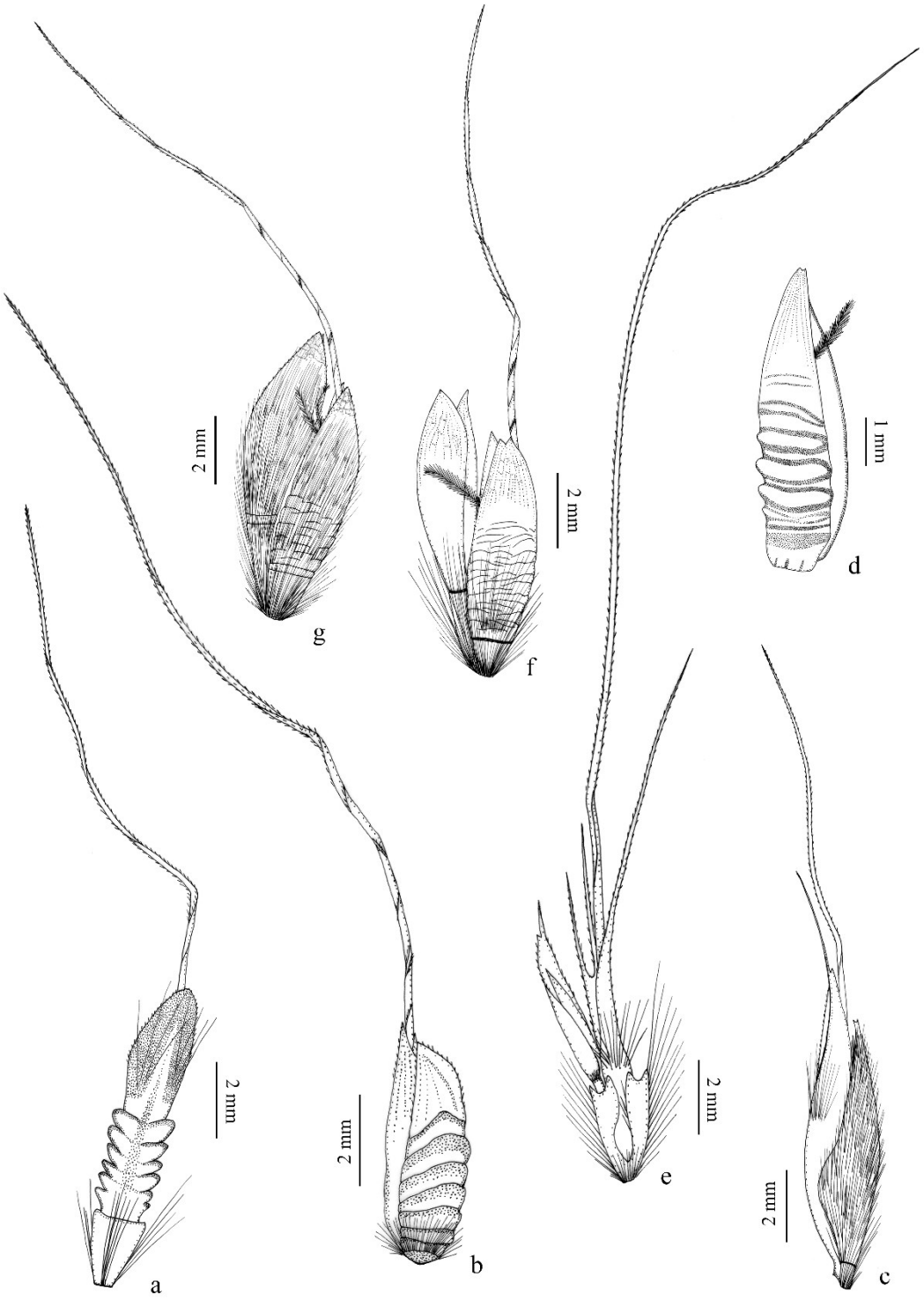

Fig. 195. Sessile spikelet: **a.** *Ischaemum rangacharianum* C.E.C.Fisch.; **b.** *Ischaemum rugosum* Salisb.; **c.** *Ischaemum timorense* Kunth; **d.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.; **e.** *Ischaemum kingii* Hook.f.; **f & g.** *Ischaemum molle* Hook.f. (**e–g:** spikelet pair showing sessile and pedicelled spikelets).

Fig. 196. Spikelet pairs showing sessile and pedicelled spikelets: **a–d.** *Ischaemum semisagittatum* Roxb.; **e.** *Apluda mutica* L.; **f.** *Thelepogon elegans* Roth ex Roem. & Schult.

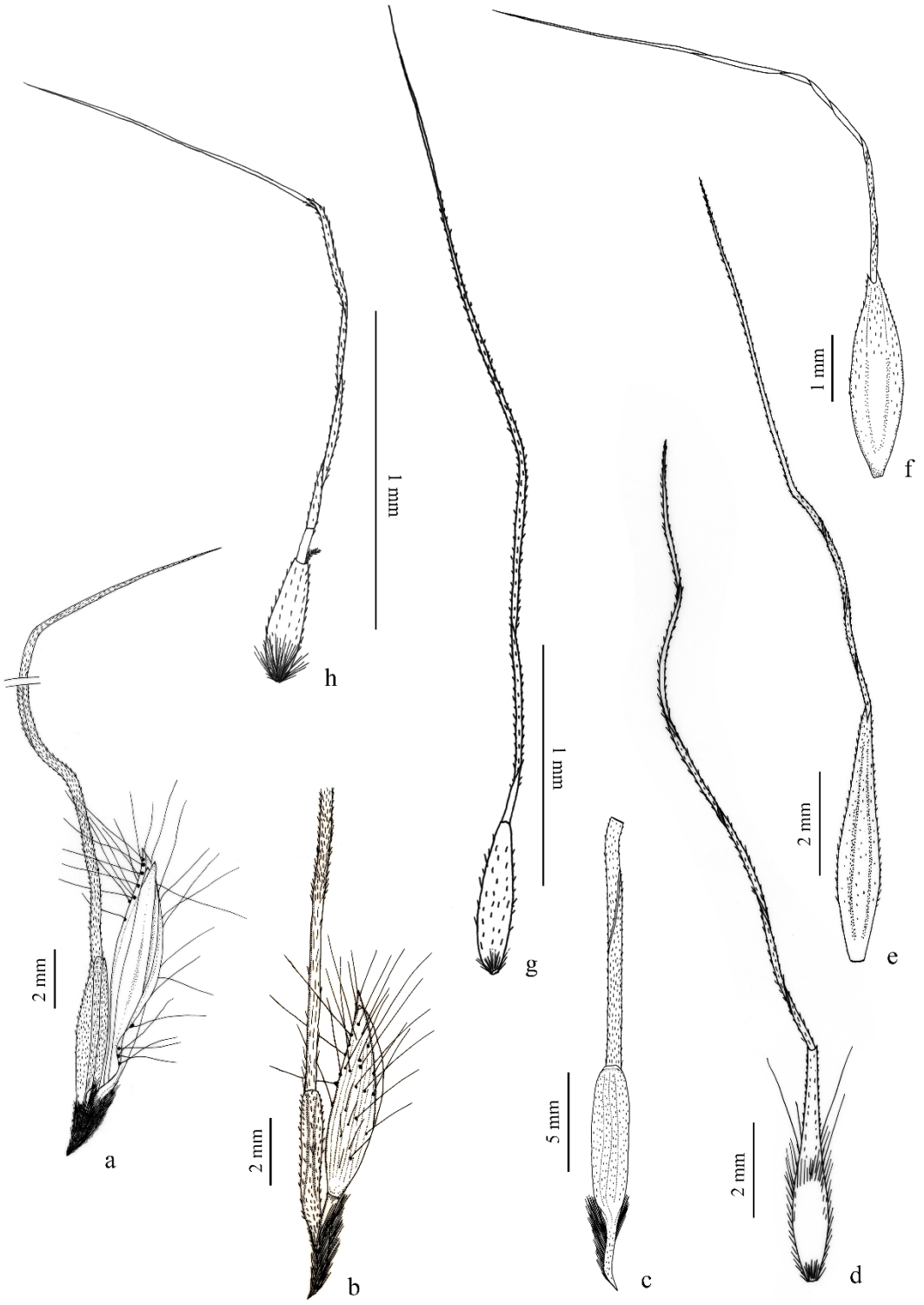

Fig. 197. Upper heterogamous spikelet pair showing sessile & pedicelled spikelets: **a.** *Agenium ritchiei* (Hook.f.) Drisya & Pradeep; **b.** *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.; Sessile spikelet: **c.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **d.** *Iseilema anthephoroides* Hack.; **e.** *Iseilema jainiana* P.Umam. & P.Daniel; **f.** *Iseilema prostratum* (L.) Andersson; **g.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **h.** *Pseudanthistiria umbellata* (Hack.) Hook.f.

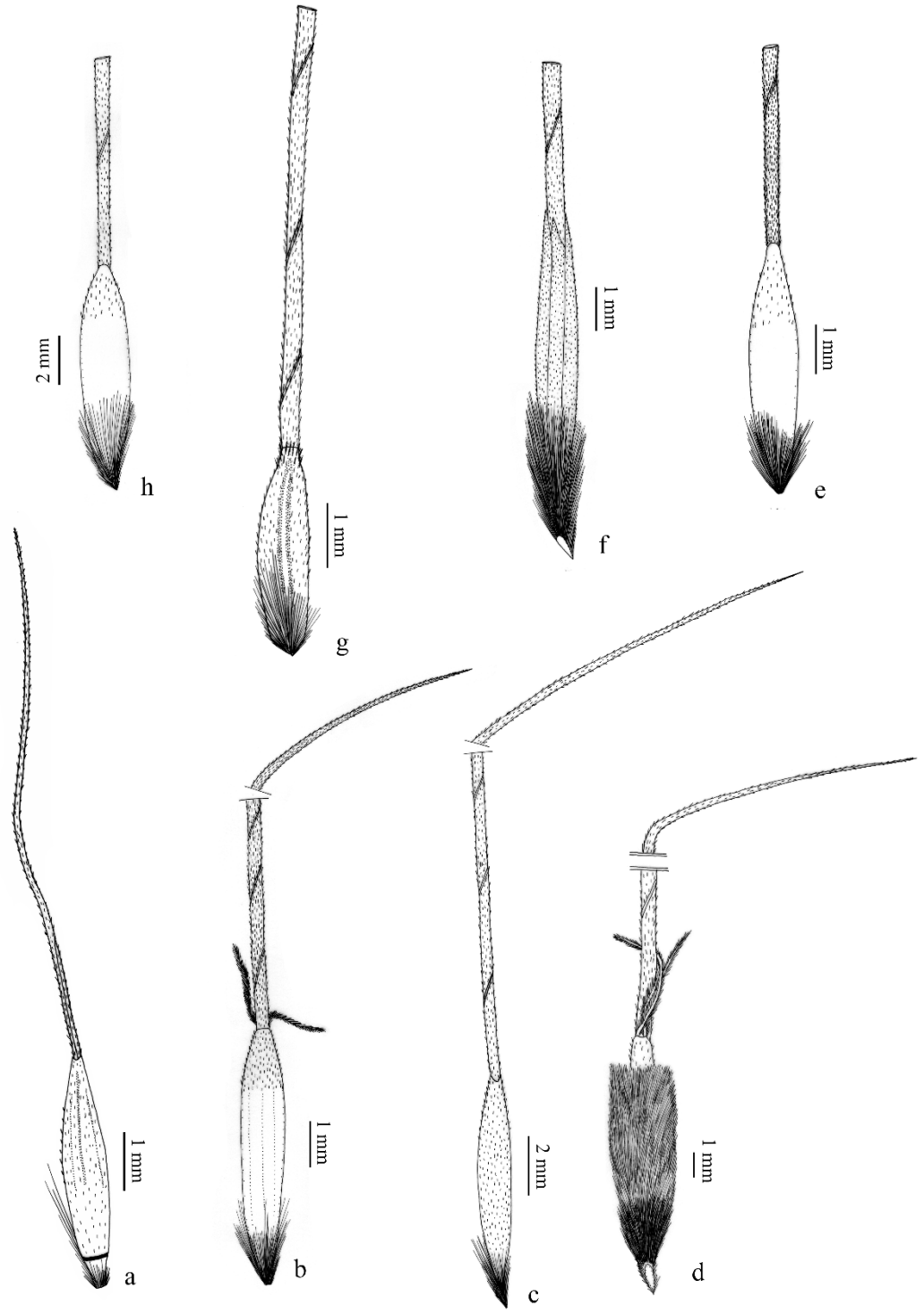

Fig. 198. Sessile spikelet: **a.** *Themeda cymbaria* Hack.; **b.** *Themeda laxa* (Andersson) A.Camus; **c.** *Themeda mooneyi* Bor; **d.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **e.** *Themeda quadrivalvis* (L.) Kuntze; **f.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **g.** *Themeda tremula* (Nees) Hack.; **h.** *Themeda triandra* Forssk.

