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**The floristic treatment of the tribe Andropogoneae: Subtribes
Andropogoninae, Anthistiriinae and Saccharinae (Gramineae)
for the flora of Thailand**

Nanakorn, Weerachai, Ph.D. ,
City University of New York, 1990

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**THE FLORISTIC TREATMENT OF THE TRIBE ANDROPOGONEAE:
SUBTRIBES ANDROPOGONINAE, ANTHISTIBIINAE AND SACCHARINAE
(GRAMINEAE) FOR THE FLORA OF THAILAND**

by


WEERACHAI NANAKORN

A dissertation submitted to the Graduate Faculty in
Biology in partial fulfillment of the requirements for
the degree of Doctor of Philosophy, The City University
of New York.


1990


This manuscript has been read and accepted for the Graduate Faculty in Biology in satisfaction of the dissertation requirements for the degree of Doctor of Philosophy.

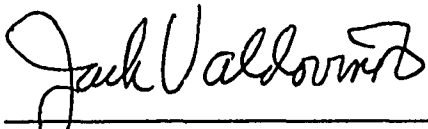
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Abstract**THE FLORISTIC TREATMENT OF THE TRIBE ANDROPOGONEAE: SUBTRIBES
ANDROPOGONINAE, ANTHISTIRIINAE AND SACCHARINAE (GRAMINEAE) FOR THE
FLORA OF THAILAND**

by

Weerachai Nanakorn

Advisor: Professor Tetsuo M. Koyama

The main purpose of this study is to prepare a taxonomic account of the tribe Andropogoneae (Gramineae) for the "Flora of Thailand". Three major subtribes Andropogoninae, Anthistiriinae and Saccharinae, presenting difficulties in the classification, were selected for the present study. Specimens of the studied taxa were all carefully dissected and studied, and both macro- and micro-morphological, geographical and ecological data were utilized for drawing the taxonomic conclusion. Fully described taxonomic accounts have been prepared for all the taxa that I recognized as valid, and selected species were illustrated by line drawings and macroscopic photographs so that the vegetative and floral parts are better shown. Within the whole tribe Andropogoneae, the study covers only a relatively small regional part. Therefore, no attempt has been made to discuss the relationships among the genera and subtribes. Being a floristic study, the effort of taxonomic research was focussed on the specific and infraspecific taxonomic levels and a large number of previously undetermined Thai specimens of the tribe were identified. As a result, a total of 73 species in 19 genera are

described. Keys to the Thai species are prepared and their nomenclatural problems have been solved. Four specimens: Adisai 995 (BK); Kerr 10133 (BK); Koyama et al. 15522 (NY); and Smitinand 8423 (BKF), are being studied separately as they may represent new taxa. The taxonomic study is based on the material collected from Thailand from the following herbaria: AAU, BK, BKF, GH, K, NY, UC, and US.

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I am grateful to the Directors, keepers and staff members of the following Institutions for permitting me to study the specimens at their herbaria during my visits: Botanical Institute, University of Aarhus, Denmark (AAU); Department of Agriculture, Bangkok (BK); The Forest Herbarium, Bangkok (BKF); Gray Herbarium, Harvard University (GH); Royal Botanic Gardens, Kew (K); The New York Botanical Garden, New York (NY); Department of Botany Herbarium, University of California at Berkeley (UC); and the United States National Herbarium, the Smithsonian Institution (US).

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1. INTRODUCTION.

1.1 Vegetation of Thailand

Thailand is situated at the center of continental Southeast Asia, above the equator in the latitudes between 7.6 - 23.3° N and in the longitudes between 97.5 - 106° E. The country's total area is 514,000 sq. km. Northern Thailand shares a border with Burma and Laos, and lies only 150 km from Yunnan province in southern China. The northeast and eastern parts of Thailand adjoin Laos and Cambodia, being separated from them by the Mae Kong river. The whole southwestern part of Thailand adjoins Burma, with the long Tanawstri mountain range acting as a huge natural boundary. Peninsular Thailand is almost surrounded by sea; only the southernmost part is bounded by Malaysia.

The vegetation of the Asian continent, particularly that of South and Southeast Asia, is affected directly by the influence of the Himalayan ridges, the Pacific ocean and the Indian ocean. These physiographic and climatographic conditions influence the different types of formation. The evergreen forest in mainland Southeast Asia ranges from Nepal, northern India, Bhutan, southern China, Burma, Thailand, Indo-China (Laos, Cambodia and Vietnam) to the Malay peninsula. The altitude at the roof of the world (8848 m.) decreases along mountain ranges emanating from the Himalayas. The ranges extending into Southeast Asia drop sharply in Nepal and gradually change in Burma and Thailand. The highest point in Thailand is 2562 m. in the North at Doi Inthanon and the elevation decreases to sea level in the peninsula.

The latest work on Thai vegetation is that of Smitinand (1987). In this publication the country is divided into seven floristic regions: the Northern, the Northeastern, the Eastern, the Central, the Southeastern, the Southwestern, and the Southern or the Peninsular (Figure 1).

The latest national survey of Thailand's forest areas was made in 1982 from Land-Sat. images and rechecked by ground survey. The result indicated that Thailand has approximately 17 % of forest cover. The figure also included approximately 4 % occupied by rubber plantations, orchards and forest plantation.

1.2 Climatic factors

The climate in Thailand is influenced by the monsoons from the Pacific and the Indian oceans, modified largely by regional topography, especially the Himalayas ridges. It is characterized by seasonal winds, blowing from North and North-West of the continent during the winter months and from the Pacific and Indian oceans in the opposite direction during the remainder of the year. These factors produce the three seasons in Thailand:

1. Winter Season, lasts from mid-November to January. The regular occurrence of a cold front, reaching Thailand via central China from Mongolia in the northwestern part of the continent, plays a dominant role, particularly in the northern and northeastern parts of the country. The weather is cool and dry; the coolest period is during December-January, varying from 6-16 °C. The coolest spots are in northern Thailand at the top of Doi Inthanon, Chiang Mai, alt. 2400-2500 m. where the minimal temperature varies from 1 to -2 °C, and

in northeastern Thailand at Phu Luang Wildlife Sanctuary, at 1800 m. where the minimum varies from 4 to -1 °C.

2. Dry Season, March to June. The weather is dry and hot; the hottest period is in May, with the average temperature varying from 26-36 °C. This period is usually without monsoon or variable winds. The hottest area is in the eastern part of the country on Korat plateau in Nakhon Ratchasima province, where the averages maximum temperature 35-45 °C.

3. Rainy Season, June to November. The weather is humid; the temperature is quite stable between 17 and 25 °C. The average rain fall is about 1500 to 2000 mm/year. Peninsular Thailand is situated between the Andaman sea of the Indian ocean and the South China sea of the Pacific ocean. During May to October, the climate is directly affected by the southwest monsoon from the South China sea and during October to November by the southeast monsoon from the Andaman sea. Ranong province, which is located between these two oceans, receives the direct effect of the monsoons and experiences the maximum rainfall recorded in Thailand, averaging 4500 mm/year.

High mountainous ranges, e.g. Doi Inthanon in northern Thailand, Phu Luang and Phu Kradueng in the northeast, and Khao Tanawsri in the southwest, obstruct and change the direction of winds and precipitation. These effect the floristic composition and vegetation types of the whole country.

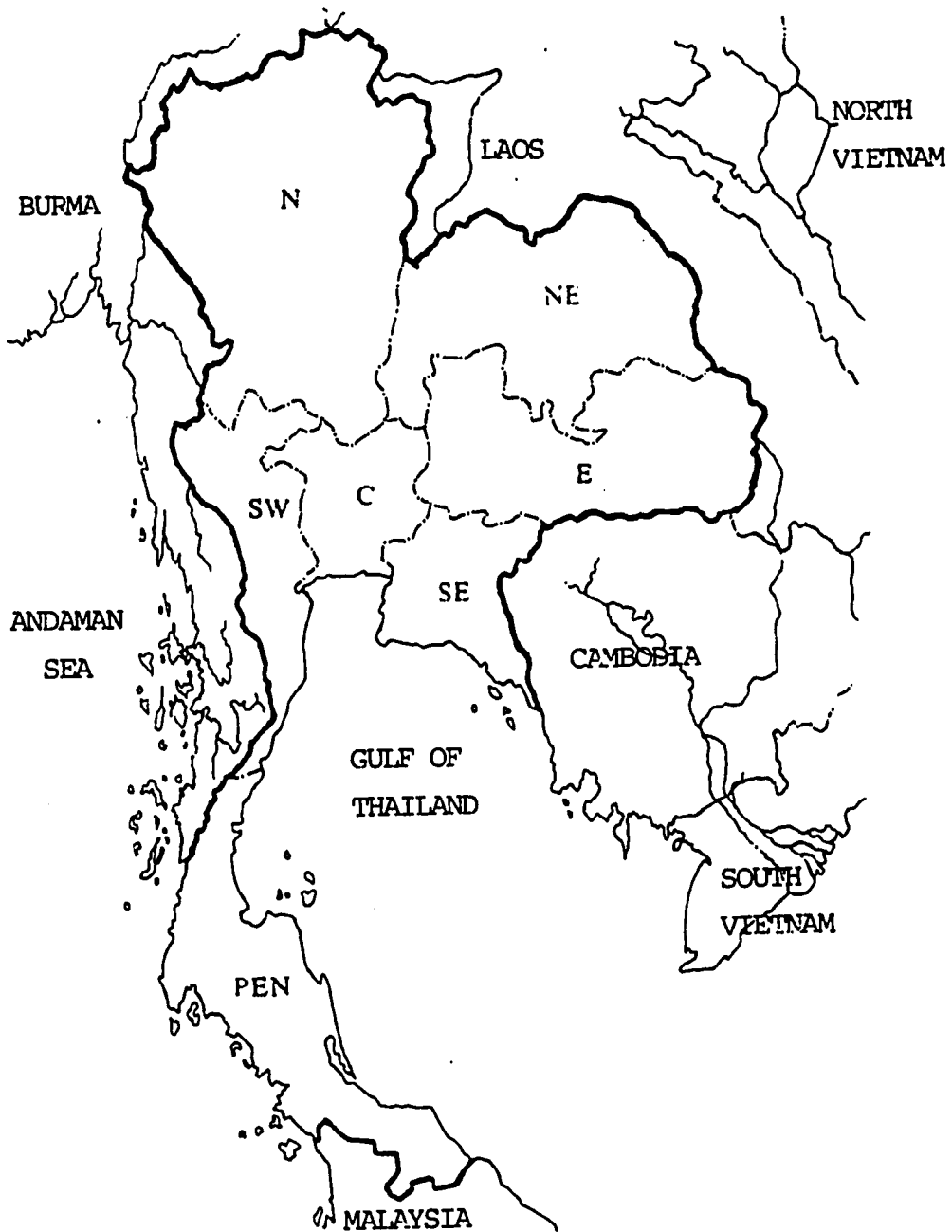


Figure 1. Floristic regions of Thailand

1.3 Geographical remarks

Many geographical names in Thai are to be found on maps and in publications, including this work. Below are a list of the most common spellings of some Thai words occurring in geographical names.

Amphur	=	county, usually omitted before the place name i.e. Amphur Chiang Dao = Chiang Dao.
Ban	=	house, village
Chiang	=	town (northern)
Doi	=	mountain (northern)
Huay or huai	=	stream
Khao	=	mountain
Klong	=	canal
Koh	=	island
Kwae	=	small river
Menam	=	river
Mueng	=	county capital, usually omitted before the place-name i.e. Mueng Fang = Fang
Noi	=	little, small
Phu	=	mountain (northeastern)
Thale	=	sea
Thale sap	=	lake
Yaa, Yah	=	grass
Yai	=	big, large

1.4 Botanical activities in Thailand

The establishment of the Royal Forest Department in 1896 resulted in the commencement of the conservation of the forest areas and the study on the Thai flora particularly the species of commercial and economic value. The first record on botanical exploration in Thailand had occurred earlier during 1778-1779 by J.G. Koenig, a leading Danish botanist. Unfortunately, the majority of his collection was lost in transit to Copenhagen, Denmark.

The seminal study of the Thai flora was performed by Dr. A.F.G. Kerr and Professor W.G. Craib from 1911-1940. Kerr gathered a valuable collection of about 23,500 specimens from all over Thailand, while Craib made identifications of these specimens at the Royal Botanic Gardens, Kew, in England. A main set of Kerr's collection is deposited at the Herbarium, Department of Agriculture (BK), in Thailand and another set at Kew (K). *Florae Siamensis Enumeratio* was edited by Craib and Kerr in 3 volumes from 1925 to 1962.

Important progress in the study of the Thai flora was initiated in 1955 under the Thai-Danish Flora of Thailand Project. Field expeditions were undertaken intensively during 1957-1960 by Th. Sorensen, K. Larsen and B. Hansen from Denmark and His Excellency, the Ambassador of Denmark to Thailand, Gunnar Seidenfaden. This work was carried out in cooperation with leading Thai botanists Dr. Tem Smitinand, of the Royal Forest Department, and Professor Kasin Suvatabandhu, of the Department of Botany, Chulalongkorn University. These activities contributed approximately 15,000 herbarium specimens, including preserved specimens in alcohol and living material. A

series of botanical papers on taxonomical floristic and ecological topics comprising the results of the expeditions undertaken during 1957-1963 were published in the *Natural History Bulletin of the Siam Society* and the *Dansk Botanik Arkiv*.

The famous Thai botanist, Dr. Tem Smitinand has made over 20,000 collections since he began his work at the Botanical Section, Royal Forest Department, in 1940. A complete set of his specimens is deposited at the Forest Herbarium (BKF), Thailand, and other sets were distributed to the Royal Botanic Gardens, Kew and the Herbarium of the Botanical Institute, Aarhus University (AAU), Denmark.

Contemporary botanical activities primarily have been the work of the botanists of the Forest Herbarium, Royal Forest Department, namely C. Phengkklai, T. Santisuk, C. Niyomdham and W. Nanakorn. In 1990, there are about 95,000 specimens, mainly of Thai wild species, deposited at the Forest Herbarium in Bangkok. It is estimated that the Thai flora has about 23,000 species belonging to the natural vegetation.

2. HISTORICAL REVIEW

2.1 Studies on indigenous Gramineae in Thailand

The first major comprehensive study of Asian Gramineae was accomplished by Sir Joseph Hooker (1897), in his *Flora of British India*. Standard works by other botanists related to the Asian grass flora include: E.G. Camus and A. Camus (1912-1923), *Gramineae of Indo-China (Laos, Cambodia and Vietnam) in Flore Generale de l'Indo-Chine*; Ridley (1925), *Flora of the Malay Peninsula*; Keng (1933), *Grasses of China*; Rhind (1945), *The grasses of Burma*; Bor (1960), *The Grasses of*

Burma, Ceylon, India and Pakistan; Ohwi (1965), *Flora of Japan*; Froideville (1968), in Becker and Bakhuizen van Den Brink, *Flora of Java*; Gilliland (1971), *Flora of Malaya*; Tsvelev (1976), *Grasses of the Soviet Union*; Hsu (1978), *Flora of Taiwan*; Lazarides (1980), *The Tropical Grasses of Southeast Asia* and T. Koyama (1987), *Grasses of Japan and its Neighboring Regions*.

Since 1778, a total of approximately 116,000 specimens have been collected from Thailand (Smitinand, 1989), of which approximately 10,000 specimens are Gramineae. In the past all of these grass specimens were sent to the Royal Botanic Gardens, Kew in England for the identification by Dr. N.L. Bor (Bor, 1962). The studies of the Gramineae of Thailand were made in many small parts corresponding to the identified specimens gathered at Kew at each interval.

It was Craib (1913), who first published *Contributions to the Flora of Siam (Monocotyledons)*, which listed species and cited specimens mainly collected by Dr. A.F.G. Kerr during 1907-1913; and later Craib & Kerr (1932-1939) published a series of *Flora Siamensis Enumeratio*. Since then all international activities were diminished due to the second World War and the death of the authors. The Thai-Danish Botanical Projects carried over in 1957 have inspired the study on the Thai flora. Specimens collected in these expeditions were identified and species were published in parts in *Dansk Botanisk Arkiv (Studies in the Flora of Thailand)*, Bor (1962, 1965) and Larsen (1963). Starting from this point, the Thai government has realized the importance of floristic studies. Consequently, the *Flora of Thailand* project was initiated in 1970 and is still on-going.

At present botanical expeditions are arranged regularly by the cooperation of the Thai and foreign botanists. The study of certain families has been performed through the cooperation of specialists from the main herbaria all over the world: Orchidaceae by G. Seidenfaden and T. Smitinand; Leguminosae and Zingiberaceae by K. Larsen; Cyperaceae by T. Koyama; Palmae by J. Dransfield; Dipterocarpaceae by T. Smitinand and J. Vidal; Pteridophytes by staff taxonomists, Kyoto University, Japan etc. However, taxonomic studies in Thailand proceed quite slowly as there are only a few well-trained botanists, references and type specimens are insufficient, and the collection of Thai regional flora in many families are still inadequate for the study. Prior to this study, little attention has been paid to the grasses of Thailand. The identification, geographical distribution and economic uses of grasses from Thailand have come from the literature of neighboring countries.

2.2 Anatomical studies

The structure of the grass leaf in general is determined by the longitudinal vascular bundles, and its tissues are arranged as a module around each bundle. In addition to chlorenchyma, these tissues usually include sclerenchymatous girders to give mechanical strength, and a number of colorless thin-walled cells termed bulliform cells in the epidermal layer, and motor cells in the mesophyll. The photosynthetic apparatus consists of the chlorenchyma cells of the mesophyll and two sheaths surrounding the vascular bundle. The inner sheath is of small thick-walled cells corresponding to an endodermis and derived from the vascular tissues; the outer sheath is of large

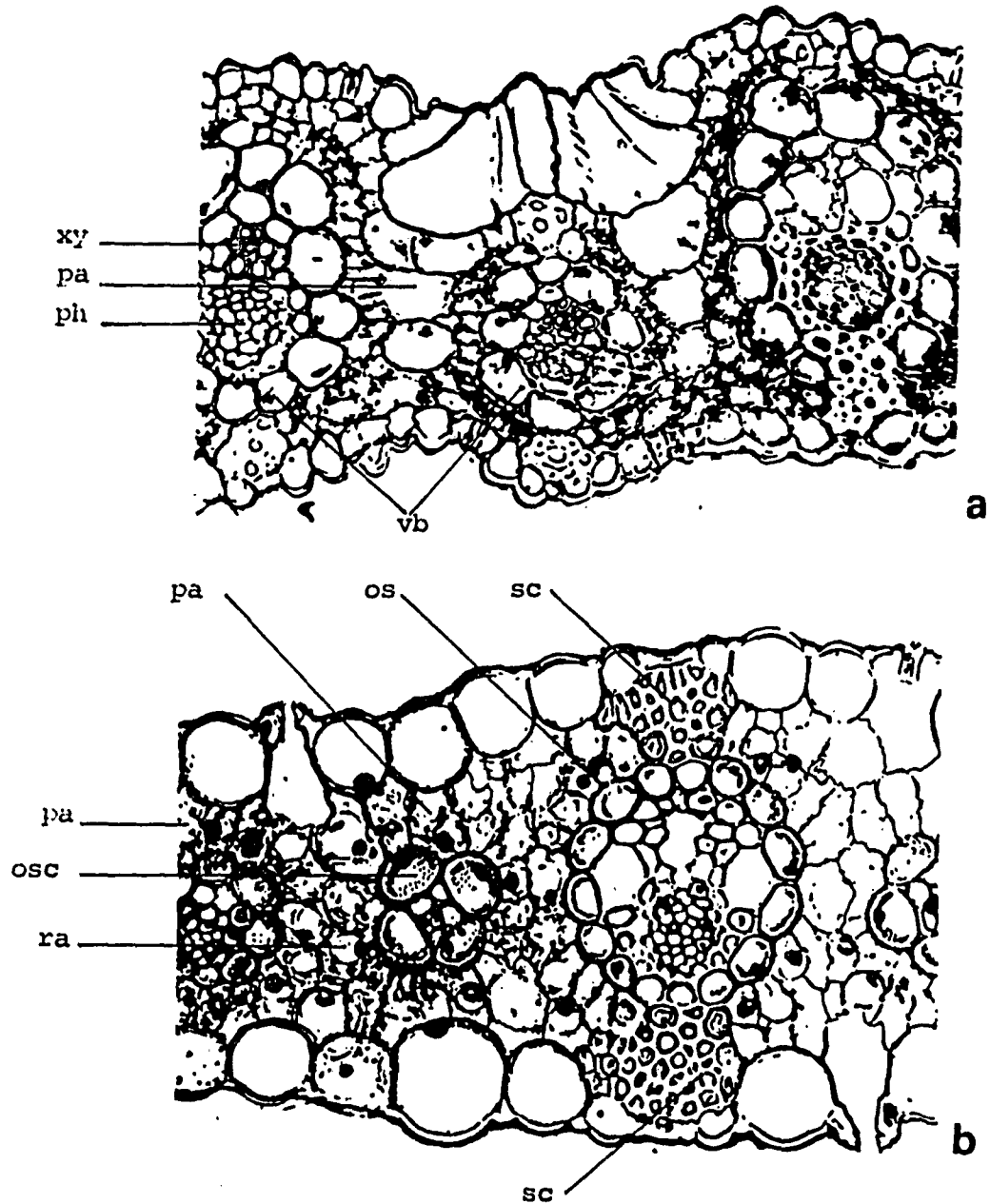


Figure 2. Leaf anatomy: transverse sections of grass leaf
 A. *Imperata cylindrica* (Andropogonoid type) x 250
 B. *Eremochloa bimaculata* (Andropogonoid type) x 400;
 pa, parenchyma; ph, phloem; ra, radially disposed mesophyll
 cells; os, outer vascular bundle sheath without chloroplast;
 osc, outer vascular bundle sheath containing chloroplast sc,
 sclerenchyma; vb, vascular bundle; xy, xylem;
 (from Clifford & Watson, 1977).

thin-walled parenchyma cells originating in the mesophyll (Clayton & Renvoize, 1986).

Brown & Emery (1958) recognized six types of anatomical feature in leaf-blades of the Gramineae: Festucoid, Bambusoid, Panicoid, Chloridoid, Aristidoid and Arundinoid types. Each type has a unique shape and arrangement of mesophyll cells, sclerified cells, chlorenchyma, parenchyma and vascular bundle.

The Andropogoneae belong in the Panicoid type. Leaf-blades of the Panicoid type have their vascular bundles surrounded by a well-developed outer parenchyma sheath, of which the component cells usually contain large chloroplasts for starch production and storage, thus constituting the Kranz-type (German for wreath, referring to the prominent sheath cells) leaf anatomy. The inner bundle sheath is poorly developed with the component cells not markedly sclerified, or nearly wanting. The chlorenchymatic cells are densely packed and those around the vascular bundles tend to be more or less radially disposed (Koyama, 1987). Figure 2

2.3 Palynological studies

The palynological studies carried out so far in the Gramineae have demonstrated that the pollen grains are of the wind-pollinated type: simple, spheroid to ovoid in shape, 1-porate aperturate, the exine surface generally pilate or simple reticulate, and with a size range from 10-100 microns (Faegri and Iversen, 1964; Sharma, 1967; Nair, 1970; Erdtman, 1971; Dahlgren et al., 1985; Clayton & Renvoize, 1986 and Soderstrom et al., 1987).

The pollen grains of the Gramineae are very small, light

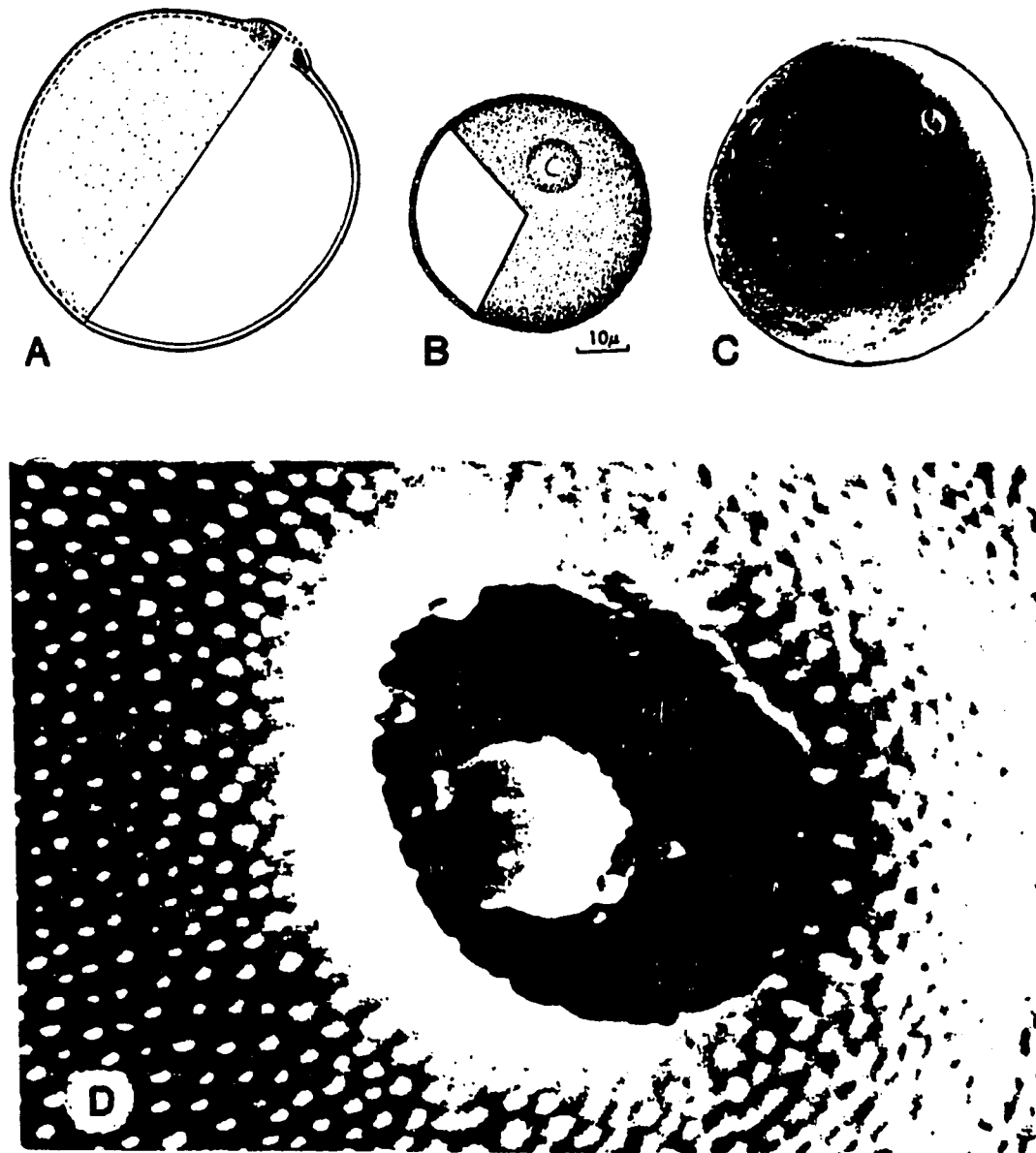


Figure 3. Pollen morphology

A. General diagram of grass pollen grain B. pollen diagram of *Agropyron cristatum* (Gramineae) C. Pollen grain of *Triticum aestivum* (Gramineae) x 800 D. SEM micrographs of aperture with operculum, of *Zea mays* (Gramineae) x 10,000 (from Iwanami et al., 1983).

and very simple. The character of pollen morphology in Gramineae is of little significance, and therefore only important at the family level. Palynological observations in the Andropogoneae have been determined to be valuable for the intra-tribal classification of taxa (Clayton & Renvoize, 1986). Figure 3.

2.4 Cytological studies

Cytological data play a very important role in the understanding of phylogeny and taxonomy in plant taxa, especially in Gramineae. However, chromosome counts can be made only from fresh material. It is very difficult in the field to make specially prepared material from root tips or anthers. It also takes much time to germinate the collected viable seeds in the greenhouse for replication treatments, which is considered mandatory for cytological studies. Cytological work in the treatment of a large group of Gramineae is, therefore, an immense undertaking.

The Gramineae are wind-pollinated and the family is among the most widely distributed family of vascular plants. Grasses have very specialized adaptations enabling them to grow in various habitats. There are many intermediates occurring in nature because of hybridization. Variation in chromosome number within a single species is also common in Gramineae.

Data on the chromosome numbers of some Thai Gramineae are available from the studies by Price (1959) and Larsen (1963). Larsen collected material from Thailand for cytological studies during the Thai-Danish expedition in 1958 and voucher herbarium specimens were sent to Kew for determination by Dr. N. L. Bor. In addition,

cytological studies in Gramineae of neighboring countries, mostly India, are also available i.e.; Audulov (1928); Brown (1948); Darlington & Wylie (1956); Celarier (1956-57); Tateoka (1954-65); Bor (1960) and Hunziker & Stebbins (1989). This data is compiled below.

**STATUS OF CYTOLOGICAL STUDIES IN THE THAI ANDROPOGONEAE
(SUBTRIBE ANDROPOGONINAE, ANTHISTIRIINAE, AND SACCHARINAE)**

* refers to reference cited

Subtribe Andropogoninae

Andropogon ascinodis	2n = 40	* Olorode, 1974
A. burmanicus		
A. distichus		
A. fastigiatus	2n = 20 2n = 20	Larsen, 1963 Moffet & Harcombe, 1949
A. polyptichus		
Arthraxon castratus	2n = 18 2n = 36 n = 8	Larsen, 1963 Gould & Soderstrom, 1974 Welzen, 1981
A. hispidus	2n = 36 2n = 36, 40	Tateoka, 1953 Fedorov, 1969
A. lanceolatus	2n = 36 n = 8 2n = 16, 20, 30 & 36	Fedorov, 1969 Welzen, 1981 Kumar & Subramanium, 1987
A. lanceolatus var. meeboldii	2n = 18, 20	Kumar & Subramanium, 1987
A. lancifolius	n = 10 2n = 18, 36	Welzen, 1981 Kumar & Subramanium, 1987
A. microphyllus		

Cymbopogon annamensis**C. calcicola****C. calciphilus****C. cambogiensis**

C. citratus	2n = 40, 60	Senaratna, 1956
	2n = 40, 60	Bor, 1960
	2n = 60	Soenarko, 1977
	2n = 40, 60	Kumar & Subramanium, 1987

C. clandestinus

C. flexuosus	2n = 20, 40	Bor, 1960
	2n = 20, 40	Soenarko, 1977
	2n = 20, 30, 40 & 60	Kumar & Subramanium, 1987

C. khasianus	2n = 60	Soenarko, 1977
	2n = 20, 60	Kumar & Subramanium, 1987

C. martinii	2n = 20, 40	Soenarko, 1977
	2n = 20, 40	Kumar & Subramanium, 1987

C. microstachys	2n = 30	Kumar & Subramanium, 1987
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C. nardus	2n = 20	Senaratna, 1956
	2n = 20	Bor, 1960
	2n = 40	Soenarko, 1977
	2n = 20, 40 & 60	Kumar & Subramanium, 1987

C. nardus var. confertiflorus	2n = 60	Soenarko, 1977
	2n = 20, 30, 40 & 60	Kumar & Subramanium, 1987

C. traninhensis

C. winteranus	2n = 20	Kumar & Subramanium, 1987
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Schizachyrium brevifolium	2n = 20, 40	Fedorov, 1969
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	2n = 20, 40	Kumar & Subramanium, 1987
<i>S. exile</i>	2n = 20, 40	Olorode, 1974
<i>S. sanguineum</i>	2n = 30, 50 2n = 40, 50 & 80	Bor, 1960 Kumar & Subramanium, 1987

Subtribe Anthistiriinae

<i>Heteropogon contortus</i>	2n = 20 2n = 40 2n = 40 2n = 20, 44, 60 2n = 40 2n = 20-90	Senaratna, 1956 de Wet, 1958 Emery & Brown, 1958 Bor, 1960 Larsen, 1963 Kumar & Subramanium, 1987
<i>H. triticeus</i>	2n = 22-60	Kumar & Subramanium, 1987
<i>Hyparrhenia diplandra</i>	2n = 20	Clayton, 1969
<i>H. newtonii</i>	2n = 40	Moffet & Hurcombe, 1949
<i>H. nyassae</i>	2n = 20 2n = 40	Tateoka, 1965 Celarier & Harland, 1957
<i>H. rufa</i> var. <i>siamensis</i>		
<i>Iseilema siamensis</i>		
<i>I. thorelii</i>		
<i>Parahyparrhenia siamensis</i>		
<i>P. tridentata</i>		
<i>Pseudanthistiria burmanica</i>		
<i>Themeda arguens</i>	2n = 20	Bor, 1960
<i>T. arundinacea</i>	2n = 60 2n = 22, 40 & 60	Larsen, 1963 Kumar & Subramanium, 1987

<i>T. caudata</i>		
<i>T. quadrivalvis</i>	2n = 40 2n = 40, 60 & 80	Bor, 1960 Kumar & Subramanium, 1987
<i>T. triandra</i>	2n = 30 2n = 60 2n = 20, 30, 40, 50, 60, 70 & 80 2n = 20, 40, 60, 70 & 80	Larsen, 1963 Senaratna, 1956 de Wet, 1960 Bor, 1960
<i>T. villosa</i>	2n = 32	Gould & Soderstrom, 1974

Subtribe Saccharinae

Eulalia bicornuta

E. contorta

E. irritans

E. leschenaultiana

E. monostachyus

E. quadrinervis

2n = 40
Kumar & Subramanium,
1987

E. siamensis

2n = 50
Larsen, 1963

E. smitinandiana

E. speciosa

2n = 40
Kumar & Subramanium,
1987

E. trispicata

2n = 18, 20
Kumar & Subramanium,
1987

Eulaliopsis binata

2n = 20, 24
Kumar & Subramanium,
1987

Imperata cylindrica

2n = 20
2n = 20
2n = 20
2n = 20
2n = 20

Larsen, 1963
Janaki Annal, 1941
Takeoka, 1954
Senaratna, 1956
Fedorov, 1969

	2n = 20, 40, 52 & 60	Kumar & Subramanium, 1987
<i>I. conferta</i>	2n = 20	Gabel, 1982
<i>Microstegium ciliatum</i>	2n = 40, 60 & 72	Kumar & Subramanium, 1987
<i>M. delicatulum</i>		
<i>M. petiolare</i>	2n = 20	Kumar & Subramanium, 1987
<i>M. vagans</i>	2n = 20, 60 & 80	Kumar & Subramanium, 1987
<i>M. vagans var. scandens</i>		
<i>Miscanthus fuscus</i>	2n = 48, 96 2n = 30, 48 & 96	Bor, 1960 Kumar & Subramanium, 1987
<i>Pogonatherum crinitum</i>	2n = 20	Tateoka, 1956
<i>P. paniceum</i>	2n = 20, 40	Kumar & Subramanium, 1987
<i>Polytrias amaura</i>	2n = 20	Larsen, 1963
<i>Saccharum arundinaceum</i>	2n = 40, 60 2n = 40, 60 2n = 40, 60	Senaratna, 1956 Koyama, 1987 Kumar & Subramanium, 1987
<i>S. longisetosum</i>	2n = 30	Larsen, 1963
<i>S. officinarum</i>	2n = 80 2n = 40	Senaratna, 1956 Koyama, 1987
<i>S. porpyrocoma</i>	2n = 30	Kumar & Subramanium, 1987
<i>S. rufipilum</i>	2n = 20	Kumar & Subramanium, 1987
<i>S. spontaneum</i>	2n = 54-128 2n = 80-96	Senaratna, 1956 Price, 1959

2n = 48-128	Bor, 1960
2n = 100	Larsen, 1963
2n = 56	Koyama, 1987
2n = 40, 172	Kumar & Subramaniam, 1987

Spodiopogon lacei

2.5 Evolution and phylogeny

According to Dahlgren & Rasmussen (1983) the origin of the grasses is obscure, for whatever link existed with the rest of the monocotyledons is now extinct, and there is little evidence to indicate the nature of their common ancestor. The most closely related, extant relatives of grasses belong to a group of six families: Anarthriaceae, Centrolepidaceae, Ecdeiocolaceae, Flagellariaceae, Joinvilleaceae and Restionaceae. They are related by morphological similarities, pollen type, and chemical data from alkaloids, protein sequences, enzymes and DNA. These small families grow in the Southern Hemisphere, but their fossils are widespread in the Northern Hemisphere as well. These six families and the Gramineae have been placed in the Poales by Dahlgren et al. (1985).

Clayton & Renvoize (1986) state that the Andropogoneae is a well-defined, monophyletic tribe. The characters for the tribe are uniform and its relationships within the Gramineae are reasonably clear, but the lack of sharp boundaries between subtribes and between genera is a source of difficulty. The taxonomy of many genera is still confused, and more information is needed for a better understanding of the tribe.

There have been a number of phenetic analyses of the Gramineae i.e. Clifford et al. (1969), Hilu & Wright (1982), Macfarlane & Watson (1982), and Kellogg & Campbell (1987). Most of these attempts to study the phylogeny of the Gramineae only attempted a partial treatment. Considerable work still needs to be done to come to a complete relationships within Gramineae and between the Gramineae and related families.

The phylogenetic relationships among the subtribes could not easily be drawn, as the boundaries are often overlapping, many links are missing, and the base of each line could not be traced. However, a simple diagram showing suggested evolution of selected genera in the Andropogoneae based on reproductive characters of the inflorescence and their spikelets has been presented by Clayton & Renvoize (1986).

3. ECONOMIC IMPORTANCE OF GRASSES IN THAILAND

The Gramineae is one of the largest and most widespread of the families of flowering plants. Members of the Gramineae have economic importance, especially for their consumption as food, fodder and forage, essential oils, use in paper making, lawn and ornamental plantings, as soil binders and moisture conservers, medicinals, and miscellaneous and local domestic uses. In Thailand, major examples of human and animal food are rice, *Oryza sativa*; maize, *Zea mays*; millet, *Sorghum vulgare*; sugar cane, *Saccharum officinarum*; Job's tears, *Coix lacryma-jobi*. The genera *Arthraxon*, *Bothriochloa*, *Chrysopogon*, *Coix*, *Dichanthium*, *Schizachyrium* and *Sorghum* are reported to be excellent

fodder-grasses (Roshevits, 1931; Arber, 1965).

Grassland is importance in terms of ecology, biotic factors and vegetation. In Thailand, natural grasslands are mostly occupied by lalang, *Imperata cylindrica*, which is considered to be one of the most aggressive weeds and wild cane, *Saccharum spontaneum*, commonly exposed in wet areas, while elephant's eyelashes grass, *Themeda triandra* and *Hyparrhenia diplandra* are commonly found in moist places in open area and by the edge of the dry-dipterocarp forest.

A number of species in the genera *Bothriochloa*, *Capillipedium*, *Cymbopogon* and *Vetiveria* are sources of aromatic oils (Stapf, 1906). The most important are lemon grass and citronella in the genus *Cymbopogon* which contain diverse aromatic compounds differing considerably in scent. These species are used in the flavor and perfume industries. *Cymbopogon citratus* and *C. martinii* are used for food and food flavoring and are also a good source of ginger-grass oil and palmarosa oil.

Species of coarse grasses yield fibers and cellulose suitable for paper making or mixtures for pulp, as seen in *Bothriochloa intermedia*, *Cymbopogon nardus*, *Eulaliopsis binata*, *Heteropogon contortus*, *Imperata cylindrica*, *Saccharum officinarum*, *S. spontaneum* and *Vetiveria zizanoides*. However, the fiber length in paper pulp produced from these species are too short and inferior in strength compared with fibers obtained from other material such as pine and bamboo (Bhat & Karnick, 1952; Bor, 1960).

The common species *Chrysopogon aciculatus*, *Dichanthium annulatum*, *Polytrias amaura* and *Imperata cylindrica* are planted as lawn grasses,

but they grow extremely fast hence requiring frequent cutting. Soil binding species are commonly planted along roadsides and stream banks in Thailand to prevent erosion caused by heavy rainfall. Perennial species such as *Chrysopogon aciculatus*, *Dichanthium annulatum*, *Hyparrhenia rufa* var. *Siamensis*, *Imperata cylindrica*, *Ischaemum muticum* and *Saccharum spontaneum* are good soil binders because their clumps, rhizomes and stolons effectively hold soil.

Imperata cylindrica and *Saccharum spontaneum* are among the most common weeds in Thailand. Both are fire resistant, with thick rhizomes which makes them difficult to eradicate. They produce a huge number of light fruits with wooly hairs to be easily carried away by wind. Love grass, *Chrysopogon aciculatus* is also a common weed, the sharp awned fruits are easily and firmly attached to animals for dispersal. *Hyparrhenia rufa* var. *siamensis* is now becoming a roadside weed in northern Thailand at high elevation.

Other grasses are used for miscellaneous applications such as local medicines, building materials, and handicrafts. Few species in the Andropogoneae are used as local medicine. The most common one is *Cymbopogon nardus* which has long been well-known for its effectiveness in comforting stomach and intestinal problems (Burkill, 1966).

Imperata cylindrica is commonly used as weaving and binding material for making roofs and walls for huts. The hard fruits of *Coix lacryma-jobi* are used by the hill tribes of Northern Thailand for food and for their decorative value in earrings, necklaces, pendants and wristlets.

4. SCOPE AND CLASSIFICATION SYSTEM FOR THE STUDY ON THE THAI GRAMINEAE

4.1 Scope of the study

The Andropogoneae consisting of 15 subtribes. In this work the three main subtribes comprising nineteen genera were studied. They are: *Andropogon*, *Arthraxon*, *Cymbopogon*, and *Schizachyrium* of *Andropogoninae*; *Heteropogon*, *Hyparrhenia*, *Iseilema*, *Parahyparrhenia*, *Pseudanthistiria*, and *Themeda* of *Anthistiriinae*; and *Eulalia*, *Eulaliopsis*, *Imperata*, *Microstegium*, *Miscanthus*, *Pogonatherum*, *Polytrias*, *Saccharum*, and *Spodiopogon* of *Saccharinae*.

Herbarium specimens collected from Thailand were examined to determine the species and to record the collectors, localities, ecology, distribution, local names and morphological observations. The specimens were from the following herbaria (Herbarium codes are cited according to Holmgren et al., 1981).

AAU: Botanical Institute, University of Aarhus, Denmark;

BK: Department of Agriculture, Bangkok;

BKF: The Forest Herbarium, Bangkok;

GH: Gray Herbarium, Harvard University;

K: Royal Botanic Gardens, Kew;

NY: The New York Botanical Garden, New York;

UC: Department of Botany Herbarium, University of California at Berkeley;

US: United States National Herbarium, Smithsonian Institution.

Besides the specimens from the major herbaria, about 200 specimens of the rarer species and additional material for microscopic study were collected in the field in Thailand in 1988 and 1989.

4.2 Classification system selected for the study

There have been many classification systems of the Gramineae including those of: A.L. de Jussieu (1789), P. Beauvois (1812), C.B. Trinius (1839), Bentham & Hooker (1883), Stapf (1934), C.E. Hubbard (1948), R. Pilger (1954), Bor (1960), A. Engler (1964) and Clayton & Renvoize (1986).

In this work, taxa have been arranged to genera according to the classification system of Clayton & Renvoize (1986). The system treats Gramineae to the genus level on a worldwide basis. The Andropogoneae appears as a somewhat modified version of the standard work of Stapf (1934) and Bor (1960). The generic concepts are not much changed but regrouped into many smaller subtribes, according to the phylogenetic relationship among them, reflecting the present knowledge on grass research delivered from morphology, anatomy, cytology, phytochemistry and the present availability of more material for the study.

Specifics information are provided from the specimens collected from Thailand and from major taxonomic literature quoting Thai material. The identification of species and keys to the species of the Thai Andropogoneae was formed mainly based on similarities and differences in the micro-morphological characters obtained from the microscopic studies and partly from the characters evaluated in the major regional floras: Camus & Camus (1922), Bor (1960), Gilliland (1971), and T. Koyama (1987).

Terminology used in describing the Gramineae in this work follows A. Chase (1959) and Harrington (1977). Abbreviations of

literature cited follow Stapf (1934), Bor (1969) and B. Hansen (1978). Identifications of the exotic species were accomplished by using Stapf (1917-30), Hitchcock (1971), Gould (1983) and Hubbard (1984). The format of the taxonomic part follows the publication *Flora of Thailand*.

5. SYSTEMATIC TREATMENT OF THE ANDROPOGONEAE

The tribe Andropogoneae dominates the Old World tropics, especially in Asia, with a high number of taxa and broad morphological diversity. Nanakorn (1989), has estimated a total of approximately 133 genera and 480 species for the Gramineae of Thailand. Of these, the Andropogoneae is the largest tribe, representing 51 genera and a total of 225 species.

The Andropogoneae is regarded as a specialized, well-defined and advanced tribe. It is considered a homogeneous group sharing essential characters of entire falling of the spikelets. Spikelets are arranged in pairs, one sessile, the other pedicelled, the members of each pair commonly dissimilar; glumes are as long as the spikelet, often indurated and always firmer than the hyaline floret scales; florets are two per spikelet, the lower male or barren, the upper female or bisexual; lemma of the upper floret are often geniculate awned (Clayton, 1986).

5.1. Vegetative characters

The vegetative characters of the grass are rather uniform; they are mostly more or less herbaceous, with acuminate leaves and parallel venation. The vegetative characters clearly shown the very

high variation in differences of size, shape, indumentum and color. This caused a lot of problems in the study of the regional floras in the past and lead to superfluous names and varieties. Vegetative characters are important supporting characters at the generic level but are not of much taxonomic significance at the species level. As a result the use of vegetative parts for the identification in this work is restricted to certain characters as follows: Figure 4.

Perennial or annual: Grasses may be either annual or perennial; it is however, not always possible to distinguish annuals from perennials especially from herbarium specimens. The presence of rhizomes, strong roots, old basal culms, and tufted and solid culms are good evidence for the perennials.

Disarticulation: The shedding of the spikelets which is from the joints or rhachis internodes at maturity. In Andropogoneae the whole spikelet is shedding below the glumes or for the entire unit.

Sessile spikelets usually separate with the rhachis internode and a pedicel of the adjacent spikelet, while pedicelled spikelets fall separately.

Culm: A specific term for stems of grasses, usually hollow except at the swollen nodes. Culms are usually upright, or may be prostrate or decumbent or ascending. The presence of rhizomes, adventitious roots or being densely rufous at the base in *Eulalia* sp. is significant.

Nodes: A joint on the culm, and the area between each node is called

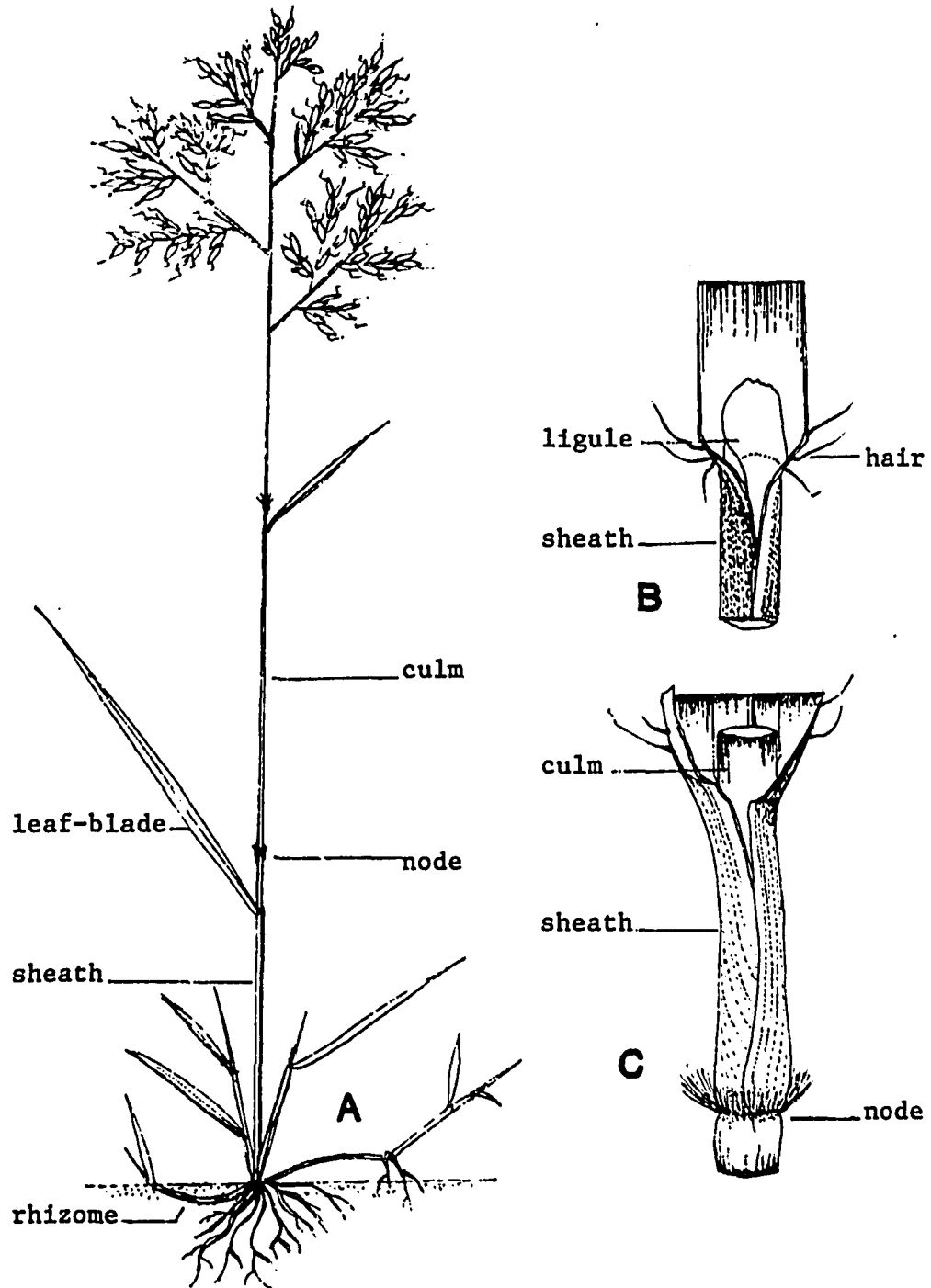


Figure 4. The grass plant and its vegetative parts
 A. habit B. leaf-blade and ligule C. sheaths and internode.

the internode. The adventitious rooting at the nodes and the branching habit above the ground such as in *Microstegium vagans* var. *scandens* are important. The glabrous or hairy indumentum at the nodes is also a valuable character.

Sheaths: These are the lower parts of the leaf, more or less a long tubular structure surrounding the culm and which may be open or closed for at least a part of their length. The indumentum on the sheaths, whether glabrous, pubescent or sparse with tubercle-based hairs is significant. However, these characters vary with localities. The character of terete basal sheaths, such as in *Heteropogon triticeus*, is valuable.

Ligule: A structure at the junction of the sheath and leaf-blade, on the inside, is a small appendage, commonly thin or membranous, or sometimes only a ring of hairs; rounded or truncate at the apex.

Leaf-blades: Usually narrowly linear, flat, folded or with rolled margins. Their sizes, shape, and indumentum on leaf surfaces are important. Broader leaves with auricular base and tubercle-based hairs on margins are characteristic of the genus *Arthraxon*. The presence of a petiole, as in *Spodiopogon lacei* and *Microstegium petiolare*, is significant.

5.2 Reproductive characters

The reproductive characters are the most important and helpful characters in the identification of the Gramineae. It has

been estimated that there are about five hundred genera of grasses in the world, almost all differing from each other in various combinations of their reproductive characters. The important characters used in the identification of the Andropogoneae in this study are as follow: Figure 5, 6.

Spatheoles: A modified leaf-blade structure enclosing or subtending an inflorescence or floral unit. The shape, length, indumentum and color of the spatheole are very important taxonomic characters. The textures are often membranous to coriaceous. The shapes vary from lanceolate, cymbiform to broaden with membranous wings. This character is significant, especially in the genera *Themeda* and *Hyparrhenia* of subtribe Anthistiriinae.

Involucral spikelets: Modified small leaves becoming a part of the reproductive unit at the base of the inflorescence. Apparently similar to pedicelled spikelets in outline and either male or neuter. This character is very important in the genera *Themeda* and *Iseilena*.

Inflorescence: An inflorescence is considered to be the arrangement of flowers on the floral axis. For grasses, this term means the special flowering branch unit as a whole, including the racemes, axis, branches and spikelets. The number of racemes, shape, size, color and indumentum of the inflorescence are among the main characters employed for the classification at the tribe and generic level.

Raceme: An elongated, indeterminate inflorescence with pedicelled or stalked flowers, normally simple but branching also common, such as in

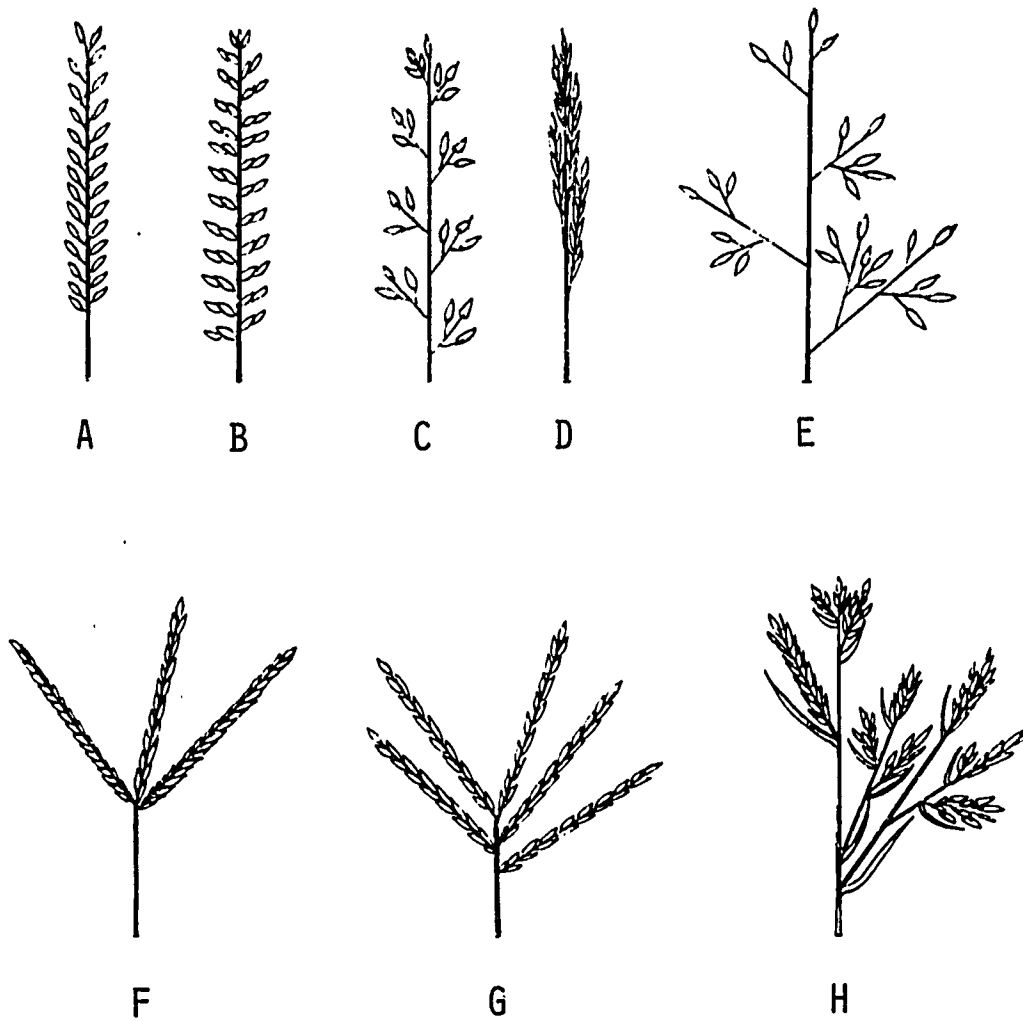


Figure 5. Inflorescence types of the Andropogoneae
 A,B. simple raceme C,D. spike-like raceme or contracted
 panicle E. open panicle F. digitate panicle G. sub-
 digitate panicle H. spatheate panicle

Imperata and *Saccharum*. The Andropogoneae raceme may be either single as in *Polytrias*, in pairs as in *Cymbopogon* and *Hyparrhenia* or numerous as in *Arthraxon* and in *Eulalia*.

Raceme bases: In *Cymbopogon* and *Hyparrhenia*, the inflorescence consists of a pair of racemes, each supported by a stalk called a raceme-base. The two bases are fused together above the point where they are articulated with the common peduncle. Raceme-bases may be normal or deflexed, flat or swollen, glabrous or hairy, but the upper part is always cupuliform, and the lower raceme-base is usually shorter and are variable than the upper one.

Rhachis internodes and pedicels: The rhachis internodes and pedicels are similar to one another; they are subtending the spikelets and usually cupuliform at the tip, flattened on one side and slightly rounded on the other. The margins are usually pilose, glabrous, or sparsely or densely pilose on the back and normally the rhachis internode is longer than the pedicel. These characters are uniform and thus is one of the promising characters for the identification.

Spikelets: The basic floral unit of grass which incorporates one or more flowers or florets. In the Andropogoneae spikelets are generally in pairs, one sessile and one pedicelled on a fragile rhachis. In many grasses spikelets in the same inflorescence are all more or less similar as in *Saccharum*. Some grasses have spikelets which differ in form and sex and are associated in pairs as in *Heteropogon* and

Schizachyrium, or some are variously reduced such as in *Arthraxon* sp.

Callus: The base of the spikelet that is sometimes enlarged into a little knob, or stalk, or disc, either glabrous or covered with hairs, and blunt or pungent. It is also an important character for identification.

Glumes: Bract-like husks in outline and variously modified in size, shape, texture, nerve number, hairiness and color. Basically there are two glumes for each spikelet and they are dissimilar. These characters are critical and very useful in the classification of the whole Gramineae. The sculpturing of the lower glume shows a high degree of accuracy in the determination of the species.

Florets: Normally one or more florets are enclosed in the glume. Each floret consists of its two lemmas, two paleas, three stamens, two plumose stigmas, one ovary and two tiny lodicules. Lemma and palea are normally hyaline, with few nerves or nerveless, more or less the same series of modifications as the glume. In the Andropogoneae, a spikelet contains 2-florets in most genera, variously reduced or modified in their sexual parts. Generally a fertile floret contains an ovary, which is noticed by the presence of stigmas, with or without male parts or anthers. A male floret is devoid of an ovary and is reduced only to the male parts or anthers. A sterile floret is devoid of both sexual parts and both lemma and palea may be severely reduced.

Awn: A more or less stiff bristle or linear appendage part, developing from a prolongation of a nerve. In the Andropogoneae, the

sessile spikelet and the pedicelled spikelet may both be awned, awnless, or the sessile spikelet awned and the pedicelled without an awn. The awns are mostly modified from the upper lemma, usually dark in color, geniculated and glabrous or setaceous. This character is uniform overall and significance able to employ in the identification to the species level. However, in different localities the length may be variously reduced, weak or absent due to variation.

Caryopsis: A kind of fruit which has a thin pericarp firmly adherent to the seed, normally smooth, subcylindrical and dark brown in color. All gramineae has the fruit of this type but morphologically this character has little of diagnostic significance.

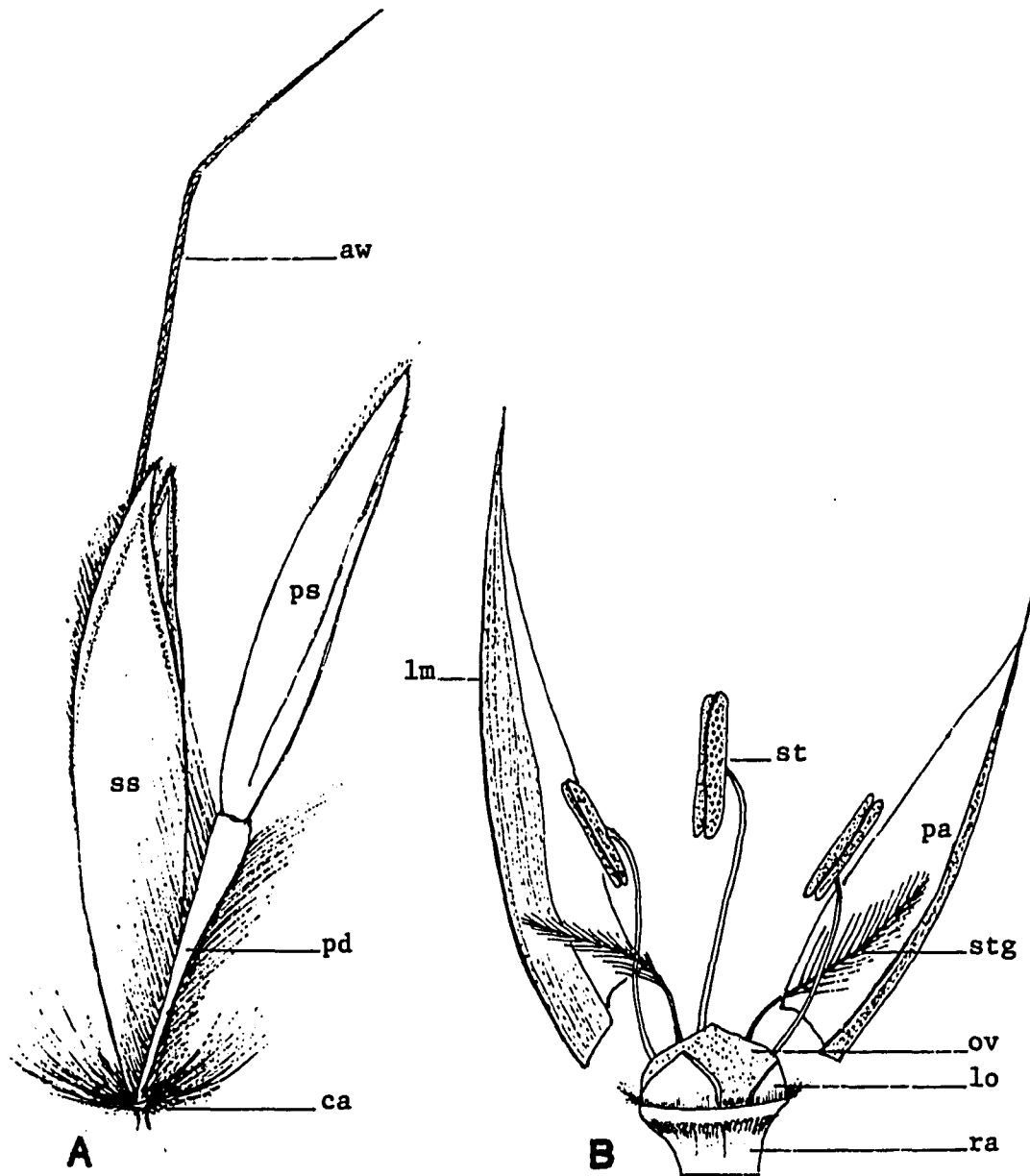


Figure 6. The grass spikelets and floret
 A. spikelet pair B. floret; aw, awn; ca, callus;
 lo, lodicule; lm, lemma; ov, ovary; pa, palea;
 pd, pedicel; ps, pedicelled spikelet; ss, sessile
 spikelet; st, stamen; ra, rachis internode.

KEY TO THE TRIBES OF GRAMINEAE
(After Clayton & Renvoize, 1986)

- 1 Bamboos with woody culms **Bambuseae**
- 1 Herbs (cane-like, reed-like or suffrutescent in a few genera)
- 2 Spikelets 1-many-flowered, if 2-flowered then both
bisexual or the upper barren
- 3 Spikelets with 1 fertile floret, with or without
additional male or barren floret
- 4 Inflorescence branches subtended by spathes **Anomochloaeae**
- 4 Inflorescence not spatheate
- 5 Spikelets with a whorl of 5 empty scales at base,
a long coiled awn, and borne in a raceme **Streptochaeteae**
- 5 Spikelets not as above
- 6 Palea 1-keeled, glumes absent or minute **Oryzeae**
- 6 Palea 2-keeled, rarely 0-1-keeled and
then glumes well developed
- 7 Spikelets unisexual (or leaf-blades sagittate);
lemma entire
- 8 Spikelets not in verticels
- 9 Leaf-blades parallel nerved **Olyreae**
- 9 Leaf-blades obliquely nerved **Phareae**
- 8 Spikelets in verticels of 5 male surrounding
a hermaphrodite; male spikelets with glumes **Parianeae**
- 7 Spikelets bisexual, sometimes unisexual
but then lemmas 3-awned or 3-toothed

- 10 Leaf-blades with distinct cross-nerves,
broadly linear to ovate
- 11 Lower floret male or empty **Bambuseae**
- 11 Lower floret bisexual
- 12 Grain globose with thick pericarp;
spikelets falling entire **Phaenospermateae**
- 12 Grain ellipsoid to trigonous;
lemma 3-9 nerved **Centotheceae**
- 10 Leaf-blades without evident cross-nerves
- 13 Inflorescence a panicle
- 14 Ligule membranous, or spikelet with
- 15 Lemma terete to gibbous, firmly
membranous to coriaceous, usually
enfolding and concealing palea;
spikelets 1-flowered without rhachilla
extension; awn terminal, rarely absent
Stipeae
- 15 Lemma not indurated and clasping palea,
or if so then accompanied by rhachilla
extension, dorsal awn or sterile florets
- 16 Spikelets with at most 1 barren
floret below the fertile
- 17 Glumes shorter than floret, this with
or without a straight terminal awn
- 18 Glumes tiny, the lower more or less
suppressed; rhachilla extension a

- bristle almost as long as floret
Brachyelytreae
- 18 Glumes well developed, rarely
reduced and then no rhachilla
extension **Poaeae**
- 17 Glumes longer than floret, or lemma
with dorsal or geniculate awn
- 19 Fertile spikelets deciduous in
triad, or accompanied by sterile
spikelets **Poaeae**
- 19 Fertile spikelets not as above
Aveneae
- 16 Spikelets with 2 male or barren
florets below fertile
- 20 Spikelets disarticulating above glume
- 21 Lower lemmas coriaceous, barren,
at least the upper longer than
fertile floret **Ehrharteae**
- 21 Lower lemmas membranous or
subulate, sometimes coriaceous
and then male **Aveneae**
- 20 Spikelets falling entire
Brylkinieae
- 14 Ligule a line of hairs; lower floret fertile
- 22 Lemma cleft into 7-9 awns or deep lobes
Pappophoreae
- 22 Lemma 0-3 awned
- 23 Spikelets disarticulating above

glumes, rarely falling entire and then
strongly laterally compressed

24 Lemma (1-)3-awn, involute or
convolute and concealing palea;
spikelets strictly 1-flowered

25 Palea as long as lemma **Arundineae**

25 Palea less than 1/2 length
of lemma **Aristideae**

24 Lemma awnless, rarely 1-awned and
then either accompanied by sterile
florets or palea not concealed
Eragrostideae

23 Spikelets falling entire, subterete
Arundinelleae

13 Inflorescence composed of racemes

26 Racemes single, the spikelets edgewise
on and more or less sunk in rhachis;
lower glume suppressed

27 Upper glume suppressed or almost so
Nardeae

27 Upper glume longer than lemma **Leptureae**

26 Racemes several, or if single then
spikelet broadside on

28 Body of lemma 5-9-nerved, or
leaf-blades auriculate

29 Spikelets with 2 sterile lemmas
below fertile floret **Ehrharteae**

- 29 Spikelets without sterile lemmas
 - 30 Raceme unilateral, or irregular
 - and then awn geniculate **Avineae**
 - 30 Raceme bilateral, awn never
 - geniculate **Triticeae**
- 28 Body of lemma 3-nerved; leaf-blades
 - not auriculate
 - 31 Racemes single, bilateral, the
 - spikelets strictly 1-flowered
 - and in 2 opposite row **Hainardeae**
 - 31 Raceme 1-many, unilateral
 - or bottle-brush **Cynodonteae**
- 3 Spikelets with 2 or more fertile florets
 - 32 Leaves short, imbricate, spirally arranged; plant moss-like
 - Micraireae**
 - 32 Leaves 2-rowed, not moss-like:
 - 33 Spikelet urn-like, of 2 opposing lemmas fused into a tube
 - Lygeae**
 - 33 Spikelet with free lemmas:
 - 34 Lemma margins clasping palea keels, both scales usually
 - more or less indurated; spikelets strictly 2-flowered
 - 35 Lemma at most puberulous, never awned **Ischneae**
 - 35 Lemma pilose or awned **Eriachneae**
 - 34 Lemma margins not clasping palea keels:
 - 36 Lemmas 5 or more nerved:
 - 37 Inflorescence of several racemes:
 - 38 Leaf-blades with distinct cross-nerves,

- or lower floret sterile **Centotheceae**
- 38 Leaf-blades without cross-nerves or
apparently so; lowest floret fertile
Eragrostideae
- 37 Inflorescence a panicle or single raceme:
- 39 Laves without ligule; lemmas
prominently 13-15 nerved **Orcuttieae**
- 39 Leaves with ligules:
- 40 Ligule membranous, rarely with a
ciliolate margin:
- 41 Inflorescence a panicle, sometimes a
raceme and then unilateral or spikelets
edgeways on or lemma geniculately awned:
- 42 Stigmas retrosely barbed and tangled;
inflorescence a raceme
Streptogyneae
- 42 Stigmas plumose:
- 43 Upper glume shorter than adjacent
floret or almost so; lemma
with or without terminal or
subterminal awn:
- 44 Ovary rarely hairy or
appendaged, and then
the stigmas terminal:
- 45 Glumes not side by side:
- 46 Leaf-blades without
cross-nerves **Poeae**

- 46 Leaf-blades broad with
prominent cross-nerves
on the underside
Centotheceae
- 45 Glumes side by side;
spikelets sunk in rachis
of raceme Hainardieae
- 44 Ovary capped by a hairy
lobed appendage, the stigmas
subterminal Bromaeae
- 43 Upper glume exceeding adjacent
floret, or awn dorsal, or awn
geniculate Aveneae
- 41 Inflorescence a simple or compound
bilateral raceme, the spikelets
broadside to rachis; leaf-blades
linear; ovary hairy Triticeae
- 40 Ligule a line of hairs, sometimes
mounted on a brief scarious base:
- 47 Spikelets disarticulating between
florets, rarely falling entire but
then awn geniculate or whole
panicle deciduous
- 48 Leaf-blades herbaceous, or if pungent
the plant tufted Arundineae
- 48 Leaf-blades stiff, distichous,
pungent; plant rhizomatous or

stoloniferous **Eragrostideae**

47 Spikelets not disarticulating

between florets:

49 Glumes falling with spikelet
Eragrostideae

49 Glume persistent on inflorescence:

50 Inflorescence a panicle;

lemmas 2-19-awned **Pappophoreae**

50 Inflorescence a raceme
Cyanodonteae

36 Lemmas 1-3-nerved:

51 Pericarp thickened into a pallid beak
or knob at tip of grain **Diarrheneae**

51 Pericarp more or less uniform in thickness:

52 Inflorescence a panicle or several racemes, if
a single raceme then spikelets broadside on
Eragrostideae

52 Inflorescence a single raceme, the spikelets
edgeways on and sunk into its axis
Leptureae

2 Spikelets 2-flowered, the lower floret male or barren,
the upper fertile, without rhachilla extension

53 Spikelets breaking up at maturity above the persistent glumes,
or rarely falling in triads from a fragile hooked peduncle

54 Glumes deciduous; fertile floret dorsally compressed;
lower glume 5-9-nerved

55 Paleas present **Isachneae**

55 Paleas absent **Hubbardieae**

- 54 Glumes persistent; fertile floret terete **Arundinelleae**
- 53 Spikelets falling entire at maturity:
- 56 Upper lemma or palea cartilaginous to bony, thicker than lower glume; spikelets seldom paired and then similar in appearance; upper lemma awnless; rarely with a straight awn:
- 57 Spikelets falling singly with pedicel attached, very small, borne in a large panicle **Thysanolaeneae**
- 57 Spikelets rarely falling with pedicel attached and then not as above:
- 58 Inflorescence axis herbaceous, enfolding deciduous raceme; spikelets unisexual, the lower lemma indurated **Phyllorachideae**
- 58 Inflorescence axis seldom herbaceous, and then spikelets not as above:
- 59 Leaf-sheath clasping stem **Paniceae**
- 59 Leaf-sheath cylindrical, culm-like; upper palea thickened, convolute **Steyermarkochloaeae**
- 56 Both lemmas hyaline to membranous, thinner than lower glume, this usually indurated
- 60 Spiklets never paired, nor in fragile racemes, nor geniculately awned **Paniceae**
- 60 Spikelets paired, one sessile the other pedicelled, usually dissimilar, the pedicelled sometimes much reduced, rarely single and then either in fragile racemes or the upper lemma geniculately awned; lower glume as long as spiklet or almost so **Andropogoneae**

**KEY TO THE GENERA OF ANDROPOGONEAE:
SUBTRIBE ANDROPOGONINAE, ANTHISTIBIINAE AND SACCHARINAE
IN THAILAND**

- 1 Spikelet solitary or only accompanied by a stipe, pedicelled spikelet reduced. Inflorescence terminal, in pair or digitate racemes. Spikelets with spicules and awned; awn arising from the basal part on the back of the lemma **Arthraxon**
- 1 Spiklets paired, or in group of three. Inflorescence of single, digitate or subdigitate racemes, or in simple or spatheate panicle. Spikelets without spicules, awned or awnless
- 2 Spikelets in group of three, two sessile and one pedicelled. Inflorescence terminal **Polytrias**
- 2 Spikelets paired, both sexes and shapes, similar or dissimilar
- 3 Spikelets of each pair similar, both fertile
- 4 Inflorescence a simple panicle, with elongated central axis
- 5 Lower glume coriaceous, rounded on the back; nerves 5-9, prominently raised. Leaf-blades with petiole **Spodiopogon**
- 5 Lower glume membranous to coriaceous, flattened to rounded on the back; nerves flat or only slightly raised. Leaf-blades without petiole
- 6 Raceme rhachis fragile; one spikelet of the pair sessile. Panicle ample, with long loose racemes; spikelets awned or awnless. Culms solid rarely herbaceous **Saccharum**

- 6 Raceme rhachis tough; both spikelets pedicelled;
spikelets awnless
- 7 Panicle loose; glumes cartilaginous to
coriaceous; callus hairs shorter than
the glume **Miscanthus**
- 7 Panicle contracted or spiciform; glumes
membranous; callus hairs twice as long as
the glume or more **Imperata**
- 4 Inflorescence of single or subdigitate racemes:
- 8 Inflorescence axillary:
- 9 Spikelets laterally compressed; nerves of lower
glume flatted or obscured; upper glume with
long aristate awn **Pogonatherum**
- 9 Spikelets dorsally compressed; nerves of lower
glume raised; upper glume without or with only
short aristate awn **Eulaliopsis**
- 8 Inflorescence terminal:
- 10 Rambling, decumbent grasses; leaf-blades broad
or sometimes petioled; lower glume usually with
a deep longitudinal groove; spikelets seldom
copiously hairy **Microstegium**
- 10 Erect grasses; leaf-blades narrow, without
petiole; lower glume convex to flat, rarely
slightly concave; spikelets conspicuously
hairy **Eulalia**
- 3 Spikelets of each pair differing in shape and sex;

sessile spikelet fertile; the pedicelled male,
barren or suppressed

11 Racemes short; consisting of 2 pairs of involucrel
homogamous spikelets, connate at the base; spatheoles
sparse with tubercled-glands on the ridges; spikelets
without or with only minute callus Iseilema

11 Racemes with or without involucrel spikelets;
spatheoles glabrous or with tubercle-based hairs;
spikelets with short or long hairy callus

12 Leaf-blades broad, base amplexicaul, cordate
or rounded; sparse to dense with tubercle-based
hairs; spikelets sparse with spicules; upper
lemma of sessile spikelet awned from basal part
on the back Arthraxon

12 Leaf-blades mostly linear-lanceolate, flat
or broad; spikelets without spicules; upper
lemma awned from upper part, tip or sinus

13 Lower glume of sessile spikelet 2-keeled.
Callus obtuse, usually very short, more or
less inserted in hollowed internode tip:

14 Racemes single; pedicelled spikelets
small to very small; lower glume of
sessile spikelet convex, awnless Schizachyrium

14 Racemes paired, digitate or spatheate,
rarely single; pedicelled spikelets
smaller, equal or larger than the

sessile; lower glume of sessile spikelet
concave or grooved between the keels,
awned or awnless

15 Racemes paired, digitate (single in
A. fastigiatus), not accompanied by
spatheoles, not deflexed, borne upon
unequal terete racemes-bases; lower
glume without winged. Leaves not
aromatic Andropogon

15 Racemes in compound panicle,
accompanied by spatheoles, usually
deflexed at maturity, borne upon
subequal flattened raceme-based;
lower glume with broad, narrow or
without winged. Leaves nearly
always aromatic Cymbopogon

13 Lower glume of sessile spikelet convexly
rounded without keels. Callus pungent or
oblong, bearded, short or long, applied
obliquely to the internode with its tip free

16 Upper lemma bidentate, awned

17 Inflorescence a solitary raceme,
raceme-base without distinct
appendage. Sessile spikelets
filiform, lower glume with a median
grooved, upper with an aristate awn
Parahyparrhenia

- 17 Inflorescence a spatheate panicle,
 raceme-base distinct. Sessile
 spikelets broad or oblong, lower
 glume rounded on back, upper with
 or without an aristate awn
 Hyparrhenia
- 16 Upper lemma entire
- 18 Raceme in a compound panicle, with
 2 large homogamous pairs at the base,
 forming an involucre Themeda
- 18 Raceme solitary, with or without
 homogamous pairs; or if present not
 forming an involucre:
- 19 Inflorescence supported by
 spatheoles. Spikelets dorsally
 compressed, not overlapping;
 callus obtuse; awn short, weak
 Pseudanthistiria
- 19 Inflorescence without a spatheole.
 Spikelets subterete, imbricately
 arranged; callus pungent; awn long,
 usually twisted and entangled at
 the top of the inflorescence
 Heteropogon

TRIBE ANDROPOGONEAE Dumort.

Andropogoneae Dumort., Obs. Gram. Belg.: 84.1824; Hackel, in DC., Monogr. Phan. 6: 1889; Clayton in Kew Bull. 27: 457.1972; *ibid*, 28: 49.1973; Gen. Gram.: 320.1986; in Soderstr., Int. Grass. Symp.: 307.1987.

- *Sacchareae* Dumort., Obs. Gram. Belg.: 83.1824.
- *Maydeae* Dumort., l. c.: 84.1824 (nom inval.).
- *Zeeae* Reichenb., Consp. Reg. Veg.: 55.1828.
- *Ophiureae* Dumort., Anal. Fam.: 64.1829.
- *Rottboellieae* Kunth, Rev. Gram. 1: 150.1829.
- *Imperateae* Gren. & Godr., Fl. France 3: 471.1855.
- *Coiceae* Nakai, Ord. Fam. etc: 223.1943.
- *Euchlaeneae* Nakai, l. c.: 223.1943.
- *Tripsaceae* Nakai, l. c.: 223.1943.

Herbs; culm weak to reed-like. *Inflorescence* a panicle; spatheate, digitate, subdigitate or a false panicle. *Racemes* fragile, single, paired or digitate. *Spikelets* arranged in pairs and usually terminating in triads, one sessile, the other pedicelled; the member of each pair commonly dissimilar; occasionally with one or more of the lowermost pairs in the raceme alike and homogamous. *Florets* 2 per spikelet. *Sessile spikelets* usually dorsally compressed, awned or without, normally falling entire at maturity with the adjacent rhachis-internode and the accompanying pedicel. *Pedicelled spikelets* normally smaller than the sessile spikelet, awnless, falling separately.

Approximately 85 genera and 950 species, distributed throughout the tropics, particularly in the Old World, and extending into warm temperate regions. In Thailand, the Andropogoneae is the largest tribe, with 51 genera and 225 species.

SUBTRIBE ANDROPOGONINAE Presl

Andropogoninae Presl, Rel. Haenk. 1: 331.1830; Clayton, Gen. Gram.: 349.1986; - *Arthraxoninae* Benth., in J. Linn. Soc. 19: 67.1881.

Inflorescence of a single, paired or sometimes digitate or subdigitate racemes; aggregated into a compound panicle. *Racemes* with fragile rachis, with or without homogamous spikelets at the base. *Spikelets* paired, generally dissimilar; rachis-internodes and pedicels thickened upwards, broadened at the tip, base cuneate. *Florets* bisexual, male or barren. *Sessile spikelets* bisexual, dorsally or laterally compressed; callus blunt, hairy; lower glume mostly firm, commonly keeled, grooved between the keels, sometimes winged. Lower floret reduced to a barren lemma; upper lemma narrowly oblong, nearly always bilobed with an awn. *Pedicelled spikelets* normally smaller than the sessile spikelet, sometimes subequal or larger than the sessile spikelet; callus normally short, indistinct.

In Thailand four genera occur: *Andropogon*, *Arthraxon*, *Cymbopogon* and *Schizachyrium* with a total of 27 widely distributed species.

ANDROPOGON Linn.

Andropogon Linn., Sp. Pl. ed. 1: 1045.1753; et Gen. Pl. ed. 5: 468.1754; Stapf in Prain, Fl. Trop. Afr. 9: 208.1919; Bor, Fl. Ind., Burm. & Ceyl. 1: 89.1960; Clayton in Hook., Ic. Pl. 37: 3644.1967; Gen. Gram.: 349.1986.

- *Anatherum* P. Beauv., Essai. Agrost.: 128.1812.
- *Diectomis* Kunth in Mem. Mus. Hist. Nat. Paris 2: 69.1815
(non P. Beauv., 1812).
- *Dimeiostemon* Raf., Neogenyton: 4.1825.
- *Hypogynium* Nees, Agrost. Bras.: 364.1829.
- *Arthrostachys* Desv., Opusc.: 74.1831.
- *Heterochloa* Desv., l. c.: 66.1831.
- *Eupogon* Desv., l. c.: 67.1831.
- *Homoeatherum* Nees in Lindley, Nat. Syst. ed. 2: 448.1836.
- *Eriopodium* Hochst., in Flora 29: 115.1846.
- *Euklastaxon* Steud., Syn. Pl. Glum. 1: 412.1854.
- *Athrolophis* (Trin.) Chiov., in Bull. Soc. Bot. Ital. 1917: 57.1917
(as *Arthrolophis*, nom superfl.).
- *Leptopogon* Roberty, Monogr. Androp.: 193.1960 (non Borzi, 1907).

Note.- Name from Greek, Aner (andr-) = man, male; pogon = a beard: alluding to the villous pedicels of the staminate or sterile spikelets.

Annual or Perennials, variable in habit; culms and sheaths commonly smooth and glaucous except near the joint; ligule normally short, membranous. *Leaf-blades* linear-acuminate or very narrow.

Inflorescence a false panicle, spatheate; racemes solitary, 2-3-nate or subdigitate, spiciform, many jointed; rhachis-internodes and pedicels cupuliform, glabrous, rounded on the back, broadened at the top, cuneate at base, densely pilose with long white hairs along the margins towards the base. *Spikelets* in pairs, dissimilar in sex and shape. Lower floret neuter; upper bisexual in sessile and neuter in pedicelled spikelet. *Sessile spikelets* laterally compressed; callus obtuse, hairy. Glumes subequal, herbaceous to membranous, truncate to aristulate at apex; lower glume concave or channelled on back, 2-keeled; upper glume more or less cymbiform, keeled upwards, 1-3-nerved. Lemmas hyaline, margins ciliate, lower 2-nerved; upper 2-toothed, awned from sinus. Palea if present, minute, hyaline, nerveless, or absent. Lodicules 2, minute, glabrous. Stamens 3. Styles terminal; stigmas laterally exerted. Caryopsis subterete; embryo ca. 1/2 as long. *Pedicelled spikelets* more or less compressed dorsally, not concave or channelled on back, subequal or larger than the sessile spikelet; lower glume muticous.

A genus of ca. 80 species distributed mainly in warm-temperate and tropical regions, poorly represented in Thailand, with 5 species *A. ascinodis*, *A. burmanicus*, *A. distachyus*, *A. fastigiatus* and *A. polyptichus*.

KEY TO THE SPECIES OF ANDROPOGON IN THAILAND

1. Annual or short-lived perennial; raceme single, solitary.
Pedicelled spikelets 7-8 mm long, glumes light yellowish-brown, distinctly unequal, much larger and broader than the sessile spikelet. Awn 2.5-4.0 cm long, column normally dark brown colored **A. fastigiatus**
1. Perennials; racemes 2-5-nate, subdigitate. Pedicelled spikelets 3-6 mm, glumes yellow to brownish red, smaller than the sessile spikelet. Awn shorter than 2.5 cm long, column normally yellow to brown colored
2. Rachis internodes and pedicels distinctly enlarged, cupular shape; glumes with aristate apex
3. Inflorescence 3-4 racemes, 5-6 cm long; rachis internodes and pedicels broadly urceolate-oblong with 2 big longitudinal lobes. Lower glume of sessile spikelets concave. Nodes often dark color **A. burmanicus**
3. Inflorescence 2-nate, 1.5-3 cm long; rachis internodes and pedicel dorsally rounded, without longitudinal lobes. Lower glume of the sessile spikelet convex. Nodes not dark color **A. ascinodis**
2. Rachis internodes and pedicels linear in outline, slightly enlarge at the top; glumes with acuminate or truncate apex
4. Culms 50-90 cm high; nodes hairy. Leaf-blades and

sheaths sparsely to densely with tubercle-based hairs.

Sessile spikelets ovate-lanceolate, 4.5 mm, narrowly winged; pedicelled spikelets 3.5-4 mm, prominent 9-11 -nerved

A. polypticus

4. Culms 20-40 cm high; nodes glabrous. Leaf-blades and sheaths glabrous except near the joint, without tubercle-based hairs. Sessile spikelets broadly lanceolate, 7 mm, without winged; pedicelled spikelets 5-6 mm, 5-7-nerved

A. distachyus

1. *Andropogon ascinodis* C.B. Clarke, in J. Linn. Soc. Bot. 25,36: 87.1889; Camus et Camus, Fl. Gen. I.- C., 7,3: 307.1922; Rhind, Grass. Burma: 69.1945; Bor, Fl. Assam, 5: 380.1940; Fl. Ind., Burm. & Ceyl. 1: 90.1960; Lazarides, Pharn. Monogr. 7: 18.1980.

- *Andropogon apricus* Hook., Fl. Br. Ind. 7: 169.1896 (non Trin. 1836).

Type.- India, Naga Hills; Nov. 1885, s.n. 41890 A,B (K-holotype!).

- *A. apricus* var. *indicus* Hackel in DC., Monogr. Phan. 6: 457.1889

Type.- India from Khasia, Herb Hook.f. & Thomson s.n. (K-holotype!).

Perennial; culms 80-120 cm tall, erect, slender; sheaths rounded, smooth; ligule papyraceous, truncate, glabrous, 2-4 mm long. **Leaf-blades** linear-acuminate, 10-40 cm long by 1-3 mm broad; pubescent later glabrescent, coriaceous, margins scabrid; flat or rolled, commonly reddish when dry. **Inflorescence** 1.5-3 cm long, spiciform; racemes 2-nate or subdigitate; rhachis internodes 3-3.5 mm long, enlarged at the top, narrowly cupuliform; hairs up to 3 mm long dense

near the base of internode. *Sessile spikelets* compressed laterally, obovate-oblong in outline, 5-5.5 mm long, all hermaphrodite; lower glume membranous, linear-oblong, truncate, glabrous; two-keeled, with a deep groove between the keels; 3-5 nerved; callus 1 mm long; upper glume keeled, oblong-elliptic, apex obtuse, entire at the top; aristate awn 5-15 mm. Lemma 4-5 mm long, linear-oblong, membranous, ciliate below the top; shortly 2-toothed, apex finely aristate, 2.5-3 cm long. Awn geniculate, 2-2.5 cm long, column normally straw color. Palea 3.0-3.5 mm long, linear-oblong, nerveless. *Pedicelled spikelets* almost equalling the sessile spikelet in outline, oblong-elliptic, 3-4 mm, pedicels 2.5-3 mm long; lower glume herbaceous, membranous, 3-nerved; apex bicuspidate, acute; aristate awn twice as long as the spikelet; margins hairy near the top, hairs brownish red, up to 3 mm long; upper glume glabrous, apex shortly aristate.

(Fig. 7 & Plate 1 A-B).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); EASTERN: Surin;

SOUTH-EASTERN: Prachin Buri (Krabin).

Distribution.- India (Type!), Burma and Indo-China.

Ecology.- Scattered in lowland forests, and in open deciduous forests at ca. 100-600 m altitude.

Specimens.-Kerr 8251 (BK, K), 9779 (K); Smitinand 4004 (BKF, K); Smitinand & Abbe 6186 (K).

Remarks.- The plants said to be introduced as a fodder grass from India. The cupuliform rhachis internodes and pedicels, and the present of aristate awns on both upper and lower glumes are good field characters.

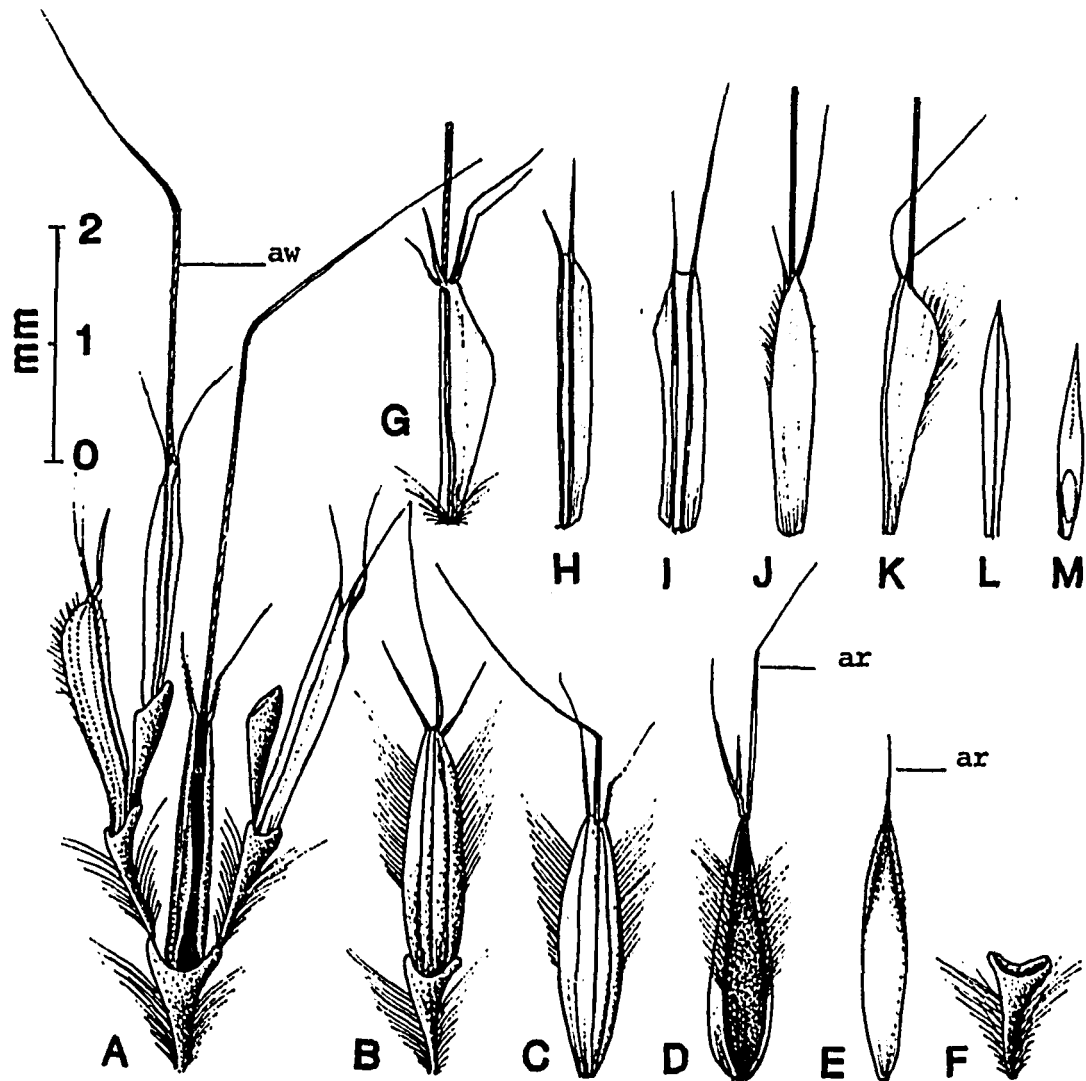


Figure 7. *Andropogon ascinodis* C.B. Clarke
 A. habit, spikelet in raceme B-F. pedicelled spikelet B, C.
 dorsal view of lower glume D. ventral view of upper glume
 E. lemma F. pedicel G-M. sessile spikelet G, H. lateral
 view of lower glume I. dorsal view of lower glume J, K.
 dorsal view and lateral view of upper glume L. lemma M.
 palea; ar, aristate awn; aw, awn; (Kerr 8251, BK).