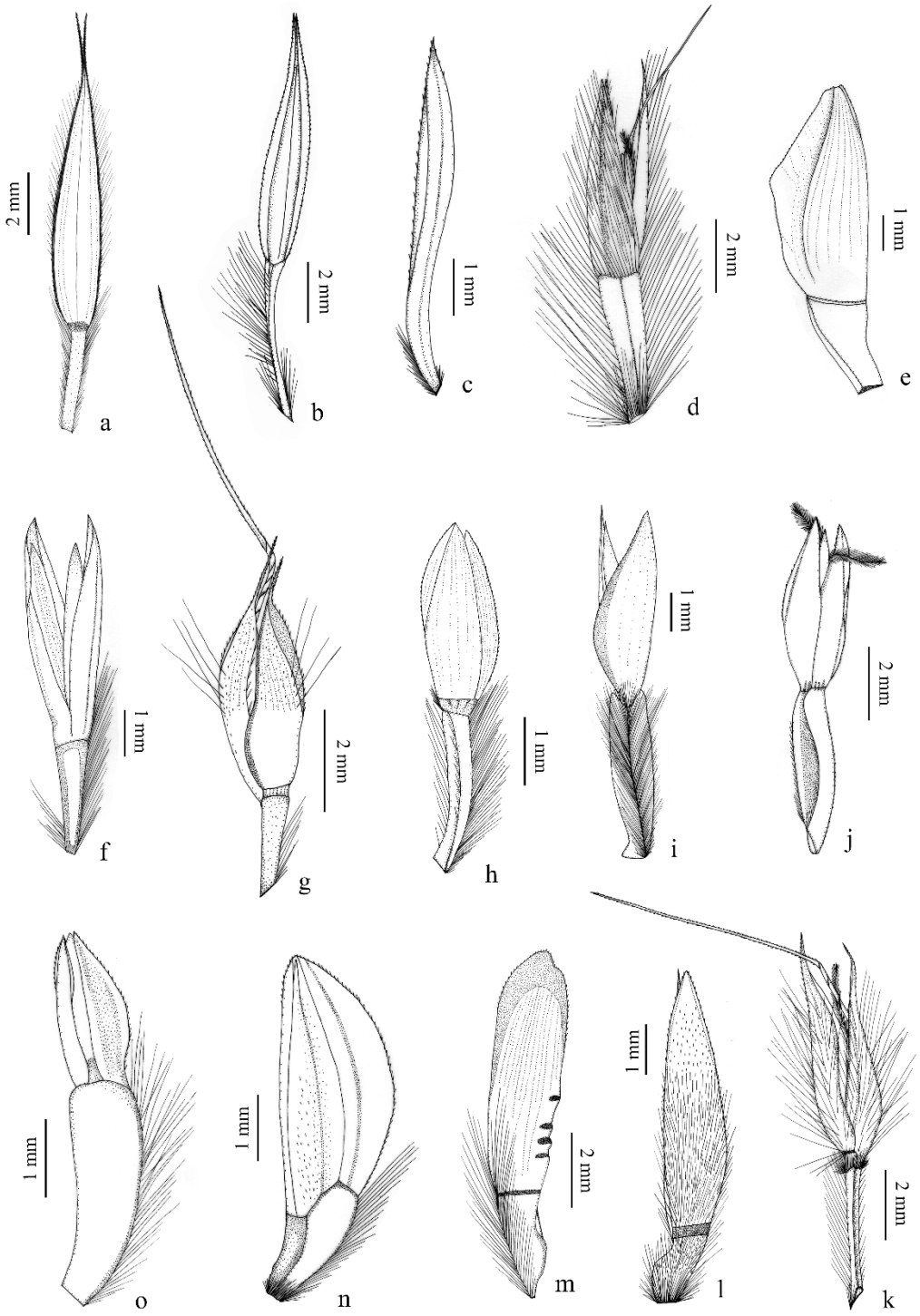

Fig. 199. Pedicelled spikelet: **a.** *Sehima nervosa* (Rottler) Stapf; **b.** *Sehima sulcata* (Hack.) A.Camus; **c.** *Thelepogon elegans* Roth ex Roem. & Schult.; **d.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **e.** *Ischaemum barbatum* Retz.; **f.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **g.** *Ischaemum ciliare* Retz.; **h.** *Ischaemum commutatum* Hack.; **i.** *Ischaemum impressum* Hack.; **j.** *Ischaemum muticum* L.; **k.** *Ischaemum polystachyum* J.Presl; **l.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **m.** *Ischaemum rangacharianum* C.E.C.Fisch.; **n & o.** *Ischaemum rugosum* Salisb.

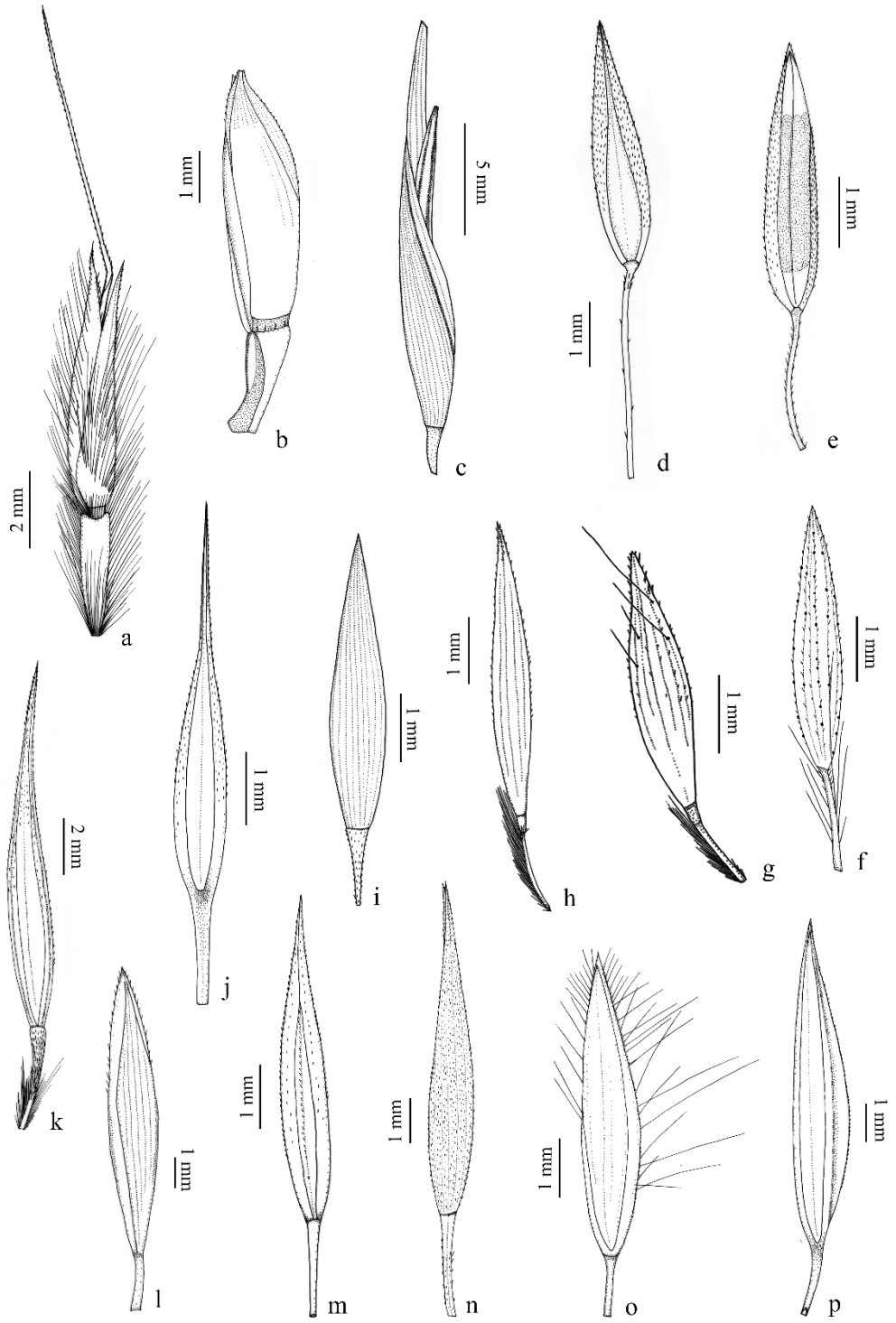

Fig. 200. Pedicelled spikelet: **a.** *Ischaemum timorense* Kunth; **b.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.; **c.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **d.** *Iseilema anthephoroides* Hack.; **e.** *Iseilema jainiana* P.Umam. & P.Daniel; **f.** *Iseilema prostratum* (L.) Andersson; **g.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **h.** *Pseudanthistiria umbellata* (Hack.) Hook.f.; **i.** *Themeda cymbaria* Hack.; **j.** *Themeda laxa* (Andersson) A.Camus; **k.** *Themeda mooneyi* Bor; **l.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **m.** *Themeda quadrivalvis* (L.) Kuntze; **n.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **o.** *Themeda tremula* (Nees) Hack.; **p.** *Themeda triandra* Forssk.

Lower glume (Sessile spikelet)

In *Heteropogon*, the lower glume of sessile spikelet in upper heterogamous pair is normally without a median groove (as in *H. contortus*), but in *H. triticeus* the lower glume is laterally 2-grooved. Whereas, *Agenium* which is closely related to *Heteropogon* is distinguished by the presence of medianly grooved lower glume of sessile spikelet in upper pair. Otherwise, the lower glume is similar in these two genera and are almost oblong in shape and coriaceous in nature. But in case of *Iseilema*, lower glume of sessile spikelet has an upper narrow beak-like area and a lower broad portion. This lower glume is more or less similar in all southern Peninsular Indian species of *Iseilema*. In *Parahyparrhenia bellariensis*, the lower glume is greenish, chartaceous and dorsally grooved. Similarly in case of *Pseudanthistiria*, lower glume is chartaceous to coriaceous in texture and pale greenish or brownish in colour. In *Themeda*, lower glume of sessile spikelet is coriaceous and brownish in colour. Moreover, except *T. tremula* all other species (*T. cymbaria*, *T. laxa*, *T. mooneyi*, *T. palakkadensis*, *T. quadrivalvis*, *T. sabarimalayana* and *T. triandra*) are devoid of dorsal groove in lower glume.