2. *Andropogon burmanicus* Bor, Fl. Ind., Burm. & Ceyl. 1: 688.1960;

Type.- Burma, Pegu, U Thein Lwin s.n. (K-holotype!).

Perennial; culms 70-100 cm tall, glabrous, nodes dark color, glabrescent; sheaths terete, glabrous; ligule a small fringe of hairs, 0.5 mm. *Leaf-blades* linear, apex finely acuminate; glabrous or glabrescent; 15-40 cm long by 1-2 mm wide; midnerve prominent beneath, white. *Inflorescence* a digitate panicle, consisting of 3-4 racemes, fasciculate, 5-6 cm long; peduncle 15-20 cm. Rhachis internode broadly urceolate-oblong, base cuneate, 3-4 mm long, widest at the middle up to 1.3 mm broad, straw colored; dorsally glabrous, convex, with 2 big longitudinal lobes; ventrally concave; densely with silky hairs along the margins and at the top, hairs half as long as the spikelets. *Sessile spikelets* narrowly lanceolate, apex acuminate, 2-toothed, 5-6 mm long; callus small, densely bearded, hairs 1-1.5 mm; glumes papyraceous, lower compressed, sulcate, 2-nerved, 2-keeled with deep longitudinal groove between the keel, scabrid near the top; upper glume ovate-elliptic, cymbiform, apex aristulate, aristate awn 6-9 mm long; lower floret empty; upper unisexual, lower lemma hyaline, oblong; upper oblong, 4 mm, apex bifid to half of the length, awn 17-23 mm long; stigmas plumose, 3-5 mm long. *Pedicelled spikelets* broadly ovate, 3.5-4 mm long; lower glume dorsally flat to shallowly concave, glabrous, apex shortly bifid, margins ciliate; 2-nerved; upper cymbiform, apex shortly aristate awn 1-1.5 mm; pedicel 3 mm long.

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng); EASTERN: Nakhon

Ratchasima (Bua Yai, Pak Thong Chai).

Distribution.- India (Type!), Burma and Thailand.

Ecology.- In open grassland edge of hill evergreen forest at 400 m.

Specimens.-Charoenphol, Larsen & Warncke 4879 (AAU, BKF, K, NY); Kerr 8108, 9395 (K); Put 4232 (K).

Remarks.- The spikelet arrangement in *A. burmanicus* raceme is apparently like that of the genus *Ischaemum*. Bor has placed the species in *Andropogon* because of the urceolate-oblong rhachis internodes and pedicels, and the presence of aristate awns on both sessile and pedicelled spikelets, indicating the grass is more close related to the genus *Andropogon* than to the genus *Ischaemum*.

3. *Andropogon distachyus* Linn., Sp. Pl. ed. 1: 1046.1753; Steud., Syn. Pl. Glum. 1: 372.1854; Hackel in DC. Monogr. Phan. 6: 461.1889; Stapf in Prain, Fl. Trop. Afr. 9: 218.1917;

Perennial; culms erect, slender, glabrous, 20-40 cm high; sheaths terete at base, glabrous, except near the joint; ligule membranous, truncate, ciliolate, 1 mm long. *Leaf-blades* linear, flat, apex finely acuminate; 10-20 cm long by 2 mm wide; glabrescent particularly on lower surface; midnerve white, raised beneath; margins scabrid. *Inflorescence* a 2-nate raceme, 2.8-3 cm long; rhachis internode cuneate-linear, 2 mm long; glabrous or subpubescent on the back; slightly enlarge at the top. *Sessile spikelets* broadly lanceolate, apex acuminate, base slightly oblique, 7 mm long; distinctly thin winged, wings light brown to reddish-brown color;

callus obtuse, shortly bearded; glumes unequal; lower subherbaceous, flat on the back, glabrous or puberulous; intracarpal nerves 5-9, prominent; upper glume shorter, cymbiform, 3-nerved, tip minutely 2-toothed. Lower floret reduced to an empty lemma; upper bisexual, upper lemma bi-lobed, stipitate; awn slender 9-15 mm long. *Pedicelled spikelets* similar to sessile spikelets but narrower, 5-6 mm long; pedicel 2 mm long.

Thailand.- NORTHERN: Chiang Mai (Chiang Dao).

Distribution.- Widely distributed through the Mediterranean region from southern Europe to Eastern Asia, South Africa and introduced to Thailand.

Ecology.- On open slope at 800 m.

Specimens.-Put 4465A (K).

Remarks.- *A. distachyus* is the type species of the genus. The grass is said to have been introduced from Europe to Thailand for fodder and later escaped to the wild.

4. *Andropogon fastigiatus* Sw., Prodr. Veg. Ind. Occ.: 26.1788; Hook, Fl. Brit. Ind. 7: 167.1896; Craib in Fl. Siam Monocot: 35.1913.

- *Pollinia fastigiata* (Sw.) Spreng., Pugill. 2: 13.1815;

- *Diectomis fastigiata* (Sw.) Kunth in Humb. et Bonpl., Nov. Gen. et Sp. 1,64: 193.1816; Bor, Fl. Ind., Burm. & Ceyl. 1: 135.1960; Jacque-Felix, Les Gram D'Afr. Trop. 1: 298.1962; Froideville in Backer & van der Brink Jr., Fl. Java 3: 611.1968; Roy, Fl. Ind. 4: 66.1984.

- *Andropogon hochstetteri* Steud., Syn. Pl. Glum. 1: 384.1854;

- *A. diatherus* Hochst. ex Steud., l. c.: 378.1854;
- *Heteropogon hochstetteri* (Steud.) Anderss. in Schweinf., Beitr. Fl. Aethiop.: 306.1867.

Annual or short-lived *perennial*, 60-90 cm tall; culm slender, glabrous except near the internodes; sheaths glabrous; ligule membranous, 10-13 mm. *Leaf-blades* very narrow, flat, rather scabrid, 7.5-40 cm by 1-4 mm. *Inflorescence* mostly a solitary raceme, 4-7 cm, rarely 2-nate, 10-15 jointed; rachis internodes and pedicels 3-3.5 mm. *Sessile spikelets* laterally compressed, oblong, 4.5-5.5 mm; callus shortly bearded; lower glume membranous, strongly 2-keeled, deeply grooved between keels, cymbiform, 3-nerved, ciliate, 2-dentate; aristate awn, 4-6 mm. Lemmas hyaline, ciliolate; lower ciliate on nerves; upper 2-dentate, with a perfect awn from sinus. Awn 2.5-4.0 cm, column normally dark brown, subule lighter color. Palea if present hyaline, nerveless. *Pedicelled spikelets* prominently enlarged, apex acute, 7-8 mm long, glumes distinctly unequal much larger and broader than the sessile spikelet; lower glumes herbaceous, large, flat, oblique and twisted, light yellowish-brown, margins ciliate, many-nerved, aristate awn shorter than 1.5 cm; upper glume shallowly cymbiform, entire, apex shortly aristate; pedicels 2.8-3 mm long. (Fig. 8 & Plate 1 C-D).

Thailand.- NORTHERN; Chiang Mai (Doi Suthep); Lampang (Thoen-Li);
 NORTH-EASTERN: Loei (Phu Kradueng, Phu Luang); EASTERN:
 Nakhon Ratchasima (Chan Tuk); Ubon Ratchathani (Pha Taem
 NP); SOUTH-WESTERN: Kanchanaburi (Ban Kao).

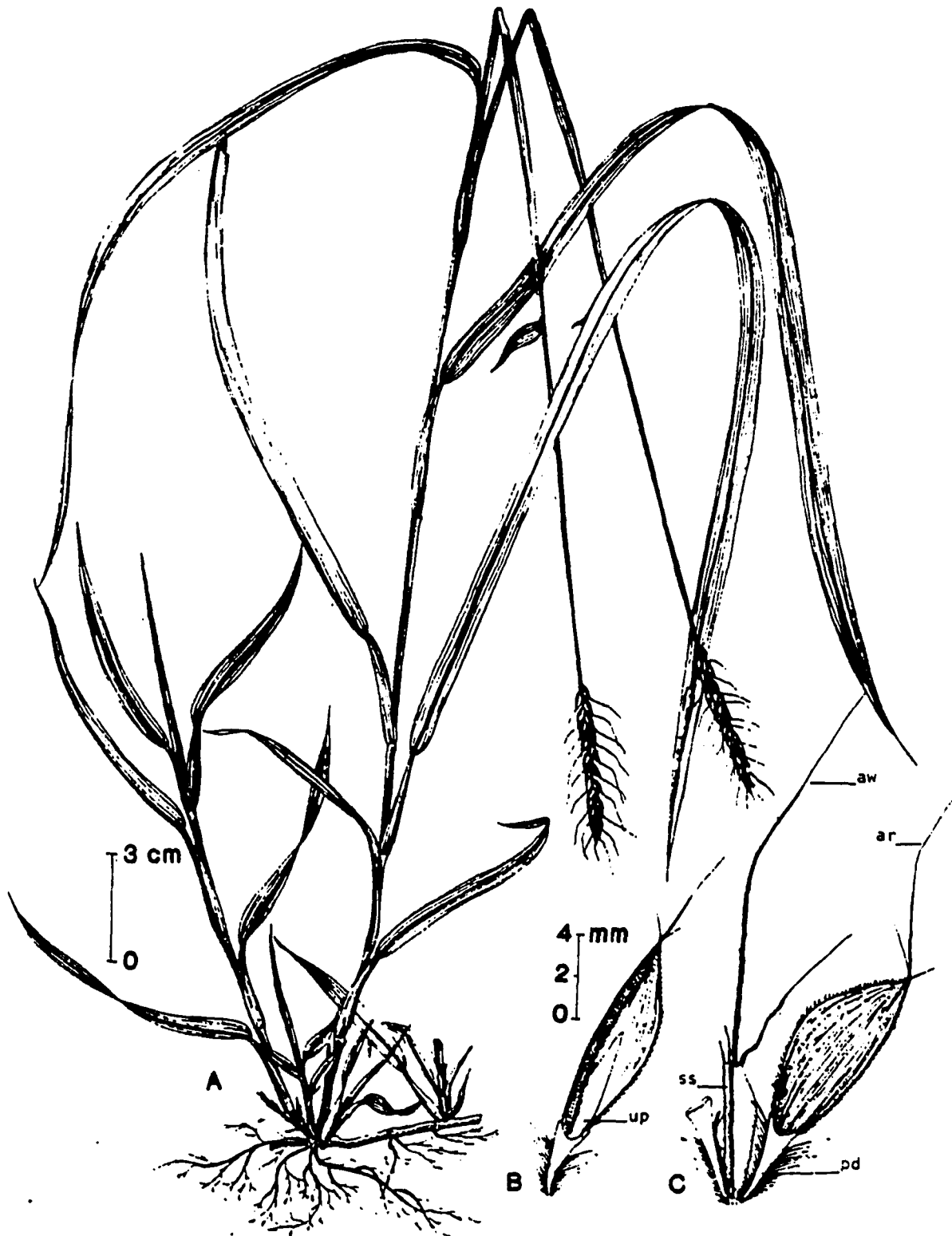


Figure 8. *Andropogon fastigiatus* Sw.

A. habit B. lateral view of pedicelled spikelet C. spikelet pair; ar, aristate apex; aw, awn; pd, pedicel; ss, sessile spikelet; up, upper glume; (Nanakorn 1252, NY).

Distribution.- Throughout the tropics of the world, India (Type!), southern China, Indo-China, Philippines, Indonesia, tropical Africa and America.

Ecology.- Scattered in dry open areas on sandy soils and in dry dipterocarp forest at ca. 150-600 m.

Specimens.-Charoenphol, Larsen & Warncke 4890 (K); Godefroy-Lebeuf s.n. (K); Kerr 2243 (K), 4609 (BK, K), 8069, 16209 (K); Larsen 8135, 8302 (K); Nanakorn 1252 (BKF, NY); Smitinand & Abbe 6174 (K); Sorensen, Larsen & Hansen 5890 (K);

Remarks.- Said to be a very good fodder grass in the young stages before the awns begin to form. The whitish hairs at the base of the spikelets are noticeable in the field.

5. *Andropogon polyptichus* Steud., Syn. Pl. Glum. 1: 380.1854; Hook.f., Fl. Brit. Ind. 7: 198.1896; Bor, Fl. Ind., Burm. & Ceyl. 1: 91.1960.

- *Dichanthium polyptichum* (Steud.) A. Camus in Bull. Mus. Hist. Nat. Paris 27: 549.1921; Senaratana, Grass. Ceyl.: 191.1956;
- *D. polyptichum* var. *deccanense* Bor, Fl. Ind., Burm. & Ceyl. 1: 91.1960; Type.- India, Madras, Bourne 1337 (K-holotype!).
- *Andropogon polyptichus* var. *deccanensis* Bor ex W.D. Clayton in Kew Bull. 27: 448.1972.

Perennial, tufted; culms 50-90 cm high; nodes bearded; sheaths sparsely with tubercle-based hairs; ligule membranous, truncate, 2-2.5 mm. *Leaf-blades* flat, lanceolate-acuminate, base cuneate, 10-25 cm long by 2-5 mm wide; glabrous to sparsely with

tubercle-based hairs particularly near the base. *Inflorescence* a subdigitate panicle, consisting of 2-5 racemes, 2-4 cm long; rhachis internodes linear, slightly enlarged at the top, 2.5 mm long, ciliate along the margins, hairs 1-1.5 mm long. *Sessile spikelets* broadly ovate-lanceolate, 4.5 mm long; callus short, bearded, hairs half as long as the spikelets; lower glume chartaceous, 7-9-nerved, margins infolded, glabrous, hispid on the upper half; upper cymbiform, glabrous, margins ciliate in the upper part; Lower floret empty, upper floret bisexual; lower lemma 2-3 mm long; upper lemma small, 1-1.2 mm, deeply bi-lobed, stipitate, awn 14-18 mm long; palea minute or absent. *Pedicelled spikelets* lower glume herbaceous, ovate-oblong, 3.5-4 mm, apex acute, much narrower than the sessile spikelet, 9-11 nerved, margins ciliate at the top; pedicel 2 mm long.

Thailand.- NORTH-EASTERN: Loei (Phu Luang).

Distribution.- India, Ceylon (Type!), Burma, to Indo-China.

Ecology.- In grassland and wet places at ca. 500 m.

Specimens.-Tagawa 11039 (BK, K)

Remarks.- The upper lemma of the sessile spikelet is deeply 2-lobed, the spikelets are overlapping, and there are many nerves on the lower glume of the pedicelled spikelets, unlike in the other species of the genus. Due to these reasons Bor (1960) has treated this species under *Andropogon* Linn. as well as *Dichanthium* Willemet. Later Clayton (1986) evaluated the critical characters of the species and place it under *Andropogon*.

ARTHRAXON Beauv.

Arthraxon P. Beauv., Essai Agrost., 11,6: 111.1812; Hochst., Flora 39: 177.1856; Hackel, Monogr. Androp. 6: 345.1883; Keng, Grass. China, 2: 224.1933; Chang, S-C., Man. Grass. Korea: 54.1954; Bor, Fl. Ind., Burm. & Ceyl. 1: 96.1960; Gilliland, Fl. Mal. 3: 286.1971; Hsu, Fl. Taiwan 5: 618.1978; Welzen in Blumea, 27: 260.1981; Koyama, Grass. Japan: 442.1987.

- *Pleuroplitis* Trin., Fund. Agrost.: 174.1822.
- *Lucaea* Kunth, Rev. Gram. 2: 489.1831.
- *Bathratherum* Nees in Edinb. Phil. J. 18: 180.1835.
- *Lasiolytrum* Steud in Flora 29: 18.1846.
- *Alectoridia* A. Rich., in Tent. Fl. Abyss. 2: 447.1851.
- *Psilopogon* Hochst. ex A. Rich., l. c.: 447.1851.

Note.- Arthron = a joint, axon = an axis: referring to the jointed inflorescence-rhachis.

Annual or perennial; culm slender, ascending, usually rooting at the decumbent nodes; sheaths glabrous to sparsely pubescent with tubercle-based hairs; ligule membranous, glabrous or shortly ciliolate, decurrent into the sheath. *Leaf-blades* broadly ovate-oblong to ovate-lanceolate, base cordate and amplexicaul, margins sparse to dense with tubercle-based hairs particularly at base, apex acute to acuminate. *Inflorescence* a subdigitate or spike-like subdigitate racemes, with 2-many branches, rarely solitary; rachis internodes and pedicels laterally densely pilose. Spikelets paired or solitary, laterally compressed. Lower floret sterile, upper bisexual

in sessile and neuter in pedicelled spikelet. *Sessile spikelets* chartaceous to chitinous. Glumes ovate-lanceolate; lower rounded on back and sides, 3-many nerved, glabrous, scabrid to coarsely muricate; marginal nerves usually sparse with spicules; upper glume thinner than lower, keeled, margin membranous without tubercle-based hairs. Lemma hyaline, glabrous; upper awned from near the base. Awns geniculate, straw colored. Palea usually absent. Lodicules small, ob-trapezoid. Anthers 2 or 3. Stigmas laterally exerted near the base, plumose. Caryopsis linear, terete; embryo half as long. *Pedicelled spikelets* usually suppressed or variously reduced, sometimes like a stipe or a vestigial linear glume, if present awnless and smoother than the sessile spikelet.

A genus of 7-10 species distributed chiefly in tropical and subtropical regions of the Old World, but extending into warm-temperate regions and introduced into the New World, the large majority of species confined to India. In Thailand, 6 species occur including the three widespread species *A. lanceolatus*, *A. lancifolius* and *A. hispidus*.

KEY TO THE SPECIES OF ARTHRAXON IN THAILAND

1. Pedicelled spikelets suppressed or reduced, not fully developed; spikelets solitary or accompanied by a stipe; sessile spikelets asymmetrical in outline

2. Spikelets 5-6.5 mm long, relatively broad; rhachis internodes 4-5 mm long. Lower glume of sessile spikelet chitinous to coriaceous, commonly dark purple

A. castratus

2. Spikelets 3-3.5 mm long; rhachis internodes 2-3 mm long. Lower glume of sessile spikelet papyraceous to subcoriaceous, commonly light green to yellow

A. hispidus

1. Pedicelled spikelets well-developed, spikelets paired; sessile spikelets more or less symmetrical in outline

3. Margins of the lower glume of the sessile spikelet flat, not inflexed, marginal nerves with small spicules. Sessile spikelets 2.5-3.5 mm; pedicelled spikelets 1.9-2.2 mm. Plant annual

4. Lower glume of the sessile spikelet with 5-6 longitudinal grooved on the back; spicules sparse on the ridges in the upper part. Pedicelled spikelets narrowly linear in outline

A. microphyllus

4. Lower glume of the sessile spikelet without longitudinal grooved on the back; scabrid at the top.

Pedicelled spikelets ovate-lanceolate in outline

A. lancifolius

3. Margins of the lower glume of the sessile spikelet

inflexed, marginal nerves with broad-based spicules.

Sessile spikelets 6-9 mm; pedicelled spikelets 5-6 mm.

Plant perennial

5. Sessile spikelet ovate-oblong, 6-7.5 mm long, 1-1.5 mm

wide. Stamens 2; anthers 2.5-3 mm long

A. lanceolatus var. lanceolatus

5. Sessile spikelet narrowly linear-lanceolate, 7.5-9 mm

long, 0.8-1 mm wide. Stamens 3, rarely 2; anthers

0.5-2.5 mm long

A. lanceolatus var. neeboldii

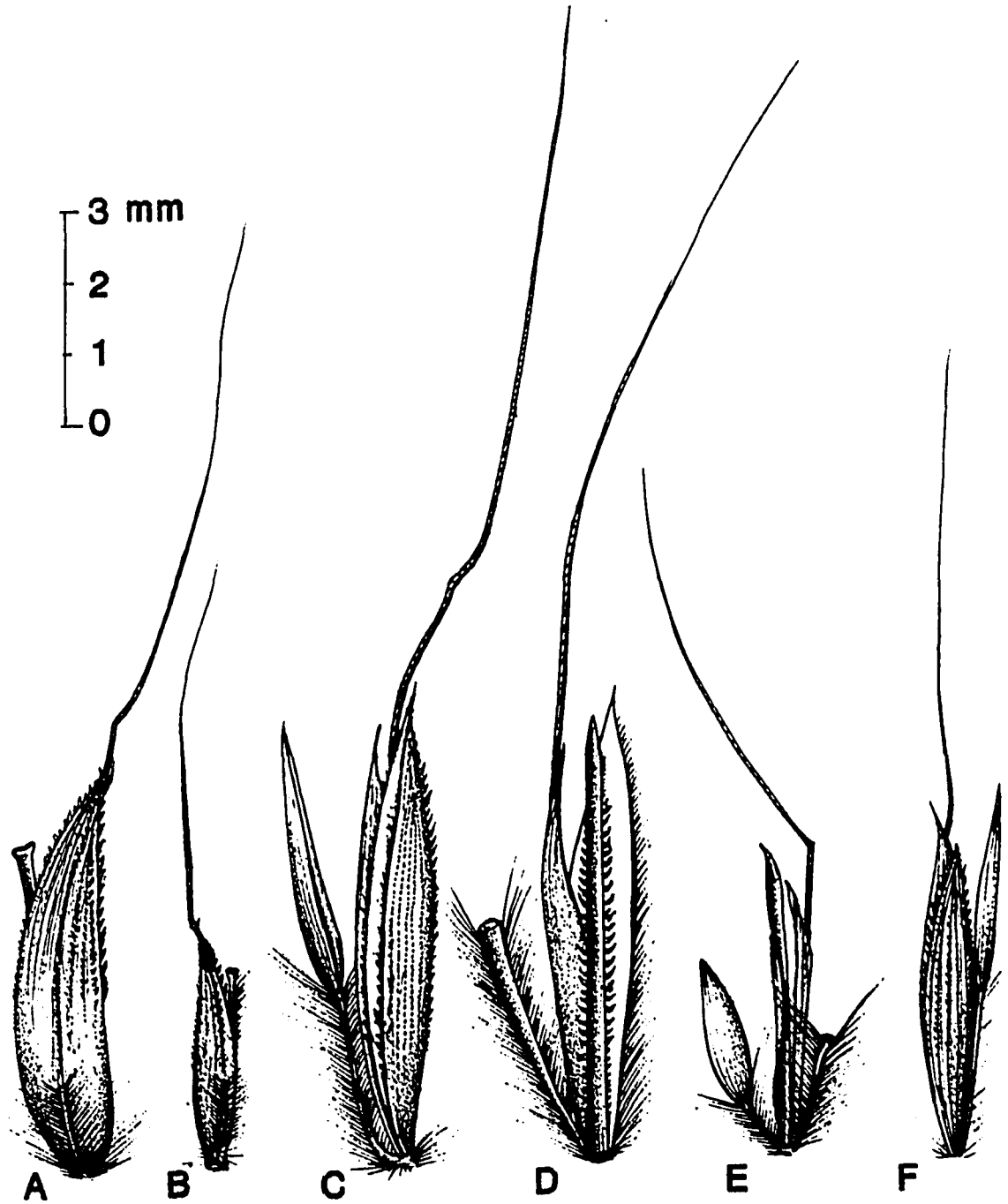


Figure 9. Spikelet shapes of the *Arthraxon*
 A. *Arthraxon castratus* B. *A. hispidus* C. *A. lanceolatus*
 D. *A. lanceolatus* var. *meeboldii* E. *A. lancifolius*
 F. *A. microphyllus*.

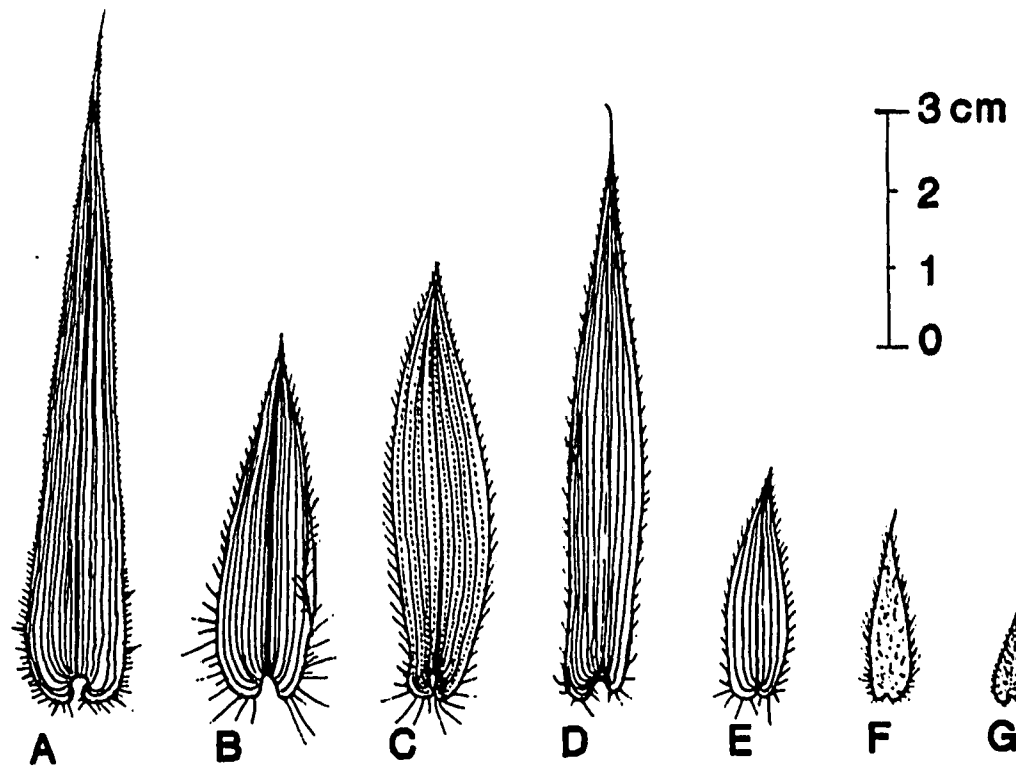


Figure 10. Leaf shapes of the *Arthraxon*
 A. *Arthraxon castratus* B, C. *A. hispidus*
 D. *A. lanceolatus* E. *A. lanceolatus* var. *neeboldii*
 F. *A. lancifolius* G. *A. microphyllus*.

1. *Arthraxon castratus* (Griff.) Naray. ex Bor, Fl. Assam 5: 376.1940; Bor, Fl. Ind., Burm. & Ceyl. 1: 99.1960; Jain, J. Ind. Bot. Soc. 51: 165.1972; Gould & Soderstrom, Can. J. Bot. 52: 1085.1974; Mehra & Kalia, Taxon 23: 806.1974; Lazarides, Pharn. Monogr., 7: 21.1980. Welzen in Blumea, 27: 263.1981.

- *Andropogon castratus* Griff., Notul. 3: 89.1851;

Type.- Suddyah in campis graminosis, Griffith 292 (K-holotype!).

- *A. rudis* Steud., Syn. Pl. Glum. 1: 383.1854;

Type._ India, Silheti, Wallich 8837 (K, BM-isotype!).

- *Arthraxon rudis* (Steud.) Hochst., in Flora 39: 188.1856.

- *Andropogon pilipes* Back. in Heyne, Nutt. Pl. 1: 124.1922.

Annual; culms ascending from a decumbent rooting and branched base, 0.5-1 m tall, slender, very smooth and glabrous, short noded below; sheaths somewhat lax with long cilia and tubercle-based hairs particularly at the throat; ligule a narrow membranous ring, ciliate. *Leaf-blades* ovate to broadly ovate-lanceolate, with a cordate amplexicaul base, 2-5 cm long by 10-12 mm broad, tip acuminate, with a few to many tubercle-based hairs near the base and along the margins. *Inflorescence* a subdigitate raceme, 3-7 cm long; 2-8 racemes, glabrous; rhachis internode with a straight disarticulation, angled, appressed-pubescent or ciliate, 4-5 mm. *Sessile spikelets* ovate-lanceolate, 5-6.5 mm long, commonly dark purple; callus glabrous; lower glume chitinous to coriaceous, rather hard; oblong-lanceolate, subacute, convex, 7-9 nerved, margins with long spicules towards the apex, not inflexed; upper glume almost papyraceous, linear-acute, or mucronate; keel acute, ciliate, 3-

nerved; margins hyaline ciliolate; lemma 3-5 mm long, linear-obtuse, glabrous. *Aw*n almost basal, 6-8 mm long, shortly exerted. Stamens 3 rarely 2. Anthers 3 mm. Stigmas 3 mm, twice as long as the styles. *Pedicelled spikelets* suppressed not fully developed, stipe 2-3 mm.

(Fig. 11 & Plate 2)

Thailand.- NORTHERN: Chiang Mai (Chiang Dao, Fang); NORTH-EASTERN:

Loei (Ban Sithan, Phu Kradueng); EASTERN: Chaiyaphum

(Kamang); SOUTH-EASTERN: Prachinburi (Krabinburi, Watana).

Distribution.- India (Type!), Ceylon, Indo-China and Indonesia (Java).

Ecology.- A grass with remarkable dark, purple, hard glumes. Common in savannah at high elevations, 1000-1300 m. and frequent on dry ground in open places and in dry deciduous forest at 200-300 m.

Specimens.-Beusekom et al. 4289 (BKF); Kerr 9780 (BK, K); Smitinand

2048, 4975 (BKF), s.n. (BKF 26382/17 Sept. 1954);

Smitinand, Poore & Robbins 7803 (BKF); Sorensen, Larsen and

Hansen 1800 (K), 6145 (BKF, K); Tagawa et al. 548 (BKF);

Yongboonkird 110 (BK).

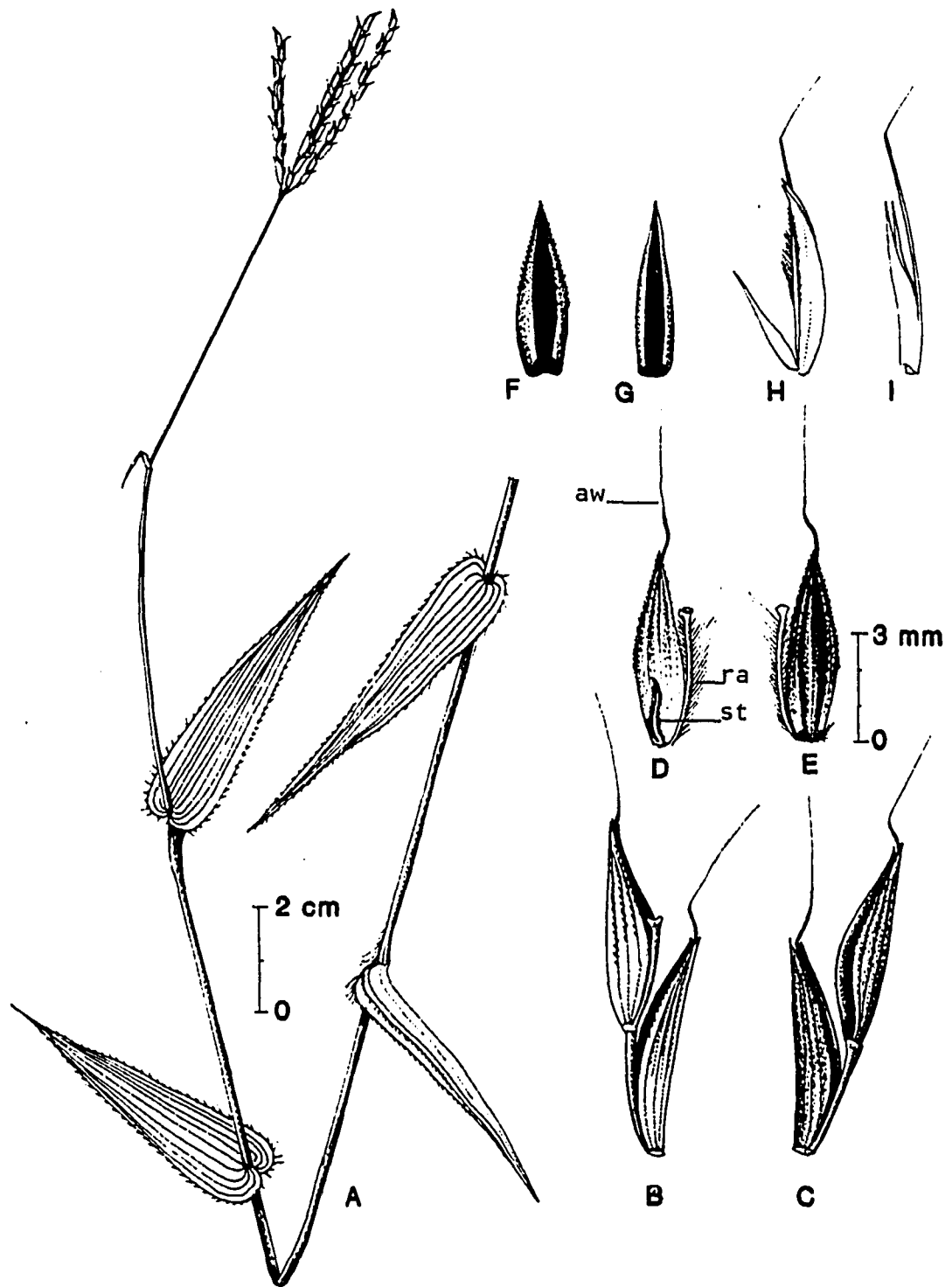


Figure 11. *Arthraxon castratus* (Griff.) Naray. ex Bor
 A. habit B, C. lateral view of spikelet pairs D-I. sessile
 spikelet D, F. lateral, dorsal and ventral view of lower glume
 G. upper glume H. lemma I. upper lemma and awn; aw, awn;
 st, stipe; ra, rhachis internode; (Smitinand 2548, BKF).

2. *Arthraxon hispidus* (Thunb.) Makino, in Bot. Mag. Tokyo 26: 214.1912; Merr., in Philip. J. Sci. 7: 229.1912; Nakai, Rep. Veg. Quelp.: 16.1914; et Bull. Nat. Sci. Mus. 31: 135.1952; Honda, J. Fac. Sc. Imp. Univ. Tokyo, 3: 324.1930; Keng, Grass. China, 2: 226.1933; Hitchc., Brittonia 2: 128.1937; Bor, Fl. Assam 5: 378.1940; Fl. Ind., Burm. & Ceyl. 1: 99.1960; Ohwi, in Acta Phytotax. Geobot. 11: 164.1941; Fl. Jap.: 192.1965; Cheng, I-C., Man. Grass Korea: 55.1954; Hsu in Taiwania 16: 305.1971; Taiwan Grass : 635.1975; Fl. Taiwan 5: 618.1978; Jain, J. Ind. Bot. Soc. 51: 173.1972; Lazarides, Pharn. Monogr., 7: 21.1980; Welzen in Blumea, 27: 266.1981; Koyama, Grass. Japan: 442.1987.

- *Phalaris hispida* Thunb., Fl. Jap.: 44.1784;

Type.- Japan, no locality cited (K-phototype!).

- *Pollinia ciliaris* Spreng, Syst. Pl. 1: 289.1805;

- *Arthraxon ciliaris* P. Beauv., Essai. Agrost.; 11,6: 152.1812;

- *Pleuroplitis lansdorfii* Trin., Fund. Agrost.: 175.1820;

- *Lucaea gracilis* Kunth, Rev. Gram, 2: 489.1831;

- *Pleuroplitis plumbea* Nees ex Arn. in Edinb. Phil. J.: 18.1835;

- *Batratherum micans* Nees, Edinb. Phil. J: 18: 182.1835;

- *Alectoridia quartiniana* A. Rich., in Tent., Fl. Abyss. 2,99:

448.1851;

- *Andropogon cuspidatus* Hochst. ex A. Rich., in Tent., Fl. Abyss. 2:

456.1851;

- *Pleuroplitis centrasiatica* Griseb. in Ledeb., Fl. Ross. 4: 477.1853;

- *Andropogon lasiocoleos* Steud., Syn. Pl. Glum. 1: 59.1854;

- *A. submuticus* Nees ex Steud., l. c.: 382.1854;

- *A. nudus* Nees ex Steud., l. c.: 383.1854;
- *Lucaea vriesii* Buse in Miq., Pl. Jungh.: 366.1854;
- *L. major* Hochst. ex Steud., l. c.: 414.1854;
- *L. violacea* Steud., l. c.: 414.1854;
- *Arthraxon coloratus* Hochst., Flora 39: 188.1856;
- *A. micans* Hochst., l. c.: 188.1856;
- *A. japonicus* Miq., Ann. Mus. Bot. Lugd. Bat. 2:288.1866;
- *Pleuroplitis langsdorffii* var. *breviseta* Regel, Bull. Acad. Sci. Petersb. 10: 374.1866;
- *P. langsdorffii* var. *caucasica* Rupr. ex Regel, l. c.: 373.1866;
- *P. langsdorffii* var. *chinensis* Regel, l. c.: 375.1866;
- *P. langsdorffii* var. *japonica* Regel, l. c.: 373.1866;
- *P. langsdorffii* var. *submutica* Regel, l. c.: 373.1866;
- *P. quartiniana* Regel var. *caepitosa* Regel, l. c.: 377.1866;
- *Arthraxon ciliaris* var. *australis* Benth., Fl. Austr. 7:524.1878;
- *A. breviaristatus* Hackel, Monogr. Androp.: 350.1889;
- *A. ciliaris* var. *glabrescens* Hackel, l. c.: 357.1889;
- *A. ciliaris* var. *hookeri* Hackel, l. c.: 357.1889;
- *A. inermis* Hook., Fl. Brit. Ind. 7: 145.1879;
- *A. quartinianus* Nash, N. Am. Fl. 17: 99.1912;
- *A. pauciflorus* Honda, Bot. Mag. Tokyo 39: 276.1925;
- *A. pauciflorus* var. *muticus* Honda, l. c.: 277.1925;
- *A. hispidus* var. *microphyllus* Honda, l. c. 45:697.1935;
- *A. kobuna* Honda, l. c. 49: 697.1935;
- *A. hispidus* var. *hispidissimus* Honda, l. c. 49: 698.1935;
- *A. mauritianus* Stapf ex Hubb., Kew Bull: 653.1939;

- *A. pallidus* Henr., Blumea 4: 526.1941;
- *A. okamotoi* Ohwi, Acta Phytotax. Geobot. 11: 165.1942.
- *A. hispidus* var. *monticola* Hiyama, J. Jap. Bot. 22: 56.1948;
- *A. antsirabensis* A. Camus, Bull. Soc. Bot. Fr. 95: 149.1948;
- *A. quartinianus* var. *monostachys* Jansen, Reinwardtia 2: 231.1953;
- *A. nitidulus* Stapf ex Bor, Fl. Ind., Burm. & Ceyl. 1: 101, 688.1960;
- *A. satarensis* Almeida, J. Bomb. Nat. Hist. Soc. 51: 181.1972.

Annual; culms weak, densely tufted, procumbent, short or tall, leafy to the panicle; sheaths glabrous, smooth, striate, ciliate on one margin, rather loose or inflated; ligule membranous, glabrous, ciliate, 1 mm long. *Leaf-blades* broadly ovate, ovate to lanceolate, 2-6 cm long by 1-1.6 mm wide, apex acute or acuminate; sparsely to densely hairy on both surfaces and margins with tubercle-based hairs, particularly near the base. *Inflorescence* a subdigitate raceme, emerging from the sheath of the uppermost leaf, consisting of several spike-like racemes, 2.5-3 cm long; pedicels completely suppressed or reduced to a merge point; rachis-internode 2-3 mm long, ciliate, curved. *Sessile spikelets* solitary on the nodes of the rachis, oblique and lanceolate in outline, 3-3.5 mm long, commonly light green to yellow color; lower glume papery to subcoriaceous, very scabrid towards the apex; upper glume keeled, scabrid towards the top; lemma usually absent or if present 2 mm long. *Awn* from the base of the upper lemma, up to 9 mm long. Stamens 2; anthers minute 0.7 mm long. *Pedicelled spikelets* suppressed not fully developed, stipe 4-4.5 mm (Fig. 12 & Plate 3).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Mae Klang Waterfall);

NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-EASTERN:
 Chantaburi (Pong Namrawn, Khao Saming); SOUTH-WESTERN:
 Kanchanaburi (Huay Ban Kau); PENINSULAR: Trang (Chong).

Distribution.- Widely distributed from Central and East Africa to Eastern, Central and Southeast Asia; and to Philippines, Indonesia, Japan (Type!), and Australia; introduced in Hawaii and Central America.

Ecology.- Found in various habitats, from lowland open areas, and limestone areas to dry deciduous forest at 100-400 m.

Vernacular names.- Yaa luk phai (Chantaburi).

Specimens.-Anderson 3877 (BKF); Beusekom et al. 3594, 3872 (BKF); Fukuoka 6151 (BKF); Kerr 2774 (K), 9421 (K, NY, UC), 16404 (BK, K); Maxwell 86-11 (BK); Murata et al. 155, 12320, 13324, 13858 (BKF); Schimizu 14673 (BKF); Smitinand 2048 (K), 3665 (BKF), 4975 (K); Sorensen et al. 592 (C, K), 598 (BKF); Suvatabandhu 385a (BK);

Remarks.- This is one of the most variable and widely distributed species, and therefore there is much variation in stem size, spikelet size and color, length of awns, size and shape of leaf-blade, hairs, etc. Welzen (1981) in his revision of the genus *Arthraxon* studied the distribution of the species and noticed the linking and intermediate characters. The following species are recorded as collected in Thailand: *Arthraxon breviaristatus*, *A. micans*, *A. ciliaris*, *A. inermis*, and *A. quartinianus*, but are here combined under *A. hispidus*.

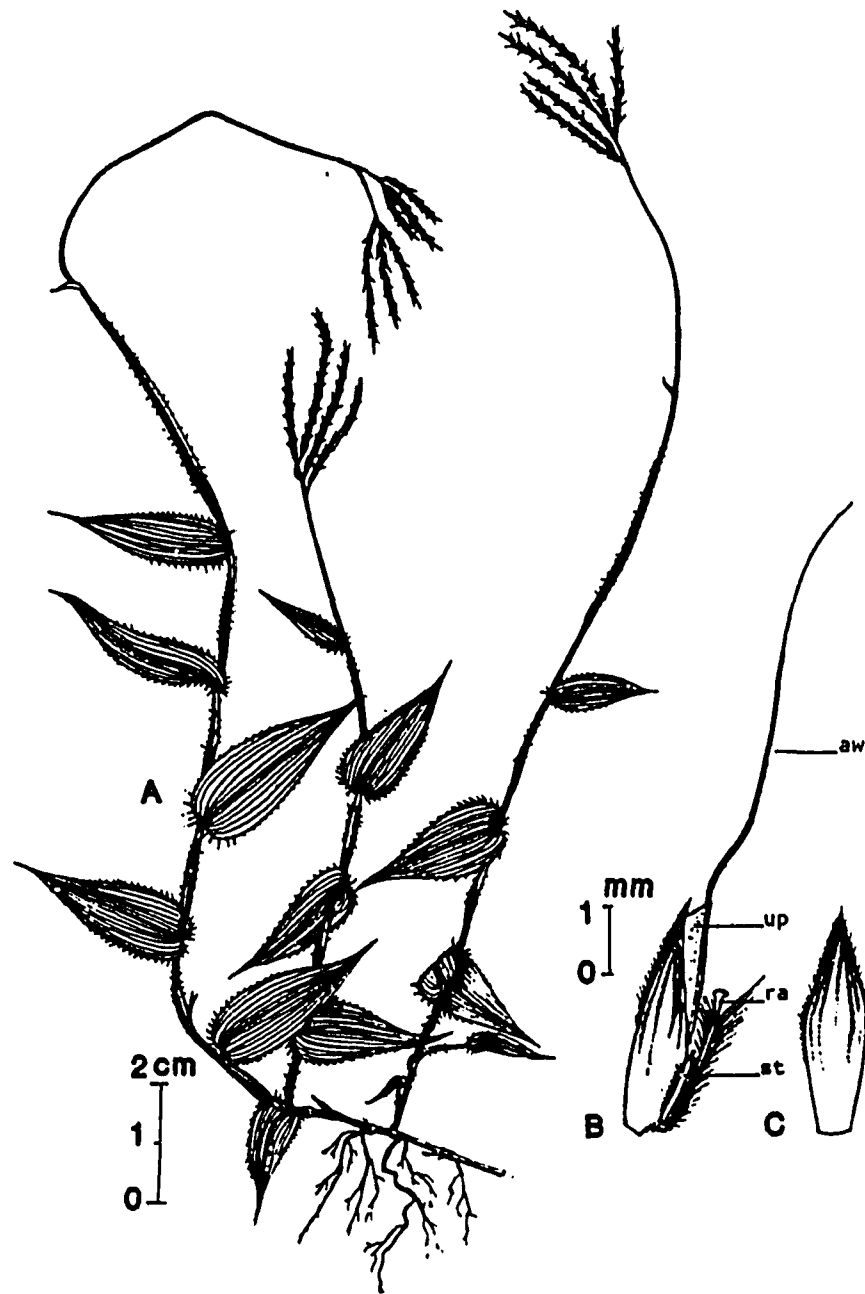


Figure 12. *Arthraxon hispidus* (Thunb.) Makino
 A. habit B. lateral view of sessile spikelet
 C. dorsal view of lower glume; aw, awn; st,
 stipe; ra, rhachis internode; up, upper glume;
 (Beusekom 3594, BKF).

3. *Arthraxon lanceolatus* (Roxb.) Hochst., in Flora 39: 188.1856;
 Hackel, Monogr. Androp. 6: 347.1889; Hook. Fl. Brit. Ind. 7:
 143.1897; Rendle, J. Linn. Soc. Bot. 36: 361.1904; Camus et Camus,
 Fl. Gen. I.- C. 3: 296.1922; Keng, Grass. China, 2: 225.1933;
 Bor, Fl. Assam 5: 374.1940; Fl. Ind., Burm. & Ceyl. 1: 100.1960;
 Ohwi, Fl. Jap.: 192.1965; Jain, J. Ind. Bot. Soc. 51: 175.1972;
 Lazarides, Pharn. Monogr., 7: 21.1980; Welzen in Blumea, 27:
 281.1981.
- *Andropogon lanceolatus* Roxb., Fl. Ind., 1: 262.1820;
 - *A. serrulatus* Link, Hort. Berol. 1: 241.1827;
 - *Batratherum lanceolatum* Nees in Edinb. Phil. J. 18: 181.1835.
 - *Andropogon prionodes* Steud., Syn. Pl. Glum. 1: 383.1854; Smitinand,
 Thai Pl. Names: 34.1980;
 - *Arthraxon prionodes* Dandy in Andrews, Flow. Pl. Sudan 3: 399.1856;
 - *A. serrulatus* Hochst., in Flora 39: 188.1856 (nom. superfl);
 - *A. lanceolatus* subvar. *wallichii* Hackel, Monogr. Androp.: 348.1889;
 Type.- India, Wallich 8830 (K-isotype!).
 - *A. lanceolatus* forma *glaberrimus* Chiov. in Pirootta, Ann. R. Ist.
 Bot. Roma 8: 278.1908;
 - *A. lanceolatus* forma *puberulus* Chiov., l. c. : 278.1908.

Perennial; culms 40-80 cm high, slender, decumbent, rooting at the lower nodes, glabrous or scaberulous; sheaths glabrous or hirsute with tubercle-based hairs; ligule membranous, ciliate, 2-3.5 mm long. **Leaf-blades** ovate-lanceolate to linear-lanceolate, up to 9 cm long by 5-15 mm wide, marginal nerves with broad-based spicules. **Inflorescence** a subdigitate racemes, 1.5-5 cm long; rhachis sparsely

hairy, rhachis internodes and pedicels about half as long as the spikelets. *Sessile spikelets* ovate-oblong, 6-7.5 mm long by 1-1.5 mm wide; callus shortly puberulous; lower glume chartaceous, attenuate from the middle, acute, with the apex normally entire, margins inflexed, marginal nerves with broad-based spicules, 5-7-nerved, convex and glabrous or slightly muricate on the back; upper glume lanceolate, acuminate, 3-nerved, glabrous or ciliate; lemma linear-oblong, acute. Awn up to 2.6 cm long. Stigmas broadly oblong, 2-3 mm long. *Pedicelled spikelets* linear-lanceolate, 5-6 mm, keels hispidulous; stamens 2; anthers 2.5-3 mm long. (Fig. 13 & Plate 4 A-C).

Thailand.- NORTHERN: Chiang Mai (Chiang Dao); NORTH-EASTERN: Loei (Phu Kradueng); EASTERN: Nakhon Ratchasima (Chan Tuk); SOUTH-EASTERN: Prachin Buri (Krabinburi, Watana);

Distribution.-India (Type!), Ceylon, Southern China, Indo-China, Indonesia and Japan.

Ecology.- In deciduous forests, open oak-pine and limestone crevices, at 200-1300 m.

Vernacular name.- Yaa yung phaa (Chiang Mai).

Specimens.-Charoenphol et al. 4891 (BKF); Kerr 4628, 8049 (BK, K); Put 4465 (K); Smitinand 2031 (BKF, K); Smitinand, Poore & Robbins 7844 (BKF); Sorensen 1257 (BKF, K), 2400 (BKF); Yongboonkird 147 (BK).

Remarks.- *Arthraxon lanceolatus*, *A. prionodes* and *A. serrulatus* have been recorded from Thailand. The amount of pubescence of the leaf-blades, convexity of the lower glume and the

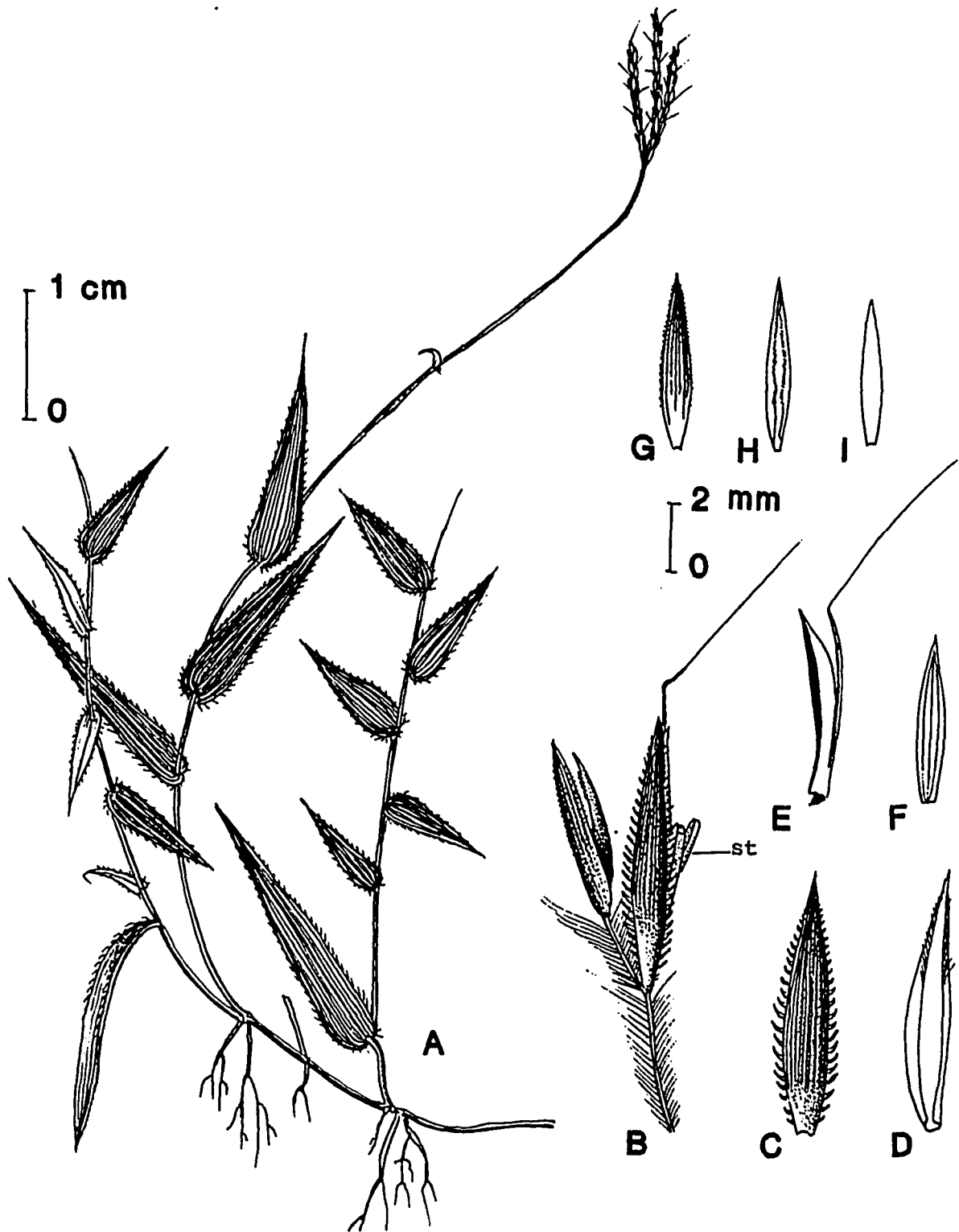


Figure 13. *Arthraxon lanceolatus* (Roxb.) Hochst.
 A. habit B. spikelet pair C-F. sessile spikelet C, D. lower
 glume E. upper lemma and awn F. lower lemma G-I. pedicelled
 spikelet G, H. lower glume I. lemma; st, stamen; (Kerr 8049).

spicules on the spikelets were characters employed by Hackel (1889) and Chiovenda (1908) to distinguish a number of taxa. These characters show too many intermediate forms, and are of no taxonomic value. These species are now combined under *A. lanceolatus*.

3a. *Arthraxon lanceolatus* Hochst. var. *meeboldii* (Stapf) Welzen, in *Blumea*, 27: 285.1981.

- *Arthraxon meeboldii* Stapf, *Kew Bull.* 1908: 449.1908; Jain, *J. Ind. Bot. Soc.* 51: 105.1972; Type.- India, from Concan, Sept. 1907, Meebold 9132 (K-holotype!).

- *A. purandharensis* Bharucha & Satyanarayan, *J. Bomb. Nat. Hist. Soc.* 75: 937.1978; Jain, *J. Ind. Bot. Soc.* 51: 179.1972.

Perennial; culms 10-30 cm long. *Leaf-blades* small with few indistinct nerves, ovate to broadly ovate, 2-3 cm long by 5-10 mm wide. *Inflorescence* arising from the spatheole, sparse with tubercle-based hairs; racemes few and narrow, 6-15 mm; spicules position mainly in the upper part. *Sessile spikelets* narrowly linear-lanceolate, 7.5-9 mm long by 0.8-1 mm broad; lower glume dorsally glabrous, marginal and submarginal nerves in respectively at about the middle and the upper part, sparse to dense with broad-based spicules; stamens 3, rarely 2; anthers 0.5-2.5 mm long. *Pedicelled spikelets* ovate-oblong, 4-5 mm long, 7-nerved; pedicel 2 mm long. (Fig. 14 & Plate 4 D-F).

Thailand.- NORTHERN: Tak (Phumibhol Dam).

Distribution.-India (Type!) to Indo-China.

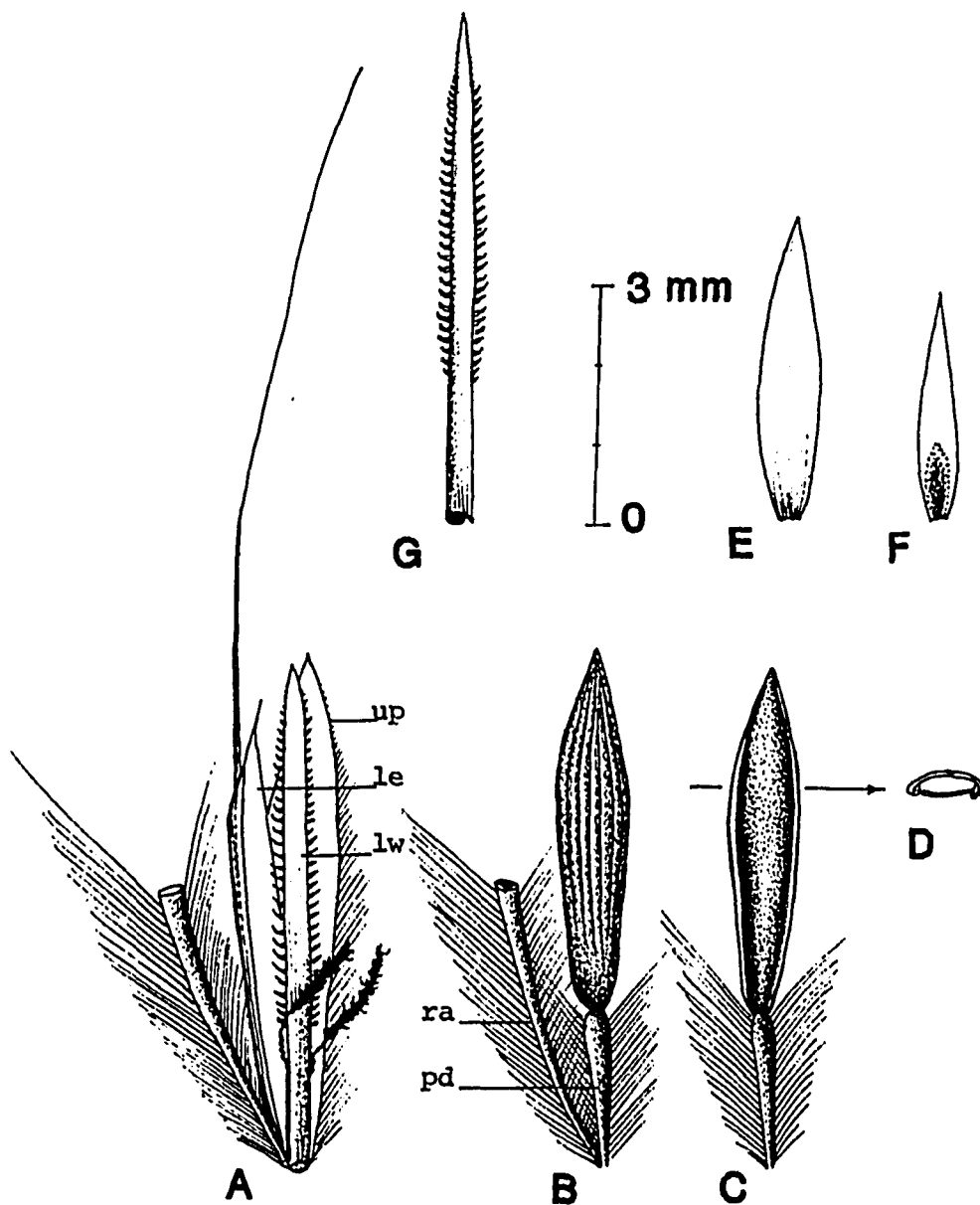


Figure 14. *Arthraxon lanceolatus* var. *meeboldii* Welzen
 A. sessile spikelet B-F. pedicelled spikelet B. dorsal view
 C. ventral view D. X-section of lower glume E. lemma F. palea
 G. lower glume of sessile spikelet; le, lemma; lw, lower glume;
 pd, pedicel; ra, rhachis internode; up, upper glume;
 (Ploenchit 471, BK).

Ecology.- In open deciduous forest by roadsides.

Specimens.-Ploenchit 471 (BK).

Remarks.- Represented by a single specimen which was misdetermined as *Arthraxon villosus*. The leaf-blades, and the size, shape and indumentum of the spikelets match exactly those of *A. lanceolatus* var. *meeboldii*.

4. *Arthraxon lancifolius* (Trin.) Hochst., in Flora 39: 188.1856; Stapf in Prain, Fl. Fl. Trop. Afr. 9: 165.1917; Camus et Camus, Fl. Gen. I. C. 3: 299.1922; Bor, Fl. Assam 5: 378.1940; Fl. Ind., Burm. & Ceyl. 1: 100.1960; Henr., Blumea 4: 525.1941; Jain, J. Ind. Bot. Soc. 51: 176.1972; Smitinand, Thai Pl. Names: 34.1980; Lazarides, Pharn. Monogr., 7: 22.1980; Welzen in Blumea, 27: 288.1981.

- *Andropogon lancifolius* Trin., in Acad. Sci. Petersb. 6.2: 271.1832;

Type.- Nepal, s.n. (Herb LE-holotype, K-phototype!).

- *Bathratherum molle* Nees et Arn., in Edinb. Phil. J. 18: 181.1835;

- *Pleuroplitis lancifolia* (Trin.), Regel in Bull. Acad. Sci. Petersb. 10: 375.1866;

- *Bathratherum lancifolium* Watson in Atk., Gaz. N.W. Prov. Ind. 10: 392.1882;

- *A. molle* Balf., in Trans. Roy. Soc. Edinb. 31: 315.1888;

- *Arthraxon microphyllus* var. *lancifolius* Hackel, Monogr. Androp.: 350.1889;

- *A. microphyllus* forma *lancifolius* Back., Handb. Fl. Java 2:73.1928;

- *A. lancifolius* var. *lancifolius* Jain, J. Ind. Bot. Soc. 51:176.1972;

- *Batratherum molle* var. *tenuis* Nees, Edinb. Phil. J. 18: 182.1835;

- *Psilopogon schimperi* Hochst. ex Rich., Tent. Fl. Abyss. 2: 447.1851;
- *Andropogon muticaulis* Steud., Syn. Pl. Glum. 1: 383.1854;
- *Lucaea schimperi* Steud., Syn. Pl. Glum. 1: 414.1855;
- *Arthraxon minor* Hochst., Flora 39: 188.1856;
- *Pleuroplitis ciliata* J.A. Schmidt, Beitr. Fl. Cap. Verde Ins.:
152.1852;
- *Psilopogon figarii* de Not., Ann. Sc. Nat. III, Bot. 19: 370.1853;
- *Arthraxon lancifolius* var. *birmanicus* O. Ktze, Rev. Gen. Pl. 2:
760.1891;
- *Arthraxon microphyllus* forma *intermedius* Back., Handb. Fl. Java 2:
73.1928;
- *Arthraxon linifolius* Henr., Blumea 4: 525.1941;
- *A. comorensis* A. Camus., Bull. Soc. Bot. Fr. 98: 36.1951;
- *A. lancifolius* var. *eremophilus* Bor, J. Ind. Bot. Soc. 50a:95.1971;
- *A. lancifolius* var. *hindustanicus* Jain & Deshpande, J. Ind. Bot.
Soc. 51: 176.1972.

Annual; culms 10-40 cm tall, very slender, decumbent at the base, then ascending, multi-noded; sheaths striate, terete, shorter than the internodes; ligule 1-2 mm long, rounded, truncate, membranous, ciliate. *Leaf-blades* lanceolate with a cordate, amplexicaul base, slightly acuminate, 1.5-3 cm long by 6-9 mm wide, the older flat, softly hairy, margins with tubercle-based hairs. *Inflorescence* a subdigitate raceme, slender, long, exserted, puberulous; spike-like racemes 2-10, soft, densely flowered, unequal, 0.7-1.4 cm long; rhachis-internodes 1-1.75 mm long, articulation straight, not appendaged. *Sessile spikelets* 2.5-3.5 mm long,

straight, linear-lanceolate, almost compressed laterally; lower glume membranous, lanceolate or linear-oblong, narrowed towards the base, acute, margins not inflexed, marginal nerves with small spicules, two-
 aristate, 5-7 nerved, without longitudinal grooved on the back, scabrid at the top; upper glume membranous, lanceolate acute, ending in silky hairs 0.5-0.8 mm long, 1-nerved; lemma 1-1.8 mm long, linear-oblong, obtuse, glabrous. Awn 5-10 mm long. Stamens 2; anthers 0.4 mm long. Stigmas small, equalling the styles in length. *Pedicelled spikelets* 2 mm long, ovate-lanceolate, empty; pedicel 1 mm long (Fig. 15 & Plate 5 C-D).

Thailand.- NORTHERN: Chiang Mai (Chiang Dao, Doi Angka, Doi Suthep, Mae Chaem); Tak (Doi Musor); CENTRAL: Nakhon Nayok (Nang Rawng Waterfall); NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-WESTERN: Kanchanaburi (Erawan NP, Huay Ban Kau).

Distribution.- India, Nepal (Type!), Burma, Indo-China and Indonesia.

Ecology.- Common gregarious grass in wet and moist places, in old clearings, edges of evergreen forest, shady open mixed deciduous forest, and on crevices of exposed limestone rocks, up to 1800 m.

Vernacular names.- Yaa doi, Yaa yung daeng (Chiang Mai).

Specimens.- Beusekom et al. 3510 (BKF, K, US), 3752 (BKF, K); Charoenphol 4600 (BKF, K); Harniff s.n. (K); Kerr 849 (K), 6595 (BK, K); Larsen et al. 4600 (BKF); Put 3427, 4547 (K); Smitinand 6987 (BKF, K, GH); Smitinand s.n./BKF 22237 (K); Smitinand & Anderson 7235 (BKF); Smitinand & Phengklai 6049 K); Sorensen, Larsen & Hansen 6256 (BKF, K).

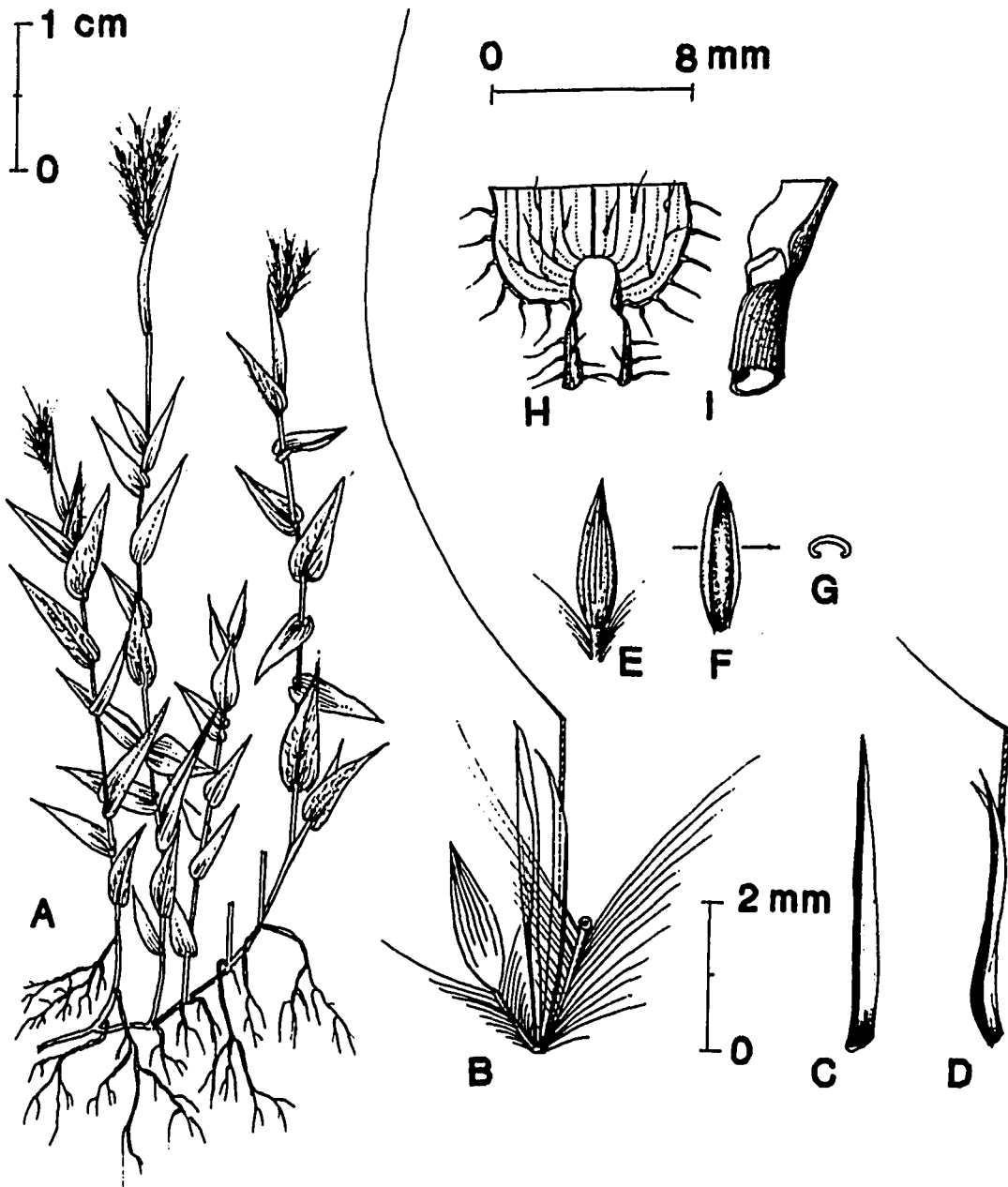


Figure 15. *Arthraxon lancifolius* (Trin.) Hochst.
 A. habit B. spikelet pair C-D. sessile spikelet C. upper
 glume D. lemma and awn E-G. lower glume of pedicelled
 spikelet E. dorsal view F. ventral view G. X-section of lower
 glume H. front view of leaf-blade and ligule I. lateral view of
 ligule; (Sorensen, Larsen and Hansen 4600, BKF).

Remarks.- The plants are normally small and slender in habit. The inflorescences are easily recognized by their soft puberulence and the frequent lack of pedicelled spikelets.

5. *Arthraxon microphyllum* (Trin.) Hochst., Flora 39: 188.1856; Hackel, Monogr. Androp.: 351.1889; Jain, Ind. For. 97: 220.1971; Bor, Ind. For. 98: 520.1972; Welzen, Blumea 27: 292.1971.

- *Andropogon microphyllum* Trin., Mem. Acad. Sci. Petersb. 6: 275.1833;

Type.- Nepal, Wallich s.n. (K-holotype!).

- *Batratherum molle* var. *parvulum* Nees, Edinb. Phil. J. 18:182.1835;

- *Pleuroplitis microphylla* Regel, Bull. Acad. Sci. Petersb. 10: 370.1866;

- *Arthraxon lancifolius* var. *microphyllum* O. Ktze, Rev. Gen. Pl. 2: 760.1891;

- *A. microphyllum* forma *genuinus* Back., Handb. Fl. Java 2: 73.1928;

- *A. sikkimensis* Bor, Kew Bull. 1951: 447.1952; Grass. Burm. Ind. & Ceyl. 1: 102.1960; **Type.-**India, Sikkim, Gammie 1079 (K-holotype!).

Annual; culms slender up to 30 cm high, glabrous; nodes pubescent; sheaths glabrous to pilose with patent tubercle-based hairs; ligule 0.4-2.5 mm high, fimbriate. **Leaf-blades** 0.3-1.0 by 0.1-0.3 cm; puberulous on both surfaces, margins with tubercle-based hairs. **Inflorescence** 0.7-2.3 cm long, leafy at base; with 1-3 branches and 4-15 spikelets; rhachis-internode 1.2-2.4 mm long; peduncle 4-12 cm; spikelets paired. **Sessile spikelets** 2.8-3.5 cm long by 0.4-0.6 mm wide; herbaceous to chartaceous; callus 0.2-0.5 mm long,

densely white-pubescent; lower glume rounded with 5-6 longitudinal grooves on the back; margin not inflexed, marginal nerves with small spicules; nerves 6 or 7, very conspicuous, ridged with spicules in the upper part; upper glume 3-5 nerved; lemma nerveless. *AWN* 8-10 mm long. Palea absent. Lodicules 0.2-0.3 mm. Anthers 2, ca 0.6 mm. Style 0.7 mm long, stigmas 0.4 mm long. Caryopsis 2 mm long by 0.5 mm wide. *Pedicelled spikelets* sterile, compressed laterally, narrowly linear, 1.9-2.2 by 0.2-0.3 mm, 6-nerved, somewhat protruding with minute spicules; stipe 1.6-1.9 mm long, laterally pilose (Fig. 16 & Plate 5 A-B).

Thailand.- NORTHERN: Ching Mai (Doi Langka).

Distribution.- India, Nepal, Sikkim to Indo-China.

Ecology.- Hill evergreen forest in open areas at about 1000 m altitude.

Specimens.-Garett 840 (BKF, K, NY).

Remarks. *Arthraxon microphyllus* and *A. lancifolius* are similar but they are clearly distinct species. *A. microphyllus* always has pedicelled spikelets and very conspicuous 6-7-nerved ridges with spicules on the lower glumes.

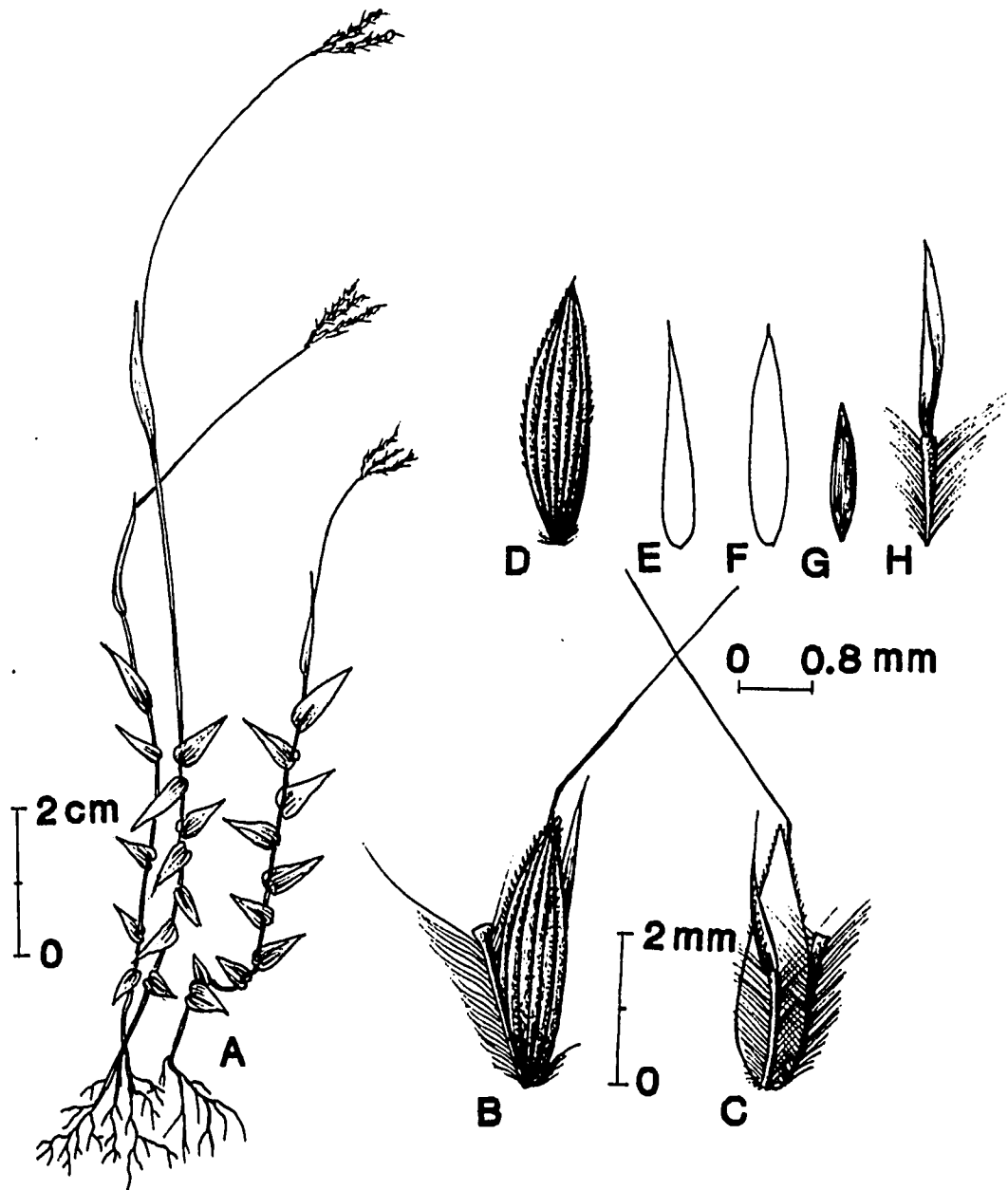


Figure 16. *Arthraxon microphyllum* (Trin.) Hochst.
 A. habit B, C. spikelet pair, dorsal and ventral view
 D, F. sessile spikelet D. dorsal view of lower glume
 E. lemma F. palea G. caryopsis H. pedicelled spikelet;
 (Gerette 840, BKF).

CYMBOPOGON Spreng.

- Cymbopogon* Spreng., Pl. Pugill. 2: 14.1815; Stapf in Kew Bull. 1906: 297.1906; in Prain, Fl. Trop. Afr. 9: 265.1919; Chiov., Gram. Ess. 1909; Domin in Bibl. Bot. 85: 273.1915; A. Camus in Rev. Bot. Appl. Colon. 1: 270.1921; Keng, Grass. China, 2: 288.1933; Pilger in Engl. & Prantl, Pfl. Fam., 2, 14: 162.1940; Bor in J. Bomb. Nat. Hist. Soc. 51: 890,897.1953; Fl. Ind., Burm. & Ceyl. 1: 121.1960; Blake in Proc. Roy. Soc. Queensl. 80: 69.1969; in Contr. Queensl. Herb. 17: 29.1974; Gilliland, Fl. Mal. 3: 294.1971; Soenarko, in Reinwardtia 9,3: 273.1977; Hsu, Fl. Taiwan 5: 634.1978; Koyama, Fl. Jap.: 448.1987.
- *Andropogon* sect. *Cymbopogon* (Spreng.) Steud., Syn. Pl. Glum. 1: 383.1854;
 - *Gymnanthelia* Schweinf., Beitr. Fl. Aethiop. 1: 299.1867 (nom nud);
 - *Andropogon* subgen. *Cymbopogon* sect. *Gymnanthelia* Hackel in DC., Monogr. Phan. 6: 594.1889.

Note.- Cymbe = a boat, pogon = a beard: referring to the boat-like sheaths which enclose the small racemes, which are bearded.

Perennial rarely annuals, usually aromatic; culms densely tufted, rarely solitary; sheaths persistent; ligule a ciliolate membrane. *Leaf-blades* linear-lanceolate, base usually clasping the culm. *Inflorescence* a spatheate compound panicle, contracted; racemes with many-jointed fragile rhachis, subtended by a spatheole.

Spikelets in pairs, one sessile, the other pedicelled, dissimilar in sex and shape; except the lowest pair, homogamous and both male or

neuter. *Sessile spikelets* compressed, rather chartaceous; callus short, obtuse, shortly bearded; lower glumes 2-keeled, flat or depressed or grooved on back, with sharply inflexed margins at least above the middle; upper glumes rather cymbiform, keeled upwards, usually 1-nerved; lemmas hyaline, ciliate or ciliolate; lower usually 2-nerved, entire, upper bifid or 2-lobed at apex, awned or reduced. *Caryopsis* oblong. *Pedicelled spikelets* slightly compressed, rather round, not depressed or grooved on back; lower glume rather chartaceous; upper thinner. Lemmas hyaline, or absent.

A genus of ca. 60 species, predominantly in Asia, the plants distributed chiefly in the tropics of the Old World and also extending into subtropical and warm-temperate regions. In Thailand 13 species are recorded including the 5 species widely cultivated as a commercial source of essential aromatic oils: *C. citratus*, *C. flexuosus*, *C. martinii*, *C. nardus* and *C. winteranus*.

KEY TO THE SPECIES OF CYMBOPOGON IN THAILAND

1. Lower glume of sessile spikelet with deep median groove from the middle downwards; leaf-blades rounded to cordate at the base. Perennial, rarely annual
2. Culm often with stilt roots at the lower nodes, solitary, rarely loosely tufted. Lower glume of sessile spikelet tomentose. Perennial or annual **C. clandestinus**
2. Culm without stilt roots at the lower nodes, tufted. Lower glume of sessile spikelet glabrous. Perennial
3. Leaf-blades cordate at the base; lower glume of sessile spikelet with deep median groove, awn more than 14 mm long **C. martinii**
3. Leaf-blades rounded or attenuate at the base, awned or awnless
4. Lowermost pedicel swollen; ligule less than 1.5 mm long; sessile spikelet 4.5 mm long, awn 14-18 mm long **C. annamensis**
4. Lowermost pedicel not swollen; ligule about 3.5 mm long; sessile spikelet 2.8-3.2 mm long, awn reduced **C. cambogiensis**
1. Lower glume of sessile spikelet flat or concave on the back; leaf-blades narrow, tapering or attenuate at the base. Perennial
6. Lower glume of sessile spikelet 5-7 mm long, broadly winged

7. Awn more than 15 mm long; spikelet 7 mm; lower glume of sessile spikelet lanceolate to broadly lanceolate, 2-nerved or nerveless, often tomentose on back, 1-2 wrinkled; nodes usually bearded *C. traninhensis*
7. Awn less than 12 mm long; spikelet 5 mm; lower glume of sessile spikelet oblong-lanceolate, often with 3-wrinkled; nodes usually glabrous *C. khasianus*
6. Lower glume of sessile spikelet 3.5-5 mm long, narrowly winged
8. Leaf-blades 4-11 mm wide
9. Lower glume of sessile spikelet shallowly concave in the lower part; racemes 10-12 mm long, nearly deflexed, awn 5-8 mm long *C. microstachyus*
9. Lower glume of sessile spikelet flat and often wrinkled on the back
10. Culm up to 150 cm high; nodes glabrous.
Raceme slender, 20 mm long; lower glume of sessile spikelet subcoriaceous, 3-nerved
C. calcicola
10. Culm less than 100 cm high; nodes bearded.
Raceme 15 mm long; lower glume of sessile spikelet membrano-chartaceous, nerveless or 2-nerved *C. calciphilus*
8. Leaf-blades more than 14 mm wide
11. Sessile spikelet awnless; basal sheaths remain attached at the base, whitish green *C. citratus*

11. Sessile spikelet normally awned; basal sheaths loose often slip from the culm, green to purplish green
12. Leaf-blades with long spreading hairs at the base on the upper surface. Lower glume of sessile spikelet often nerveless
C. flexuosus
12. Leaf-blades glabrous. Lower glume of sessile spikelet often 2-3 nerved
13. Panicle congested, interrupted; lower glume of sessile spikelet broadly winged, usually 2-3 nerved; awned, 6-7.5 mm long
C. nardus var. *confertiflorus*
13. Panicle interrupted, spreading, branches arranged in zig-zag axis; awn up to 5 mm long
C. winteranus

1. *Cymbopogon annamensis* (A. Camus) A. Camus in Bull. Mus. Hist. Nat. Paris 26: 563.1920; Camus & Camus in Lecomte, Fl. Gen. I.-C. 7: 344.1922.

- *Cymbopogon martinii* var. *annamensis* A. Camus in Bull. Mus. Hist.

Nat. Paris 25: 670.1919; Type.- Indo-China, Chevalier 30652

(P-holotype, K-phototype!).

- *C. bassacensis* A. Camus in Bull. Mus. Hist. Nat. Paris 26: 564.1920.

Type.- Thorel, Expedition de Mekong 1866-1868 (P-holotype).

Perennial; culm 65-100 cm high, wiry and slightly geniculate, glabrous or hairy near the joints; sheaths glabrous, commonly brownish red when dry; ligule rounded, 0.5-1.5 mm long. *Leaf-blades* 30-40 cm long by 3-9 mm wide, smooth, tapering to apex, more or less rounded at the base, very rarely attenuate. *Inflorescence* erect, 20 cm long, narrow; spatheole 2.5-4.5 cm long, hairy near the joint; racemes 18-20 mm long; lower raceme-base and lowermost pedicel swollen, fused in the lower part, almost glabrous; rhachis-internodes and pedicels broaden upwards, pilose along the margins, glabrous on the back, 3 mm long. *Sessile spikelets* 4-4.5 mm long; lower glume 0.8-1 mm wide, upper part broadly winged with scabrid margins, lower part with deep median grooves, nerveless to 2-nerved. Awn 14-18 mm long. *Pedicelled spikelets* 4 mm long; lower glume 0.8-1 mm wide, broadly lanceolate, prominent 7-nerved. (Fig. 17 & Plate 6).

Thailand.- EASTERN: Nakhon Ratchasima (Pak Tong Chai, Bua Yai).

Distribution.- Indo-China (Type!).

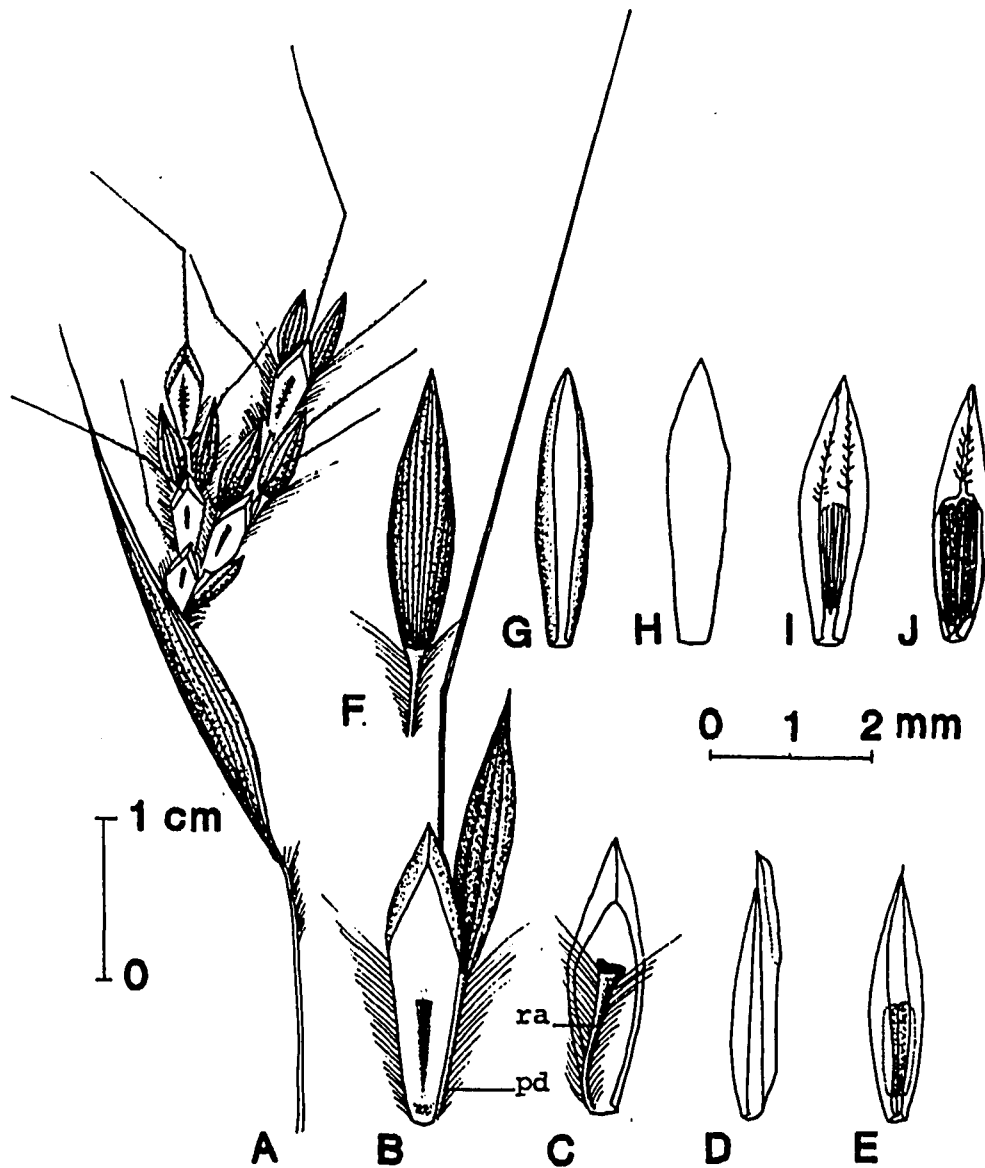


Figure 17. *Cymbopogon annamensis* (A. Camus) A. Camus
 A. raceme and spatheole B. spikelet pair, dorsal view
 C-E. sessile spikelet C. ventral view of lower glume
 D. upper glume E. lemma F-J. pedicelled spikelet
 F, G. lower glume, dorsal and ventral view H, I. upper
 glume J. lemma; pd, pedicel; ra, rhachis internode;
 (Kerr 7948, BK).

Ecology.- In open grasslands and edge of dry dipterocarp forests at 250-400 m altitude.

Specimens.-Kerr 7948 (BK, K), 8130 (AAU, BK, K); Put 4245 (BKF, K); Thorel s.n. (P);

Remarks.- The species is recognized by the spikelet character: sessile spikelets broadly winged at the top, and smooth with a deep groove at the middle, while the pedicelled spikelets clearly have 7 longitudinal nerves on the back.

2. *Cymbopogon calcicola* Hubbard, Kew Bull. 1941: 24.1941; Gilliland, Fl. Mal. 3: 297.1971; Soenarko, in Reinwardtia 9,3: 367.1977; Lazarides, Phan. Monogr. 12: 30.1980.

Type.- Malay Peninsula, SFN 36256 (K-holotype!).

Perennial; culm 150 cm high, glabrous; nodes and sheaths glabrous, smooth, yellowish; ligule 1-3 mm long, subchartaceous, glabrous. *Leaf-blades* narrow, 70 cm long by 8-11 mm wide, base attenuate, glabrous and smooth above, often slightly rough below, minutely puberulous at the base. *Inflorescence* up to 90 cm long, narrow, interrupted by spatheoles; spatheole 21 mm long; racemes slender, drooping, 20 mm long; rhachis internodes and pedicels pilose along the margins, glabrous on the back; peduncle glabrous, 6-10 mm long. *Sessile spikelets* lanceolate, 4 mm long; lower glume flat or concaved, subcoriaceous, 0.8 mm wide, narrowly winged, rarely wrinkled, 3-nerved. *Awn* 8-11 mm long. *Pedicelled spikelets* 3.5 mm long; lower glume 0.8 mm wide, 7-nerved. (Plate 7).

Thailand.- A small island near Palau Pauji of Malaysia in peninsular Thailand.

Distribution.- Peninsular Thailand and Malaysia.

Ecology.- On open slopes among the crevices of limestone hills.

Specimens.-Haniff 4074, s.n. 16 Dec. 1918 (K).

Remarks.- This species is represented by many collections from Malaysia. So far in Thailand there is only an imperfect specimen collected in 1918 from an island closed to the Malaysian border. The description of the species is drawn from the Malaysian specimens deposited at Kew.

3. *Cymbopogon calciphilus* Bor, in Dansk Bot. Arkiv 23,2: 157.1965; Soenarko in Reinwardtia 9,3: 362.1977; Lazarides, Phan. Monogr. 12: 30.1980. **Type.**- Thailand, Kanchanaburi, Tha ki len, Larsen 8335 (K-holotype!; BKF-isotype!, GH-isotype!).

Perennial, loosely tufted; culm 70-100 cm high, smooth, glabrous, nodes often bearded; sheaths smooth, whitish, densely tomentose at the base; ligule shortly fimbriate, glabrous, 1 mm long. *Leaf-blades* 40-60 cm long by 4-8 mm wide; tapering and densely tomentose at the base. *Inflorescence* 15-20 cm long, narrow, often interrupted; spatheole 13-16 mm long, membranous-chartaceous, tomentose at base; peduncle 6-10 mm long; racemes 15 mm long; lower raceme-base and lowermost pedicels not swollen; rhachis-internodes and pedicels pilose along the margins, glabrescent on the back. *Sessile spikelets* 4-4.5 mm long; lower glume membrano-chartaceous, slightly concave on the lower part, narrowly winged with shortly ciliate

margins on upper part, often with 1-2 wrinkles on the back, nerveless to 2-nerved. *Awn* 10-12 mm long. *Pedicelled spikelets* 4 mm long; lower glume ovate-lanceolate, 7-nerved. (Fig. 18 & Plate 8).

Thailand.- NORTHERN: Lampang (Thoen-Lee); NORTH-EASTERN: Khon Kaen (Phu Wieng); Loei (Phu Kradueng); EASTERN: Nakhon Ratchasima (Lat Bua Kao); SOUTH-WESTERN: Kanchanaburi (Kanburi, Phra Taen, Tha ki len); Phetchaburi (Tung Luang); Prachuap Khiri Khan (Hua Hin, Kao Tao).

Distribution.- Endemic to Thailand.

Ecology.- Common in limestone hills at lower altitudes, ca. 130 m.

Specimens.-Kerr 13478, 19876, 19998, 20596 (K); Larsen 8335 (BKF, GH); Marcan 2437 (K); Put 4319; Smitinand 2028, 3870 (K); Smitinand & Abbe 6168 (BKF), 6169 (K).

Remarks.- The type specimen Larsen 8335 at Kew has glabrous, flat and nerveless lower glumes. Other collections from Thailand show the lower glumes are glabrous, flat, but without nerves or faintly 2-nerved. This character is not present in other members of the genus, and therefore, is characteristic of this species.