Within the subtribe Ischaeminae, lower glume characters of sessile spikelet has a great role in separating the southern Peninsular Indian species of *Sehima*. In *Sehima sulcata*, lower glume is rounded on the back with a deep longitudinal slit-like groove. Whereas in *S. nervosa*, it is not rounded on the back and without a deep slit but shallowly to deeply grooved. The other genus *Thelepogon* is unique with its rugose lower glume. Rugose lower glumes are also seen in many species of *Ischaemum* (*I. rugosum*) and the intensity of rugose nature varies between or within species. Similarly, the lower glume in *I. molle* is wrinkled but not exactly rugose as in earlier cases. In addition to the rugose nature, lower glume may be broad towards base (*I. ciliare*, *I. polystachyum* and *I. timorense*) or side noduled (*I. barbatum*, *I. kingii*, *I. rangacharianum*, *I. pushpangadanii*, *I. semisagittatum* and *I. travancorense*) and with broadly or narrowly winged margins (*I. barbatum*, *I. ciliare*, *I. commutatum*, *I. impressum*, *I. muticum*, *I. rangacharianum* and *I. timorense*). In some populations of *I. pushpangadanii*, *I. rangacharianum*,

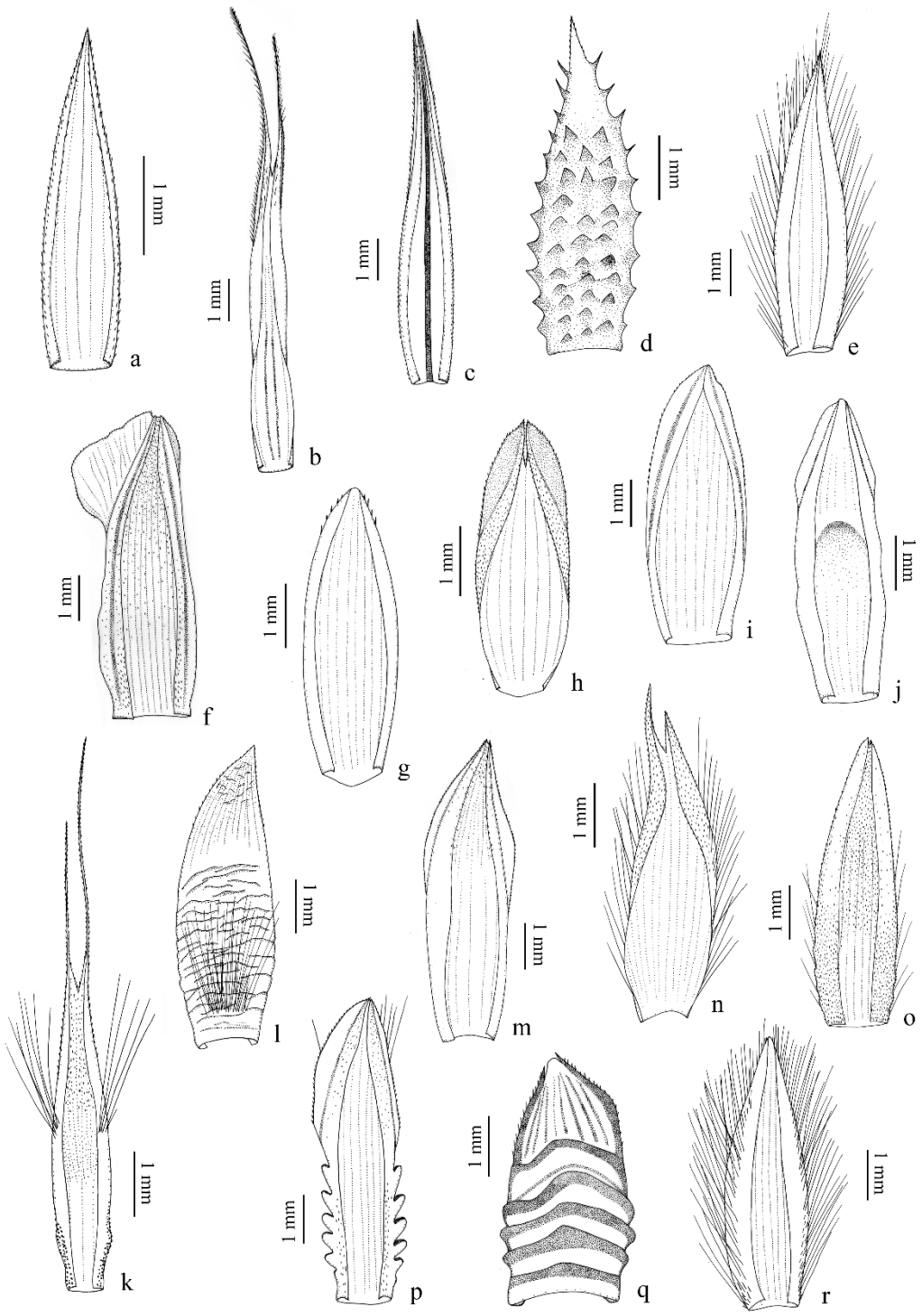

Fig. 201. Lower glume of Sessile spikelet: **a.** *Apluda mutica* L.; **b.** *Sehima nervosa* (Rottler) Stapf; **c.** *Sehima sulcata* (Hack.) A.Camus; **d.** *Thelepogon elegans* Roth ex Roem. & Schult.; **e.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **f.** *Ischaemum barbatum* Retz.; **g.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **h.** *Ischaemum ciliare* Retz.; **i.** *Ischaemum commutatum* Hack.; **j.** *Ischaemum impressum* Hack.; **k.** *Ischaemum kingii* Hook.f.; **l.** *Ischaemum molle* Hook.f.; **m.** *Ischaemum muticum* L.; **n.** *Ischaemum polystachyum* J.Presl; **o.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **p.** *Ischaemum rangacharianum* C.E.C.Fisch.; **q.** *Ischaemum rugosum* Salisb.; **r.** *Ischaemum semisagittatum* Roxb.

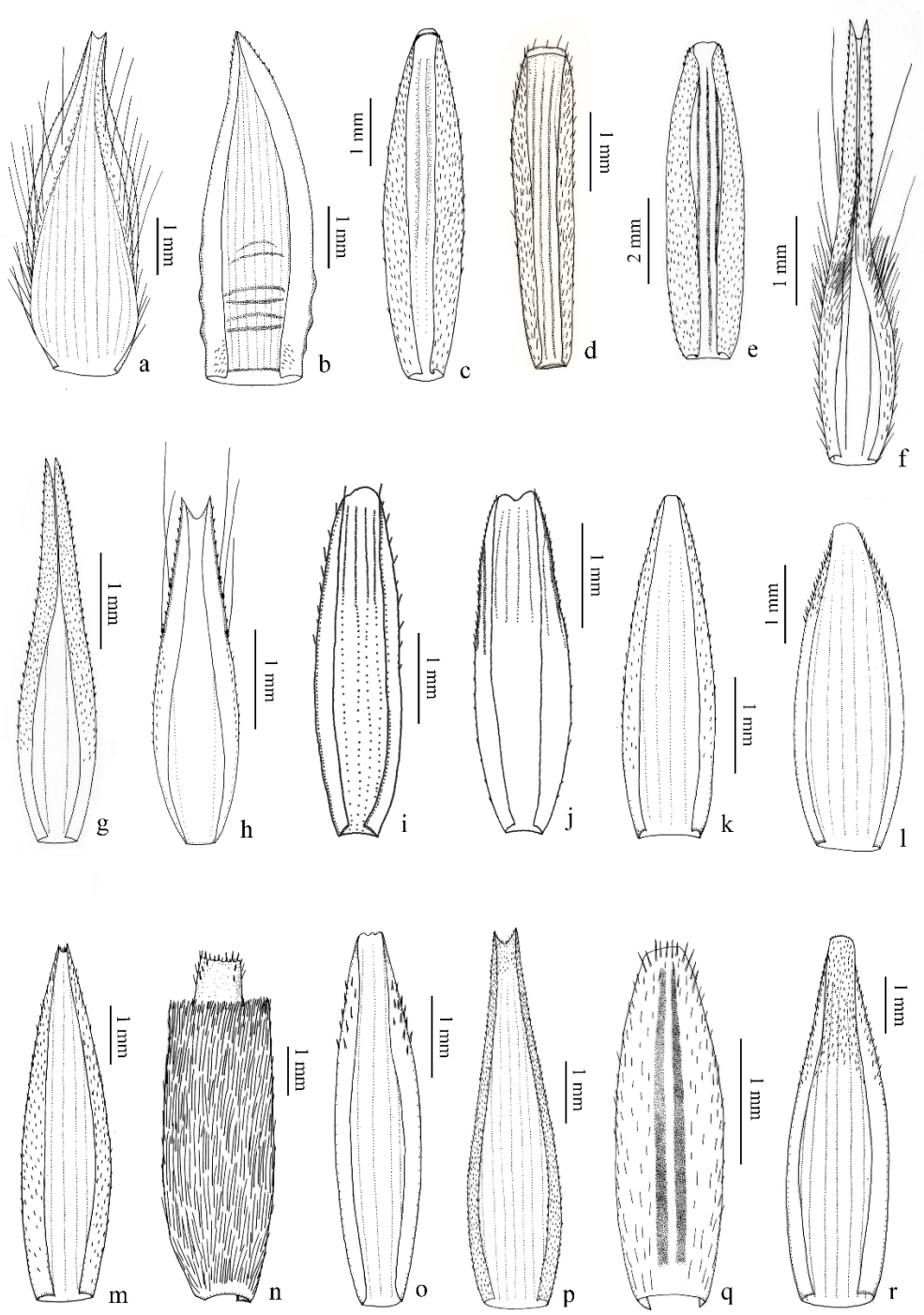

Fig. 202. Lower glume of Sessile spikelet: **a.** *Ischaemum timorense* Kunth; **b.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.; **c.** *Agenium ritchiei* (Hook.f.) Drisya & Pradeep; **d.** *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.; **e.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **f.** *Iseilema anthephoroides* Hack.; **g.** *Iseilema jainiana* P.Umam. & P.Daniel; **h.** *Iseilema prostratum* (L.) Andersson; **i.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **j.** *Pseudanthistiria umbellata* (Hack.) Hook.f.; **k.** *Themeda cymbaria* Hack.; **l.** *Themeda laxa* (Andersson) A.Camus; **m.** *Themeda mooneyi* Bor; **n.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **o.** *Themeda quadrivalvis* (L.) Kuntze; **p.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **q.** *Themeda tremula* (Nees) Hack.; **r.** *Themeda triandra* Forssk.

I. rugosum, *I. semisagittatum* and *I. travancorense*, the side nodules may shallowly or deeply interconnect to form ridges and furrows. Moreover, *I. kingii* is the only species in *Ischaemum* having lower glume with two aristae. However, in *Apluda*, the lower glume characters are not much useful in distinguishing species (**Figs. 201 & 202**).

Upper glume (sessile spikelet)

In general, upper glumes are unawned in Ischaeminae and Anthistiriinae. But in the case of *Sehima* (Anthistiriinae), the two species, *S. nervosa* and *S. sulcata* have awned upper glume. Moreover, some species of *Ischaemum* also exhibits awned or aristate upper glume (as in *I. timorense*, *I. ciliare* and *I. kingii*) (**Figs. 203 & 204**).

Upper lemma (sessile spikelet)

The upper lemma of Ischaeminae and Anthistiriinae members are usually geniculately awned. It is one of the key characters of the tribe Andropogoneae. Based on the shape and the point of attachment of awn, there are different types of upper lemma. In the case of Anthistiriinae, in genera such as *Agenium*, *Heteropogon, Iseilema, Parahyparrhenia, Pseudanthistiria* and *Themeda* upper lemma is reduced to the hyaline base of the awn. Whereas in Ischaeminae, upper lemma is well developed. In case of *Apluda mutica*, *Thelepogon elegans, Sehima nervosa*, *S. sulcata* and all southern Peninsular Indian species of *Ischaemum* except *I. muticum* and *I. travancorense*, the upper lemma was bilobed or deeply clefted and awned from the sinus. In *I.travancorense*, upper lemma was bifid, but not bilobed and aristate or shortly awned from the sinus. Whereas in *I. muticum*, the upper lemma is aristate or briefly awned but not bilobed or bifid (**Figs. 205–207**).

Lower glume (Pedicelled spikelet)

In *Agenium* and *Heteropogon* one margin is infolded, keeled and winged whereas the other is inflexed, but they are never be side noduled. In the case of *Iseilema* lower glumes are inflexed or infolded and keeled towards apex but not winged and side noduled. In *Parahyparrhenia bellariensis*, it is inflexed or infolded

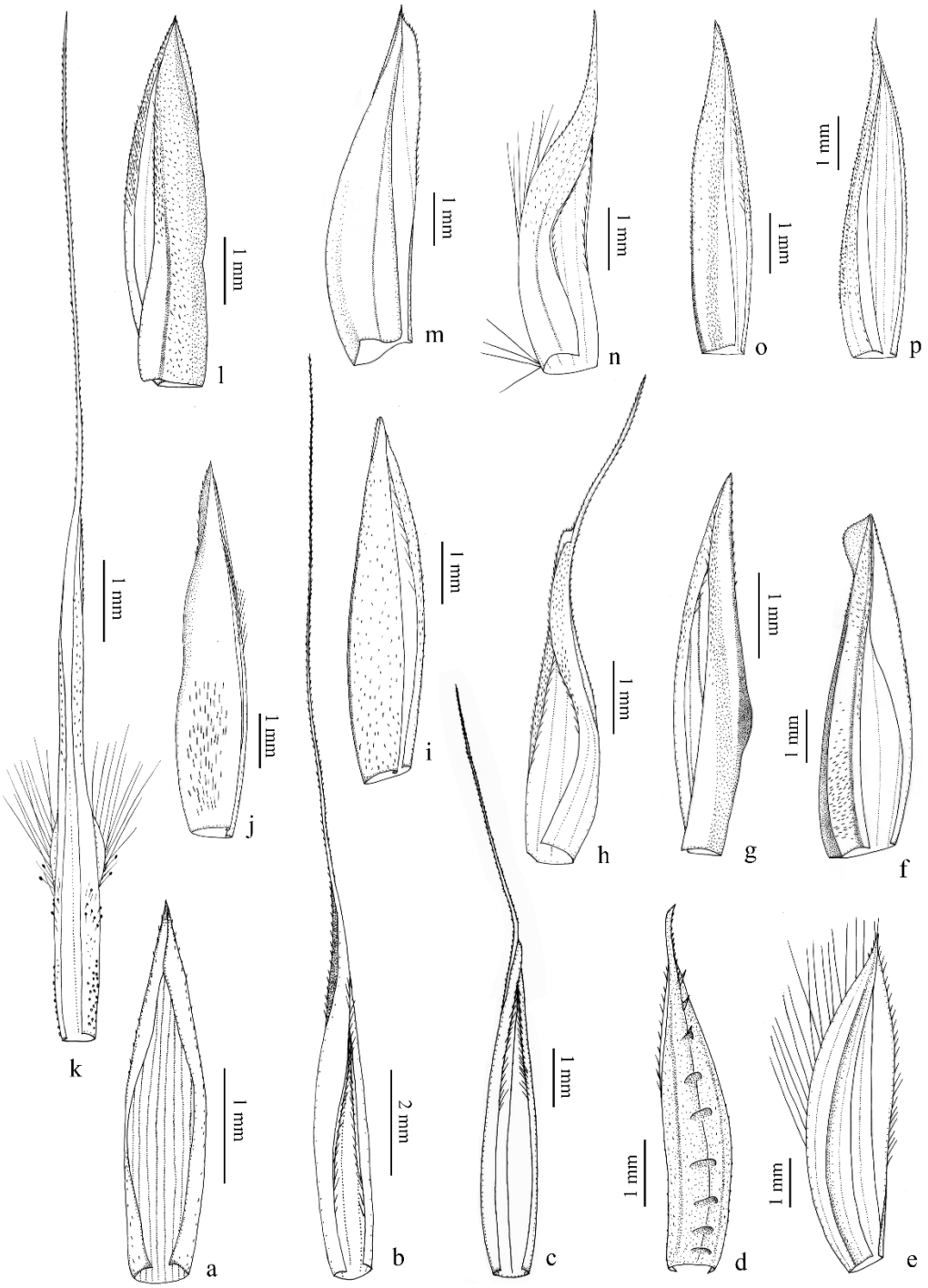

Fig. 203. Upper glume of Sessile spikelet: **a.** *Apluda mutica* L.; **b.** *Sehima nervosa* (Rottler) Stapf; **c.** *Sehima sulcata* (Hack.) A.Camus; **d.** *Thelepogon elegans* Roth ex Roem. & Schult.; **e.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **f.** *Ischaemum barbatum* Retz.; **g.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **h.** *Ischaemum ciliare* Retz.; **i.** *Ischaemum commutatum* Hack.; **j.** *Ischaemum impressum* Hack.; **k.** *Ischaemum kingii* Hook.f.; **l.** *Ischaemum molle* Hook.f.; **m.** *Ischaemum muticum* L.; **n.** *Ischaemum polystachyum* J.Presl; **o.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **p.** *Ischaemum rangacharianum* C.E.C.Fisch.

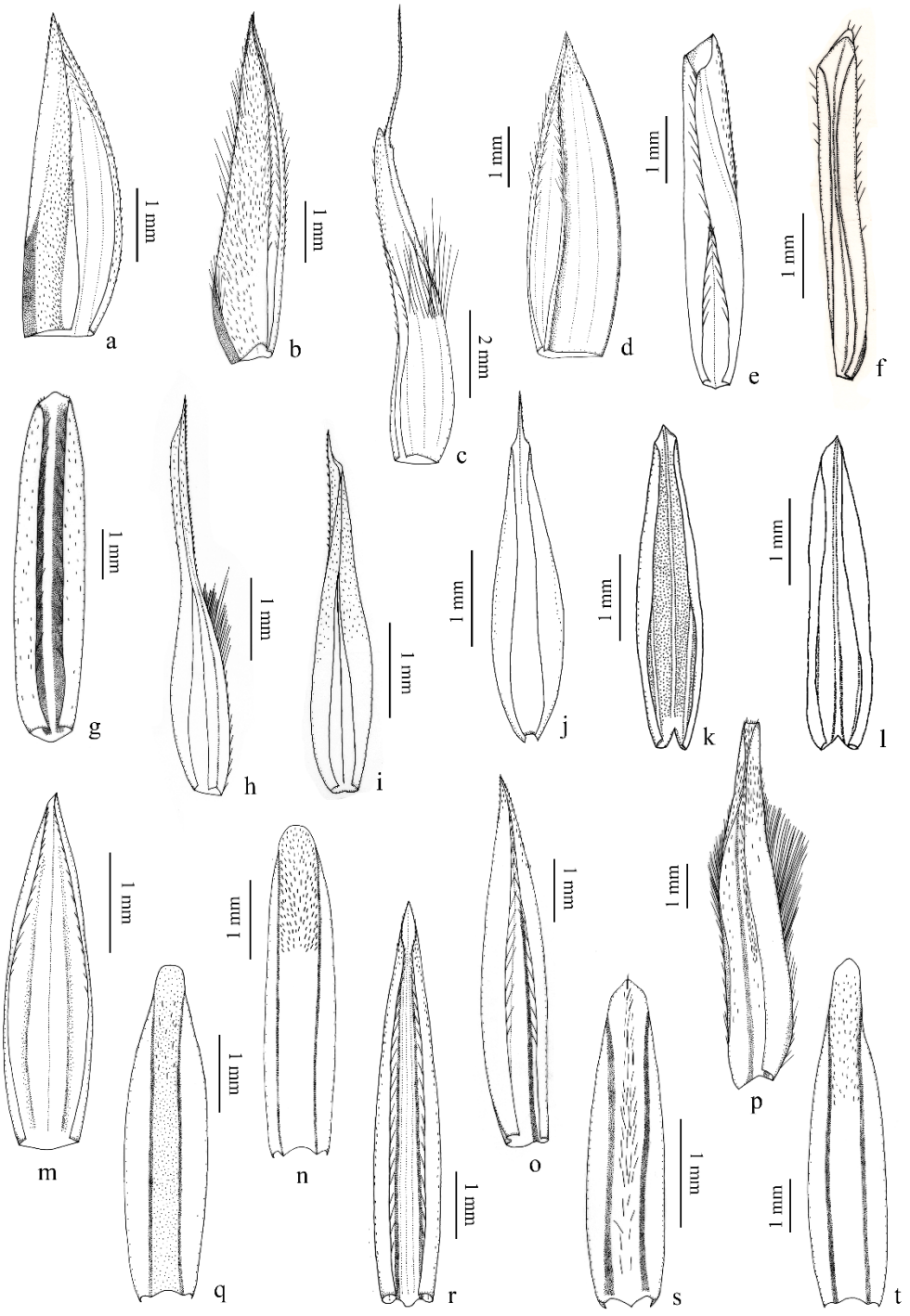

Fig. 204. Upper glume of Sessile spikelet: **a.** *Ischaemum rugosum* Salisb.; **b.** *Ischaemum semisagittatum* Roxb.; **c.** *Ischaemum timorense* Kunth; **d.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.; **e.** *Agenium ritchiei* (Hook.f.) Drisya & Pradeep; **f.** *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.; **g.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **h.** *Iseilema anthephoroides* Hack.; **i.** *Iseilema jainiana* P.Umam. & P.Daniel ; **j.** *Iseilema prostratum* (L.) Andersson; **k.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **l.** *Pseudanthistiria umbellata* (Hack.) Hook.f.; **m.** *Themeda cymbaria* Hack.; **n.** *Themeda laxa* (Andersson) A.Camus; **o.** *Themeda mooneyi* Bor; **p.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **q.** *Themeda quadrivalvis* (L.) Kuntze; **r.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **s.** *Themeda tremula* (Nees) Hack.; **t.** *Themeda triandra* Forssk.

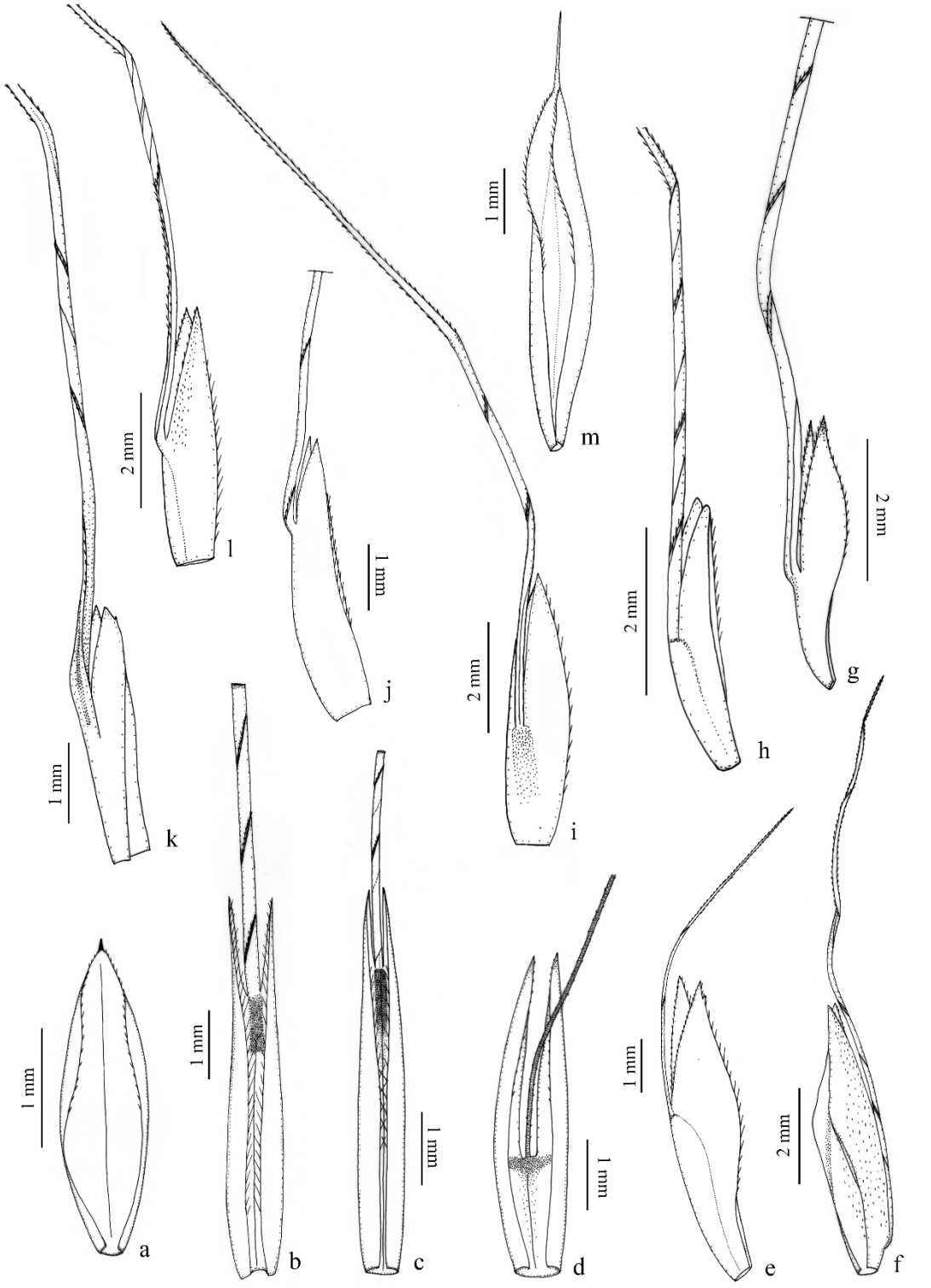

Fig. 205. Upper lemma of sessile spikelet: **a.** *Apluda mutica* L.; **b.** *Sehima nervosa* (Rottler) Stapf; **c.** *Sehima sulcata* (Hack.) A.Camus; **d.** *Thelepogon elegans* Roth ex Roem. & Schult.; **e.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **f.** *Ischaemum barbatum* Retz.; **g.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **h.** *Ischaemum ciliare* Retz.; **i.** *Ischaemum commutatum* Hack.; **j.** *Ischaemum impressum* Hack.; **k.** *Ischaemum kingii* Hook.f.; **l.** *Ischaemum molle* Hook.f.; **m.** *Ischaemum muticum* L.