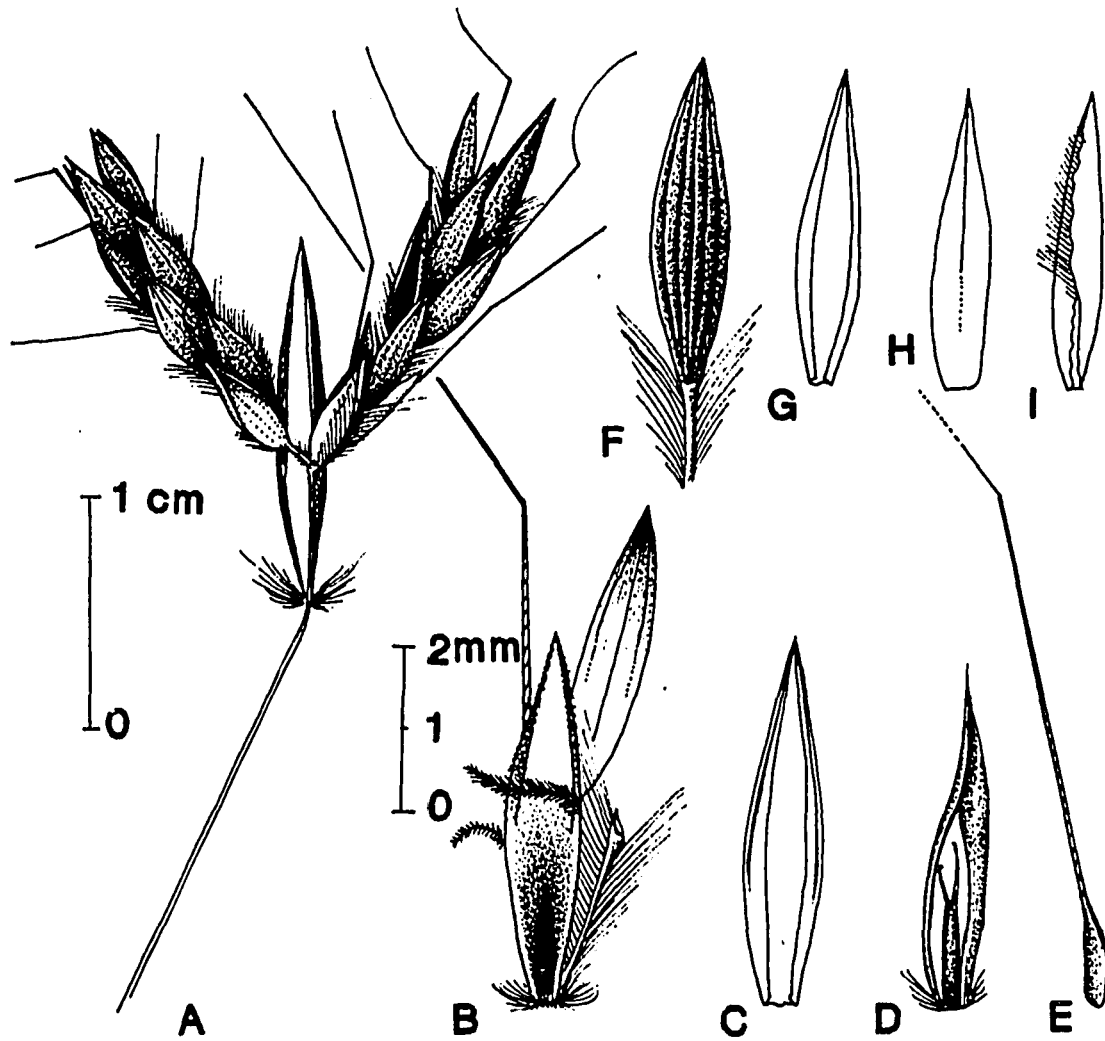


Figure 18. *Cymbopogon calciphilus* Bor

A. raceme B. spikelet pair C-E. sessile spikelet C. ventral view of lower glume D. upper glume and ovary E. upper lemma and awn F-I. pedicelled spikelet F. dorsal view of lower glume G. ventral view of lower glume H. upper glume I. lemma; (Larsen 8335, GH).

4. *Cymbopogon cambogiensis* (Bal.) Camus & Camus in Lecomte, Fl. Gen. I.-C. 7: 351.1922 (cambodgiensis); Soenarko in Reinwardtia 9,3 : 334.1977; Lazarides, Phan. Monogr. 12: 30.1980; Smitinand, Thai Pl. Names: 103.1980.

- *Andropogon cambogiensis* Balansa in Morot, J. Bot. 4: 114.1890;

Type.- Cambodia, Godefray 292 (K-isotype!).

- *Cymbopogon siamensis* Bor in Dansk Bot. Arkiv 23: 158.1965.

Type.- Thailand, Larsen 8989 (K-holotype!).

Perennial; culm tufted, up to 175 cm high, 3-4 mm in diameter, wiry, often branched, nodes swollen; sheaths lanceolate, glabrous; ligule membranous, truncate, glabrous, 3-5 mm. *Leaf-blades* flat, 20-40 cm long by 9 mm wide, glabrous, margins scaberulous towards the apex, rounded at base. *Inflorescence* narrow, 12-20 cm long; spatheole 1.5-2 cm long; racemes few jointed, deflexed, 1.2-1.5 cm long; lower raceme-base and lowermost pedicels flat, not swollen, glabrous; rhachis internodes and pedicels glabrous on back, sparsely pilose along the margins, 1.4-1.6 mm. *Sessile spikelets* 2.8-3.2 mm long; lower glume narrowly ovate to ovate-elliptic, 0.8 mm wide, glabrous, narrowly winged, nerveless or 2-nerved, lower part with shallow median groove on the back; color much lighter than the pedicelled spikelet. Awn reduced. *Pedicelled spikelets* glabrous; lower glume 2.8-3 mm long by 0.8 mm wide, broadly ovate to ovate-oblong, 5-7 nerved. (Fig. 19 & Plate 9).

Thailand.- CENTRAL: Chai Nat, Suphan Buri; SOUTH-EASTERN:

Chanthaburi (Makham); Prachin Buri (Aran pratet);

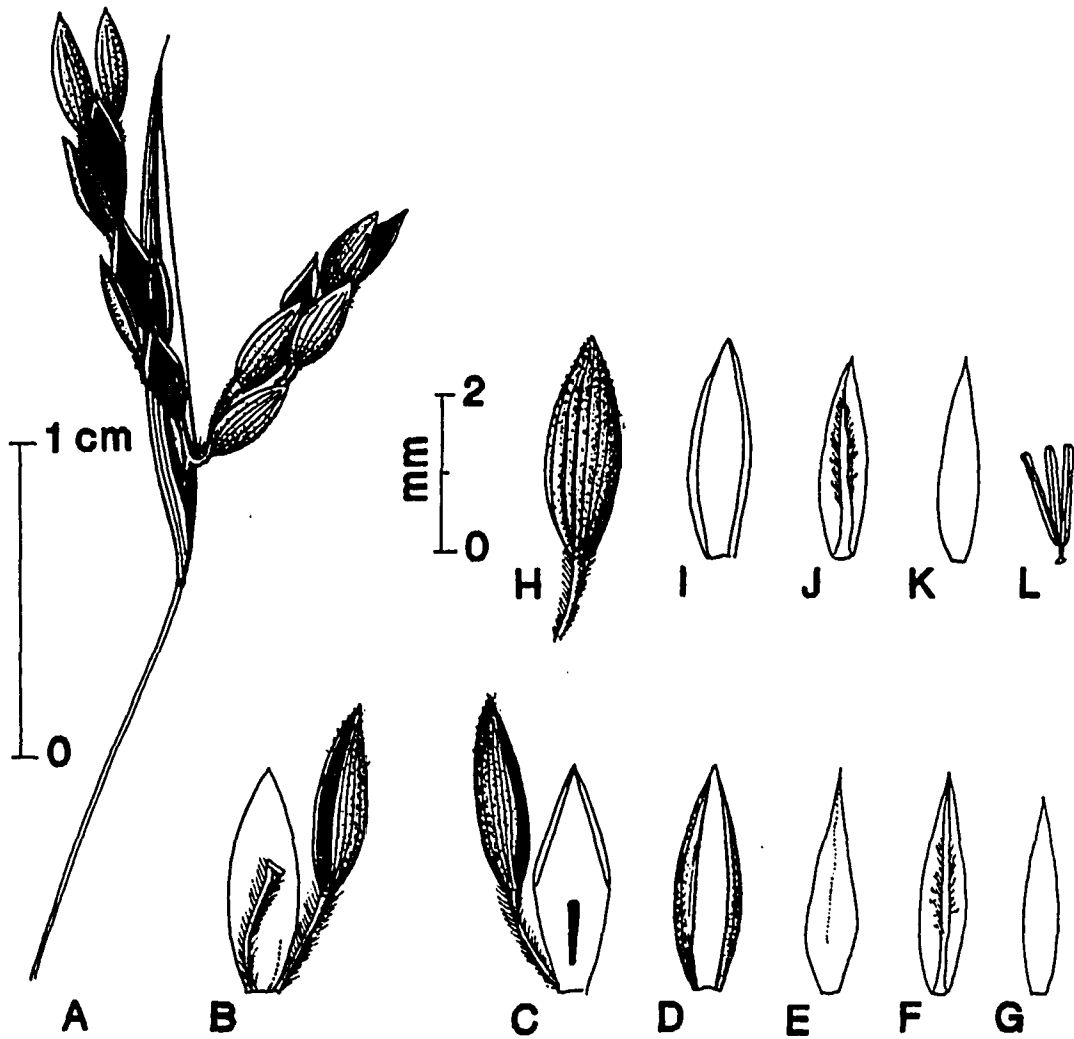


Figure 19. *Cymbopogon cambogiensis* (Bal.) Camus & Camus
 A. raceme B, C. spikelet pairs, ventral and dorsal view
 D-G. sessile spikelet D. ventral view of lower glume
 E, F. upper glume G. lemma H-K. pedicelled spikelet
 H, I. lower glume J. upper glume K. lemma L. stamens;
 (Larsen 8989, BKF).

PENINSULAR: Chumphon.

Distribution.- Indo-China, Cambodia (Type!).

Ecology.- Frequent in lowland savannah and scattered in open grassy grounds in deciduous forest at ca. 50 m altitude.

Vernacular name.- Yaa phrik phraan (Chai Nat).

Specimens.-Kerr 11391, 19586, 19677 (BK, K); Larsen 8989 (K), 10027 (BKF, K).

Remarks.- *Cymbopogon cambogiensis* is easily confused with *C. annamensis* because the sessile spikelets of both species are grooved in the middle. *C. cambogiensis* is distinguished by having a narrow spikelet with narrow wings and a shallow median groove.

5. *Cymbopogon citratus* (DC. ex Nees) Stapf, in Kew Bull 1906: 357.1906; Bor in J. Bomb. Nat. Hist. Soc. 51: 907.1953; Fl. Ind., Burm. & Ceyl. 1: 126.1960; Senaratana, Grass. Ceyl.: 193.1956; Froideville in Becker & van der Brink Jr., Fl. Java 3: 611.1968; Gilliland, Fl. Mal. 3: 296.1971; Soenarko in Reinwardtia 9,3: 351.1977; Hsu, Fl. Taiwan 5: 635.1978; Smitinand, Thai Pl. Names: 103.1980.

- *Andropogon citratus* DC., Cat. Hort. Monsp.: 78.1813 (nom. nud.);
DC. ex Nees, Allgem. Gartenz. 3: 266.1835;

Type.- Based on *Andropogon citratus* DC. in Cult. Hort. Monspel, source unknown.

- *A. citriodorum* Desf., in Tabl. ed. 2: 15.1815 (nom. nud.);

- *A. schoenanthus* Roxb., Fl. Ind. ed. 2,1: 278.1820 (non Linn., 1753);

- *A. roxburghii* Nees, Wight, Cat. no.: 1699.1833 (nom. nud.);
Nees ex Steud, Syn. Pl. Glum. 1: 395.1854;
- *A. cerifereus* Hackel in Mart., Fl. Bras. 2,3: 281.1883;
Type.- Brazil, Glaziou 1496 (K-phototype).
- *A. nardus* ssp. *ceriferus* Hackel, in DC., Monogr. Phan. 6:
605.1889.

Perennial; culm up to 200 cm high, smooth, glabrous, densely tufted at base; sheaths terete, glabrous, smooth; basal sheath persistent remaining attached to the base, whitish green; ligule chartaceous, minute, less than 1 mm long, glabrous. *Leaf-blades* linear-lanceolate, flat, tapering, up to 90 cm long by 14-20 mm wide, base attenuate, margins scaberulous, glabrous, smooth on both surfaces. *Inflorescence* a decompound spatheate panicle, 30-45 cm long; spatheole reddish-brown, 14-20 mm long; raceme 15-17 mm long; rhachis internodes and pedicels pilose along the margins and on the back, 2.0-2.5 mm long. *Sessile spikelets* 4-4.5 mm long; lower glume 0.8-1.0 mm wide, lanceolate, narrowly winged, flat on the back, slightly concave in the lower part, glabrous, nerveless or with 3(4) fainted intracarinial nerves. *Awn* reduced. *Pedicelled spikelets* 4.5 mm long; lower glume 0.7 mm wide, glabrous, 5-7 nerved. (Fig. 20 & Plate 10).

Thailand.- NORTHERN: Mae Hong Son; EASTERN: Surin; SOUTH-EASTERN: Prachin Buri; CENTRAL: Bangkok; PENINSULAR: Surat Thani;
Distribution.- Philippines, Sumatra, Indonesia, Borneo, New Guinea Thailand (cultivation).

Ecology.- Commonly cultivated as a kitchen plant for the spicy flavor and for medicinal purposes.

Vernacular names.- Cha khrai (Northern); Khaa-hom (Shan-Mae Hong Son); Ho-wo ta-po (Karen-Mae Hong Son); Soet-kroei, Loe-kroei (Khmer-Surin); Hua-sing-khai (Khmer-Prachin Buri); Ta Khrai (Central); Khrai (Peninsular); Lemon Grass, Lapine.

Specimens.-Kerr 20648 (BK).

Remarks.- Lemon grass is one of the most common kitchen plants in Southeast Asia; young shoots are used as a spice for flavoring several kinds of food and the plant is used for medicinal purposes such as to regulate the stomach. All parts of the plant when crushed yield a strong smell of lemon. The oil has a high content of citronelol, citronellal, citral, geraniol and myrcene, as well as other compounds (Burkill, 1966).

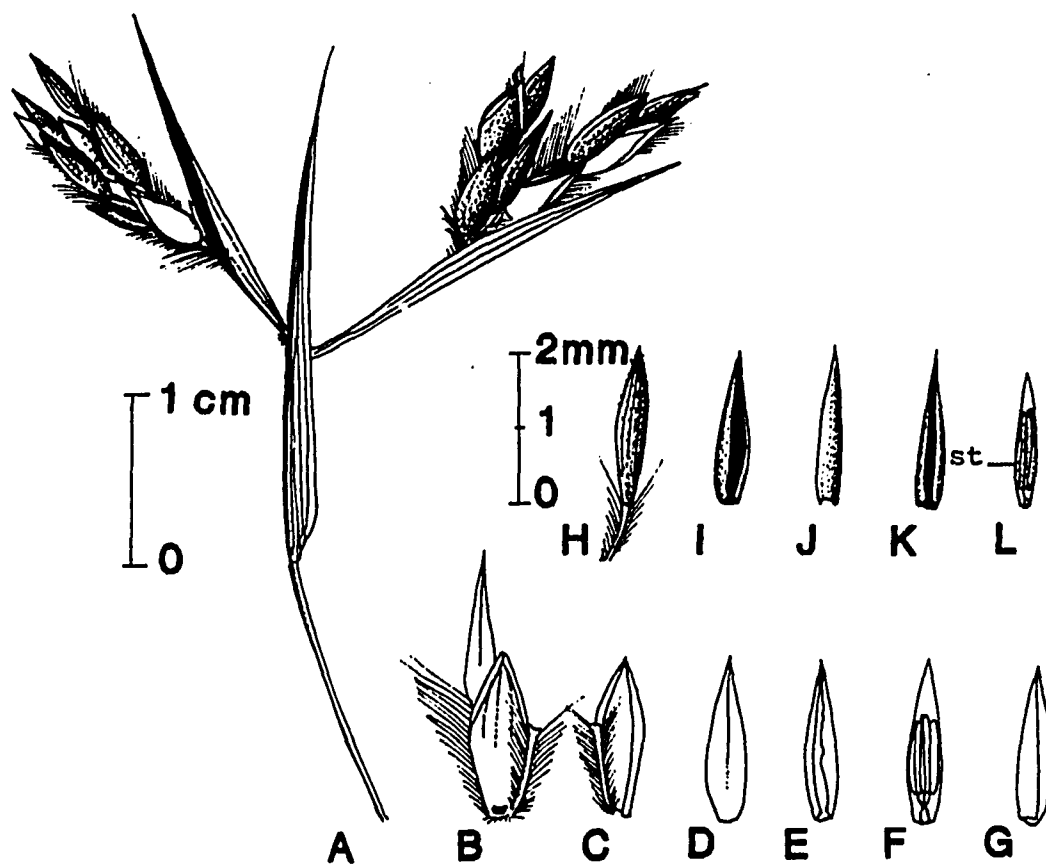


Figure 20. *Cymbopogon citratus* (DC.) Stapf
 A. raceme B. spikelet pair C-G. sessile spikelet C. ventral
 view of lower glume D dorsal view of upper glume E. ventral
 view of upper glume F-G. lemma H-L. pedicelled spikelet H.
 dorsal view of lower glume I. ventral view of lower glume
 J-K. upper glume L. lemma; st, stamens; (Kerr 20648, BK).

6. *Cymbopogon clandestinus* (Nees ex Steud.) Stapf in Ann. Rept. Board Sci. Advice, India: 10.1918; Bull. Imp. Inst. London 27: 458.1929; Bor in J. Bomb. Nat. Hist. Soc. 52: 149.1954; Fl. Ind., Burm. & Ceyl. 1: 126.1960; Soenarko in Reinwardtia 9,3: 322.1977; Lazarides, Phan. Monogr. 12: 30.1980;

- *Andropogon clandestinus* Nees ex Steud., Syn. Pl. Glum. 1: 388.1854.

Type.- Burma, Wallich 8794K (K-isotype!).

Perennial or annual; culm up to 200 cm high, 4 mm in diameter, erect, sometimes geniculate, solitary, greenish to purplish, often with stilt roots on the lower nodes; sheaths glabrous; ligule 3 mm long, membranous. *Leaf-blades* up to 45 cm long, 9 mm wide, hard in texture, glabrous, slightly rounded at the base. *Inflorescence* a spatheate panicle, narrow, erect, with loose branches, 15-60 cm long, greenish to purplish; peduncle 25-31 mm long, subchartaceous; raceme 17.5-23 mm long; pedicels and rhachis internodes pilose along the margin and on the back. *Sessile spikelets* 5 mm long; lower glume narrowly ovate, tomentose on the back, with deep median groove, 1.4 mm wide, broadly winged, 2-nerved. *Aw* 20-24 mm long. *Pedicelled spikelets* 5 mm long, tomentose; lower glume 1 mm wide, densely tomentose on the back, ciliate along the margins.

Thailand.- NORTHERN: Chiang Mai (Ban Aen).

Distribution.- Burma (Type!) and Thailand.

Ecology.- In open areas, gravelly soil, and on hillslopes in dry mixed-deciduous forest at ca. 600 m.

Specimens.- s.n. (BK 33204).

Remarks.- The plant was reported as endemic to Burma by Soenarko (1977). An unknown specimen from BK, collected from Northern Thailand was indentified in this study and was determined as *C. clandestinus* by the characters of its hairy spikelets and pilose rhachis-internodes. The plant was said to have stilt roots supporting the culm, but these are not present in the specimen.

7. *Cymbopogon flexuosus* (Nees ex Steud.) Wats., in Atkins., Gaz. N.W. Prov. Ind.: 392.1882; Stapf in Kew Bull. 1906: 319,356.1906; Bor in J. Bomb. Nat. Hist. Soc. 52: 16.1954; Fl. Ind., Burm. & Ceyl. 1: 127. 1960; Blake in Proc. Roy. Soc. Queensl. 80,6: 73.1969; Gilliland, Fl. Mal. 3: 297.1971; Soenarko in Reinwardtia 9,3: 353.1977.

- *Andropogon flexuosus* Nees ex Steud., Syn. Pl. Glum.: 388.1854;

 Type.- India, Madras, Wight 1704 (K-isotype!);

- *A. nardus* var. *flexuosus* (Nees ex Steud.) Hackel in DC., Monogr.

 Phan. 6: 603.1889; Type.- India, Wight 1704 (K-isotype!);

- *A. ampliflorus* Steud., Syn. Pl. Glum. 1: 388.1889; Type.- Java,

 Zollinger 849 (P-holotype);

- *Cymbopogon nardus* var. *grandis* (Nees ex Steud.) Haines, Bot. Bihar &

 Orissa 5: 1047.1924;

- *C. travancorensis* Bor in J. Bomb. Nat. Hist. Soc. 52: 179.1954.

 Type.- India, Bourne 5309 (K-holotype!).

Perennial, tufted; culm about 250 cm high, terete, smooth, glabrous, nodes often shortly bearded; sheaths glabrous, often auricled; ligule 5 mm long, chartaceous. *Leaf-blades* linear, 100 cm

long by 15 mm wide, tapering, scabrid particularly along the margins, glabrescent or with spreading long hairs on the upper surface at the base. *Inflorescence* a decompound spatheate panicle, spatheole 10-20 mm long, glabrous; racemes flexuosus or drooping, 15-17 mm long, slender, often deflexed; rays often arranged on a zig-zag axis; rhachis-internodes and pedicels 2-2.5 mm. *Sessile spikelets* 4.5 mm long by 0.8 mm wide, lanceolate, acuminate, flat, narrowly winged, often with 2-3 wrinkles on the back, often nerveless or 3-nerved. *Awn* 10-11 mm long. *Pedicelled spikelets* 4 mm long; lower glume narrowly lanceolate, acuminate, 7-9-nerved. (Plate 11).

Thailand.- NORTHERN: Chiang Mai (Chiang Dao, Doi Saket); Chiang Rai (Doi Pha Hom Pok, Doi Tung); Tak (Doi Musor); SOUTH-EASTERN: Chon Buri (Sriracha); SOUTH-WESTERN: Prachuap Khiri Khan (Hua Hin); PENINSULAR: Ranong (Kao Talu); Satun (Betong).

Distribution.- Native in India (Type!), distributed to Thailand and Indo-China, naturalized in Indonesia (Java, Bali and Sumbawa), cultivated throughout the tropics.

Ecology.- Frequent in grassfields, teak forests and on limestone mountains at 100-1500 m.

Vernacular names.- Lemon grass, malabar grass.

Specimens.-Collins 1892 (K); Iwatsuki et al. 9738, 11144 (BKF); Kerr 6956, 11799 (K), 13478 (BK), 14057 (K); Shimizu et al. 10087 (BKF), Smitinand 7079 (BKF); Smitinand & G.S. 10629 (BKF);

Remarks.- *C. flexuosus* is recognized by the winged lower glume

together with 2 or 3 wrinkles on the back. The grass is planted on a large scale in India for commercial purposes. It is the source of a valuable aromatic oil known as "oil of lemon grass" which contains 70-85% citral, and is used for scenting soaps, detergents, cosmetics and perfumes. According to Bor (1960) *C. flexuosus* was considered to exist in two forms, indistinguishable morphologically, but easily separated by the color of the stems. The red-stemmed variety was believed to be the true Lemon-grass, while the other, a white-stemmed, wild variety, yielded an inferior kind of oil which could not be marketed commercially.

8. *Cymbopogon khasianus* (Munro ex Hack.) Bor in Ind. For. Rec. Bot. 1,13: 92.1938; in J. Bomb. Nat. Hist. Soc. 52: 168.1954; Soenarko in Reinwardtia 9,3: 347.1977.

- *Andropogon nardus* var. *khasianus* Munro ex Hackel in DC., Monogr. Phan. 6: 603.1889; Hook. Fl. Brit. Ind. 7: 206.1896.

Type.- India, Khasi Hills, Griffith 6764 (K-isotype!).

Perennial, culm about 170 cm high, glabrous and smooth, nodes usually glabrous; sheaths glabrous, basal sheath often tomentose; ligule membrano-chartaceous, 4 mm long. *Leaf-blades* linear-acuminate, base attenuate, 50 cm long by 9.5 mm wide, slightly rough, glabrous except wooly hairs at the joint. *Inflorescence* a compound spatheate panicle, lax, interrupted; spatheole 21 mm long; peduncle 9 mm long, slender, with scattered hairs on the upper part;

racemes 20 mm long, slender, rhachis-internodes and pedicels pilose along the margins, glabrous on the back. *Sessile spikelets* 4.5-5 mm long; lower glume oblong-lanceolate, chartaceous or often subcoriaceous, glabrous, flat on the back, often with 3-wrinkles, broadly winged, 4-5 nerved. Awn 12 mm long. *Pedicelled spikelets* 4.5 mm long; lower glume broadly lanceolate, 1 mm wide, 7-nerved. (Plate 12).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep).

Distribution.- India (Type!), and Indo-China.

Ecology.- In grasslands and pine forests at 1300-2000 m altitude.

Specimens.-Kerr 1554b (BK, K).

Remarks.- This species is represented by a single collection from Thailand. Neither duplicate is in good condition and only a few spikelets remain. The description was taken from the type specimens and from specimens collected from India and deposited at Kew.

9. *Cymbopogon martinii* (Roxb.) Wats. in Atkins., Gaz. NW. Prov. Ind.: 382.1882; Stapf in Kew Bull. 1906: 335,359.1906; Bor in J. Bomb. Nat. Hist. Soc. 51: 908.1953; Fl. Ind., Burm. & Ceyl. 1: 129.1960; Morton in Taxon 8: 13.1959; Gilliland, Fl. Mal. 3: 295.1971; Soenarko in Reinwardtia 9,3: 330.1977.

- *Andropogon martinii* Roxb., Fl. Ind. 1: 280.1820;

Type.- India, based on material sent by Gen. Martin from Lucknow, (K-holotype!).

- *A. pachnodes* Trin., in Mem. Acad. Sci. Petersb. 6,2: 284.1832;

- *Cymbopogon martinianus* Schult., Syst. veg. 2: 459.1824;
- *C. pachnodes* (Trin.) Wats., l.c. : 392.1882.

Perennial; culm slender, erect, up to 2 m high, smooth, glabrous, lower nodes often swollen; sheaths glabrous; ligule membrano-chartaceous, 2-4 mm long. **Leaf-blades** linear-lanceolate, flat or rolled, 20-60 cm long by 2.5-10 mm wide, cordate or rounded at the base, often amplexicaul, glabrous, smooth. **Inflorescence** a compound spatheate panicle, erect, narrow; spatheole 20-30 mm long; peduncle hairy in the upper part; racemes 15-20 mm long; lower raceme-base and lowermost pedicel swollen; rhachis internodes and pedicels pilose along the margins, sparsely pilose on the back, 1.5-2 mm. **Sessile spikelets** 3.5 mm long, glabrous; lower glume chartaceous, 1 mm wide, ovate, with deep median groove, broadly winged, 2-nerved. Awn 15-18 mm long. **Pedicellate spikelets** 4 mm long by 1 mm wide, glabrous; lower glume lanceolate, 7-8 nerved. (Fig. 21 & Plate 13).

Thailand._ CENTRAL: Bangkok; SOUTH-WESTERN: Kanchanaburi (Si Sawat).

Distribution._ Native in India (Type!), cultivated throughout the tropics.

Ecology._ Scattered in open deciduous forest at 100 m alt.

Vernacular names._ Motia grass.

Specimens._ Hambanonda 328a, 328b (BKF); Kerr 10192 (K).

Remarks._ *Cymbopogon martinii* exists in two forms, differing by their oil content and their odor when crushed, but they are indistinguishable in the dry specimens. The two forms are known as "Motia" and "Sofia"; palmarosa oil is distilled

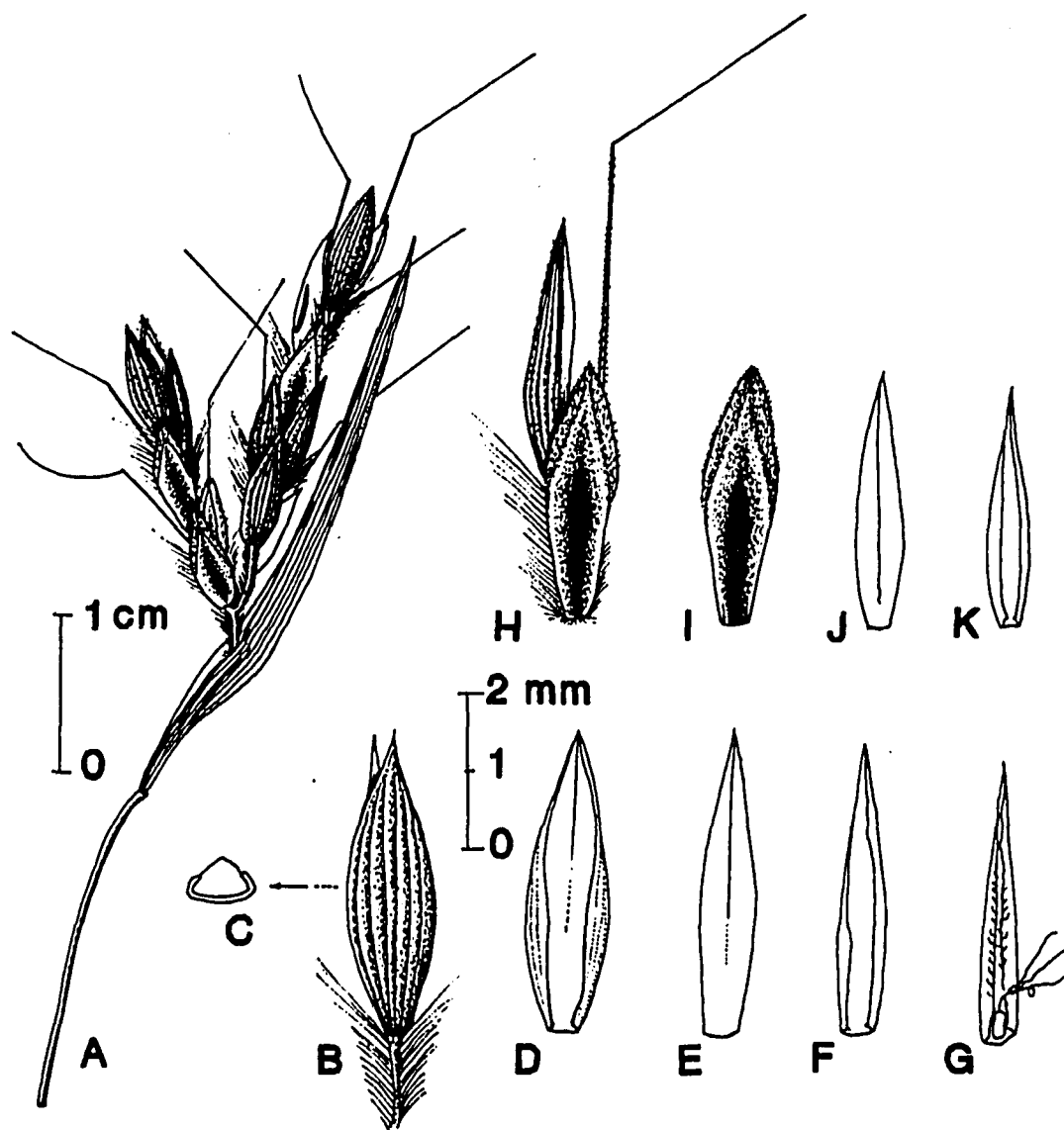


Figure 21. *Cymbopogon martinii* (Roxb.) Wats.
 A. raceme B-G. pedicelled spikelet B. dorsal view of lower
 glume C. X-section of spikelet D. ventral view of lower
 glume E-F. upper glume G. lemma H. spikelet pair I-K.
 sessile spikelet I. ventral view of lower glume J-K. upper
 glume; (Haabanonda 228A, BKF).

from the leaves of "Motia", and ginger oil is obtained from the leaves of "Sofia". According to Soenarko (1977) the two forms can be separated in the field by their habit; in "Motia" the upper surface of the leaves makes a right or obtuse angle with the culm, whilst in "Sofia" it makes an acute angle with the culm. Data from cytological studies also indicates a difference in the chromosomes number; in "Motia" $2n = 20$, whereas "Sofia" was tetraploid with $2n = 40$. She suggested treating the two forms as varieties, but they are hardly separable either in the field or in the herbarium; therefore, they are maintained in *C. martinii*.

10. *Cymbopogon microstachys* (Hook.f.) Soenarko in Reinwardtia 9,3: 364.1977.

- *Andropogon nardus* var. *microstachys* Hook.f., Fl. Brit. Ind 7: 207.1896; Type. India, Mann 5 (K-lectotype!).

- *Cymbopogon flexuosus* var. *microstachys* (Hook.f.) Bor in J. Bomb. Nat. Hist. Soc. 52: 16.1954.

Perennial; culm erect, up to 3 m high, nodes glabrous, yellowish; sheaths, basal sheaths and nodes glabrous, yellowish; ligule 5-6 mm long, rounded, subchartaceous. *Leaf-blades* linear-acuminate, base attenuate, 40-75 cm long, 10-12 mm wide, rough on both surfaces, usually glabrous. *Inflorescence* a decompose spatheate panicle, 60-90 cm long, interrupted, narrow, with few to numerous racemes; spatheole 11-12 mm long; peduncle 5-6 mm long, glabrous;

raceme nearly always epinastically deflexed, 10-12 mm long, slender; rhachis-internodes and pedicels pilose along the margins, glabrous on the back. *Sessile spikelets* 3.5-4.5 mm long; lower glume lanceolate, 0.8 mm long, nerveless or 2-nerved, flat on the back, shallowly concave in the lower part, narrowly winged; awn 5-8 mm long.

Pedicelled spikelets 4 mm long; lower glume glabrous, 7-nerved.

Thailand._ NORTHERN: Mae Hong Son (Hard Palom); CENTRAL: Chai Nat (Chaibadan); SOUTH-EASTERN: Chantaburi (Kaw tao); PENINSULAR: Surat Thani (Ko Lanta Yai).

Distribution._ India (Type!), Burma and Thailand.

Ecology._ Often found in large groups in open rocky ground or open forests at 10-1000 m altitude.

Specimens._ Hansen & Smitinand 12252 (BKF, K); Kerr 8013, 16074 (BK, K); Larsen 8939 (BKF, K).

Remarks._ This species has been recognized as a variety of *Cymbopogon flexuosus*. It was raised to species rank by Soenarko (1977). *C. microstachys* can be separated from *C. flexuosus* as the former nearly always has deflexed racemes, a narrow panicle, and the lower glume of the sessile spikelet is slightly concave at the base.

11. *Cymbopogon nardus* (Linn.) Rendle in Cat. Welw. Afr. Pl. 2: 155. 1899; Stapf in Kew Bull. 1906: 314, 354. 1906; Bor in J. Bomb. Nat. Hist. Soc. 51: 903. 1953; Fl. Ind., Burm. & Ceyl. 1: 130. 1960; Senaratana, Grass. Ceyl.: 193. 1956; Gilliland, Fl. Mal. 3: 296. 1971; Soenarko in Reinwardtia 9, 3: 349. 1977; Hsu, Fl. Taiwan 5: 635. 1978;

Smitinand, Thai Pl. Names: 103.1980.

- *Andropogon nardus* Linn., Sp. Pl. ed. 1: 1046.1753; Hook.f., Fl. Br. Ind. 7: 205.1896;
- *A. ampliflorus* Steud., Syn. Pl. Glum. 1: 388.1854.

Perennial, caespitose; culm up to 2.5 m high, tufted, erect, smooth, green, pale cream to whitish sometimes tinged with purplish red, nodes often swollen; sheaths glabrous, smooth, often loose from the culm; ligule membranous, rounded, truncate, 1-3 mm long. *Leaf-blades* about 100 cm long by 15 mm wide, tapering, glabrous, lower surface rough, margins scabrid. *Inflorescence* a decompound spatheate panicle, interrupted, rather loose, 50-70 cm long; spatheole 12-15 mm long; racemes 15-17 mm long; rachis internodes and pedicels slender, 2.5 mm. *Sessile spikelets* 4-4.5 mm long; lower glume 0.9 mm wide, ovate-lanceolate, flat on the back, reddish brown or purplish in the upper part, winged, nerveless or 3(4)-nerved. Awn or awnless. *Pedicelled spikelets* 4.5 mm.

var. *confertiflorus* (Steud.) Bor in J. Bomb. Nat. Hist. Soc. 51: 905.1953.

- *Andropogon confertiflorus* Steud., Syn. Pl. Glum. 1: 385.1854;

Type.- India, Hohenacker 932 (K-holotype!).

- *A. thwaitesii* Hook., in Trimen, Fl. Ceyl.: 243.1900;

- *Cymbopogon confertiflorus* (Steud.) Stapf in Kew Bull. 1906:

318,355.1906; A. Camus in Rev. Bot. Appl. Colon. 1: 282.1921;

- *C. thwaitesii* (Hook.f) Bor in J. Bomb. Nat. Hist. Soc. 52: 172.1954.

Type.- Ceylon, Thwaites C.P. 3784 (K-holotype!).

Inflorescence a congested panicle; sessile spikelets awned, awn weak, 6-7.5 mm long; lower glume winged, 2-3 nerved. Pedicelled spikelet 4.5 mm long, 3-4 nerved. (Fig. 22 & Plate 14).

Thailand.- NORTHERN: Chiang Mai; CENTRAL: Bangkok; PENINSULAR: Nakhon Si Thammarat).

Distribution.- India (Type!), Ceylon, introduced into Indo-China and Indonesia.

Ecology.- Introduced from Ceylon, escaped from cultivation into many open areas in the lowland, at 100-400 m.

Vernacular names.- Cha khai ma khuut, Ta khrai ma khuut (Northern); Ta khrai daeng (Nakhon Si Thammarat); Ta khrai hom (Central); Citronella Grass.

Specimens.-Smitinand 2064 (BKF);

Remarks.- The grass is cultivated for citronella oil, used in scenting of soap, disinfectants and sprays. The variety confertiflorus is said to have lower yields than variety nardus.

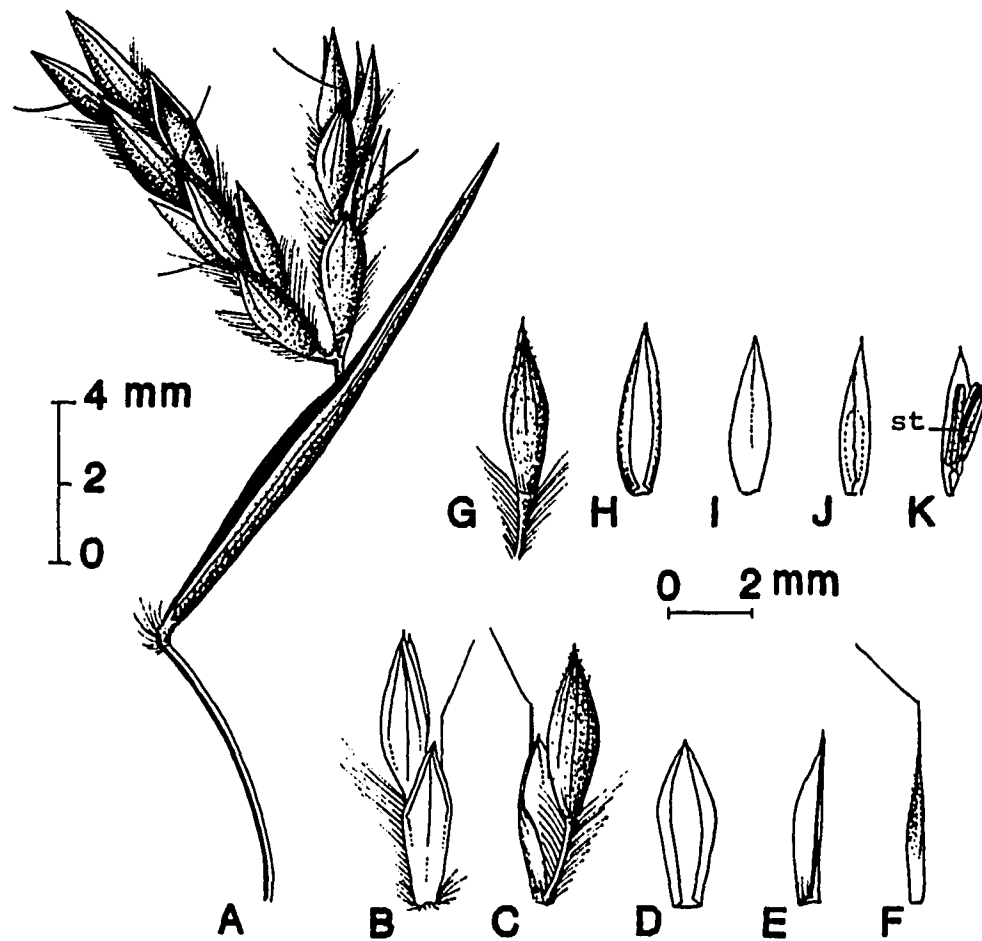


Figure 22. *Cymbopogon nardus* var. *confertiflorus* (Steud.) Bor
 A. raceme B-C. spikelet pairs B. dorsal view C. ventral
 view D. ventral view of lower glume E. lower lemma F.
 upper lemma and awn G-K. pedicelled spikelet H. ventral
 view of lower glume I, J. upper glume K. lemma; st,
 stamens; (Smitinand 2064, BKF).

12. *Cymbopogon traninhensis* (A. Camus) Soenarko, in Reinwardtia 9,3 : 347.1977.

- *Cymbopogon confertiflorus* var. *traninhensis* A. Camus in Bull Mus.

Hist. Nat. Paris 26: 565.1920; Camus & Camus in Lecomte, Fl.

Gen. I.-C. 7: 341.1922; Type.- Laos, Mieville s.n. (P-holotype).

- *C. khasianus* var. *nagensis* Bor in Bomb. Nat. Hist. Soc. 52:

169.1954. Type.- India, Assam, Naga Hills, Bor 10 (K-holotype!).

Perennial, tufted; culm 135 cm high by 3-4 mm in diameter, smooth, creamy color, glabrous; nodes usually bearded; sheaths glabrous; ligule chartaceous, 4-5 mm long, glabrous. *Leaf-blades* linear-lanceolate, flat, up to 75 cm long by 0.8-1.3 cm wide, base tapering, glabrous except hairy at the joint with the sheaths, slightly rough beneath and along the margins. *Inflorescence* a compound spatheate panicle, narrow, apparently straw color with loose racemes, joints often bearded; spatheoles 2-3 cm long, glabrous; racemes fragile, 20-30 mm long; few jointed, 2-5 spikelet pairs for each branch, lower raceme-base and the lowermost pedicel not swollen, densely villous at the joint; rhachis internodes and pedicels pilose along the margins, glabrous on the back, 2.5-3.2 mm. *Sessile spikelets* 7 mm long; lower glume glabrous to tomentose on the back, lanceolate to broadly lanceolate, 1-2 mm wide, concave with 1-2 wrinkles on the back, broadly winged; margins scaberulous towards the apex; nerveless to 2-nerved. *Awn* up to 15-18 mm long. *Pedicelled spikelets* 5.4-5.8 mm long; lower glume 1.5 mm wide, 7-nerved. (Fig. 23 & Plate 15).

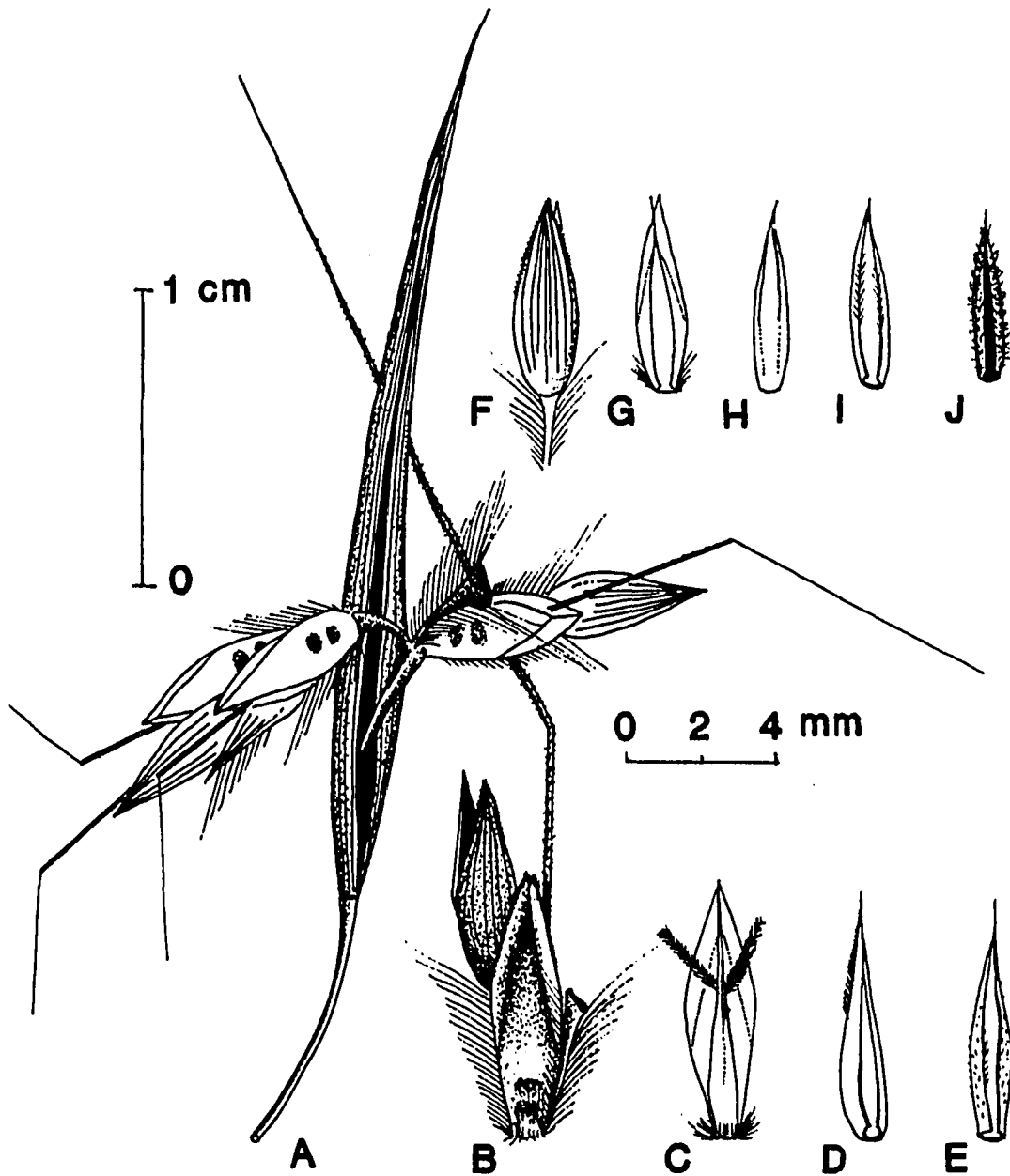


Figure 23. *Cymbopogon traninhensis* (A. Camus) Soenarko
 A. raceme B. spikelet pair C-E. sessile spikelet C.
 ventral view of lower glume D. upper glume E. lemma
 F-J. pedicelled spikelet F, G. lower glume H, I. upper
 glume J. lemma; (Smitinand & Abbe 6263, BKF).