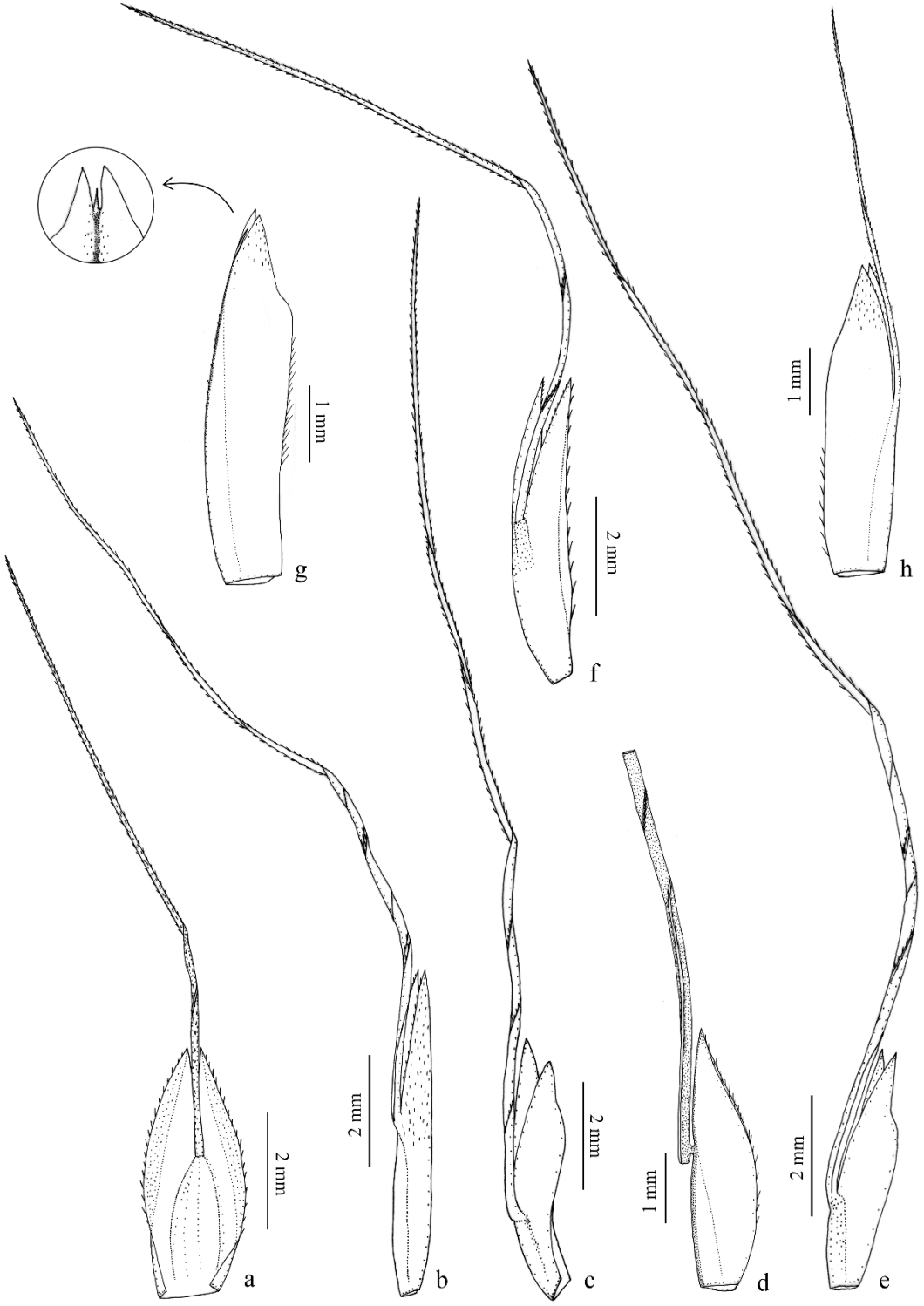

Fig. 206. Upper lemma of sessile spikelet: **a.** *Ischaemum polystachyum* J.Presl; **b.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **c.** *Ischaemum rangacharianum* C.E.C.Fisch.; **d.** *Ischaemum rugosum* Salisb.; **e.** *Ischaemum semisagittatum* Roxb.; **f.** *Ischaemum timorense* Kunth; **g & h.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.

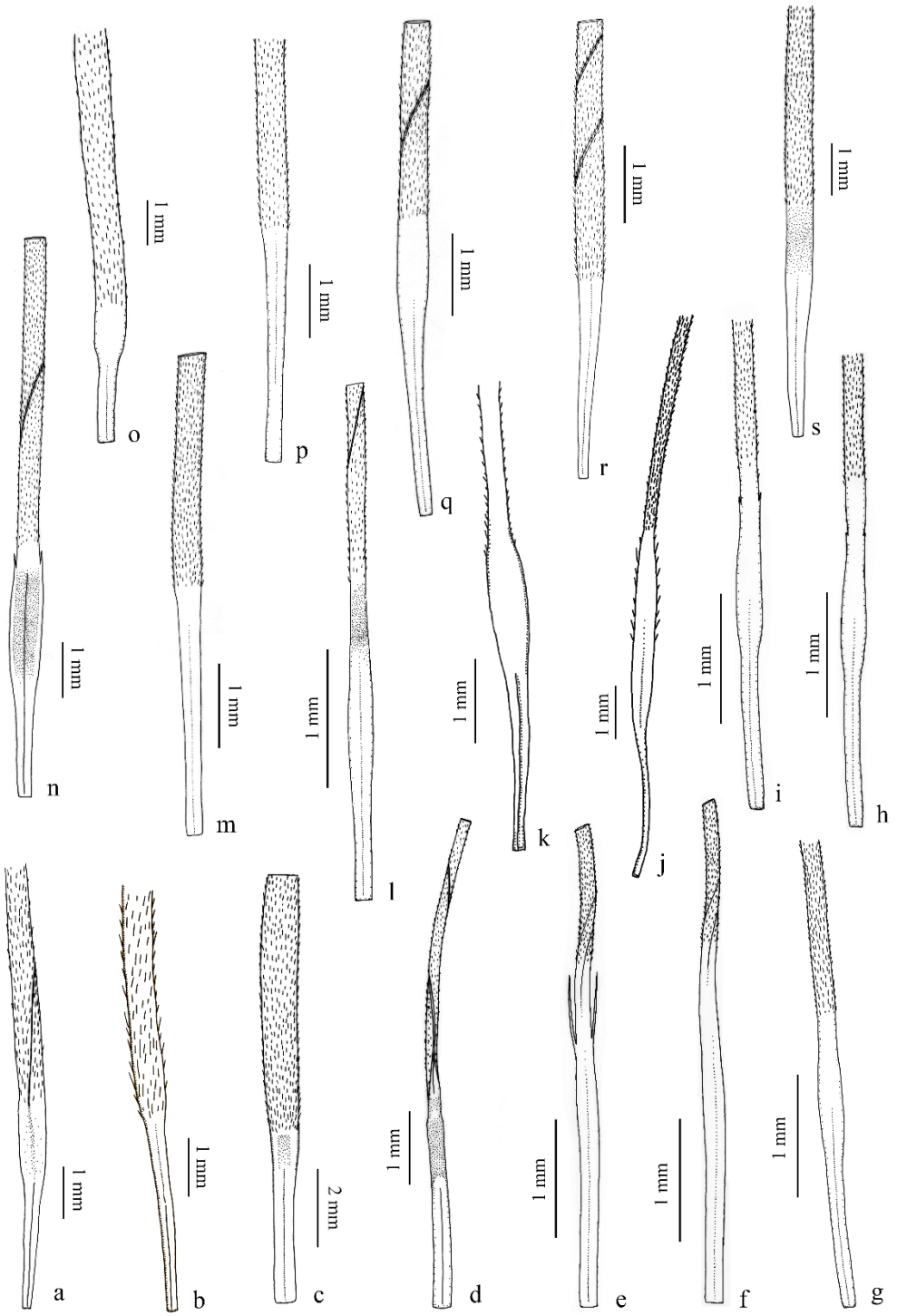

Fig. 207. Upper lemma of sessile spikelet: **a.** *Agenium ritchiei* (Hook.f.) Drisya & Pradeep; **b.** *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.; **c.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **d.** *Iseilema anthephoroides* Hack.; **e & f.** *Iseilema jainiana* P.Umam. & P.Daniel; **g, h & i.** *Iseilema prostratum* (L.) Andersson; **j.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **k.** *Pseudanthistiria umbellata* (Hack.) Hook.f.; **l.** *Themeda cymbaria* Hack.; **m.** *Themeda laxa* (Andersson) A.Camus; **n.** *Themeda mooneyi* Bor; **o.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **p.** *Themeda quadrivalvis* (L.) Kuntze; **q.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **r.** *Themeda tremula* (Nees) Hack.; **s.** *Themeda triandra* Forssk.

and keeled. Keel winged and wing broad towards upper half or at upper 3/4^{th,} and here also side nodules are absent. While in case of *Pseudanthistiria*, margins inflexed or infolded but not winged and side-noduled. However, in the genus *Themeda*, lower glume is either inflexed or infolded or both and without side-nodules, but winged in some species (Eg. *T. cymbaria*) and unwinged in some other (Eg. *T. triandra*). Within *Themeda*, the southern Peninsular Indian species having unwinged lower glume includes *T. laxa*, *T. palakkadensis*, *T. quadrivalvis*, *T. sabarimalayana*, *T. tremula* and *T. triandra*. Whereas in *T. cymbaria* and *T. mooneyi* one margin is winged throughout.

In the subtribe Ischaeminae, the monotypic genus *Thelepogon* lacks pedicelled spikelet and thus has no glumes. Similarly, in *Apluda mutica*, one pedicelled spikelet is reduced and the lower glume of the other well developed spikelet is devoid of side nodules and wings. In the genus *Sehima*, *S. nervosa* is characterized by inflexed margins with a broad wing along one margin and with a narrow wing along the other margin. Whereas in *S. sulcata*, lower glume is inflexed, infolded near apex and winged throughout, but the wing is broad towards apex.

In the genus *Ischaemum*, the lower glume usually has inflexed or infolded margins but shows variation in the side-nodules and in marginal or dorsal wings. Here, the three (*I. afrum*, *I. polystachyum* and *I. timorense*) southern Peninsular Indian species possess lower glumes without side-nodules and wings. However, in most of the cases, the lower glume was broadly winged along one margin and narrowly winged or not along the other margin as in *I. barbatum*, *I. cannanorensis*, *I. commutatum*, *I. impressum*, *I. molle*, *I. rugosum* and *I. travancorense*. Among these seven, winged species, lower glume of *I. molle* may be side-noduled or not and sometimes the narrow wing along one margin may be seen towards apex or upper half only as in *I. commutatum*, *I. impressum* and *I. rugosum*, While in *I. pushpangadanii* and *I. semisagittatum*, the lower glume is unwinged but side nodules may be present or not. But in *I. rangacharianum*, one margin is broadly winged throughout with the other is narrowly winged towards apex and side-

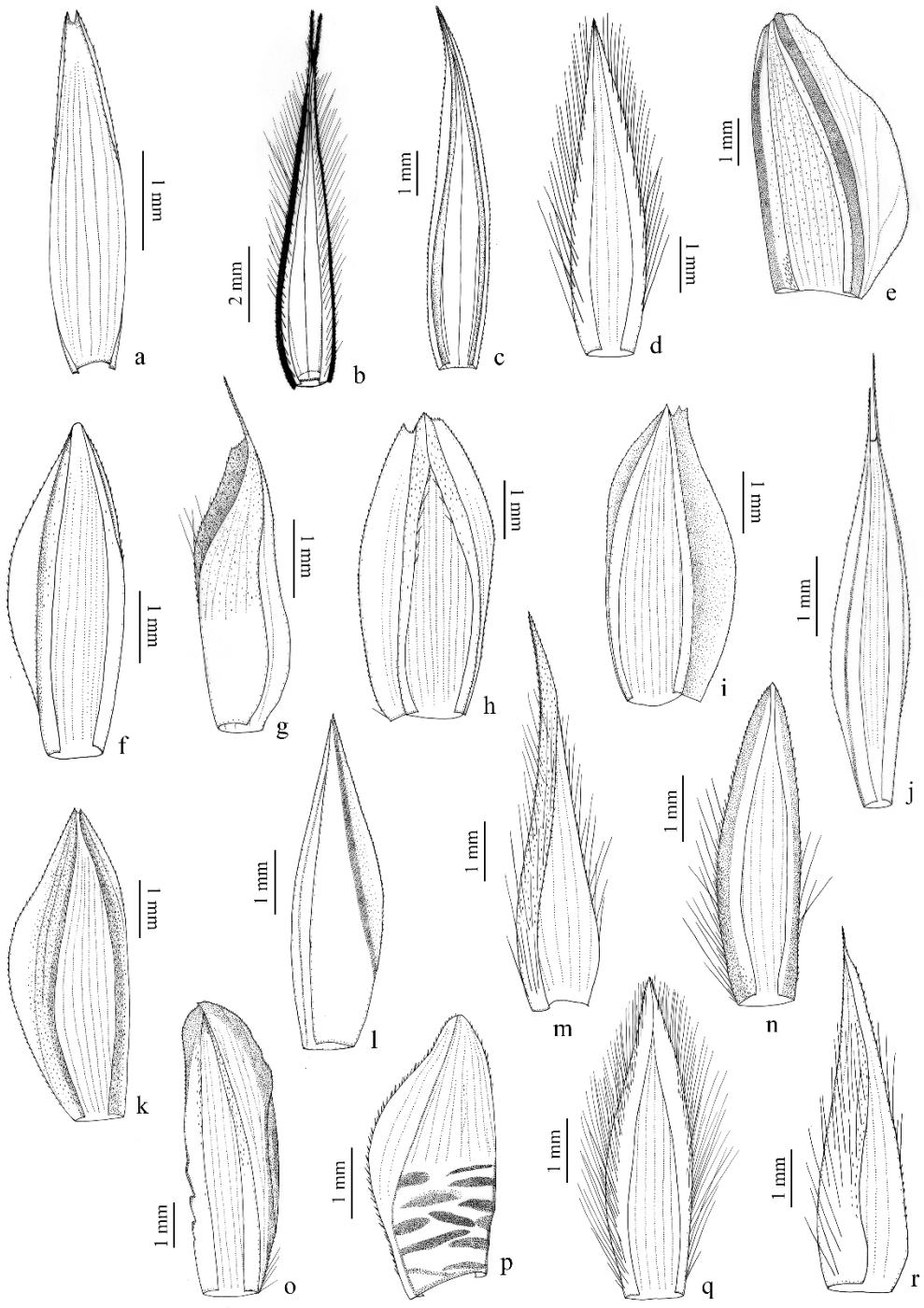

Fig. 208. Lower glume of pedicelled spikelet: **a.** *Apluda mutica* L.; **b.** *Sehima nervosa* (Rottler) Stapf; **c.** *Sehima sulcata* (Hack.) A.Camus; **d.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **e.** *Ischaemum barbatum* Retz.; **f.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **g.** *Ischaemum ciliare* Retz.; **h.** *Ischaemum commutatum* Hack.; **i.** *Ischaemum impressum* Hack.; **j.** *Ischaemum kingii* Hook.f.; **k.** *Ischaemum molle* Hook.f.; **l.** *Ischaemum muticum* L.; **m.** *Ischaemum polystachyum* J.Presl; **n.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **o.** *Ischaemum rangacharianum* C.E.C.Fisch.; **p.** *Ischaemum rugosum* Salisb.; **q.** *Ischaemum semisagittatum* Roxb.; **r.** *Ischaemum timorense* Kunth.

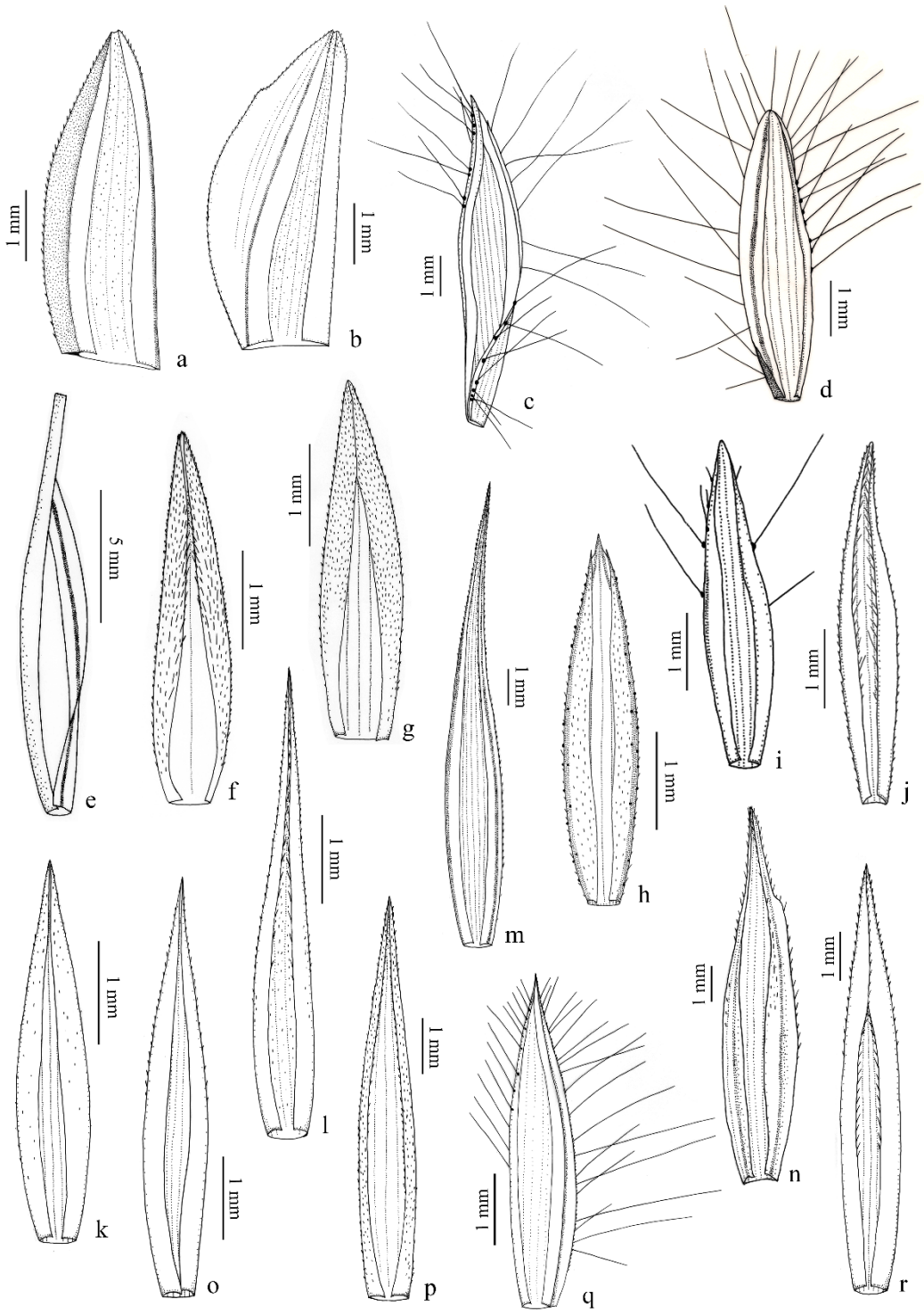

Fig. 209. Lower glume of pedicelled spikelet: **a & b.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.; **c.** *Agenium ritchiei* (Hook.f.) Drisya & Pradeep; **d.** *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.; **e.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **f.** *Iseilema anthephoroides* Hack.; **g.** *Iseilema jainiana* P.Umam. & P.Daniel; **h.** *Iseilema prostratum* (L.) Andersson; **i.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **j.** *Pseudanthistiria umbellata* (Hack.) Hook.f.; **k.** *Themeda cymbaria* (Roxb.) Hack.; **l.** *Themeda laxa* (Andersson) A.Camus; **m.** *Themeda mooneyi* Bor; **n.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **o.** *Themeda quadrivalvis* (L.) Kuntze; **p.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **q.** *Themeda tremula* (Nees) Hack.; **r.** *Themeda triandra* Forssk.

noduled towards lower half. Whereas in *I. kingii*, the lower glume is winged at upper 2/3rd or 3/4th of margin which is infolded. The lower glume is little bit different in *I. ciliare* and *I. muticum* as they possess dorsal keel and wing towards apex instead of lateral keels and wings (**Figs. 208 & 209**).

Upper glume (pedicelled spikelet)

Upper glume of pedicelled spikelet unawned in all southern Peninsular Indian members of Anthistiriinae. But in the case of Ischaeminae, upper glume is aristate or awned in certain cases. The monotypic genus, *Apluda mutica* have acuminate to aristate upper glume. Whereas in *Sehima nervosa*, the upper glume is acuminate and shortly setaceous. However, it is acute to acuminate or shortly mucronate in *S. sulcata*. When coming to the genus *Ischaemum* upper glume may be acute to acuminate or obtuse (*I. afrum, I. barbatum, I. cannanorensis, I. commutatum, I. impressum, I. molle, I. muticum, I. pushpangadanii, I. rangacharianum, I. rugosum, I. semisagittatum* & *I. travancorense*) or aristate (*I. ciliare, I. kingii, I. polystachyum, I. pushpangadanii* & *I. timorense*). Here in the case of *I. pushpangadanii*, the upper glume apex was seen either as acute or as minutely aristate (**Figs. 210 & 211**).

Lemmas and Paleas

Both lower and upper lemmas (except the upper lemma of sessile spikelet) as well as lower and upper paleas in each spikelet is of less taxonomic importance. In many cases they are absent or reduced or shows variation in size, shape etc. Hence, they are not taken here for comparison.

Lodicules

Two cuneate lodicules per floret is present in all the southern Peninsular Indian members of Anthistiriinae and Ischaeminae. It is similar in all species and thus have least taxonomic importance.