Thailand.- NORTHERN: Chiang Mai (Chiang dao).

Distribution.- India, Burma, Laos (Type!), Southern China (Yunnan).

Ecology.- Common on rocky hillslopes and in open savannah at
1000-1900 m.

Specimens.-Smitinand & Abbe 6263 (BKF, K); Smitinand & Anderson 7258
(BKF, K); Smitinand, Poore & Robbins 7838 (BKF, K).

Remarks.- The species is characterized by the flat, broad leaves;
narrow inflorescence; and lower glume broad-winged and
wrinkled on the back. From field notes (Smitinand & Abbe
6263) this species has strong aromatic leaves which smell
like citronella grass.

13. *Cymbopogon winteranus* Jowitt, Ann. Roy. Bot. Gard. Peraden. 4
: 189.1908; Bor in J. Bomb. Nat. Hist. Soc. 51: 906.1953; Fl. Ind.,
Burm. & Ceyl. 1: 636.1960; Senaratana, Grass. Ceyl.: 193.1956;
Froideville in Backer & van der Brink Jr., Fl. Java 3: 611.1968;
Soenarko in Reinwardtia 9,3: 348.1977; Hsu, Fl. Taiwan 5: 636.1978;
Lazarides, Phan. Monogr. 12: 32.1980.

Type.- Ceylon, A.W. Winter s.n. (K-holotype!).

Perennial, large tufted grass; culm 2-2.5 m high, smooth,
glabrous; sheaths loose, glabrous; ligule chartaceous, about 1 mm
long. *Leaf-blades* up to 1 m long by 15 mm wide, base attenuate,
usually light green, glabrous, smooth on the upper surface, slightly
rough below and along the margins. *Inflorescence* a decompound
spatheate panicle, large, spreading, up to 1 m long, interrupted;
spatheoles 15- 20 mm long, linear, glabrous; racemes many, 5-15 mm

long, arranged in a long a zig-zag axis; rhachis-internodes and pedicels pilose along the margins, glabrous or puberulous on the back, 2 mm long. *Sessile spikelets* 5 mm long by 1 mm wide; lower glume oblong-lanceolate, usually flat, narrowly winged, 3-nerved. *Awn* normally reduced, or if present up to 5 mm long. *Pedicelled spikelets* 4 mm long, lower glume lanceolate, 7-nerved. (Fig. 24 & Plate 16).

Thailand.- NORTHERN: Chiang Mai (Doi Angka); CENTRAL: Bangkok; SOUTH-EASTERN: Chantaburi (Makham); Trat (Koh Kut); PENINSULAR: Surat Thani (Tung Song).

Distribution.- Its origin is unknown; the plants is cultivated in Ceylon (Type!), Java, Sumatra and Borneo.

Ecology.- Cultivated only.

Vernacular names.- Takhrai hawm (Central, Chantaburi); Citronella grass.

Specimens.-Kerr 6351, 20648 (K); Nuupukdee 171 (BKF); Put 2392 (K); Smitinand 5708 (BKF, K).

Remarks.- Cultivated for Citronella oil used for scenting soaps.

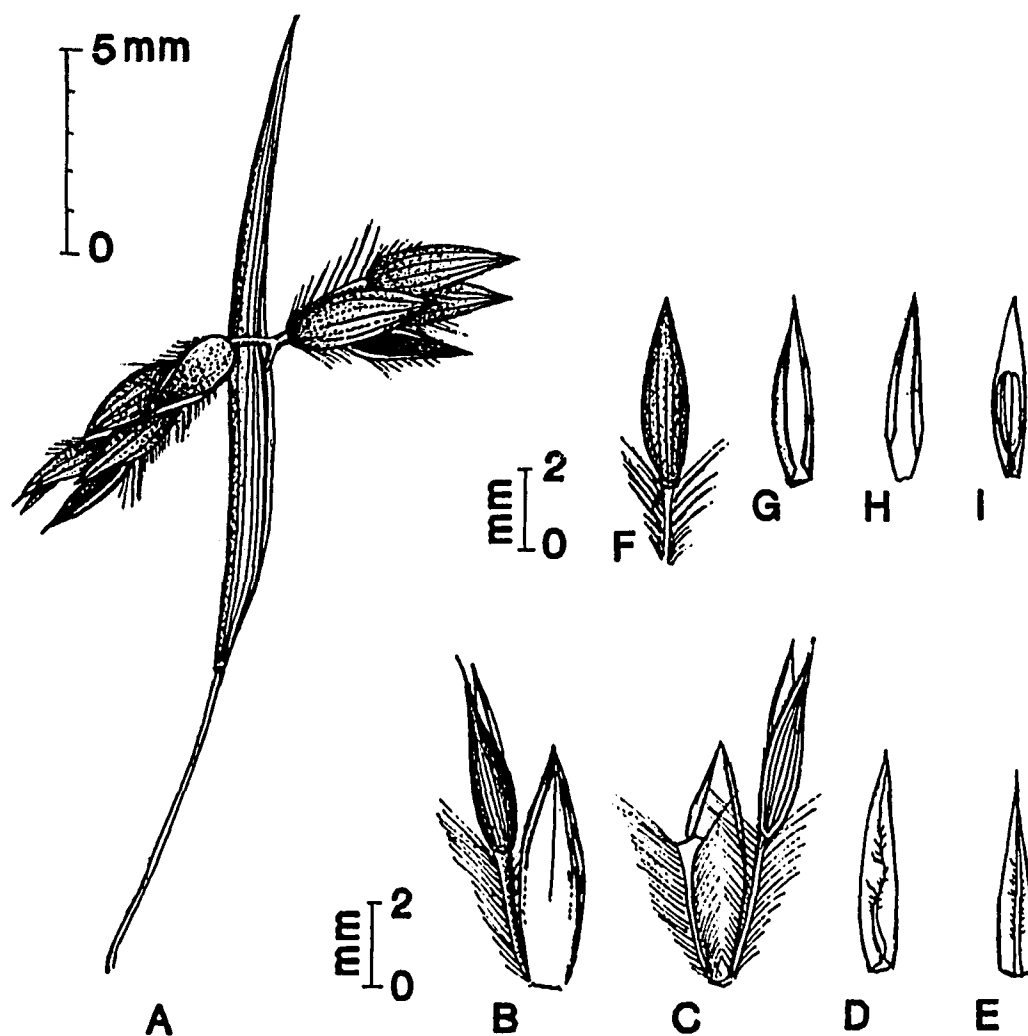


Figure 24. *Cymbopogon winteranus* Jowitt
 A. raceme B, C. spikelet pairs, dorsal and ventral view
 D. upper glume E. lemma F-I. pedicelled spikelet
 F, G. lower glume, dorsal and ventral view H. upper glume
 I. lemma enclosing stamens; (Smitinand 5708, BKF).

SCHIZACHYRIUM Nees

Schizachyrium Nees, Agrost. Bras.: 331.1829; Steud., Syn. Pl. Glum.: 366.1854; Hackel, in DC., Monogr. Phan. 6: 363.1889; Bor, Fl. Ind., Burm. & Ceyl. 1: 214.1960; Gilliland, Fl. Mal. 3: 288.1971; Hsu, Fl. Taiwan 5: 651.1978.

- *Andropogon* Wall., Cat. No. 8824, 8825, 8826;

- *Batratherum* Wall., Cat. No. 8827.

Note.- Name from Greek words Schizein = to split, auchum = chaff: alluding to the cleft of upper lemma.

Annual or perennials; culm slender, leafy at base to spaced above; sheaths glabrous, often deep redish purple; ligule a ciliolate membrane. *Leaf-blades* linear-oblong, frequently folded.

Inflorescence a spatheate spike-like raceme; racemes solitary, terminal on culms and branches, often gathered into a false panicles; peduncles with jointed fragile rhachis. *Spikelets* in pairs, strongly dimorphic; internodes and pedicels compressed, thickened upwards to a deeply cupular toothed apex, densely hairy on one margin and apex.

Sessile spikelets dorsally compressed, chartaceous to coriaceous, with a small shortly bearded callus; lower glume 2-keeled with sharply inflexed margins at least upwards, narrow-cymbiform to dorsally flattened, 1-3 nerved. Lemmas ciliolate, shorter than glumes; lower 2-nerved; upper usually 2-lobed, with a geniculate awn from sinus. Palea minute or absent. Caryopsis narrowly linear, subterete 1/3 as long. *Pedicelled spikelets* flatter than the sessile, or reduced; lower glume aristulate; lemmas if present hyaline, ciliate, mucous.

A genus of approximately 50 species distributed in tropical and subtropical regions of the world. In Thailand 3 species are represented, *S. brevifolium* widespread in the lowlands, *S. sanguineum* common at 750-1300 m elevation, and an uncommon species *S. exile* at 600-800 m in northern Thailand.

KEY TO THE SPECIES OF SCHIZACHYRIUM IN THAILAND

1. Annual; culms 30-75 cm tall. Leaf-blades 2-7 mm long.
Spikelets 2.5-4.5 mm long
 2. Culms up to 75 cm, usually smaller. Leaf-blades flat, linear-oblong, 2-4 cm long. Spikelet 2.5 mm long, rhachis internode glabrous only hairy at the top
S. brevifolium
 2. Culms up to 30-50 cm high; leaf-blades often roled, 3-7 cm long. Spikelets 4.5 mm long, rhachis internode silky villous
S. exile
1. Perennials; culms up to 120 cm tall. Leaf-blades up to 20 cm long. Spikelets 7-8 mm or longer
S. sanguineum

1. *Schizachyrium brevifolium* (Sw.) Nees, Agrost. Bras.: 332. 1829;
 Nees ex Buse. in Miquel, Plant. Jungh.: 359.1854; Ridley, Fl. Mal. 5
 : 210.1925; Rhind, Grass. Burm.: 71.1945; Bor, Fl. Ind., Burm. &
 Ceyl. 1: 215.1960; Gilliland, Fl. Mal. 3: 291.1971; Hsu, Fl. Taiwan
 5: 691.1978.
- *Andropogon brevifolius* Sw. Prodr. Veg. Ind. Occ.: 26.1788; Hook.f.,
 Fl. Brit. Ind. 7: 165.1896; Koyama, Grass. Japan: 447.1987.
 Type.- Jamaica, Swartz, s.n. (S-holotype).
- *A. obtusifolius* Poir. in Lamk., Encycl, Meth. Bot. Suppl. 1:
 583.1810;
- *A. parviflorus* Roxb., Hort. Beng.: 82.1814 (nom. nud.); Fl. Ind. 1:
 277.1820;
- *Pollinia brevifolia* (Sw.) Spreng., Pl. Pugill. 2: 13.1815;
- *P. vaginata* Spreng., l. c.: 11.1815;
- *Andropogon tenellus* J.S. Presl in C.B. Presl, Rel. Haenk. 1:
 355.1830 (non Roxb.);
- *A. debilis* Kunth, Rev. Gram. 1: 39.1830;
- *A. floridus* Trin., in Mem. Acad. Sci. Petersb. 6,2: 265.1832;
- *A. flaccidus* A. Rich., Tent. Fl. Abyss. 2: 452.1851;
- *Schizachyrium paradoxum* Buse in Miq., Pl. Jungh.: 359.1854;
- *Andropogon exsertus* Steud., Syn. Pl. Glum. 1: 366.1855;
- *A. brevifolius* var. *pullus* Franchet & Savatier, Enum. Pl. Japon.
 2: 610.1879;
- *A. brevifolius* var. *flaccidus* (Sw.) Hackel, Monogr.: 364.1889;
- *Sorghum brevifolium* (Sw.) O. Ktze., Rev. Gen. Pl. 2: 791.1891;
- *Schizachyrium brevifolium* var. *flaccidum* (A. Rich.) Stapf, Fl. Trop.

Afr. 9: 188.1917;

- *S. brevifolium* ssp. *paradoxum* (Buse) Henr., Blumea 1: 308.1935;
- *Andropogon brevifolius* var. *paradoxus* (Buse.) Ohwi, Acta. Phytotax. Geobot. 11: 169.1942;
- *Schizachyrium fasciculatum* Jacques-Felix, Rev. Internat. Bot. Appliq. Trop. 32:434.1953;
- *S. brevifolium* subvar. *tenuissimum* Roberty, Boissiera 9: 236.1960.

Annual; culms slender, tufted, somewhat decumbent, often reddish, 30-75 cm; sheaths 1.5-2.5 cm long, lax, compressed and keeled, glabrous; ligule membranous, fimbriate, shorter than 1 mm. **Leaf-blades** linear-oblong, 2-4 cm long by 2-4 mm wide, glabrous, margins scaberulous. **Inflorescence** a spike-like racemes, spatheate; 1-2.5 cm long; rachis internodes and pedicels glabrous, 2 mm long. **Sessile spikelets** broadly oblong; callus short, hairy; lower glume flat, lanceolate, apex slightly bilobed, 5-nerved, the midnerve the shortest, 2.5 mm long; upper glume hyaline, 1-nerved, narrowly cymbiform, 2.2 mm long; lemma delicately hyaline, lanceolate, with an apical sinus 0.8 mm deep. **Awn** 1.6 mm long; palea reduced. **Stamens** 2; anthers 0.5 mm long; stigmas 2, plumose. **Pedicelled spikelets** much reduced, 2.5 mm long including the pedicel, aristate apex 1.4 mm long. (Fig. 25 & Plate 17 B-C).

Thailand.- **NORTHERN:** Chiang Mai (Bo Luang, Doi Chiang Dao, Doi Suthep, Mae Klang , Pha Mon); Kamphaeng Phet (Mueng Kao, Raheng); **NORTH-EASTERN:** Nakhon Ratchasima (Chan Tuk); Loei (Phu Kradueng); **EASTERN:** Nakhon Ratchasima (Bua Yai); **SOUTH-**

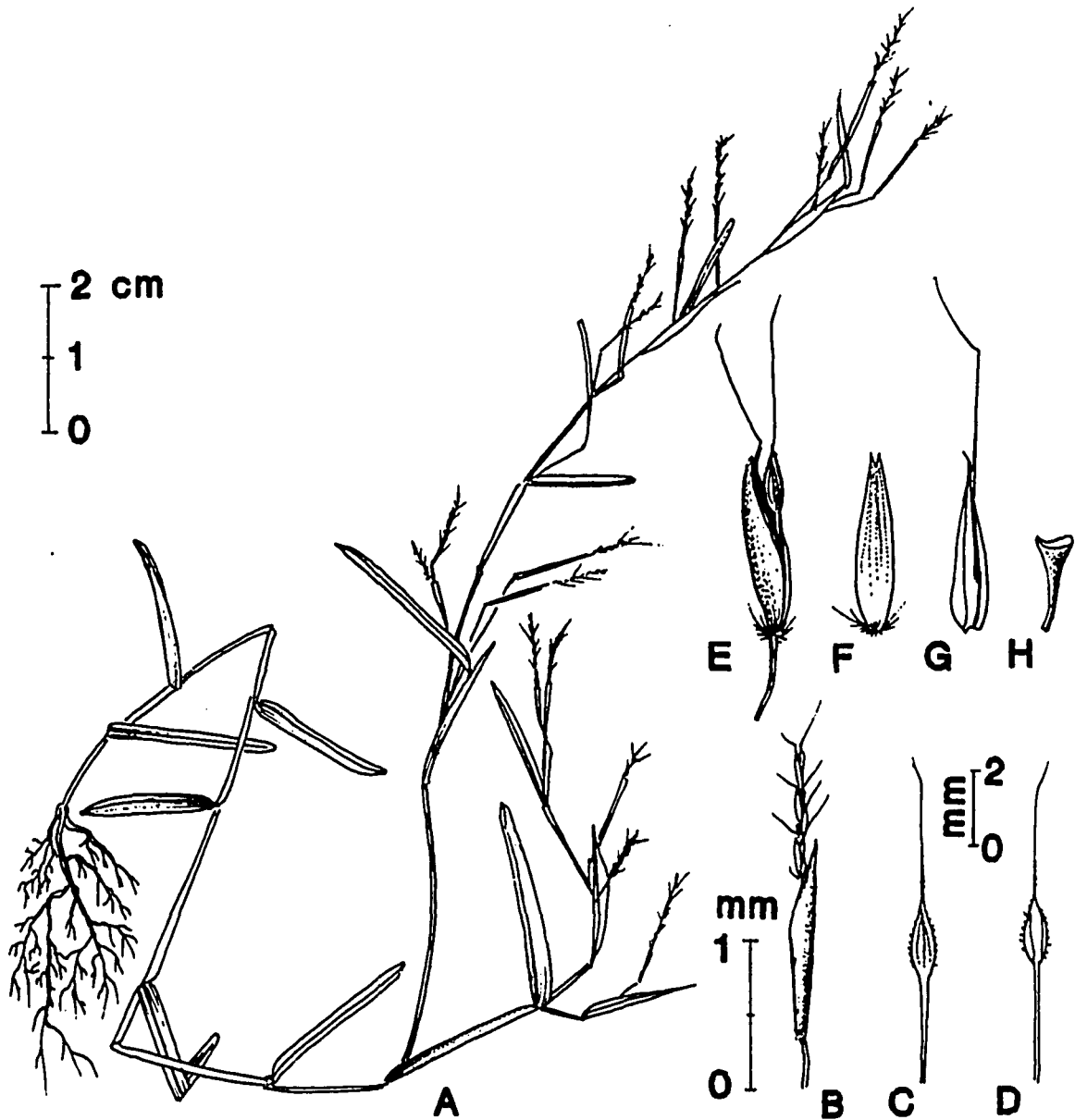


Figure 25. *Schizachyrium brevifolium* (Sw.) Nees
 A. habit B. inflorescence, a spike-like raceme C-D.
 pedicelled spikelet C. dorsal view D. ventral view E.
 lateral view of spikelet pair F. dorsal view of sessile
 spikelet G. ventral view of upper glume, sessile spikelet
 H. pedicel; (Smitinand & Abbe 6183, BKF).

EASTERN: Prachin Buri (Ban Kaeng, Krabinburi); SOUTH-
WESTERN: Kanchanaburi (Ban Kao); PENINSULAR: Phatthalung
(Sala).

Distribution.- India, Ceylon, Burma, Southern China, Indo-China,
Malaysia, to Indonesia (Sumatra, Borneo, New Guinea) and
Philippines.

Ecology.- A common species by roadsides, in old clearings, open
grassy ground and deciduous forest, at 200-1000 m altitude.

Vernacular names.- Yaa rung tukkatan (Nakhon Ratchasima).

Specimens.-Beusekom & Phengklai 2562 (BKF); Kerr 896, 8063, 19244
(K), 19812 (BK, K, NY); Larsen 8198 (GH, K); Lindhard 19
(K); Put 4298 (K, US), 4546 (K); Smitinand 2042, 3988 (BKF,
K), 11792 (BKF); Smitinand & Abbe 6183 (BKF, K); Smitinand,
Poore & Robbins 7589 (BKF); Sorensen, Larsen & Hansen 6051
(BKF, K); Tagawa et al. 2324 (BKF); s.n. (BK. 34144).

2. *Schizachyrium exile* Stapf in Prain, Fl. Trop. Afr. 9: 191.1917.

- *Andropogon exilis* Hochst. in Flora 27: 241.1844; Hack., DC. Monogr.
Phan. 6: 365.1889; Hook.f., Fl. Brit. Ind. 7: 166.1896 (err.
A. axilis); Type.- Africa, Caepund Natal-Landes, Krauss, s.n.
(K-phototype!).

- *A. petitianus* A. Rich., Tent. Fl. Abyss. 2: 451.1851;

- *A. fragillimus* Steud., Syn. Pl. Glum. 1: 384.1854;

- *A. fragillissimus* Hochst. ex Hack. in DC. Monogr. Phan. 6: 366.1889.

Annual, culms fascicled, erect, slender to filiform, many-
noded, up to 30-50 cm high, most branched from the base and the lower

nodes, glabrous; sheaths loose, the lower easily slipping off the internodes, smooth, glabrous; ligule membranous, rounded, 0.1 mm. *Leaf-blades* linear, rolled, tapering to an acute point, 3-7 cm long; glabrous except at the joint; margins scabrid. *Inflorescence* a single, spatheate raceme, very slender, 2-4 cm long; spathes narrowly lanceolate, 3-5 cm; rhachis internodes and pedicels slender, sublinear, prominently silkily villous. *Sessile spikelets* narrowly linear-lanceolate, convex on the back, 4-5 mm long; callus short, densely bearded, hairs 1-1.5 mm; glumes equal; lower glume narrowly oblong-lanceolate, subcoriaceous, apex bifid; dorsally with long white hairs, 2-intracarpal nerved, somewhat obscured; upper linear, with a long aristate apex, membranous, 1-nerved, keeled above the middle; lower floret empty; lemma of upper floret bilobed from the middle, awn 10-14 mm long. *Pedicelled spikelets* reduced to a lanceolate-subulate glume, 2-keeled, apex shortly aristate 1-3 mm long; pedicels shorter than the rhachis internode, 4 mm.

Thailand.- NORTHERN: Chiang Mai (Doi Suthep).

Distribution.- Common in Northern and Central Africa, distributed to India, Thailand.

Ecology.- In open edges of hill evergreen forest at 600-800 m.

Specimens.-Kerr 2214 (BK).

Remarks.- An uncommon species, represented by a single collection made in 1911. The specimens had been placed among undetermined specimens. It has been determined in this study and is clearly *S. exilis*, but its presence in Thailand is unexpected.

3. *Schizachyrium sanguineum* (Retz.) Alst., Suppl. Fl. Ceyl. 6: 334.1931; Bor, Fl. Ind., Burm. and Ceyl. 1: 217.1960; Gilliland, Fl. Mal. 3: 289.1971.

- *Rottboellia sanguinea* Retz., Obs. Bot. 3: 25.1783;

Type.- China (Bladh), based on *Rottboellia sanguinea* Retz.

- *Thelepogon sanguineus* (Retz.) Spreng., Syst. Veg. 1: 299.1825;

- *Andropogon semiberbe* (Nees) Kunth, Enum. 1: 489.1833;

- *A. leptostachyus* Benth., in Hook., Niger Fl.: 571.1849;

- *A. pseudograya* Steud., Syn. Pl. Glum. 1: 365.1854;

- *A. semiberbis* subvar. *leptostachyus* Hackel, in DC., Monogr.

Phan. 6: 370.1889;

- *A. hirtiflorus* Hook.f., Fl. Brit. Ind. 7: 167.1896 (non Kunth, 1832);

- *Schizachyrium semiberbe* Nees, Agrost. Bras.: 336.1829; Rhind, Grass. Burma: 72.1945.

Perennial; culms tufted, reddish, terete at base, 50-120 cm tall; sheaths compressed, keeled, glabrous; ligule 1 mm. *Leaf-blades* linear, apex acute, tapering from the base, up to 25 cm long by 5 mm wide, glabrous. *Inflorescence* a spatheate spike-like racemes, 3.5-8 cm long, terminating the culm; spikelets arranged alternately on each side of the flattened axis; rachis internodes and pedicels oblong, 6-8 mm long, broaden at the tip, glabrous on the back, densely hairy along the margins. *Sessile spikelets* 7-8 mm long, with a stiff white hairs callus; lower glume narrowly lanceolate, apex acute, margins inflexed, 5-nerved, 7.4 mm long; upper glume narrowly cymbiform, 3-nerved; lemma keeled, linear-lanceolate, nerveless, margins ciliolate, hyaline or

often purple, 6.5 mm long; palea delicately hyaline, 2 mm. Awn 2.2 cm long. *Pedicelled spikelets* 4-5 mm, oblong with cuneate apex; lower glume rough and distinctly many parallel nerved from the base.

(Fig. 26 & Plate 17 A).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); Kamphaeng Phet (Raheng);
 NORTH-EASTERN: Loei (Phu Kradueng); EASTERN: Surin;
 Prachinburi (Watana); SOUTH_WESTERN: Phetchaburi (Bo Fai);
 PENINSULAR: Satun.

Distribution.- From India to Ceylon, Burma, Southern China (Type!),
 Indo-China, Malaysia, Indonesia and Philippines.

Ecology.- Common on rocky ground in open pine forest at 750-1300 m.

Specimens.-Beusekom et al. 4568 (BKF, K); Charoenphol, Larsen &
 Warncke 4738 (AAU, BKF, K); Kerr 8252, 9785 (BK, K, UC);
 Smitinand 2052, 4003 (BKF, K), 5022 (BKF); Sorensen, Larsen
 & Hansen 6170 (BKF, K); Tagawa et al. 559, 780, 4568 (BKF);
 s.n. (BKF 57164/ 17 March 1874).

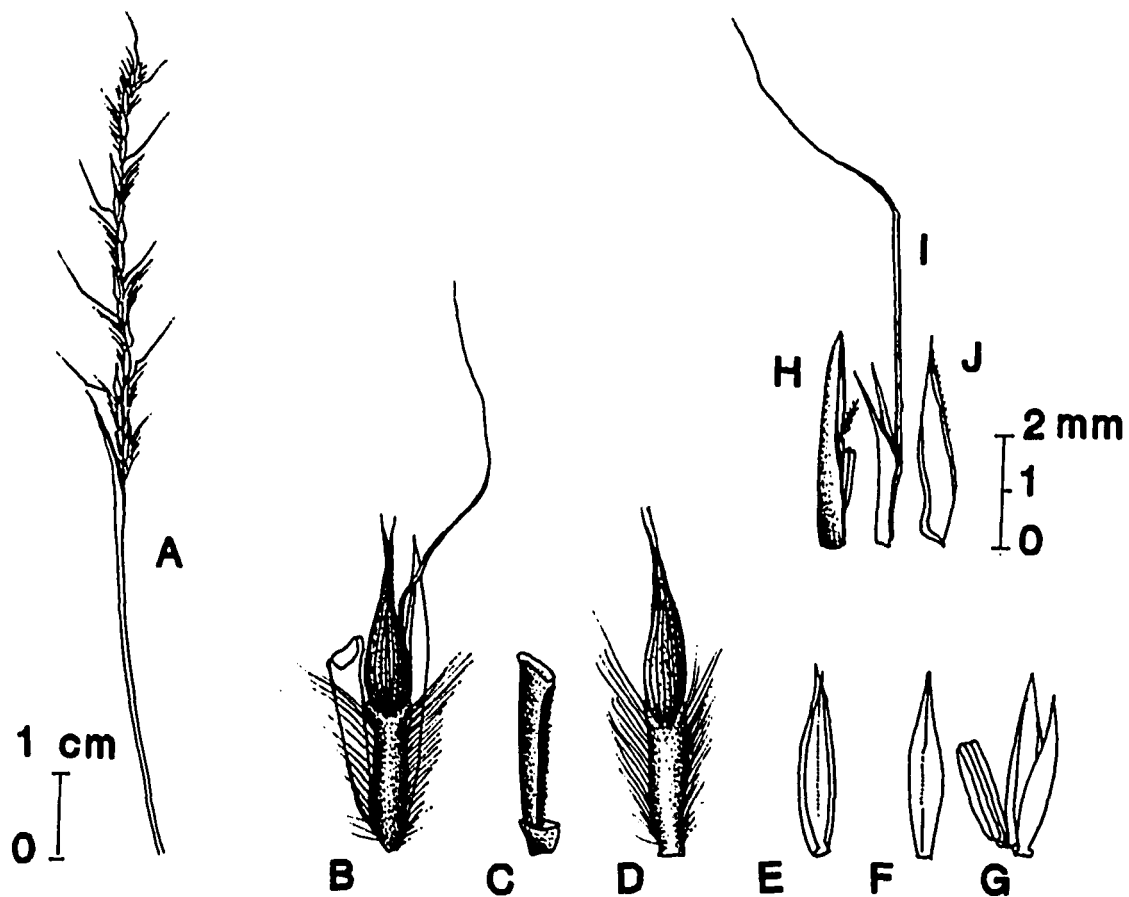


Figure 26. *Schizachyrium sanguineum* (Retz.) Alst.
 A. inflorescence, a spike-like raceme B. spikelet pair
 C. rhachis internode D-G. pedicelled spikelet D, E.
 lower glume F. upper glume G. upper glume, lemma and
 stamens H-J. sessile spikelet H. lateral view of lower
 glume I. upper lemma and awn J. lateral view of upper
 glume; (Smitinand 5022, BKF).

SUBTRIBE ANTHISTIRIINAE Presl

Anthistiriinae Presl, Rel. Haenk. 1: 347.1830; Clayton, Gen. Gram: 354.1896.

Inflorescence of simple pairs racemes, these usually axillary and aggregated into a compound panicle. *Racemes* with fragile rhachis and slender internodes, often with the lower pairs homogamous. *Spikelets* paired, dissimilar. *Sessile spikelets* bisexual, mostly subterete; callus usually pointed, applied obliquely to top of internode with its tip free; lower glume usually coriaceous, rounded on back and sides; lower floret reduced to a barren lemma; upper lemma mostly spatiform, entire or bilobed with a glabrous or hairy, often large, awn. *Pedicel spikelets* sometimes with an elongate callus.

Six genera: *Heteropogon*, *Hyparrhenia*, *Iseilema*, *Parahyparrhenia*, *Pseudanthistiria* and *Themeda* with approximately 17 species represented in Thailand.

HETEROPOGON Pers.

Heteropogon Pers., Syn. Pl. 2: 533.1807; Reeder, J. Arn. Arb. 29: 374.1948; Bor, Fl. Ind., Burm. & Ceyl. 1: 162.1960; - *Sprotheros* Raf. in Bull. Bot. Geneve 1: 221.1830.

Note.- Name from the Greek heteros = different, pogon = beard: referring to the different between the unawned male and the awned female spikelets.

Perennials or *annual*; culms simple or branched; sheaths keeled; ligule membranous. *Leaf-blades* linear or linear-oblong. *Inflorescence* a spike-like racemes, terminal on upper branches; racemes solitary, conspicuously dorsiventral. *Spikelets* in pairs, the lower 1-many pairs homogamous, staminate or neuter, alike in shape and the upper pairs dissimilar, one of each pair sessile the other pedicelled, imbricate and persistent along the rhachis; disarticulating at the base of the joints. *Florets* 2; upper in sessile spikelet of heterogamous pairs female or bisexual; all others male or neuter. *Sessile spikelets* terete or subterete; callus elongated, pungent, densely with ferruginous hairs, glumes equal; lower glume usually coriaceous, involute, obscurely nerved; upper chartaceous or coriaceous, with a deep longitudinal groove on each side, apex membranous, margins thin, 3-nerved. Lemma hyaline, lower nerveless; upper awned. *Awn* geniculated, crowded and entangled at the top. Palea small or absent. Lodicules 0-2, large to minute. Stamens 3 or absent. Stigmas plumose, exserted. Caryopsis linear, subterete. *Pedicelled spikelets* dorsally flattened, normally imbricate and

twisted, lanceolate-oblong; lower glume herbaceous, many-nerved, winged upwards from one or both keels; upper membranous, 3-nerved, acute. Lemma hyaline, 1-nerved, or variously reduced. Stamens 3, or reduced.

A genus of 8-10 species well represented in India. Their ranges are spread from India to the Mediterranean and other warm-temperate regions of the world. Two species, *Heteropogon contortus* and *H. triticeus* are recorded in Thailand.

KEY TO THE SPECIES OF HETEROPOGON IN THAILAND

1. Plant 30-100 cm tall. Sessile spikelet 5-8 mm including the 1-2 mm long callus; awns 4-7 cm
H. contortus
1. Plant 150-300 cm tall, robust. Sessile spikelet 10-12 mm including the 4-6 mm long callus; awns 8-12 cm.
H. triticeus

1. *Heteropogon contortus* (Linn.) P. Beauv. ex Roem. et Schult., Syst. Veg. 2: 836.1817; White, Proc. Roy. Soc. Queensl. 34: 15.1923; Hitchc., Lingn. Sci. J. 9: 250.1931; Reeder, J. Arn. Arb. 29: 376.1948; Senaratana, Grass. Ceyl.: 200.1956; Bor, Fl. Ind., Burm. & Ceyl. 1: 163.1960; Gilliland, Fl. Mal. 3: 292.1971; Hsu, Fl. Taiwan 5: 659.1978; Santos, Philipp. Fl. 4: 83.1986; Koyama, Grass. Japan: 452.1987.

- *Andropogon contortus* Linn., Sp. Pl. ed. 1: 1045.1753;
- *A. allionii* DC., in Lamk. et DC., Fl. Franc. 3: 97.1805;
- *Heteropogon glaber* Pers., Syn. Pl. 2: 533.1807;
- *H. hirtus* Pers., l. c.: 533.1807;
- *H. hirsutus* P. Beauv., Ess. Agrost.: 134.1812;
- *H. allionii* (DC.) Roem. et Schult., Syst. Veg. 2: 835.1817;
- *H. polystachyus* Nees, Agrost. Bras.: 364.1829;
- *H. firmus* J.S. Presl ex C.B. Presl, Rel. Haenk. 1: 334.1830;
- *H. roxburghii* Arn. ex Nees in Nov. Act. Nat. Cur. 19,1: 183.1843; Type.- India, herb Wight, s.n. (K-holotype!).
- *H. hohenackeri* Hochst. ex Miq., Anal. Bot. Ind. 2: 24.1851; Type.- India, Mangalor, Hohenacker 1847 (K-holotype!).
- *H. hispidissimus* Hochst. ex Steud., Syn. Pl. Glum. 1: 367.1854;
- *Andropogon besukiensis* Steud., l. c.: 367.1854; Type.- India, Kriohnagiri, Salem district (K-holotype!).
- *H. besukiensis* (Steud.) Miq., Fl. Ned. Ind. 3: 494.1857;
- *Andropogon bellardii* Bub., in Nuovo Giorn. Bot. Ital. 5: 317.1873;
- *A. contortus* var. *Benuinus* subvar. *roxburghii* Hack, subvar. *secundus* Hackel in DC., Monogr. Phan. 6: 586, 587.1889.

Perennial, culms 30-100 cm high; sheaths subcompressed, nodes and sheath glabrous; ligule membranous, ciliate, 1 mm. *Leaf-blades* linear-lanceolate, 10-25 cm long by 3-6 mm wide, base rounded. *Inflorescence* narrow, 4-7 cm long excluding the awns; spikelets 3-8 homogamous pairs at base and up to 12 heterogamous pairs above. *Homogamous spikelet*: sessile spikelet lanceolate, 5-8 mm long by 1 mm wide; lower glume, chartaceous; upper glume thinner; pedicelled spikelets elliptic-lanceolate, 5-8 cm long; pedicels glabrous, 1-2 mm long; lower glume thinly winged, wings oblique on one side of margin, normally sparse with long tubercle-based bristles on dorsal side. *Sessile spikelets* linear-lanceolate, densely covered with rufous hairs, 5-8 mm long by 1-2 mm wide, including 1-2 mm callus; lower glume coriaceous, apex rounded, 9-11 nerved; upper glume linear, glabrous, 3-nerved. Awn 4-7 cm, hirsute; ovary oblong, 0.5-2 mm; styles 2-3 mm; stigmas 1-6 mm. *Pedicelled spikelets* linear-oblong, 6-8 mm; pedicels 1-3 mm; lower glume obliquely twisted, sparse with tubercle-based bristles to glabrous, not broadly winged.

(Fig. 27 & Plate 18 C).

Thailand.- **NORTHERN:** Chiang Mai (Bo Luang, Ban Pha Mawn, Mae Klang, Mae Khachan Nuea, Amphur Mueng, Doi Suthep); Tak (Doi Ka, Huay Mae Lamo); Kamphaeng Phet (Phran Kratai); Nakhon Sawan (Amphur Mueng); Phayao (Amphur Mueng); Lampang (Mae Huad, Ngao); **NORTH-EASTERN:** Loei (Phu Kradueng, Phu Luang, Wang Saphung); **SOUTH-WESTERN:** Prachuap Khirikhan (Hua Hin); Kanchanaburi (Ban Kao, Kanburi, Si Sawat); **PENINSULAR:** Phuket (Mueng), Songkhla (Hadd Yai).

Distribution.- Throughout tropical and subtropical regions. From India (Type!) to Ceylon, Burma, Southern China, Indo-China, Malaysia, Philippines, Indonesia, Japan, Fiji, Hawaii and Australia.

Ecology.- Common in open, by roadsides, edge of ricefields and deciduous forests, at 50-800 m alt.

Vernacular.- Yaa phung chuu (Prachuap Khirikant); Yaa luuk nong, Yaa nuat ruesee (Central); Yaa rang takkataen (Chumphon); Yaa lem, Yaa laem (Chiang Mai).

Specimens.-Abbe & Smitinand 9241D (BKF, NY); Beusekom et al. 3789 (BKF, K); Bradley 39 (GH, US); Burkill 1238 (BKF); Geesink et al. 5631 (BKF); Larsen 8303 (GH); Maxwell 86-517, 86-1025 (BKF); Murata et al. 15610, 16553, 16554, 16825, 16833 (BKF); O'Connor & Niyomdham 15733 (BKF, NY); Shimizu et al. 19378 (BKF); Smitinand 1472 (BKF); 1613, 2032, 3063, 4001, 4264 (BKF, K); Sorensen, Larsen & Hansen 1371, 1822, 2417, 4437 (BKF, K); Tagawa et al. 1036 (BKF), 2203 (BKF, GH, K).

Remarks.- *Heteropogon contortus* is an extremely variable species found on a wide variety of habitats. The grass is highly palatable as a fodder while young, but when the awns are fully developed it is avoided by livestock. The dispersal of the species is by means of wind and animals. The sharp callus and the filiform long awns can easily stick to the skin and caused serious injury to animals.

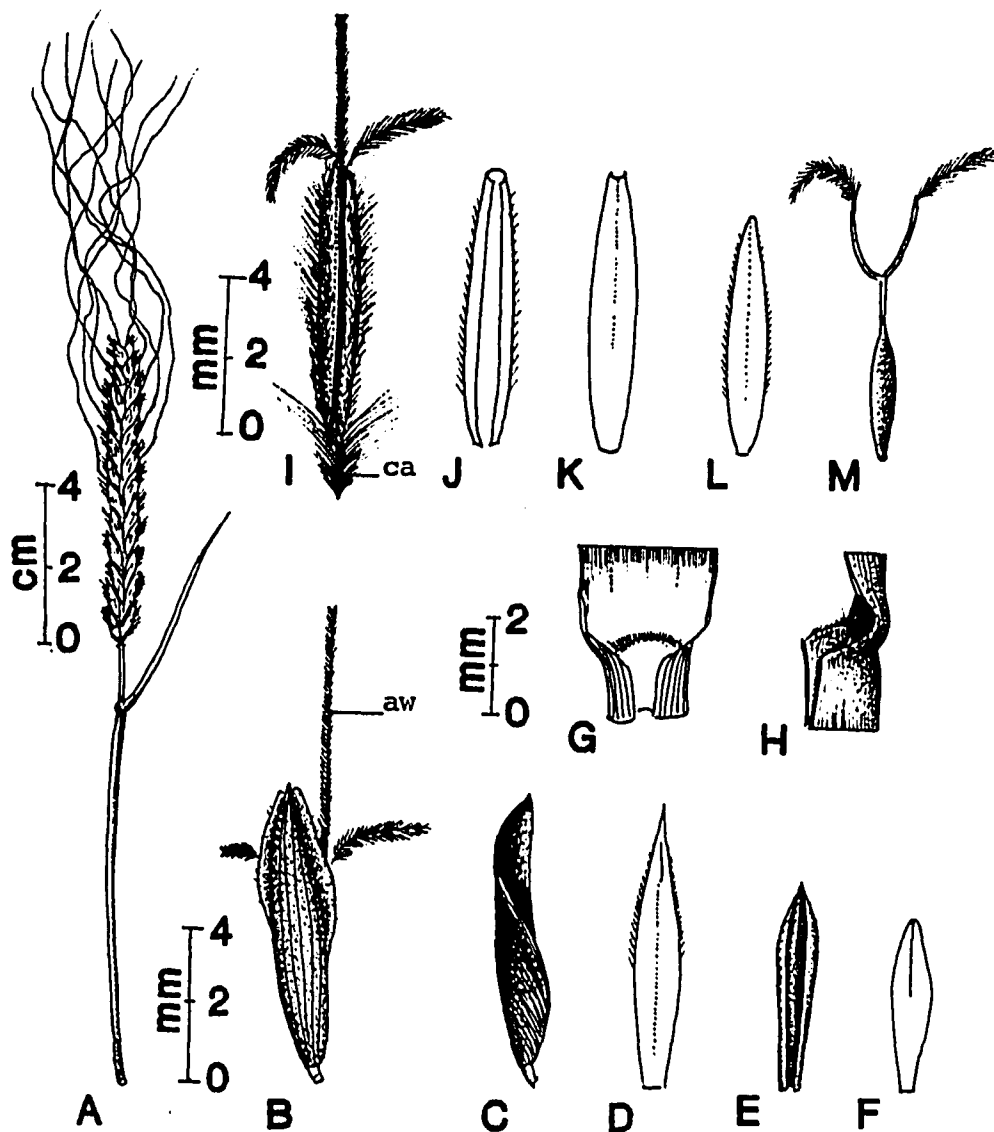


Figure 27. *Heteropogon contortus* (L.) P. Beauv.

A. inflorescence B-F. pedicelled spikelet B. dorsal view of lower glume C. lateral view of lower glume D. upper glume E. lemma F. palea G, H. ligule I-M. sessile spikelet I. lateral view J. ventral view of lower glume K. upper glume L. lemma M. ovary and styles; aw, awn; ca, callus; (Smitinand 2032, BKF).

2. *Heteropogon triticeus* (R. Br.) Stapf ex Craib, Kew Bull.: 432.1912; Reeder, J. Arn. Arb. 29: 376.1948; Senaratana, Grass. Ceyl.: 201.1956; Bor, Fl. Ind., Burm. & Ceyl. 1: 165.1960.
- *Andropogon triticeus* R. Br., Prodr.: 201.1810; Domin, Bibl. Bot. 85: 277.1915; Druce, Rep. Bot. Soc. Exchange Club: 628.1916; Hackel in DC. Monogr. Phan.: 588.1889; Trimen, Fl. Ceyl. 5: 239.1974;
 - Type.- Australia, North Holland (K-phototype!).
 - *A. segainensis* Steud., Syn. Pl. Glum. 1: 367.1854;
 - *A. ischyranthus* Steud., l. c.: 367.1854; Miq., Fl. Ned. Ind. 3: 493.1857;
 - *A. lianatherus* Steud., l. c.: 367.1854; Miq., l. c.: 493.1857;
 - *Heteropogon insignis* Thw., Enum. Pl. Zeyl.: 437.1864.

Perennial; 150-300 cm high, culms robust, hard, leafy at base; sheaths compressed, keeled, overlapping at base; ligule membranous, fimbriate, 2-5 mm. *Leaf-blades* linear-acuminate, 30-60 cm long by 6-8 mm wide, broad at base to cuneate apex, glabrous, margin scabrid. *Inflorescence* stout, 7.0-15 cm long excluding the awns; spikelets 8-14 homogamous pairs at base, heterogamous pairs above. *Homogamous spikelets*: sessile spikelet broadly elliptic, 8-15 mm long by 1 mm wide; lower glume chartaceous, apex acuminate; upper glume obtuse; pedicelled spikelets elliptic-oblong, 5-8 cm; pedicels glabrous, 1-2 mm; lower glume with oblique winged; sparse pubescent on the back. *Sessile spikelets* cylindrical, obtuse, 10-12 mm long by 1-2 mm wide, including 4-6 mm callus; cover densely with rufous hairs; lower glume coriaceous, oblong, apex rounded, 9-11 nerves; upper

linear, glabrous, 3-nerved. Awn 8-12 cm; ovary oblong, 0.5-2 mm; styles 2-3 mm; stigmas 1-6 mm. *Pedicelled spikelets* broadly ovate-oblong, 12-22 by 4-8 mm; pedicels 1-2 mm; lower glumes more or less twisted, lanceolate, many nerved, glabrous. (Fig. 28 & Plate 18).

Thailand.- NORTHERN: Chiang Mai (Chiang Dao, Doi Suthep, Mae Klang); Nakhon Sawan; Lampang (Ngao); Tak (Doi Musoe); NORTH-EASTERN: Petchabun (Nam Nao); Sakon Nakhon (Phu Phan); Khon Kaen, Chaiyaphum (Thung Kamang); Loei (Phu Kradueng); SOUTH-EASTERN: Chantaburi (Makham); SOUTH-WESTERN: Prachuap Kirikant (Sam Roi Yot).

Distribution.- From India to Ceylon, Burma, Southern China, Indo-China Malesia and Australia (Type!).

Ecology.- Common in open grassy ground, in abandoned areas and in deciduous forest, at 150-1300 m altitude.

Vernacular.- Yaa luuk nong, Yaa nong (Prachin Buri).

Specimens.-Beusekom et al. 4411 (BKF); Bradley 38 (GH); Hennipman 3095 (BKF); Khantchai 695 (BKF); Ploenchit 1962 (BKF); Shimizu et al. 18232; Smitinand 3683, 3991, 4902 (BKF); Sorensen, Larsen & Hansen 3373 (BKF); Tagawa et al. 2316 (BKF).

Remarks.- The grass is recognized by the large inflorescence with twisted long awns entangled at the top.