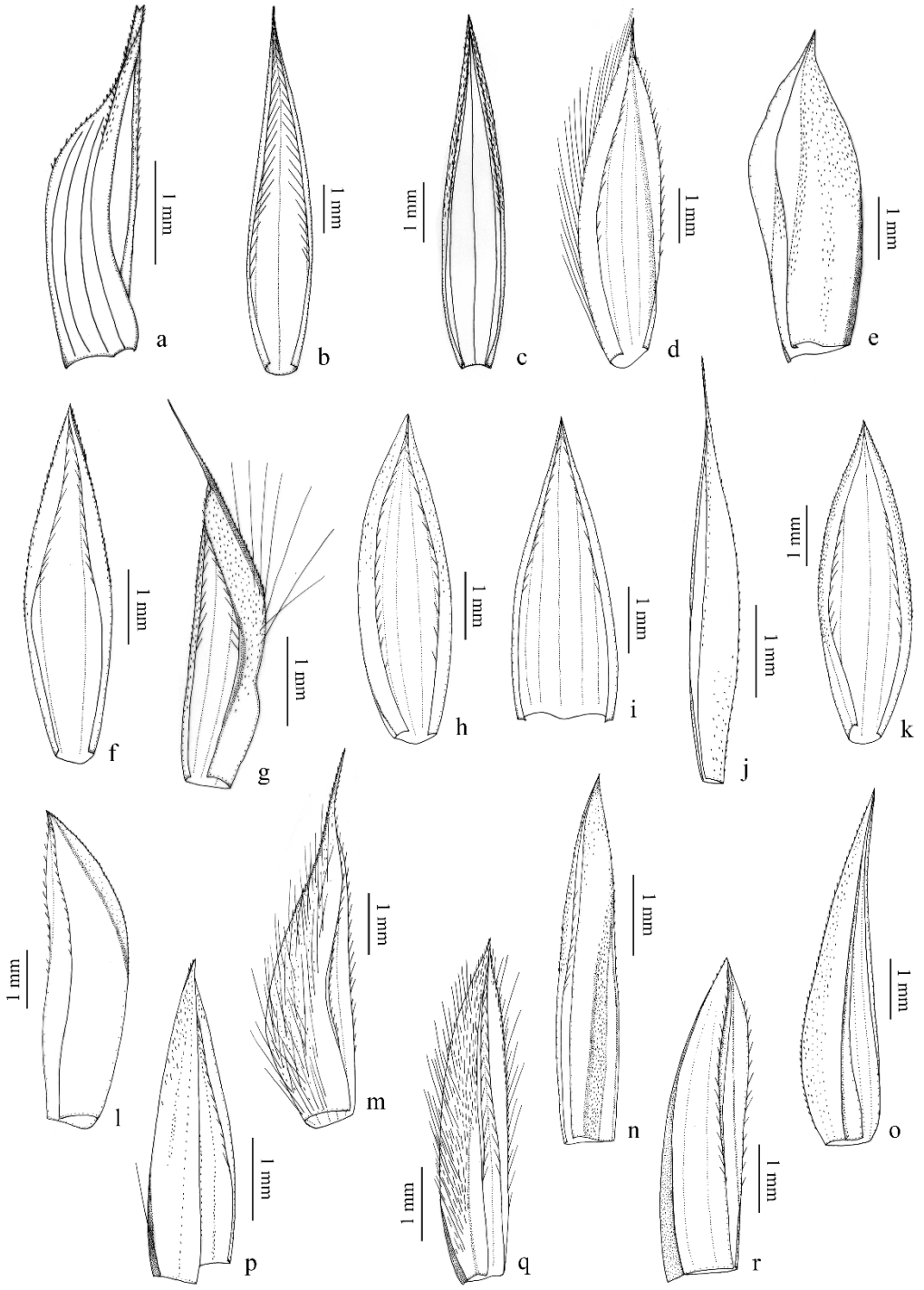

Fig. 210. Upper glume of pedicelled spikelet: **a.** *Apluda mutica* L.; **b.** *Sehima nervosa* (Rottler) Stapf; **c.** *Sehima sulcata* (Hack.) A.Camus; **d.** *Ischaemum afrum* (J.F.Gmel.) Dandy; **e.** *Ischaemum barbatum* Retz.; **f.** *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair; **g.** *Ischaemum ciliare* Retz.; **h.** *Ischaemum commutatum* Hack.; **i.** *Ischaemum impressum* Hack.; **j.** *Ischaemum kingii* Hook.f.; **k.** *Ischaemum molle* Hook.f.; **l.** *Ischaemum muticum* L.; **m.** *Ischaemum polystachyum* J.Presl; **n.** *Ischaemum pushpangadanii* Ravi, N.Mohanan & Kiran Raj; **o.** *Ischaemum rangacharianum* C.E.C.Fisch.; **p.** *Ischaemum rugosum* Salisb.; **q.** *Ischaemum semisagittatum* Roxb.; **r.** *Ischaemum travancorense* Stapf ex C.E.C.Fisch.

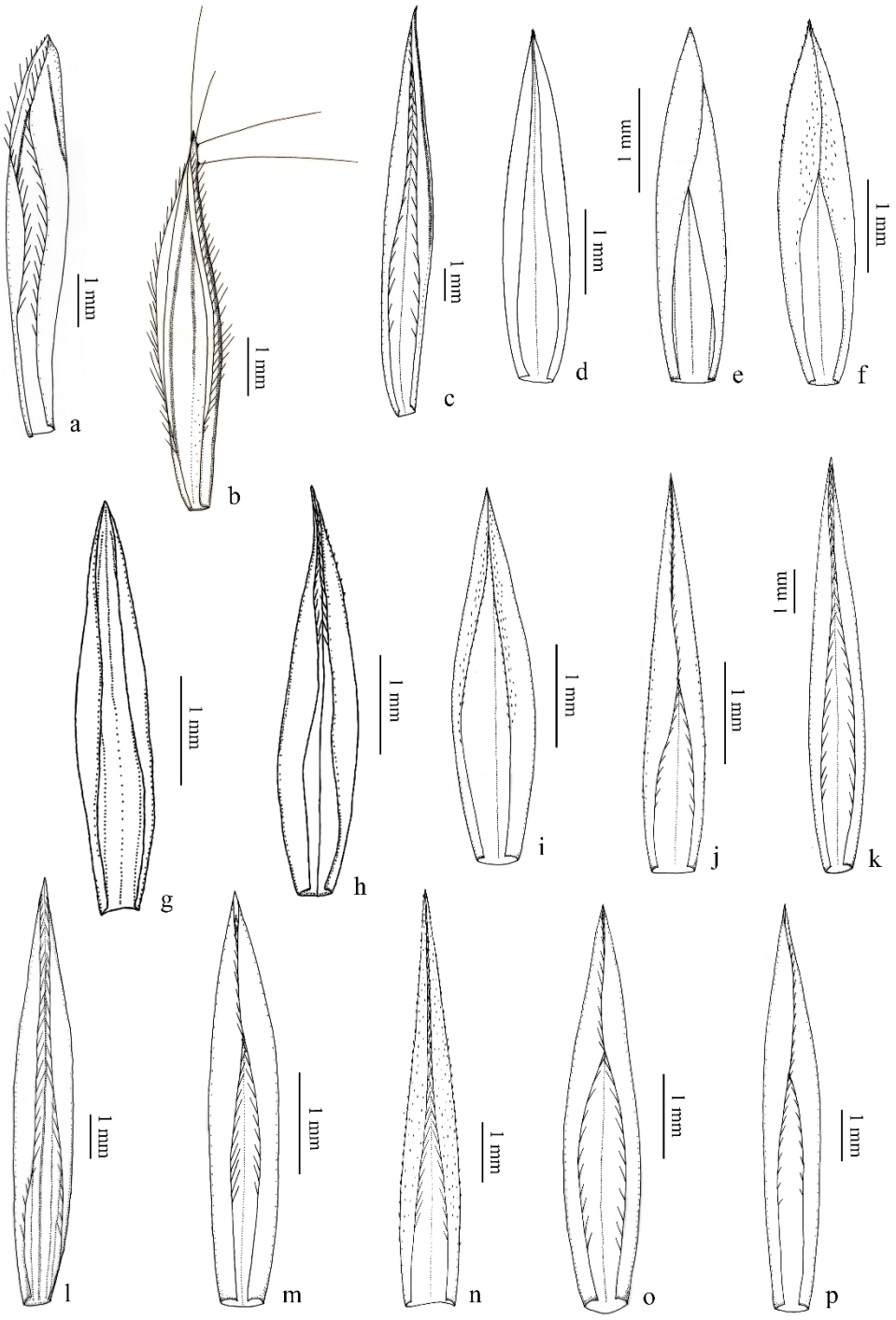

Fig. 211. Upper glume of pedicelled spikelet: **a.** *Agenium ritchiei* (Hook.f.) Drisya & Pradeep; **b.** *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.; **c.** *Heteropogon triticeus* (R.Br.) Stapf ex Craib; **d.** *Iseilema anthephoroides* Hack.; **e.** *Iseilema jainiana* P.Umam. & P.Daniel ; **f.** *Iseilema prostratum* (L.) Andersson; **g.** *Pseudanthistiria heteroclita* (Roxb.) Hook.f.; **h.** *Pseudanthistiria umbellata* (Hack.) Hook.f.; **i.** *Themeda cymbaria* Hack.; **j.** *Themeda laxa* (Andersson) A.Camus; **k.** *Themeda mooneyi* Bor; **l.** *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin.; **m.** *Themeda quadrivalvis* (L.) Kuntze; **n.** *Themeda sabarimalayana* Sreek. & V.J.Nair; **o.** *Themeda tremula* (Nees) Hack.; **p.** *Themeda triandra* Forssk.

Stamens

The number of stamens is three in all available southern Peninsular Indian members of Anthistiriinae and Ischaeminae. The number is found to be constant in all species.

Caryopsis

Morphologically, caryopsis of all southern Peninsular Indian taxa of Anthistiriinae and Ischaeminae are more or less similar. Thus, they have not that much role in distinguishing taxa.

Summary

The subtribes Ischaeminae and Anthistiriinae of the family Poaceae in southern Peninsular India is revised based on extensive field studies and by consulting herbarium specimens deposited at various Indian herbaria. The current treatment follows the modified classification by Clayton and Renvoize (1986). This study recognized four genera in Ischaeminae, *viz.*, *Apluda* L., *Ischaemum* L., *Sehima* Forssk. and *Thelepogon* Roth ex Roem. & Schult. Whereas six genera in Anthistiriinae from southern Peninsular India, *viz.*, *Agenium* Nees, *Heteropogon* Pers., *Iseilema* Andersson, *Parahyparrhenia* A.Camus, *Pseudanthistiria* (Hack.) Hook.f. and *Themeda* Forssk. Three names such as *Ischaemum lisboae* Hook.f., *Sehima ischaemoides* Forssk. and *Themeda arundinacea* (Roxb.) A.Camus were excluded from the present study. Since we were not able to collect the specimens from the study area as well as not able to trace any herbarium specimens previously collected from southern Peninsular India. Thus, out of the 37 species available, except *Parahyparrhenia bellariensis* (Hack.) Clayton, 36 were collected. This is the first comprehensive study on the taxonomy of Ischaeminae and Anthistiriinae in southern Peninsular India. The treatment provides a detailed taxonomic account including detailed description, illustration, information on phenology and distribution and taxonomic keys for easy identification.

Field exploration

Around 60 field trips were conducted during 2015 to 2023 and about 300 days were spent in the field. The southern Peninsular Indian states, Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana were extensively visited to collect live specimens and to study the distribution. In addition to these five southern Peninsular Indian states, few localities in Gujarat, Madhya Pradesh and Maharashtra were visited to collect and study some allied species of southern Peninsular Indian members. Type localities of almost all taxa were visited. Each taxon is collected with maximum available accessions to study the infraspecific variations and

distribution pattern. Herbarium of all collected specimens were prepared and deposited at Calicut University Herbarium (CALI).

Nomenclature

Nomenclature of each taxon is updated consulting original materials and protologues and by applying provisions laid out in Shenzhen Code (Turland *et al*., 2018). Specimens housed at various Indian Herbaria such as AHMA, BARO, BLAT, BSD, BSI, BSID, CAL, CALI, DD, FRC, LWG, MH, RHT, SUK and TBGT were also examined for understanding variation pattern and also for confirming the identification.

New synonyms recognized

A total of 20 new synonyms were recognized within the subtribes Ischaeminae and Anthistiriinae. In the genus *Ischaemum*, 17 new synonyms were recognized. *Ischaemum jayachandranii* R.Ansari, V.S.Ramach. & Sreek., *I. kasaragodensis* Dileep & G.G.Nair and *I. quilonense* Ravi & Shaju were found to be conspecific with *I. barbatum* Retz., and hence placed under its synonymy. *Ischaemum tadulingamii* N.C.Nair & Sreek. was placed under the synonymy of *I. commutatum* Hack. in A.L.P.P.de Candolle & A.C.P.de Candolle; *I. nairii* V.J.Nair & Sreek. and *I. sreenarayanii* Sunil, Nithya & Remya Kr. were synonymized under *I. molle* Hook.f.; *I. sunilii* Jabeena, Nithya, K.M.P.Kumar & Maya was placed under the synonymy of *I. rangacharianum* C.E.C.Fisch.; *I. pappinisseriense* Ravi, N.Mohanan & R.Rajesh under *I. rugosum* Salisb.; *I. calicutensis* Sreek., V.J.Nair & N.C.Nair, *I. copeanum* Sreek., V.J.Nair & N.C.Nair, *I. dalzellii* Stapf ex Bor, *I. keralensis* Sreek., V.J.Nair & N.C.Nair, *I. malabaricum* Sreek., V.J.Nair & N.C.Nair, *I. raui* Sreek., V.J.Nair & N.C.Nair, *I. ritchiei* Stapf ex Bor and *I. tumidum* Stapf ex Bor were placed under *I. semisagittatum* Roxb., and *I. raizadae* Hemadri & Billore under the synonymy of *I. kingii* Hook.f.

Whereas in the genus *Iseilema*, 2 new synonyms were recognized. The newly described species *I. kunhikannanii* K.C.Mohan, Y.Mahesh & K.Prasad was

found to be conspecific to *I. prostratum* (L.) Andersson, and *I. venkateswarlui* Satyavathi to *I. anthephoroides* Hack.

Similarly, *Pseudanthistiria burmanica* Hook.f. was recognized as the synonym of *P. umbellata* (Hack.) Hook.f.

Amended description

The protologue of *Iseilema prostratum* (L.) Andersson was amended by elaborating the plant description.

Lectotypification

A total of 22 names *viz.*, *Andropogon malacophyllus* Hochst. ex Steud., *A. pilosus* J.G.Klein ex Willd., *Anthistiria scandens* Roxb., *A. thwaitesii* Hook.f., *Apluda geniculata* Roxb., *Heteropogon triticeus* (R.Br.) Stapf ex Craib, *H. insignis* Thwaites, *Iseilema arguta* (Nees) Andersson, *I. hubbardii* Uppuluri, *I. venkateswarlui* Satyavathi, *I. wightii* (Nees ex Steud.) Andersson, *Pseudanthistiria heteroclita* (Roxb.) Hook.f., *P. hispida* Hook.f., *P. umbellata* (Hack.) Hook.f., *P. burmanica* Hook.f., *Sehima nervosa* (Rottler) Stapf, *Themeda ciliata* Hack., *Ischaemum ciliare* subvar. *scrobiculatum* Hack., *I. conjugatum* Roxb., *I. laxum* R.Br., *I. nilagiricum* Hack. and *I. semisagittatum* Roxb. were lectotypified.

New combination

A new combination *Agenium ritchiei* was made from *Heteropogon ritchiei* (Hook.f.) Blatt. & McCann, based on morphological characters.

Endemism

The study identified 10 species as being endemic to India. They are *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair, *I. kingii* Hook.f., *I. pushpangadanii* Ravi, N.Mohanan & Kiran Raj, *I. rangacharianum* C.E.C.Fisch., *I. travancorense* Stapf ex C.E.C.Fisch., *Iseilema anthephoroides* Hack., *Parahyparrhenia bellariensis* (Hack.) Clayton, *Themeda mooneyi* Bor, *T. palakkadensis* Chorghe, K.Prasad & Lakshmin. and *T. sabarimalayana* Sreek. &

V.J.Nair. Among these Indian endemics, 5 species namely, *Ischaemum cannanorensis* Sreek., V.J.Nair & N.C.Nair, *I. pushpangadanii* Ravi, N.Mohanan & Kiran Raj, *Parahyparrhenia bellariensis* (Hack.) Clayton, *Themeda palakkadensis* Chorghe, K.Prasad & Lakshmin. and *T. sabarimalayana* Sreek. & V.J.Nair were found to be strictly endemic to southern Peninsular India.

Chapter 8 Recommendations

A detailed taxonomic study of the subtribes Ischaeminae and Anthistiriinae of Poaceae in southern Peninsular India is presented here. Since, they constitute a highly complicated group in Andropogoneae, a comprehensive field based study is required. Most of the genera included under these subtribes are highly variable. So, a worldwide treatment on the genera treated under these subtribes are highly appreciable. A stable classification for the highly variable genus *Ischaemum* L. can only be attained by addressing all available species worldwide. To achieve this goal several regionwise intensive studies are essential.

It has been observed that cattle prefer to eat some species of *Ischaemum* (eg: *Ischaemum ciliare* Retz., *I. molle* Hook.f., *I. timorense* Kunth etc). Also, the species growing at high altitude shola grasslands (eg. *Ischaemum ciliare*, some species of *Themeda* Forssk.) play a crucial role in supporting wildlife. Besides, they provide important ecosystem services and support various economic activities such as livestock grazing, tourism and recreation.

Within the subtribes Ischaeminae and Anthistiriinae of southern Peninsular India, *Ischaemum* is found to be as the most variable genus. Many species of *Ischaemum* shows polymorphic characters. Therefore, it will be useful to study population genetics for the better understanding of adaptation and speciation of the taxa.

The present study is basically morphology based and some of the taxa included were found to be highly polymorphic and exhibits continuous variation and wide distribution. Hence, this study is incredibly important as it provide basic data on the identity, diversity, distribution and phenology of the taxa included in the subtribes Ischaeminae and Anthistiriinae of Poaceae. The data generated can be utilized for the sustainable management and conservation of grassland ecosystems, for evaluating grass species for biomass yield and to study relationships with

pollinators, herbivores and soil microbes. Here are some recommendations for future studies.

Recommendations for the future study

1. Molecular Phylogeney studies to confirm the taxonomic status and affinities of the species.

2. Molecular Dating studies to understand the biogeography, divergence and speciation of the taxa.

3. Anatomical studies: Anatomical investigations may help in comprehending how grasses grow and to understand adaptations. Such studies can also help in identifying structures that make certain grass species resistant or susceptible to pests and diseases. Anatomical studies can further provide insights into the structure and function of grass species which are crucial for addressing various environmental challenges.

4. Phytolith studies: Investigating the phytoliths of grasses can provide valuable insights into various fields including Palaeoecology, Archaeology, Agriculture and Environmental Science. It offers multidisciplinary approach to understanding the past environments, human history and modern agricultural challenges.

5. Assessment of IUCN status of species and conservation of rare as well as threated taxa.

6. Investigate the population genetics for the better understanding of adaptation and speciation.

7. Ecological studies to understand the role of various ecological parameters in determining the Character variations.

8. Ecological niche modelling.

9. To study the fodder grass values and palatability of the species.

10. Karyomorphological studies of Ischaeminae and Anthistiriinae.

11. Explore the ecological interactions between grass species and other organisms in their ecosystems.

12. Investigate how grass species are responding to climate change and explore strategies for managing grasslands to mitigate its impacts. This could involve studying change in phenology and distribution patterns.

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Appendix 1

List of Abbreviations

auct.	:	*auctorum* (of authors, used for a misapplied name)
auct. mult.	:	of multiple authors (used for a misapplied name)
ca.	:	*circa* (about)
cm	:	centimetre
comb.nov.	:	*combinatio nova* (new combination)
et al.	:	*et aliorum* (and of others)
hom.	:	homonym
Ibid.	:	*Ibidem* (in the same place)
l.c.	:	*loco citato* (in the place cited)
mm	:	millimetre
nom. illeg.	:	*nomen illegitimum* (illegitimate name)
nom. illeg. superfl.	:	*nomen illegitimum superfluum* (name that is illegitimate because it was nomenclaturally superfluous when published)
n.v.	:	*non vidi* (not seen)
nom. inval.	:	*nomen invalidum* (invalid name)
nom. nud.	:	*nomen nudum* (naked name)
p.p.	:	*pro parte* (in part)
pro syn.	:	*pro synonymo* (as a synonym)
s.coll.	:	*sine collectore* (without collector)
s.d.	:	*sine die* (undated)
s.n.	:	*sine numero* (without collection number)
s.l.	:	*sensu lato* (in a wide/broad sense)
s.loc.	:	*sine loco* (without locality)
sensu	:	in the sense of
syn. nov.	:	*synonymum novum* (new synonym)

Appendix II

Herbarium acronyms used

AHMA	:	Agharkar Research Institute, Pune, India.
BARO	:	Maharaja Sayajirao University Herbarium, Baroda, Gujarat, India.
BLAT	:	Blatter Herbarium, St. Xavier's College, Mumbai, India.
BM	:	Natural History Museum, London, England.
BR	:	Meise Botanic Garden Herbarium, Belgium.
BRIT	:	Botanical Research Institute of Texas, U.S.A.
BSD	:	Botanical Survey of India, Northern Regional Centre, Dehradun, India.
BSI	:	Botanical Survey of India, Western Regional Centre, Pune, India.
BSID	:	Botanical Survey of India, Deccan Regional Centre, Hyderabad, India.
BSJO	:	Botanical Survey of India, Arid Zone Circle, Jodhpur, India.
CAL	:	Central National Herbarium, Kolkata, India.
CALI	:	Calicut University Herbarium, Department of Botany, University of Calicut, India.
DD	:	Forest Research Institute, Indian Council of Forestry Research and Education, Dehradun, India.
E	:	Herbarium of Royal Botanic Garden Edinburgh.
FRC	:	Herbarium of Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu, India.
K	:	Herbarium of Royal Botanic Gardens, Kew, England, UK.
KFRI	:	Kerala Forest Research Institute, Kerala, India.
LINN	:	The Linnean Society of London, England, U.K.
LWG	:	Herbarium of CSIR-National Botanical Research Institute, Lucknow, India.
MEL	:	National Herbarium of Victoria, Royal Botanic Gardens

		Melbourne, Australia.
MH	:	Botanical Survey of India, Southern Regional Centre, Coimbatore, India.
P	:	Museum National d'Histoire Naturelle, Paris. France.
RHT	:	Rapinat Herbarium, St. Joseph's College, Thiruchirappalli, Tamil Nadu, India.
SUK	:	Shivaji University Herbarium, Kolhapur, Maharashtra, India.
TBGT	:	Herbarium of Jawaharlal Nehru Tropical Botanical Garden and Research Institute (JNTBGRI), Thiruvananthapuram, Kerala, India.
W	:	The Natural History Museum Vienna, Vienna, Austria.

Appendix III

Publications

1. **DRISYA V.** & A.K. PRADEEP (2021). Conspectus of the genus *Pseudanthistiria* (Poaceae: Andropogoneae) in India. *Rheedea* 31(4): 235–247. https://dx.doi.org/10.22244/rheedea

2. **DRISYA V.** & A.K. PRADEEP (2020). On reinstating *Heteropogon allionii* (Poaceae: Panicoideae). *Phytotaxa* 429 (2): 157–166. https://doi.org/10.11646/phytotaxa.429.2.6

3. **DRISYA V.** & A.K. PRADEEP (2019). Lectotypification of three names in the genus *Iseilema* (Poaceae). *Phytotaxa* 424 (1): 056–060. https://doi.org/10.11646/phytotaxa.424.1.5

Papers presented in national/international seminars

1. **DRISYA V.** & A.K. PRADEEP **(**2015). *Ischaeminae and Anthistiriinae (Poaceae) in Peninsular India: A preliminary appraisal*. Silver Jubilee Conference of IAAT and Council Meeting of IAPT & International Seminar on Advancements in Angiosperm Systematics and Conservation. 19–21 November, Department of Botany, University of Calicut, Kerala.

2. **DRISYA V.** & A.K. PRADEEP (2018). *Taxonomy of the genera Heteropogon and Pseudanthistiria (Poaceae) in Peninsular India*. XXVIII Annual Conference of Indian Association for Angiosperm Taxonomy & International Symposium on Conservation of Angiosperm Diversity: Hidden Treasure of Today and Tomorrow. 29–31 October, Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat.

3. **DRISYA V.** & A.K. PRADEEP (2019). *Diversity and distribution of Anthistiriinae (Poaceae) in Kerala*. MESMAC International Conference on People First? Man, Machine, Milieu.15–17 January, MES Mampad College (Autonomous), Mampad, Malappuram, Kerala.

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