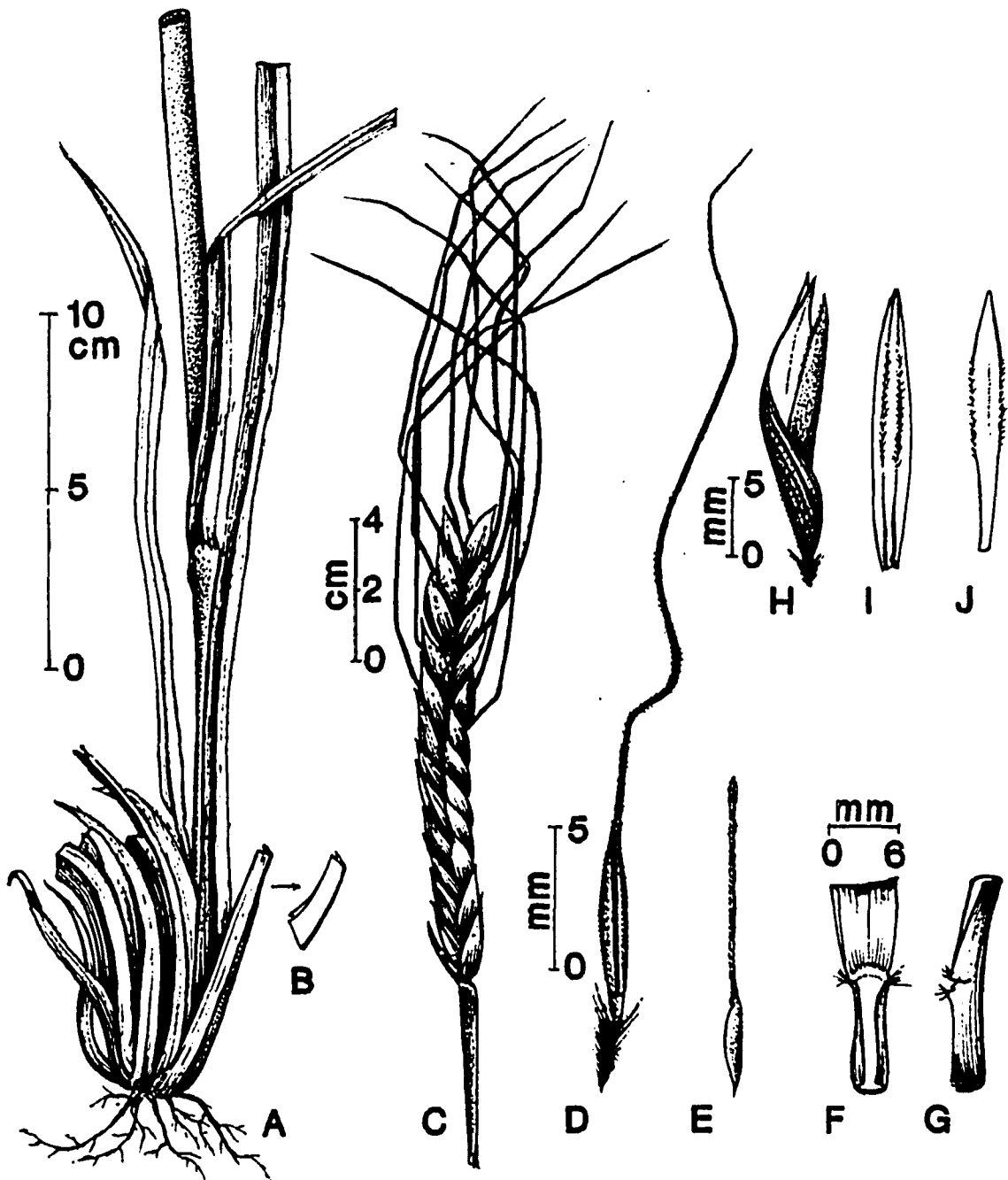


Figure 28. *Heteropogon triticeus* (R. Br.) Stapf ex Craib
 A. habit B. leaf compressed at base C. inflorescence
 D. sessile spikelet E. upper lemma and awn F-G. ligule
 F. ventral view G. lateral view H-J. pedicelled spikelet
 H. lateral view of spikelet I. ventral view of lower glume
 J. upper glume; (Ploenchit 1962, BKF).

HYPARRHENIA Anderss. ex Fourn.

Hyparrhenia Anderss. ex Fourn., Mex. Pl. 2: 51.1886; Anderss. in Nov. Act. Soc. Sci. Upsal., 3,2: 254.1856; in Schweinf., Beitr. Fl. Aethiop.: 310.1867; Stapf in Prain, Fl. Trop. Afr. 9: 291.1918; Pilger in Engler, Nat. Pflanzenfam., 2,14: 172.1940; W.D. Clayton, Kew Bull. 1969, ser. 2: 38.1969.

- *Andropogon* L. subgen. *Cymbopogon* Nees, pro parte; Benth. & Hook.f., Gen. Pl. 3,2: 1134.1883; Stapf in Thistleton-Dyer, Fl. Cap. 7: 336.1898;

- *Andropogon* L. subgen. *Cymbopogon* sect. *Hyparrhenia* (Fourn.) Hackel in DC., Monogr. Phan. 6: 617.1889;

- *Dybowskia* Stapf in Prain, Fl. Trop. Afr. 9: 382.1918.

Note.- Name from the Greek hypo = under, and arren = male: in allusion to the pair of male spikelets at the base of the raceme.

Perennials or *annuals*, often coarse. *Leaf-blades* linear, never aromatic. *Inflorescence* a spatheate panicle, terminal on culms and branches, lax; racemes in pairs, each interrupted by a spatheole, raceme-bases often deflexed at maturity. *Spikelets* in pairs, normally dissimilar in sex and shape; homogamous spikelets tardily disarticulating. *Florets* 2; lower neutral; upper normally bisexual. *Sessile spikelets* dorsally compressed with rounded margins; callus hairy, usually short and obtuse, glumes subequal; lower glume thinly chartaceous, usually broad with inflexed margins; upper narrowly and shallowly cymbiform, rounded on the back, finely keeled towards apex, 3-nerved. Lemmas hyaline, glabrous or ciliate; lower with faint,

2-nerved; upper stipitiform, awned from the sinus. Palea usually absent. Lodicules 2, minute, glabrous. Stamens 3. Stigmas laterally exerted. Caryopsis oblong, subterete to plano-convex; embryo c. 1/2 as long. *Pedicelled spikelet* usually somewhat longer than the sessile, acute; lower glume often mucronate or aristulate; upper lemma awnless, rarely suppressed.

A genus of 53 species, mostly occurring in Africa with only few extending to other regions. In Thailand 5 species are recorded including the two common species; *H. rufa* var. *siamensis* grows from 400-1900 m on mountain slopes and ridges in association with grassland, dipterocarp and open oak forests; and *H. diplandra* is known from 600-850 m in open, grassy pine forests.

KEY TO THE SPECIES OF HYPARRHENIA IN THAILAND

1. Upper raceme-base terete or filiform, not produce into a scarious appendage, usually much longer than the lower; spatheoles generally narrowly linear. Spikelets wholly or partly covered with rufous or golden-yellow hairs
2. Sheaths tomentose with white hairs; spatheoles glabrous at base. Sessile spikelets 6-8 mm long, lanceolate-oblong, densely to sparsely with golden hairs.
Raceme-bases sparsely pillose, the upper raceme-base 2-3 mm long.

H. nyssae

2. Sheaths glabrous; spatheoles hairy at the base.
Sessile spikelets 4-5 mm long, ovate-elliptic,
typically sparse with rufous hairs. Raceme-bases
glabrous, the upper raceme-base 3-5 mm long

H. rufa var. *siamensis*

1. Upper raceme-base flattened, upper part enlarged towards
the top, usually not much longer than the lower; spatheole
linear-oblong to broadly ovate-lanceolate. Spikelets
glabrous or only sparsely pubescent

3. Homogamous spikelets at the base of the lower raceme
only. Racemes 2-4 awned per pair; raceme-bases
bearded. Spatheole linear-oblong, 3.5-5 cm, margins
sparsely hairy. Lower glume of sessile spikelet
glabrous or hairy on margins near the top

H. newtonii var. *newtonii*

3. Homogamous spikelets at the base of both racemes.
Racemes 4-7 awned per pair; raceme-bases glabrous.
Spatheoles broadly ovate-lanceolate, 3-4.5 cm,
margins scabrid. Lower glume of sessile spikelet
sparsely pubescent

H. diplandra

1. *Hyparrhenia diplandra* (Hack.) Stapf in Prain, Fl. Trop. Afr. 9: 368.1918; W.D. Clayton, Kew Bull. 1969, ser. 2: 166.1969.
- *Andropogon diplandrus* Hackel in Flora 68: 123.1885; in DC., Monogr. Phan. 6: 627.1889;
Type.- Sudan, Schweinfurth 2002, 2094 (K-isosyntypes!).
 - *Sorghum diplandrum* (Hack.) Kuntze, Rev. Gen. Pl. 2: 791.1891;
 - *Andropogon osikensis* Franch. in Bull. Soc. Hist. Nat. Autun 8: 332.1895;
 - *A. pachyneuros* Franch., l.c.: 333.1895;
 - *A. obscurus* K. Schum. in Engl., Bot. Jahrb. 24: 330.1897;
 - *Cymbopogon phoenix* Rendle, Cat. Afr. Pl. Welw. 2: 156.1899;
 - *Andropogon phoenix* (Rendle) K. Schum. in Just, Bot. Jahresb. 27,1: 454.1901;
 - *A. vulgaris* Vanderyst in Bull. Agri. Congo Belge 9: 243.1918;
 - *A. vulgaris* var. *glaucus* Vanderyst, l.c.: 243.1918;
 - *Hyparrhenia pachyatachya* Stapf in Prain, Fl. Trop. Afr. 9: 370.1918;
 - *Andropogon kapandensis* De Wild., in Bull. Jard. Bot. Brux. 6: 13.1919;
 - *Cymbopogon diplandrum* (Hack.) De Wild., l. c.: 11.1919;
 - *C. eberhardtii* A. Camus in Bull. Mus. Hist. Nat., Paris 25: 133.1919;
 - *Andropogon vulgaris* var. *major* Vanderyst in Bull. Agric. Congo Belge 2: 145.1920;
 - *Hyparrhenia diplandra* var. *major* Vanderyst, l. c.: 145.1920;
 - *H. takaensis* Vanderyst in Bull. Soc. Bot. Belge. 55: 45.1923;

- *Andropogon eberhardtii* (A. Camus) Merr. in Lingn. Sci. J. 5:

27.1928;

- *Hyparrhenia eberhardtii* (A. Camus) Hitch. in Lingn. Sci. J. 7:

247.1931.

Perennial; coarse; culms erect, 1.5-3 m high, nodes swollen, glabrous; sheaths glabrous or sparsely pilose towards the top; ligule membranous, truncate, 2 mm long. **Leaf-blades** 20-60 cm long by 5-10 mm wide, flat, acuminate, glabrous above, sparsely hirsute beneath, margins scabrid, usually hairy at base. **Inflorescence** loose, 20-40 cm long; spatheoles brownish red, glabrous, broadly ovate-lanceolate, 3-4.5 cm long, scabrid along the margins and at the base; peduncles 8-15 mm long, main part folded in spathe, glabrous or shortly hirsute above. **Racemes** 1.5-2.5 cm long, 4-7 awned per pair; upper raceme-bases flatten-broaden, glabrous, upper part enlarged obliquely towards the top; rhachis subequal, the upper 1-2 mm long. Homogamous spikelets at the base of both racemes, 7-10 mm long, scabrid on the margins. **Sessile spikelets** coriaceous, ovate-oblong, 6-8 mm long by 1-1.2 mm wide, sparsely pubescent; callus 1.5 mm long, acute; lower glume 5-7 faint nerves, upper glume loosely keeled. **Awn** 3-5 cm, the column hirsute. **Pedicelled spikelets** 5-7 mm long, sparse with short bristle at the top and margins, pedicel flat, 2-4 mm long. (Fig. 29 & Plate 19).

Thailand.- NORTH-EASTERN: Khon Kaen (Phu Wieng); Loei (Phu Kradueng);

EASTERN: Chaiyaphum (Thung Kamang).

Distribution.- Mostly in tropical Africa, Sudan (Type!), also recorded

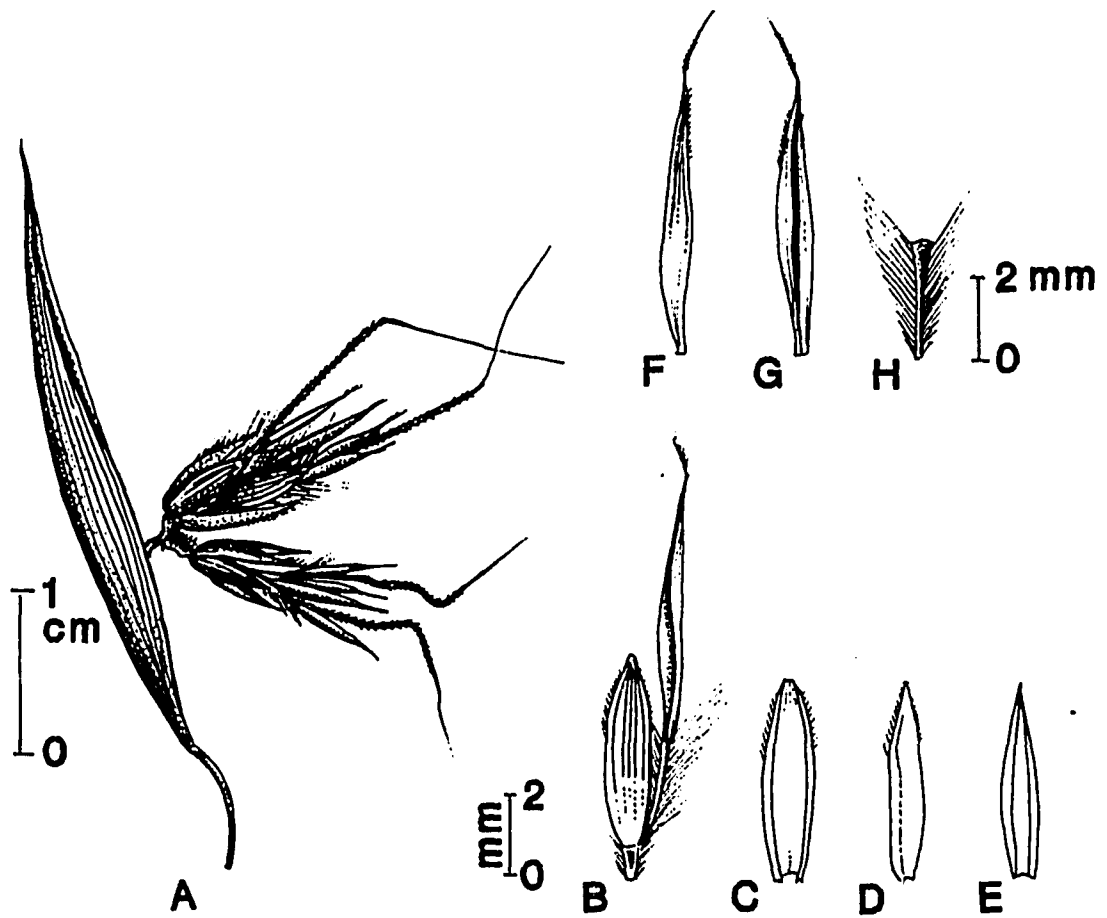


Figure 29. *Hyparrhenia diplandra* (Hack.) Stapf
 A. raceme and spatheole B. spikelet pair C-E. sessile
 spikelet C. ventral view of lower glume D. upper glume
 E. lemma F-G. pedicelled spikelet F. dorsal view G.
 ventral view H. pedicel; (Nanakorn 878, NY).

in Indo-China and Indonesia.

Ecology.- Common in marshy areas and in open savannah, at 600-850 m.

Specimens.- Adisai 348 (BK); Beusekom 4242 (K); Larsen 2280 (BKF, K);
Nanakorn 878 (NY); Smitinand 1787, 2107 (BKF, K).

Remarks.- The species occupies a wide range of habitats, and it is very variable. Clayton (1969) in his revision of the genus noticed that there seem to be no discontinuities within the variable characters and concluded that only a single species should be recognized.

2. *Hyparrhenia newtonii* (Hack.) Stapf in Prain, Fl. Trop. Afr. 9: 363.1918; W.D. Clayton, Kew Bull. 1969, ser. 2: 148.1969.

- *Andropogon newtonii* Hackel in Bol. Soc. Brot. 3: 137.1885; in DC., Monogr. Phan. 6: 644.1889.

Type.- Angola, Newton s.n. (K-isotype!).

- *A. lecomtei* (Hack.) Kuntze, Rev. Gen. Pl. 2: 792.1891;

- *Sorghum newtonii* (Hack.) Kuntze, l. c.: 792.1891;

- *Cymbopogon lecomtei* (Franch.) Rendle in J. Linn. Soc., Bot. 40: 227.1911;

- *Hyparrhenia cirrulosa* Stapf in Prain, Fl. Trop. Afr. 9: 365.1918;

- *H. lecomtei* (Franch.) Stapf, l.c.: 362.1918;

Type.- French Congo, Katabi, Lecomte A9 (P-holotype)

- *H. stolzii* Stapf, l.c.: 364.1918;

- *A. bisulcatus* Chiov. in Nuov. Giorn. Bot. Ital. N.S., 26: 60.1919;

- *A. nlemfuensis* var. *villosus* Vanderyst in Bull. Soc. Bot. Belge 55: 44.1923;

- *H. lecomtei* var. *bisulcata* (Chiov.) Robyns, Fl. Agrost. Congo

Belge 1: 192.1929; in Bull. Jard. Bot. Brux. 8: 242.1930;

- *H. squarrulosa* Peter in Fedd. Rep. Sp. Nov. Beih. 40,1: 375.1936.

var. *newtonii* W.D. Clayton, Kew Bull. 1969, ser. 2: 149.1969.

Perennial; culms 100-150 cm high, densely tufted, rufous at base; sheaths glabrous to sparsely hirsute; ligule truncate, about 1 mm long. *Leaf-blades* linear-acuminate, up to 40 cm long by 3-7 mm wide, rigid, scabrid along the margins and nerves beneath.

Inflorescence loose, often scanty, 15-30 cm long; spatheoles linear-oblong, 3.5-5 cm long, glabrous, margins sparsely hairy; peduncles pilose with stiff yellowish hairs towards the top. *Racemes* 1.5-2 cm long, 2-4 awned per pair; raceme-bases bearded, flattened, upper part enlarged towards the top into a scarious appendage; the upper densely covered with yellow hairs at the inner side of the joints, 1.5-3 mm long, the lower 1-2 mm long. Homogamous spikelets only at the base of the lower raceme, 5-8 mm long, ovate-oblong, sparsely pubescent on the back, margins ciliate. *Sessile spikelets* narrowly ovate-oblong, apex truncate, glabrous, 5-7 mm long; callus acute to pungent, 1.5-2 mm long; lower glume coriaceous, glabrous or hairy on margins near the tip, loosely keeled with the middle ridge raised between two fine grooves. *Awn* 3.5-5.5 cm long. *Pedicelled spikelets* 5-8 mm long, glabrous, terminating in a bristle 1-3 mm long; pedicel flat, 2-4 mm long, densely hairy along the margins. (Fig. 30 & Plate 20).

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng); EASTERN: Chaiyaphum
(Thung Kamang).

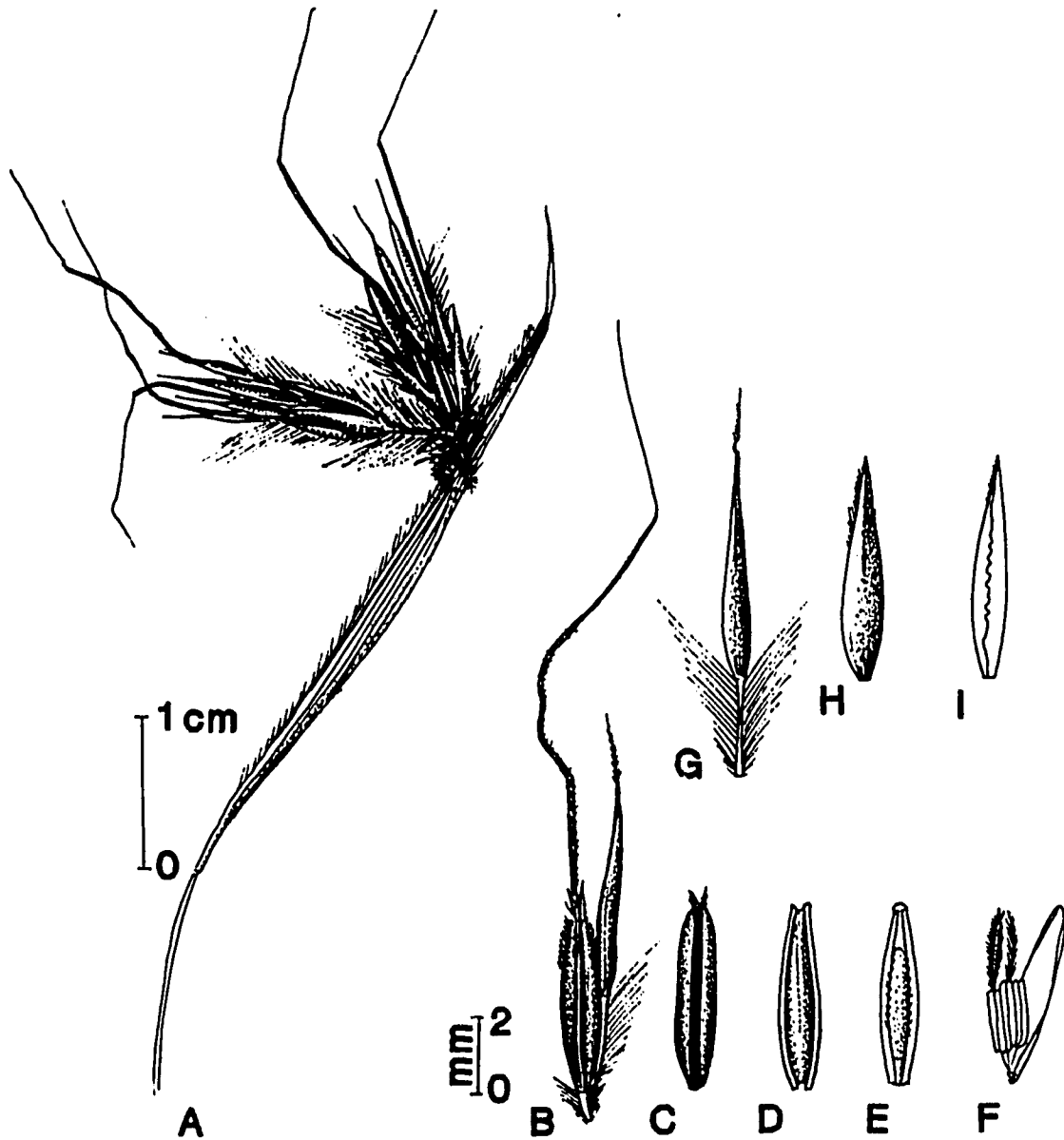


Figure 30. *Hyparrhenia newtonii* (Hack.) Stapf
 A. raceme and spatheole B. spikelet pair C-F. sessile
 spikelet C. lateral view of lower glume D. ventral view
 of upper glume E-F. lemma G. pedicelled spikelet H.
 dorsal view of lower glume I. upper glume; st, stamens;
 (Nanakorn 880, NY).

Distribution.- Western Africa, Angola (Type!), Madagascar, Indo-China and Indonesia.

Ecology.- Common along edges of pine-dipterocarp forest at 850-1300 m altitude.

Vernacular name.- Yaa khon taa chang (Loei).

Specimens.-Nanakorn 880 (BKF, NY); Smitinand 2081, 3763, 4982 (BKF, K); 9540 (BKF); Sorensen, Larsen & Hansen 6264 (BKF, K).

Remarks.- *Hyparrhenia lecomtei* in Stapf (1918) was described as different from *H. newtonii* by the denser panicle, smaller spikelets, and denser hairs on leaf-blades and sheaths. These differences were considered as minor local variation by Clayton (1969), and the species was combined with *H. newtonii*. Another species, *Hyparrhenia bracteata* is very closely related to *H. newtonii*, sharing the characteristic of purple racemes, framed in yellow hairs, and the similarity of the bearded raceme-bases; therefore, many specimens were misidentified in the field. The two species can be differentiated by the loose, large panicles, larger spikelets and longer awns of *H. newtonii*.

3. *Hyparrhenia nyassae* (Rendle) Stapf in Prain, Fl. Trop. Afr. 9: 313.1918; W.D. Clayton, Kew Bull. 1969, ser. 2: 53.1969.

- *Andropogon nyassae* Rendle in J. Bot. 31: 358.1893;

Type.- Malawi, Buchanan 1423 (K-isotype!).

- *A. rufus* var. *auricomus* Pilger in Engl., Bot. Jahrb. 30: 268.1901;

- *Cymbopogon chrysargyreus* Stapf in J. de Bot. ser. 2,2: 213.1909;

- *C. solutus* forma *trichophyllus* Stapf, l.c.: 213.1909;
- *Andropogon chrysargyreus* (Stapf) Stapf ex A. Chev., Sudania 1:
77.1911;
- *A. lasiobasis* Pilger in Fries, Wiss. Ergebn. Schwed. Rhod.-Kongo
Exped. 1911-12,1: 197-1916;
- *Cymbopogon nyassae* (Rendle) Pilger in Engl., Bot. Jahrb. 54:
287.1917;
- *Hyparrhenia vulpina* Stapf in Prain, Fl. Trop. Afr. 9.: 310.1918;
- *H. chrysargyrea* (Stapf) Stapf, l. c.: 312.1918;
- *Andropogon lugugaensis* Vanderyst in Bull. Agric. Congo Belge 9:
241.1918;
- *A. vanderystii* De Wild. in Bull. Jard. Bot. Brux. 6: 24.1919;
- *Hyparrhenia vanderystii* (De Wild.) Vanderyst in Bull. Agric. Congo
Belge 2: 144.1920;
- *H. schmidiana* A. Camus in J. Agric. Trop. 2: 201.1955;
Type.- Vietnam, Schmidiana A. Camus (P-holotype, K-phototype!).
- *Cymbopogon schmidianus* (A. Camus) A. Camus ex Schmid, Fl. Agrost.
Indo-chine: 229.1959.

Perennial; culms smooth, 50-150 cm high, 1-5 mm in diameter near the base; sheaths tomentose with white hairs particularly densely at the base; ligule up to 1.5 mm long, densely fulvous at the joint. *Leaf-blades* linear-acuminate, rigid, 20-40 cm long by 3-6 mm wide. *Inflorescence* 15-30 cm long; spatheoles narrowly linear, 3-6 cm long, glabrous; peduncles usually longer than the spatheole, upper part spreading with white hairs. *Racemes* commonly deflexed, 2-4 cm long, 6-10 awned per pair; raceme-bases terete, sparsely pilose, not

extending into a scarious appendage, densely fulvous at the joint, the upper 2-3 mm, the lower 1-1.5 mm long. Homogamous spikelets narrowly lanceolate, 5-7 mm long, acute. *Sessile spikelets* lanceolate-oblong, coriaceous, 6-8 mm long; lower glume typically covered densely to sparsely with golden-yellow hairs; callus pointed, linear to cuneate, 0.8-1.2 mm long. *Awn* 3-4 cm long, the column part normally darker than the subule, with fulvous pubescence. *Pedicelled spikelets* ovate-oblong, 5-7 mm long, acute; pedicel subulate, 3 mm long; upper enlarge, truncate 1 mm. (Fig. 31 & Plate 21).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep);

Distribution.- Tropical Africa from Cameroun and Sudan to

Transvaal, Malawi (Type!); also found in Indo-China and Vietnam.

Ecology.- Scattered in open by edge of dry dipterocarp forests at 750 m altitude.

Specimens.-Smitinand 4006 (BKF, K).

Remarks.- Although represented by specimens collected in 1957, the typical white-tomentose basal sheaths, spikelets densely pubescent with golden yellow hairs, and the long pointed callus, all clearly indicate this species. The specimens also match exactly with the type at Kew.

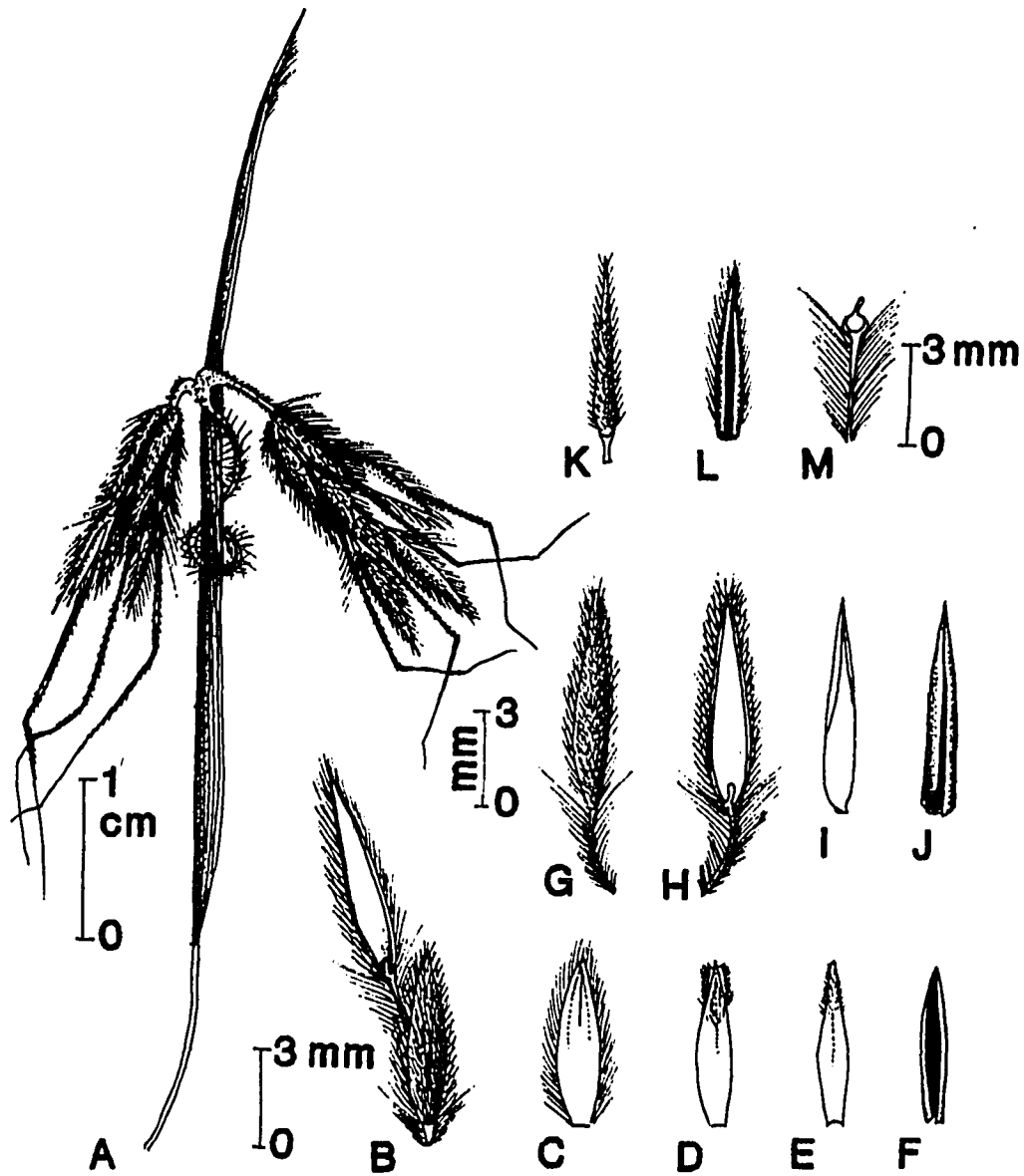


Figure 31. *Hyparrhenia nyassae* (Rendle) Stapf
 A. raceme and spatheole B. spikelet pair C-F. sessile
 spikelet C. ventral view of lower glume D. upper glume
 E. lemma F. palea G-H. pedicelled spikelet I. lemma
 J. palea K-L. homogamous spikelet K. dorsal view L.
 ventral view M. pedicel; (Smitinand 4006, BKF).

4. *Hyparrhenia rufa* (Nees) Stapf in Prain, Fl. Trop. Afr. 9: 304.1918; W.D. Clayton, Kew Bull. 1969, ser. 2: 60.1969.
- *Trychypogon rufus* Nees, Agrost. Bras.: 345.1829;
- Type.- Brazil, Martius (M, holotype!).
- *Andropogon xanthoblepharis* Trin. in Mem. Acad. Sci. Petersb. 6,2: 281.1832; Hackel in DC., Monogr. Phan. 6: 637.1889;
- *A. rufus* (Nees) Kunth, Enum. Pl. 1: 492.1833; Hackel in DC., Monogr. 6: 637.1889; Stapf in Thistleton-Dyer, Fl. Cap. 7: 358.1898;
- *A. altissimus* Hochst. ex A. Braun in Flora 24: 277.1841 (non Raspail, 1825);
- *A. fulvicomus* Hochst. in Sched., Schimp., Iter Abyss. 2: 1118.1842; A. Rich., Tent. Fl. Abyss. 2: 463.1851;
- *A. fulvicomus* var. *approximatus* Hochst. in Sched., l.c.: 928.1842;
- *Hyparrhenia fulvicoma* (Hochst.) Anderss. in Schweinf., Beitr. Fl. Aethiop: 310.1867 (nom illegimate);
- *Andropogon rufus* var. *fulvicomus* (Hochst.) Hackel in Bol. Soc. Brot. 5: 213.1887; DC., Monogr. Phan. 6: 621.1889.
- *Sorghum rufum* (Nees) Kuntze, Rev. Gen. Pl. 2: 792.1891;
- *Andropogon bouangensis* Franch. in Bull. Soc. Hist. Nat. Autun 8: 333.1895;
- *Cymbopogon rufus* (Nees) Rendle, Cat. Afr. Pl. Welw. 2: 155.1899;
- *C. rufus* var. *fulvicomus* (Hochst.) Rendle, l.c.: 155.1899;
- *C. rufus* var. *major* Rendle, l.c.: 155.1899;
- *Andropogon rufus* var. *glabrescens* Chiov. in Ann. Istit. Bot. Roma 8: 288.1903;

- *A. yinduensis* Vanderyst in Bull Agric. Congo Belge 9: 243.1918;
- *Hyparrhenia altissima* Stapf in Prain, Fl. Trop. Afr. 9: 307.1918;
- *H. rufa* var. *major* (Rendle) Stapf in Prain, l.c.: 306.1918;
- *H. rufa* var. *fulvicoma* (Hochst.) Chiov. in Nuov. Giorn. Bot. Ital. 26: 74.1919;
- *H. hirta* var. *brachypoda* Chiov. in Atti R. Acad. Ital., Mem. Cl. Sci. Fis. 2: 63.1940;
- *H. parvispiculata* Bamps in Bull. Jard. Bot. Brux. 25: 391.1955;
- *H. vulpina* ssp. *longipes* A. Camus in Bull. Soc. Bot. Fr. 107: 207.1960.

Perennial; culms 1 to 2.5 m high, tufted, sheaths glabrous; ligule up to 2-5 mm long. *Leaf-blades* linear-acuminate, 30-60 cm long and 4-8 mm wide. *Inflorescence* fasciculate, slightly drooping; spatheoles narrowly linear, 3-4 cm long by 1-3 mm wide, brownish-red; peduncles exserted, sometimes shorter than the spatheole, glabrous or white pilose above, often reaching 2 cm or more. *Raceme* exserted not deflexed, 1.5-2.5 cm long, 6-9 awned per pair, glabrous and rufous or with the callus beards and lower part of the internodes and pedicels white; raceme-bases filiform not produce into a scarious appendage, the upper 2.5-5 mm long, the lower 1-2 mm long, glabrous, more or less connate. Homogamous spikelets similar shape to pedicelled spikelets. *Sessile spikelets* narrowly ovate-elliptic 3.5-5 mm long; lower glume typically sparse with rufous hairs; callus 1-1.2 mm long, cuneate and narrowly truncate. *Awn* 2-3 cm long, the column rufous pubescent. *Pedicelled spikelets* narrowly lanceolate, 3-5 mm long, acute mucronate; pedicel tooth triangular, up to 0.3 mm long.

var. *siamensis* W.D. Clayton, Kew Bull. 1969, ser. 2: 66.1969.

Type.- Thailand, Smitinand & Abbe 6188 (K-holotype!).

Ligule slightly fimbriate, sometimes brownish-red, 2-3 mm long. *Leaf-blades* glabrous. *Inflorescence* 6-25 cm. Spatheoles 3-6.5 cm, scaberulous on keel; margins sparse with white hairs, hairy at the base. *Racemes* 6-7 awned per pair; upper raceme-base 3-5 mm long, glabrous, bearing 1-2 homologous pairs. *Sessile spikelets* ovate-elliptic, 4-5 mm long; callus slender, narrowly truncate, 1-1.2 mm long. (Fig. 32 & Plate 22)

Thailand.- NORTHERN: Chiang Mai (Doi Saket, Doi Suthep, Chiengdao, Inthanond, Mae Taeng); Lampang (Mueng, Khun Tan); Chiang Rai (Pang Boh); NORTH-EASTERN: Phetchabun (Lom Kao);

Distribution.- Thailand (Type!) and adjacent countries.

Ecology.- Common by roadsides, clearings and edge of dry dipterocarp forest at 400-1900 m.

Vernacular name.- Yaa sang dam (Northern, Chiang Mai).

Specimens.-Abbe & Smitinand 6188 (BKF); Kerr 2253 (BK, K); 6672, 8923 (BK); Nanakorn 1235, 1244 (NY); Smitinand 2614, 3915, 4005, 8756 (BKF, K); Smitinand & Phengkklai 8693 (BKF); Sorensen, Larsen & Hansen 2569 (BKF, K); Tagawa et al. 2573, 3035 (BKF); Yongboonkird 475 (BK).

Remarks.- The species *Hyparrhenia rufa* has a very wide distribution; many taxa have been described, but there have been many difficulties in identification. Plants are perennial or annual; panicles vary from dense to lax; spatheoles vary

from narrowly lanceolate to linear; the spiklets vary from mostly glabrous to almost villous, and the color from creamy-white to reddish-brown. The specimens collected from Thailand were placed as *H. rufa* var. *siamensis* by Clayton (1969). The grass has many similarities to *H. rufa* var. *rufa* but are very uniform in the number of awns per pair, the glabrous raceme-base, and the rufous spikelets. In West Africa the grass has an excellent reputation as a fodder for grazing animals, but in Thailand it is considered as a weed in the highlands.

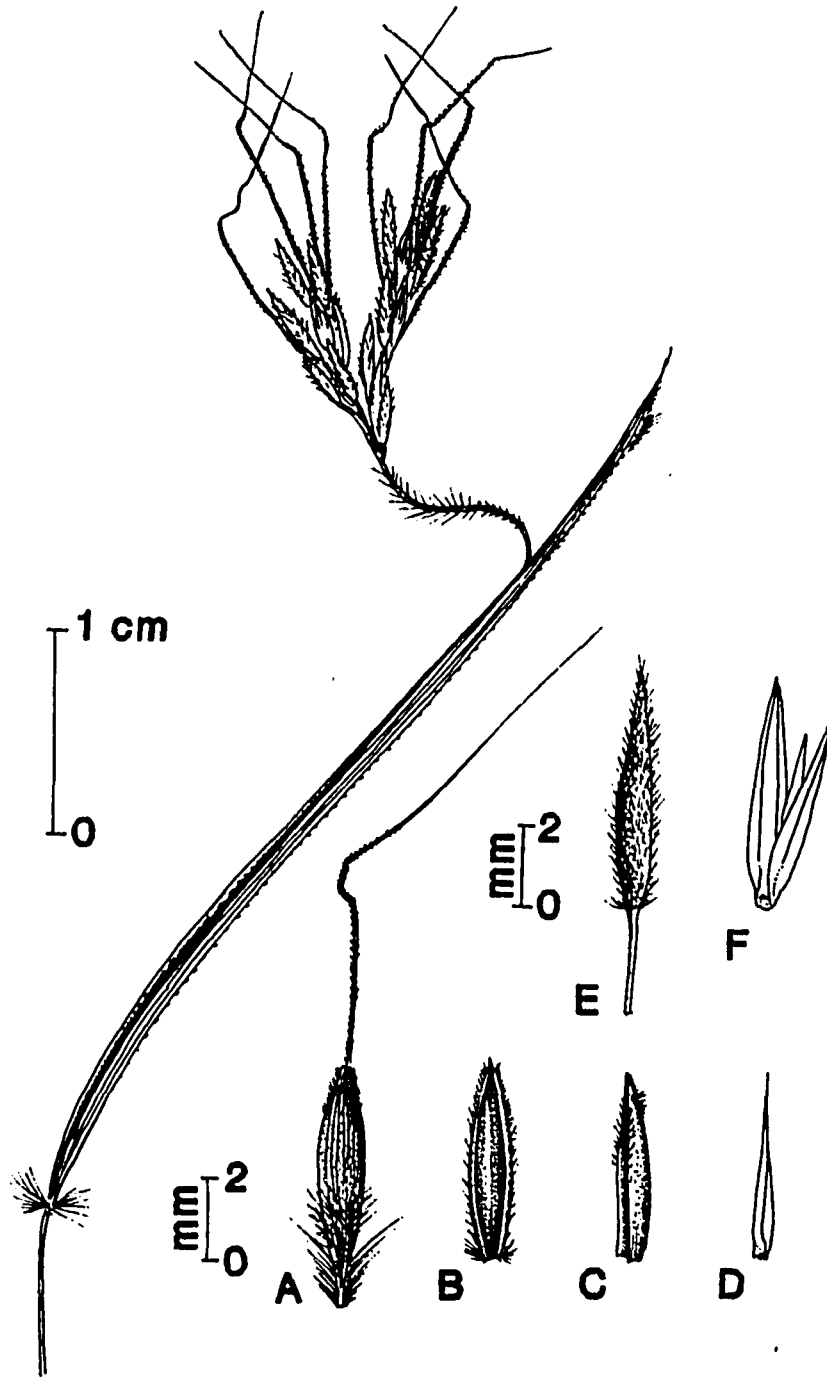


Figure 32. *Hyparrhenia rufa* var. *siamensis* W.D. Clayton
 A. raceme and spatheole A-D. sessile spikelet B.
 ventral view of lower glume C. lateral view of upper
 glume D. lemma E. pedicelled spikelet F. upper
 glume, lemma and palea; (Nanakorn 1235, NY).

ISEILEMA Anderss.

Iseilema Anderss. in Nova Acta Soc. Sci. Upsal. 3,2: 250.1856;

Hubbard in Hook., Ic. Pl. 33: 3286.1935.

Note.- Name from Greek words iso = equal, and eilema = husk: in allusion to the lower homogamous spikelets.

Annuals, often slender; culms branched; sheaths compressed-keeled; ligule short, ciliate. *Leaf-blades* flat or loosely folded. *Inflorescence* a compound spatheate panicle, interrupted by spatheoles, leafy; raceme short, consisting of 2 pairs of involucral homogamous spikelets at the base, 1 sessile spikelet usually borne upon a short internode, and 2 pedicelled spikelets; spatheoles cymbiform, acute, compressed, many-nerved, often with tubercle-based glands. *Florets* 2 in sessile spikelet, and usually 1 in involucral and upper pedicelled spikelets; lower floret male or neuter, often reduced; upper bisexual or female. *Involucral spikelets* connate at base of pedicels, subequal, strongly dorsally compressed, sometimes reduced to pedicels; glumes flattened, 2-keeled, membranous to coriaceous; lemma hyaline, nerveless, often oblong, usually without a palea; lodicules small. *Sessile spikelets* persistent or rarely deciduous, dorsally flattened; callus none or minute, the spikelet base fused to the rhachis internode; glumes membranous to coriaceous, 2-keeled; lower glume herbaceous to coriaceous; upper cymbiform, incurved, margins often hyaline; lemma hyaline, 3-nerved or nerveless, without a palea, upper lemma stipitiform, 2-lobed. *Awn* geniculated, column glabrous. Ovary glabrous. Caryopsis oblong, strongly dorsally compressed. *Pedicelled*

spikelets similar to involucre spikelets, normally smaller, tardily disarticulating from their pedicels; pedicel filiform.

A genus distributed from India to Australia, with 23 species, of which 10 are scattered in the Indo-Malaysian region and the remaining 13 being endemic in arid and northern Australia. In Thailand 2 species, *I. siamensis* and *I. thorelii*, are recorded.

KEY TO THE SPECIES OF *ISEILEMA* IN THAILAND

1. Plants 15-25 cm high, nodes glabrous. Leaf-blades, 2-4 cm long; spatheoles narrowly winged. Involucral spikelets oblong-lanceolate, oblique, minutely scaberulous, many-nerved in the upper part; sessile spikelets 9-10 mm long

I. siamensis
1. Plants 90-130 cm high, nodes fulvous. Leaf-blades 40-80 cm long spatheoles broadly winged. Involucral spikelets subelliptic, with tubercle-based glands along the margins, 5-7 nerved; sessile spikelets 5-7 cm long

I. thorelii

1. *Iseilema siamensis* Hubbard in Kew Bull. 1927: 80.1927; Smitinand, Thai Pl. Names: 191.1980. Type.- Thailand, Chai Nat, Chaibadan, Kerr 7980 (K-holotype!, BK-isotype!).

Culms geniculate, ascending, smooth, 15-25 cm high, branching above; nodes glabrous; sheaths compressed at base, glabrous except few tubercle-based glands along the ridge; ligule membranous, truncate, glabrous, 1 mm. *Leaf-blades* flat, linear-oblong, apex obtuse, base rounded, 2-4 cm long by 4-5 mm wide, margins scabrid, with sparsely scattered tubercle-based glands near the base.

Inflorescence a compound spatheate panicle, 6-12 cm long; spatheoles ovate-lanceolate 15-22 mm long, glabrous except for some tubercle-based hairs along the ridges and margins, narrowly winged; peduncle filiform, 8-12 mm, hispid to sparsely hairy. *Involucral spikelets* 4, pedicelled subequal 1.5-2 mm; lower glume oblong-lanceolate, oblique, apex acute, 6-7 mm long by 1.5-1.8 mm wide, chartaceous, many-nerved in the upper part, minutely scaberulous; upper glume oblique, acuminate, 5-nerved, firmly membranous, margin inflexed, hyaline; lemma oblanceolate, obtuse, 1.6 mm long. *Sessile spikelets* bisexual, pilose at base, hairs 2.5 mm long; oblique, oblong-lanceolate, 9-10 mm long by 2.5 mm wide; lower glume acuminate, 12-nerved, membranaceous; upper oblong, acuminate, indistinct 3-5 nerved, hyaline; lemma 3 mm long. *Pedicelled spikelets* male, 2; linear-lanceolate, acute, 5-6 mm long, glabrous; lower glume membranous, many-nerved, sparse with tubercled glands along the margins; upper glume 5-nerved, membranous; pedicel filiform, 4-6 mm long, sparsely scaberulous.

(Fig. 33 & Plate 23).

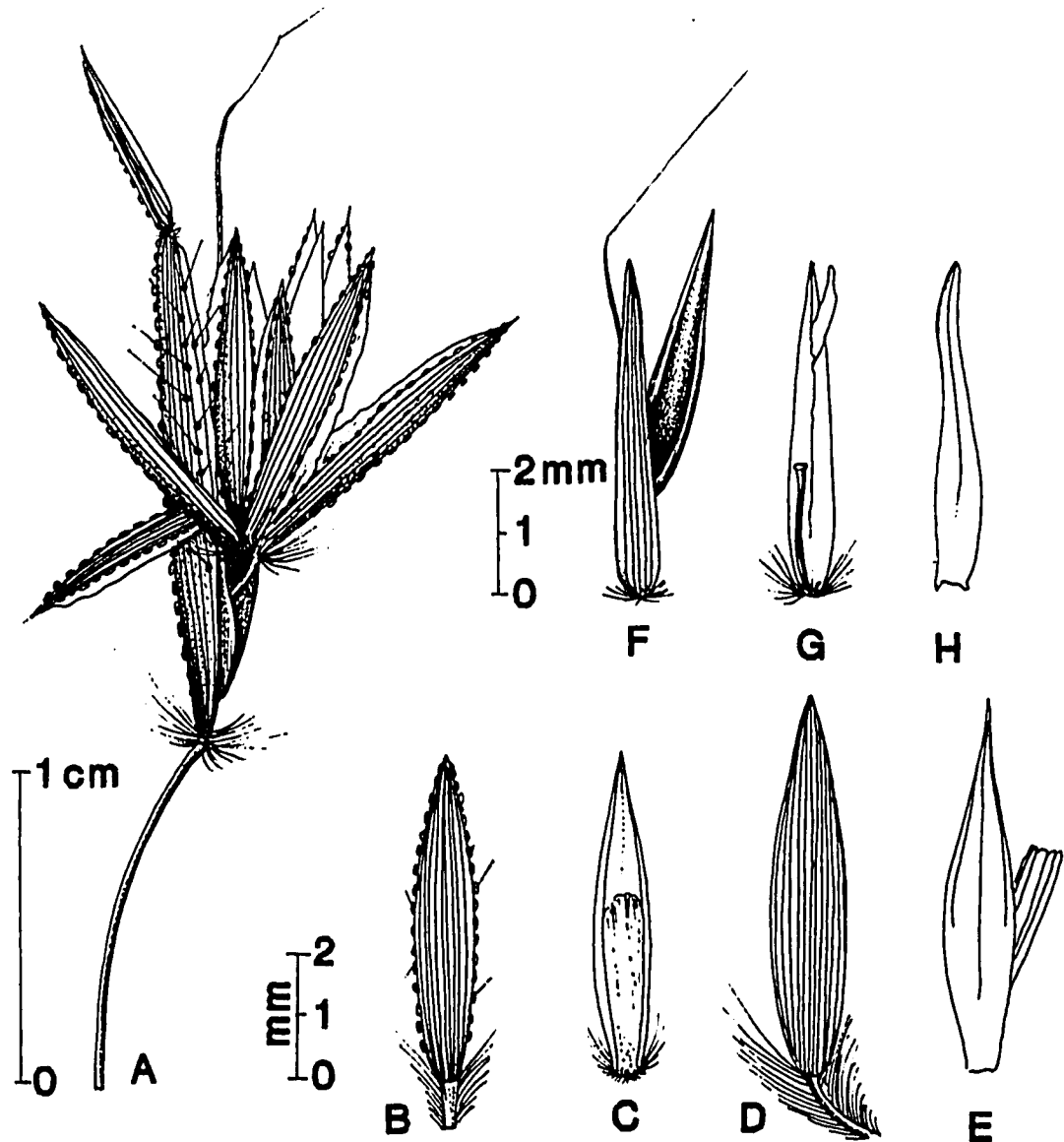


Figure 33. *Iseilema siamensis* C.E. Hubbard
 A. raceme and spatheoles B. habit of involucre
 spikelets C, D. pedicelled spikelet E, F. sessile
 spikelet; (Kerr 7980, BK).

Thailand.- NORTHERN: Nakhon Sawan (Takli); CENTRAL: Chai Nat
(Chaibadan, Menam Pasak).

Distribution.- Endemic to Thailand.

Ecology.- In bamboo jungle at 50 m elevation.

Vernacular names.- Yaa takkataen (Nakhon Sawan); Yaa phraek naa
(Saraburi).

Specimens.-Kerr 7980 (BK, K); Put 2131 (BKF, K).

2. *Iseilema thorelii* A. Camus in Bull. Mus. Hist. Nat. Paris 24:
540.1918; Camus et Camus in Lecomte, Fl. Gen. I.-C. 7,4: 365.1922;
Smitinand, Thai Pl. Names: 191.1980. Type.- Laos; Thorel, s.n. from
Mae Kong expedition 1866-1868 (P-holotype).

Annual; culms terete at base, 90-130 cm, very smooth,
fulvous at nodes; sheaths glabrous; ligule membranous, ciliate, 0.5
mm. *Leaf-blades* linear-acuminate, terete at base flat above,
glabrous, margins scabrid, 40-80 cm long by 3-5 mm wide.
Inflorescence a decompound spatheate panicle, 18-30 cm; racemes in
clusters, 1-1.5 cm; spatheoles membranous, oblong-lanceolate, keeled
with tubercle-based glands along the ridge, broadly winged, with
sparsely scattered tubercle-based hairs on wings and margins, mostly
1.5-2.5 cm or longer up to 4 cm at the base of the raceme. *Involucral
spikelets* male, 4-5 mm long, pedicels 0.5-0.8 mm; lower glume
subelliptic, 5-7 nerved, with sparsely scattered tubercled glands
particularly along the margins; upper glume 3.5-4 mm, lanceolate-
oblong, membranous to papyraceous, 5-nerved. *Sessile spikelets*
bisexual, linear-oblong, 5-7 mm, glabrescence or with few hairs on

margins near the top; lower glume papyraceous, apex truncate; upper glume oblong, apex attenuate, nerveless or obscure nerves on the upper part. *Pedicelled spikelets* neuter, similar to involucral spikelet in outline, but longer; pedicel slender, 2-2.5 mm, 3-nerved.

(Fig. 34 & Plate 24).

Thailand.- NORTHERN: Nakhon Sawan (Km. 31 North); SOUTH-EASTERN:

Chantaburi (Taruang); Prachin Buri (Aran Pratet); EASTERN:

Nakhon Ratchasima (Pi Mai).

Distribution.- Indo-China (Laos, Type!).

Ecology.- In open savannah, edge of rice field, and in deciduous forest, at 200 m alt.

Vernacular name.- Yaa plong haang (Prachin Buri).

Specimens.-Kerr 8144, 8227 (K); 9730 (BK, K); Put 1135 (K), 1981 (BKF, K); Smitinand 5814 (BKF); Sorensen, Larsen and Hansen 2151 (BKF).

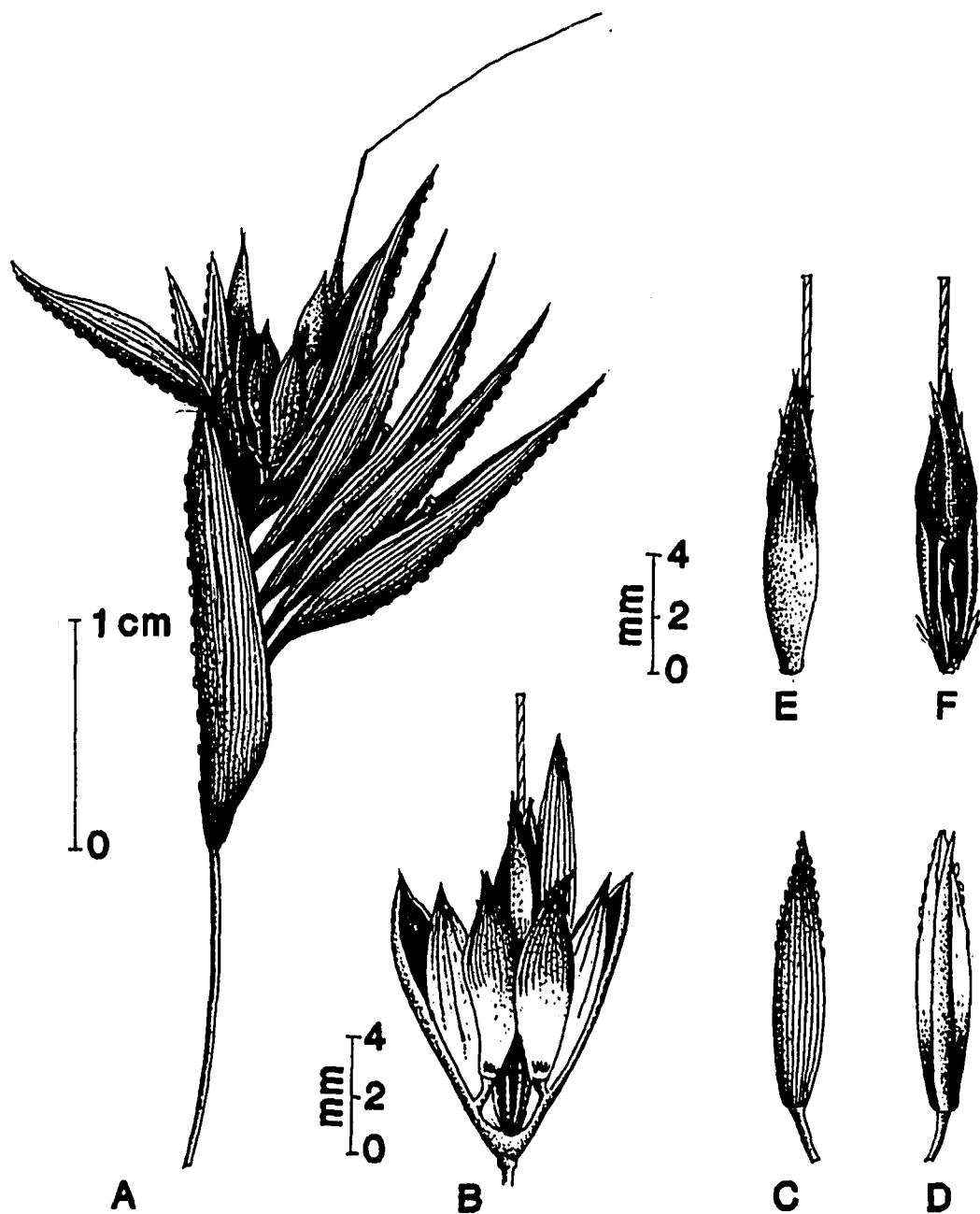


Figure 34. *Iseilema thorelii* A. Camus
 A. raceme and spatheoles B, C. habit of involucral
 spikelets D, E. pedicelled spikelet F, H. sessile
 spikelet F. dorsal view of lower glume G. ventral view
 of lower glume H. upper glume; (Put 1981, BKF).

PARAHYPARRHENIA A. Camus

Parahyparrhenia A. Camus, in Bull. Mus. Hist. Nat. Paris 2,22:
404.1950.

Note.- Name from Greek word Para = near (besides), Hyparrhenia = name of a grass genus: alluding to a resemblance to the genus Hyparrhenia.

Perennials or *annuals*; culms simple or branched, erect; sheaths compressed, glabrous or pilose; ligule short, membranous and truncate or ciliate. *Leaf-blades* flat or involute, very narrow. *Inflorescence* a spatheate raceme, terminal on culms; racemes solitary or paired, shortly peduncled, with few-many-jointed rhachis; rhachis-internodes and pedicels linear, ciliate on both sides. *Spikelets* in pairs, dissimilar in sex and shape; sometimes the lowest homogamous, male or neuter. Florets 2; lower neuter; upper bisexual in sessile spikelet of heterogamous pairs, male or neuter in all other spikelets. *Sessile spikelets* glumes equal; callus long, pungent, bearded, curved or oblique; lower glume coriaceous to indurated, weakly keeled upwards, smooth, bidentate and bimucronate, glabrous or margins ciliate and apex pilose, with a dorsal median groove and narrow involute margins; upper cymbiform, oblong, keeled upwards, awned or aristulate, margins ciliate. Lemma hyaline; lower narrow-lanceolate; upper spatiform, sparsely pilose, bidentate, long-awned from sinus. Awn geniculate, column hispid. Palea absent or very small. Lodicules 2, minute. Stamens 3, with rather long anthers. Styles 2. *Pedicelled spikelets* subulate-lanceolate; lower glume herbaceous, many-nerved, longitudinally grooved, aristulate, pilose upwards on

surface and scaberulous on margins; upper glume keeled, aristulate. Lemma linear, hyaline; upper lemma bilobed, awnless or aristulate; palea absent.

A genus of 6 species, 4 distributed in tropical West Africa, 2 species are recorded in central and southeast Asia. *P. siamensis* so far has known only from peninsular Thailand and represented by only the type collection. *P. tridentata* is also rare and represented by few collections.

KEY TO THE SPECIES OF PARAHYPARRHENIA IN THAILAND

1. Leaf-blade up to 12 cm long, pilose beneath; raceme up to 4 cm long. Sessile spikelets filiform, glabrous; lower glume with a longitudinal canal. Pedicelled spikelets with aristate apex
P. siamensis

1. Leaf-blades 12-18 cm, glabrous; racemes 4-6 cm long. Sessile spikelets linear-oblong, hispid on upper part; lower glume without longitudinal canal. Pedicelled spikelets with tridentate apex
P. tridentata

1. *Parahyparrhenia siamensis* W. D. Clayton in Dansk Bot. Arkiv 27,1: 69.1969.

Type.- Thailand, Satul, Kerr 13715 (K-holotype!, BK-isotype!).

Perennial, caespitose; culms 50 cm high, leafy at base; nodes glabrous; sheaths compressed, pilose; ligule ciliate, sericeous, 0.2 mm. *Leaf-blades* up to 12 cm long, pilose beneath. *Inflorescence* a solitary raceme, 4 cm long; spikelets filiform, glabrous 7 mm long. *Sessile spikelets* with long callus, 2-3 mm, pungent, densely bearded, oblique, glumes equal; lower glume narrowly-elliptic, coriaceous, 6-nerves with longitudinal canal, margins ciliate; upper cymbiform, 5-nerved, aristate awn 6-9 mm; lemma narrow-lanceolate, 2.5-3.5 mm. Awn stout, 4-5 mm; palea absent or very small; stamens with rather long anthers, 3-4 mm. *Pedicelled spikelets* subulate-lanceolate; lower glume herbaceous, prominently longitudinally grooved, many-nerved, shortly aristulate, pilose upwards on surface and scaberulous on margins; upper glume keeled, aristulate.

Thailand.- PENINSULAR: Satul.

Distribution.- Endemic to Thailand.

Ecology.- In open grassy ground.

Specimens.-Kerr 13715 (BK)

Remarks.- The grass is recognized by its inflorescence of a solitary raceme, filiform spikelets, and a prominent median groove on the lower glume.

2. *Parahyparrhenia tridentata* W.D. Clayton, Kew Bull. 35,4: 816.1981;

Type.- Thailand, Sam Roi Yawt, Put 2480, 30 Nov. 29 (K-holotype!).

Perennial, dense tufted at base; culms wiry, 30-60 cm long; nodes swollen, glabrous; sheaths tight, glabrous; ligule membranous, 1.5 mm. *Leaf-blades* lanceolate-acuminate, 12-18 cm long by 3mm wide; glabrous. *Inflorescence* a single spatheate raceme, filiform, 4-6 cm long; rhachis internode linear, slightly enlarged at the top, almost glabrous, hairy on upper part near the top, 2.5-3 mm long. *Sessile spikelets* linear-oblong, apex truncate, 5-7 mm long; callus short, 0.3-0.5 mm long, bearded, hairs 1-1.5 mm long; lower glume convex without grooved, subcoriaceous, glabrous, hispid on upper part, 5-7-nerved; upper glume oblong, keeled, glabrous; lower floret empty; upper floret unisexual, upper lemma 4-5 mm, bi-lobed, stipitate, awn sericeous, 4 cm. *Pedicelled spikelets* broadly ovate, apex tridentate, 4.3-4.8 mm long; convex, glabrous, narrowly winged with ciliate margins near the top, prominent 7-11-nerved; pedicel 2-3 mm long.

Thailand.- SOUTH-WESTERN: Kanchanaburi; Prachuap Khiri Khan (Sam roi yawt);

Distribution.- Thailand (Type!) and probably Burma.

Ecology.- common in wet places at 100-300 m alt.

Specimens.-Phengkklai 252 (BKF, K); Put 2480 Type! (K).

Remarks.- According to the original description of the genus *Parahyparrhenia*, the lower glume of the species is grooved. But the lower glume of *P. tridentata* is clearly convex and without a groove. Clayton (1981) in his specific description therefore suggested that "the most reasonable compromise is to widen the circumscription of *Parahyparrhenia* so as it include it".

PSEUDANTHISTIRIA (Hack.) Hook. f.

Pseudanthistiria (Hack.) Hook.f., Fl. Br. Ind. 7: 219.1896; Bor, Fl. Ind., Burm. & Ceyl. 1: 203.1960.

- *Andropogon* subgen. *Hypogynium* sect. B. *Pseudanthistiria* Hackel in DC., Monogr. Phan. 6: 400.1889.

Note.- Name from Greek words Pseudein = false or resembling, anthistiria = a name of a grass genus Anthistiria (Themeda): alluding to a resemblance to the genus Anthistiria (Themeda).

Annual, slender; culms prostrate or decumbent or ascending, smooth, often very slender; sheaths much shorter than internodes; ligule short, membranous, truncate, glabrous or ciliolate. *Leaf-blades* linear, glabrous or with long tubercle-based hairs; *Inflorescence* a spatheate panicle, narrow, leafy, loose; racemes many, axillary, short peduncled; spatheoles scarcely or much longer than racemes, sparsely hairy with long tubercle-based bristles. Involucral spikelet suppressed. Spikelets in pairs, different in sex and shape, the terminal pair usually triad; disarticulating between the 2 sessile spikelets; pedicels filiform, ciliate; glumes equal. *Sessile spikelets* with minute, obtuse shortly bearded callus; lower glume chartaceous-membranous, truncate, dorsally subconvex or concave, scabrous, with 4-7 slender nerves, these becoming prominent towards apex, the margins narrowly inflexed towards apex and broadly involute below; upper glume lanceolate, acute, membranous, glabrous, 3-nerved, keeled. Lemma stipitiform, awned. Awn with brown hirtellous column; lodicules large, cuneate; stigma as long as styles. *Pedicelled*

spikelets glabrous; lower glume membranous, acute, flat on back, many-nerved, margins inflexed; upper glume lanceolate, acute, not keeled, 3-nerved; lemma and palea wanting.

A genus of 4 species distributed in India, Ceylon, Burma and Indo-China. In Thailand, a widely distributed species *P. burmanica* is commonly represented.

Pseudanthistiria burmanica Hook.f., Fl. Br. Ind. 7: 220.1896; Bor, Fl. Ind., Burm. & Ceyl. 1: 203.1960; Kurz, Grass. Burma: 73.1945.

Type._ Burma, from Pegu, 28 Dec. 1870, Kurz 2755 (K-holotype!).

- *Andropogon monomerus* Hochst. in Hohenack., Pl. Ind. Or.: 183.1847
(nomen nudum).

Annual or semi-annuals, straggling then ascending; culms 25-70 cm tall, smooth, very slender, rooting at the nodes; sheaths glabrous except for some tubercle-based hairs near the joint; ligule membranous, truncate, 0.5 mm. *Leaf-blades* linear, glabrous or with few scattered tubercle-based hairs at the base; apex cuneate, base rounded, 2.5-4.5 cm long by 2-4 mm wide. *Inflorescence* a paniculate raceme; racemes loosely arranged, 2.4-2.8 cm; rhachis internodes 0.8-1.4 mm; spatheoles linear-oblong with acute apex, compressed, 1.5-2.5 cm; brownish-red, narrowly winged, sparsely with long tubercle-based hairs on wings. *Sessile spikelets* main part embraced in the spatheole, callus short, obtuse, fulvous; lower glume chartaceous-membranous, narrowly oblong, truncate, 3-5 nerved with shallowly grooved between the nerves, slightly scabrid, 4 mm long; upper glume

as long as the lower, oblong, membranous, glabrous, keeled. Awn slender, 25-30 mm. *Pedicelled spikelets* linear, flat; lower glume membranous, glabrous on the back, sparsely hairy at the inner side, color darker than the sessile; pedicel glabrous, enlarged at the top, 1.4 mm. (Fig. 35, Plate 25).

Thailand.- SOUTH-EASTERN: Chantaburi (Makham).

Distribution.- From India to Burma and Indo-China.

Ecology.- Commonly straggling in scrub and in dry deciduous forest at 50-100 m.

Specimens.-Kerr 13847 (K); Smitinand 4058 (BKF); Sorensen, Larsen & Hansen 211 (K); 225 (BKF, K).

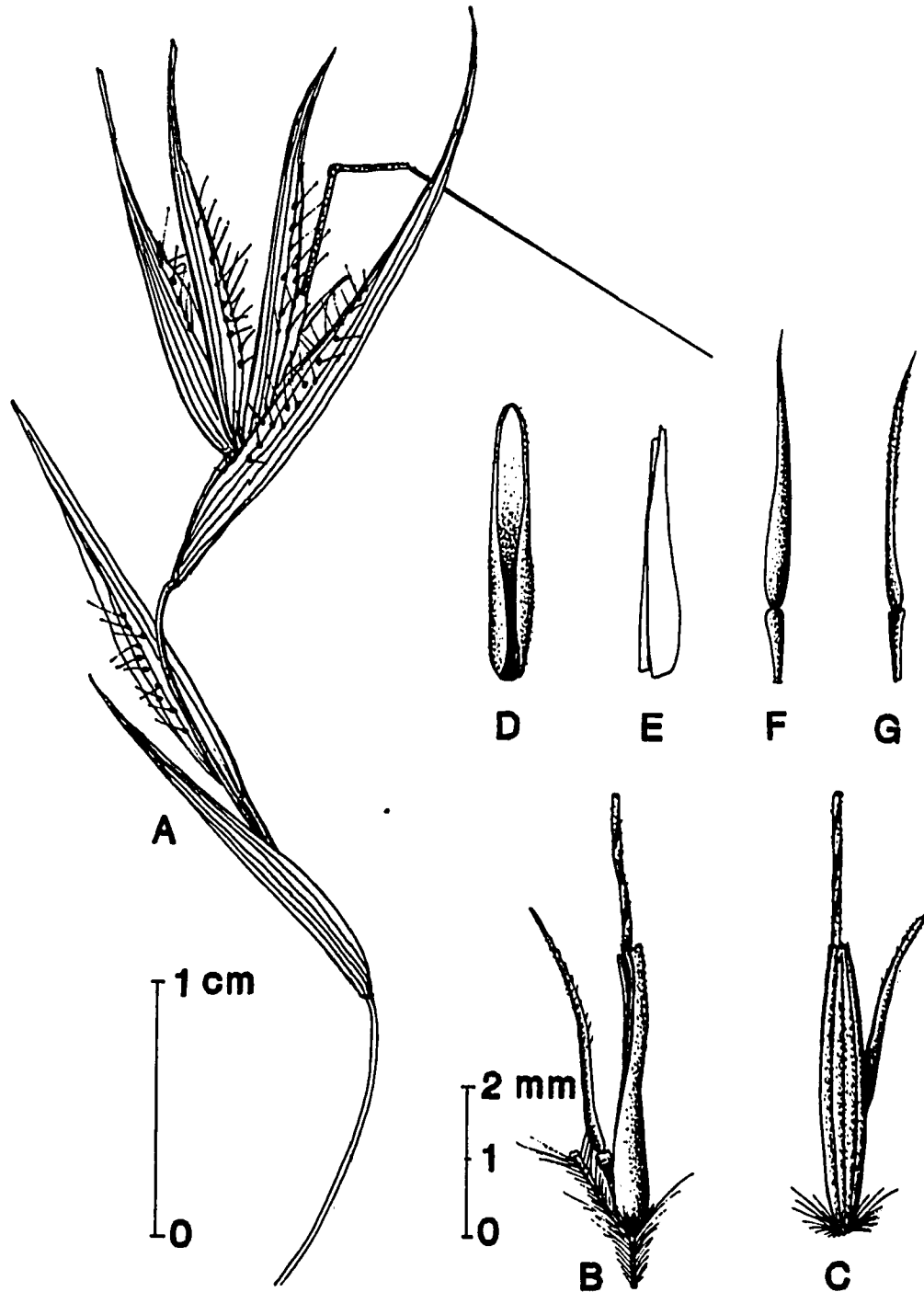


Figure 35. *Pseudanthistiria burmanica* Hook. f.
 A. raceme and spatheoles B, C. spikelet pair B. lateral
 view C. dorsal view D-E. sessile spikelet D. lower
 glume E. upper glume F-G. pedicelled spikelet;
 (Smitinand 4508, BKF).

THEMEDA Forssk.

Themeda Forssk., Fl. Aegypt.-Arab.: 178.1775; Hook., Fl. Brit. Ind. 7: 210.1897; Stapf in Prain, Fl. Trop. Afr. 9: 415.1919; Camus & Camus, Fl. Gen. I.-C. 7: 356.1922; Reeder, J. Arn. Arb. 29: 371.1948; Bor, Fl. Ind., Burm. & Ceyl. 1: 248.1960; Jacques-Felix, Les Gram. Afr. Trop. 1: 313.1962; Froideville in Backer & van den Brink Jr., Fl. Jav. 3: 614.1968; Gilliland, Fl. Mal. 3: 299.1971; Hsu, Fl. Taiwan 5: 701.1978; Lazarides, Pharn. Monogr. 7: 76.1980; Clayton, Gen. Gram.: 360.1986; Koyama, Grass. Japan: 450.1987.

- *Anthistiria* Linn.f., Nov. Gram. Gen.: 35.1779;

- *Perobachne* J.S. Presl ex C.B. Presl, Rel. Haenk. 1:348.1830;

- *Androscepia* Brongn., in Duperr., Voy. Coquille Bot.: 77.1831.

Note.- *Themeda* is a Latin name derived from an Arabic name *Thaemed* (name of a grass).

Annuals or *perennials*, often coarse; culms compressed or terete; ligule membranous, ciliate. *Leaf-blades* flat or rolled. *Inflorescence* a paniculate raceme terminal on culms and branches; spatheate; racemes solitary, fascicled; spatheoles keeled, lanceolate, herbaceous or coriaceous, with or without membranous wing; disarticulating below the sessile spikelet. *Homogamous spikelets* consisting of 2 pairs of involucreal spikelets; dorsally strongly compressed, awnless, glumes herbaceous or chartaceous, male or neuter, sessile or subsessile, forming a whorl around the raceme base, usually persistent. *Heterogamous spikelets* dissimilar in sex and shape, one of each pair sessile, the other pedicelled male or neuter. Florets 2;

lower reduced to an empty lemma; upper male or neuter in homogamous and pedicelled spikelets, bisexual in sessile spikelet. *Sessile spikelet* terete, with acute to pungent callus; glumes mostly coriaceous, obscurely nerved. Lemma hyaline, lower nerveless; upper stipitiform, terminating in a stout geniculate awn, rufous-scaberulous upwards, or awn reduced. Palea small, hyaline, nerveless, or absent. Lodicules 2, truncate-cuneate, small, glabrous. Ovary narrowly cylindrical; stigmas 2, exserted. Stamens 3. Caryopsis fusiform, terete or subterete, free; embryo small, ca. 1/2 as long. *Pedicelled spikelets* similar to involucral spikelets, but narrower and with acuminate apex.

A genus of ca. 18 species distributed mainly in the tropics and subtropics of the Old World, from India to Indonesia, also extending to temperate regions and introduced to tropical America. In Thailand 6 species are recorded including the widespread species *T. arundinacea*, *T. triandra* and *T. villosa*.

KEY TO THE SPECIES OF THEMEDA IN THAILAND

1. Pairs of involucral spikelets inserted at different levels.

Spikelets covered densely with golden, rufous, to dark brown hairs. Spatheoles coriaceous to subcoriaceous

2. Involucral spikelets densely to sparsely with golden tubercle-based hairs. Spatheoles subcoriaceous

T. arundinacea

2. Involucral spikelets glabrous or puberulous, without

tubercle-based hairs. Spatheoles coriaceous

3. Sessile spikelets with a well-developed awn, awn 2-5 cm long; spikelets normally covered with dark brown hairs

T. caudata

3. Sessile spikelets awnless or with an imperfect awn, awn if present shorter than 2 cm long; spikelets normally covered with yellow to rufous hairs

T. villosa

1. Pairs of involucral spikelets inserted at about the same levels.

Spikelets densely rufous to glabrous or strigose near the top.

Spatheoles herbaceous or chartaceous

4. Annual; spikelets arrange in a large flabelliform clusters; racemes 3-6 cm. Sessile spikelets densely rufous or at least rufous above; awns 6-7 cm. Involucral spikelets glabrous or sparse with few tubercle-based hairs on the upper part. Spatheoles herbaceous

T. arguens

4. Annual or perennials; spikelets arrange in a much smaller cluster; racemes 1.5-4.5 cm. Sessile spikelets glabrous or strigose near the top; awns shorter than 6 cm.

Involucral spikelets with tubercle-based hairs.

Spatheoles herbaceous or chartaceous

5. Perennials, up to 2.50 m. Involucral spikelets 6-12 mm; pedicelled spikelets 6-8 mm, including pedicel 2 mm

T. triandra

5. Annual, shorter than 1 m high. Involucral spikelets 4-5 mm; pedicelled spikelets 4-5 mm, including pedicel 1 mm

T. quadrivalvis

1. *Themeda arguens* (Linn.) Hackel in DC., Monogr. Phan. 6: 657.1889; Hook., Fl. Brit. Ind. 7: 211.1897; Camus & Camus, Fl. Gen. I.-C. 7: 357.1922; Rhind, Grass. Burma: 72.1945; Bor, Fl. Ind., Burma. & Ceyl. 1: 250.1960; Dansk Bot. Arkiv 23,2: 165.1965; Froideville in Backer & van den Brink Jr., Fl. Jav. 3: 615.1968; Gilliland, Fl. Mal. 3: 300.1971; Smitinand, Thai Pl. Names: 329.1980; Lazarides, Phan. Monogr. 7: 77.1980.

- *Stipa arguens* Linn., Sp. Pl. ed. 2: 117.1762;

Type.- India, s.n. (K-isotype!).

- *Anthistiria frondosa* R. Br., Prodr. Fl. Nov. Hall. 1: 200.1810;

- *A. pilifera* Steud., Syn Pl. Glum. 1: 400.1855;

- *T. frondosa* (R. Br.) Merr., Dept. Agri. Nat. Res. Sci. Manila, 9 :89.1917; Chase, J. Arn. Arb. 20: 316.1939; Reeder, J. Arn. Arb. 29: 371.1948;

- *T. arguens* var. *cochinchinensis* A. Camus in Bull. Mus. Paris: 670.1919. Type.- Indo-China, Pierre s.n. (K-Isotype!).

Annual; culms tufted, leafy at base, 80-100 cm tall by 3-5 mm in diameter near the base; sheaths subcompressed, keeled upwards, glabrous except for some tubercle-based hairs near the joint; ligule membranous, rounded-truncate, 1-2 mm long. *Leaf-blades* flat, linear-acuminate, base subcordate, margins scaberulous, 10-30 cm long by 3-6 mm wide. *Inflorescence* a compound paniculate racemes, 15-40 cm long; racemes 3-6 cm, excluding awns; spikelets arranged in a large flabelliform clusters; spatheoles thinly herbaceous, narrowly winged, 3-7 cm; dense to sparse with tubercle-based hairs. *Involucral spikelets* herbaceous, neuter, reduced to a single glume 6-10 mm long,

7-nerved, narrowly winged; glabrous or sparsely with few tubercle-based hairs only on the upper part; spikelet pairs inserted at about the same level. *Sessile spikelets* oblong-cylindric, truncate, 5-6 mm long; densely rufous to glabrous at base and setosely rufous above, 2-3 mm long; callus oblique and pungent; lower glume hardly coriaceous, apparently rounded, margins inrolled, nerved obscure; upper glume deeply grooved at the back, margins ciliate; lemma oblong, 2.8 mm long. *awn* 6-7 cm long; epaleate; anthers 1.4 mm long. *Pedicelled spikelets* lanceolate, 6 mm long; slightly bend around the sessile spikelet, glumes herbaceous; pedicel 2 mm long. (Fig. 36 & Plate 26).

Thailand.- NORTHERN: Chiang Rai (Doi Tung); Sukhothai (Ban Dan Lan Hoi); SOUTH-EASTERN: Kanchanaburi (Ban Kao); SOUTH-WESTERN: Sriracha (Khao Khiew).

Distribution.- India (Type!), Burma, Indo-China, Malay Peninsula, Philippines, Indonesia, New Guinea and Australia.

Ecology.- Common in abandoned fields, in open edges of the forest and in temporary watercovered soil, at 200-1450 m altitude.

Vernacular name.- Yaa chao chuu (Nakhon Ratchasima).

Specimens.-Bradley 45 (GH); Iwatsuki et al. 11143 (BKF); Larsen 8298 (GH, K); Maxwell 76-690 (BK); Murata et al. 16987 (BKF).

Remarks. The large flabelliform clusters of spikelets, and the thinly herbaceous spatheoles with tubercle-based hairs is characteristic of the species. The grass is said to be readily grazed when young, but not when mature and the awns fully developed.

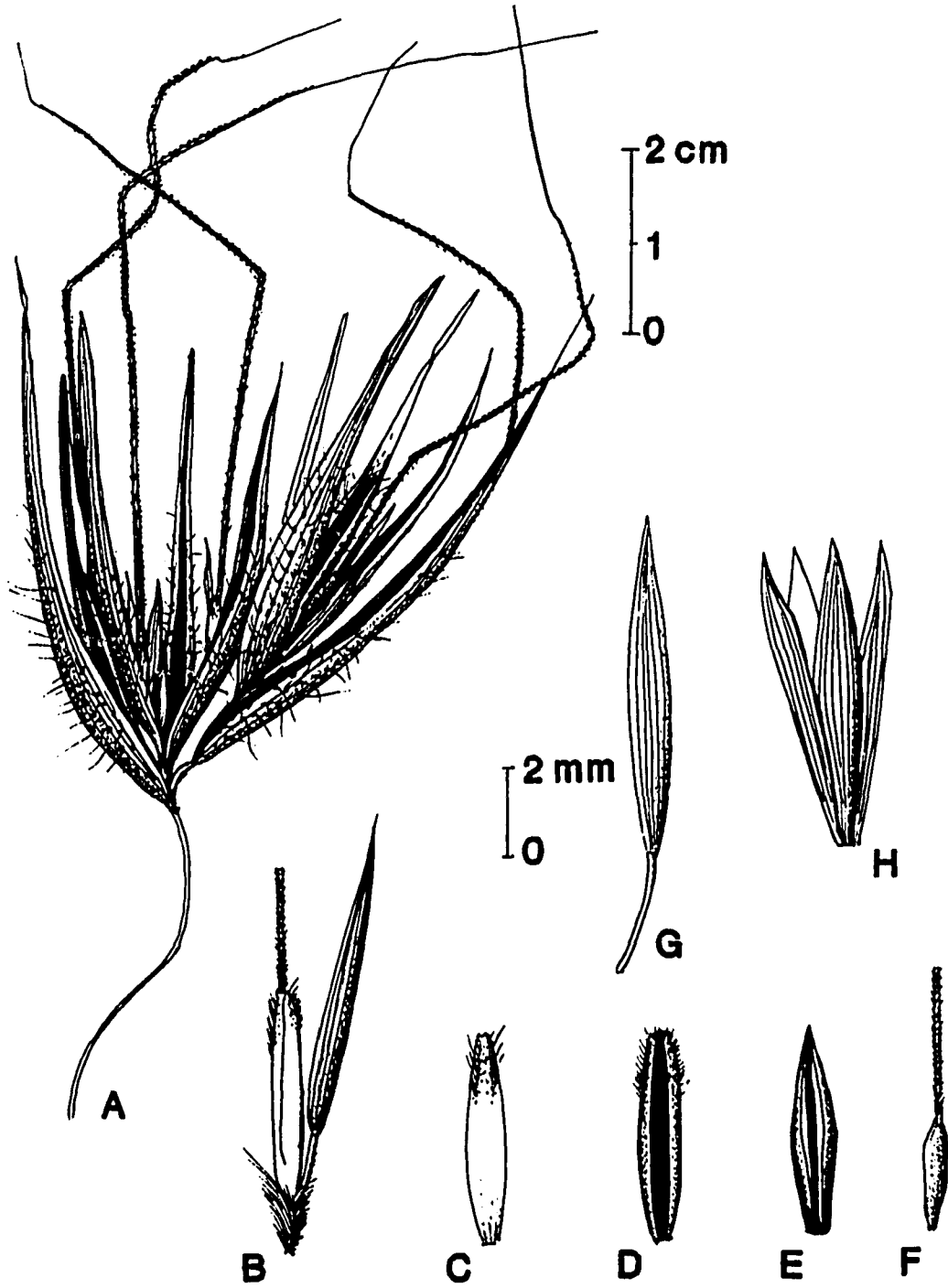


Figure 36. *Themeda arguens* (L.) Hackel

A. raceme and spatheoles B. spikelet pair C-F. sessile spikelet C, D. lower glume E. upper glume F. lemma and awn G. pedicelled spikelet H. involucral spikelets; (Larsen 8298, GH).

2. *Themeda arundinacea* (Roxb.) Ridley in Trans. Linn. Soc. 2,3: 401.1893; Camus & Camus, Fl. Gen. I.-C. 7: 363.1922; Rhind, Grass. Burma: 73.1945; Bor, Fl. Ind., Burm. & Ceyl. 1: 250.1960; Dansk Bot. Arkiv 20,2: 176.1962; Froideville in Backer & van den Brink Jr., Fl. Jav. 3: 615.1968; Gilliland, Fl. Mal. 3: 301.1971; Smitinand, Thai Pl. Names: 329.1980; Lazarides, Phan. Monogr. 7: 77.1980.

- *Anthistiria arundinacea* Roxb., Fl. Ind. 1: 256.1820;

Type.- India, Pekan, in open country (K-Isotype!).

- *Cymbopogon arundinaceus* (Roxb.) Schult., Syst. Veg. 2: 457.1824;

- *Anthistiria gigantea* ssp. *arundinacea* (Roxb.) Hackel in DC., Monogr.

Phan. 6: 674.1889; Craib, Fl. Siam Monocot.: 36.1913;

- *Themeda subsericans* (Nees) Ridl., Fl. Mal. Pen. 5: 212.1925.

Perennial, robust; culms up to 3.50 m tall with slender solid stems, 0.6-1.2 cm in diameter near the base; sheaths and nodes glabrous; ligule 1 mm. *Leaf-blades* linear-acuminate, 30-60 cm long by 6-14 mm wide, glabrous, margins scabrid. *Inflorescence* filiform, 60-80 cm, spatheate; racemes emerging at about the middle of the spatheole, drooping, 3-4 cm long excluding awns; spatheoles subcoriaceous, 4-6 cm, scabrous with minute wings. *Involucral spikelets* coriaceous, neuter, 10-16 mm; densely to sparsely covered with golden tubercle-based hairs at the back, hairs 1.5-2.5 mm, persistent; spikelet pairs inserted at different levels. *Sessile spikelets* 6-7 mm with 2-3 mm callus; glumes densely rufous hairs; lower glume coriaceous, broadly elliptic, margin inrolled; upper narrowly oblong, apex truncate. Awn 5-6.5 cm. *Pedicelled spikelets* male or neuter, 1-1.8 cm long including 3 mm pedicels,

narrowly elliptic, apex acuminate. (Fig. 37 & Plate 27).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Doi Chiangdao, Fang);
Chiang Rai (Doi Tung); Lamphun (Doi Khuntan); Tak (Thoen);
NORTH-EASTERN: Loei (Phu Kradueng, Phu ruea); Sakol Nakhon
(Phu Phan); PENINSULAR: Songkhla (Ko Hong, Haad Yai).

Distribution.- From India (Type!) to Burma, Indo-China, Malay
Peninsula and Sumatra.

Ecology.- Common in hill savannah, in open pine and oak forest at
high elevation, from 800-1600 m.

Vernacular names.- Khaem luang, Yaa faek (Chiang Mai); Faek
(Songkhla); Faek nam (Nakhon Si Thammarat); Samong daeng
(Nakhon Ratchasima); Yaa khamong (Chaiyaphum); Yaa faek
thung (Chumphon); Yaa khonta chang yai (Loei).

Specimens.-Bunpheng 902 (BK, K); Iwatsuki et al. 11145 (BKF);
Kantchai 673 (BKF); Koyama et al. 15667 (NY); Ploenchit
1974 (BKF); Shimizu et al. 8807, 8882, 20202 (BKF);
Smitinand 902 (BKF); 2106 (BKF, K); 10164 (BKF); Sorensen,
Larsen & Hansen 1397 (BKF), 4731 (GH, K); Sukkri 80 (BKF,
K); Tagawa et al. 9268, 10518 (BKF).

Remarks.- A common species in high plains, normally growing in large
groups. The chartaceous involucre spikelets covered
densely to sparsely with golden tubercle-based hairs is
most remarkable in the field. In fully mature stages the
hairs on involucre spikelets are often lost, but the
tubercle-based glands still exist and are very easy to
recognize.

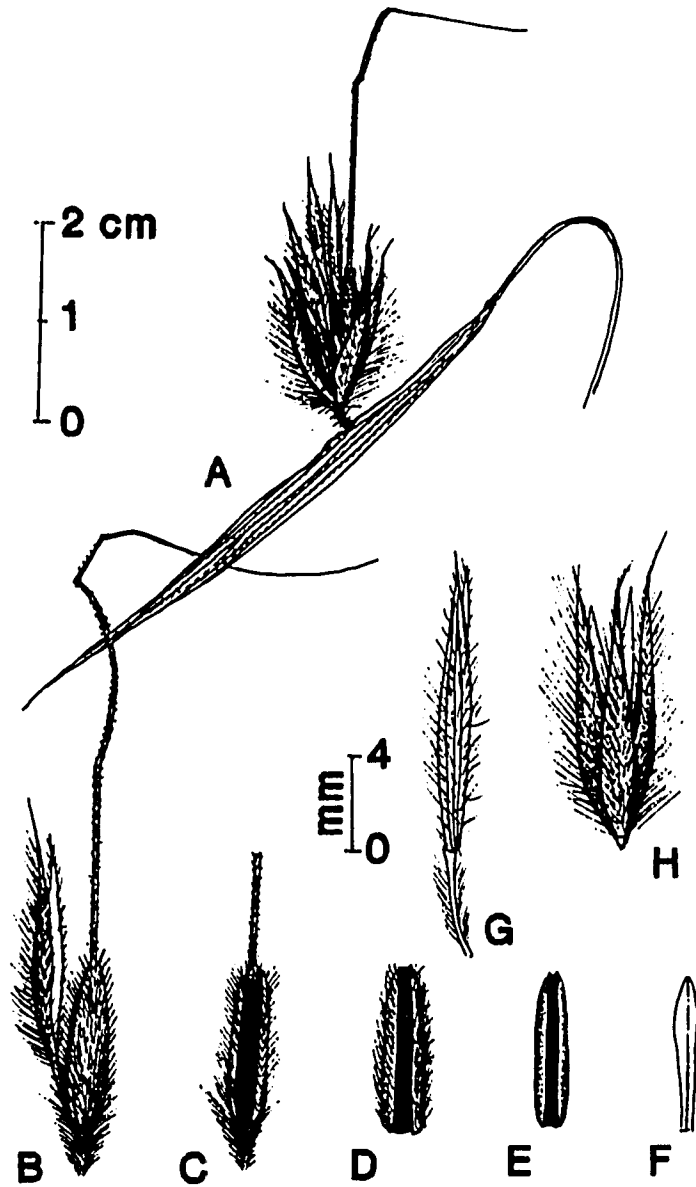


Figure 37. *Themeda arundinacea* (Roxb.) Ridley
 A. raceme and spatheole B. spikelet pair C-F.
 sessile spikelet C. lateral view D. lower glume
 E. upper glume F. lemma G. pedicelled spikelet
 H. involucral spikelets; (Ploenchit 1974, BKF).

3. *Themeda caudata* (Nees) A. Camus in Lecomte, Fl. Gen. I.-C. 7: 364.1922; Bor, Fl. Ind., Burm. & Ceyl. 1: 250.1960; Froideville in Backer & van den Brink Jr., Fl. Jav. 3: 616.1968; Hsu, Fl. Taiwan 5: 703.1978; Lazarides, Phan. Monogr. 7: 77.1980; Koyama, Grass. Japan: 450.1987.

- *Anthistiria caudata* Nees in Hook. et Arn., Bot. Voy. Beechey:

245.1838. Type.- China, Macao (K-isotype!).

- *Androscepiia gigantea* var. *armata* Anderss. in Nov. Act. Upsal. 3,2:

248.1856;

- *Themeda gigantea* ssp. *caudata* (Nees) Hackel in DC., Monogr. Phan. 6:

676.1889.

Perennial; culm tufted at base, 0.8-2 m tall, 4-10 mm thick near the base, branched at base and above; sheaths glabrous, rarely sparse pilose; ligule truncate-ciliolate, 1-1.5 mm. *Leaf-blades* linear, 8-40 cm by 5-12 mm wide, scabrous on both sides particularly on nerves beneath. *Inflorescence* narrow, 70-90 cm; racemes many, 1.5-3 cm excluding awn, zig-zag arranged; spatheoles coriaceous, 3-4 cm long, glabrous, scabrous throughout. *Involucral spikelets* subcoriaceous, neuter, lanceolate, 10-15 mm; glabrous without tubercle-based hairs; spikelet pairs inserted at different levels. *Sessile spikelets* oblong-cylindric, 6-10 mm, including callus 1-1.5 mm; covered densely with dark brown hairs, 1-1.5 mm; glumes hard, coriaceous, dark brown and shinny; lower glume with truncate apex, upper equaling with rounded apex. Awn 2-5 cm. *Pedicelled spikelets* narrowly lanceolate, 10 mm long, similar to the involucral spikelet in outline, pedicel 2 mm. (Fig. 38 & Plate 28 A-B).

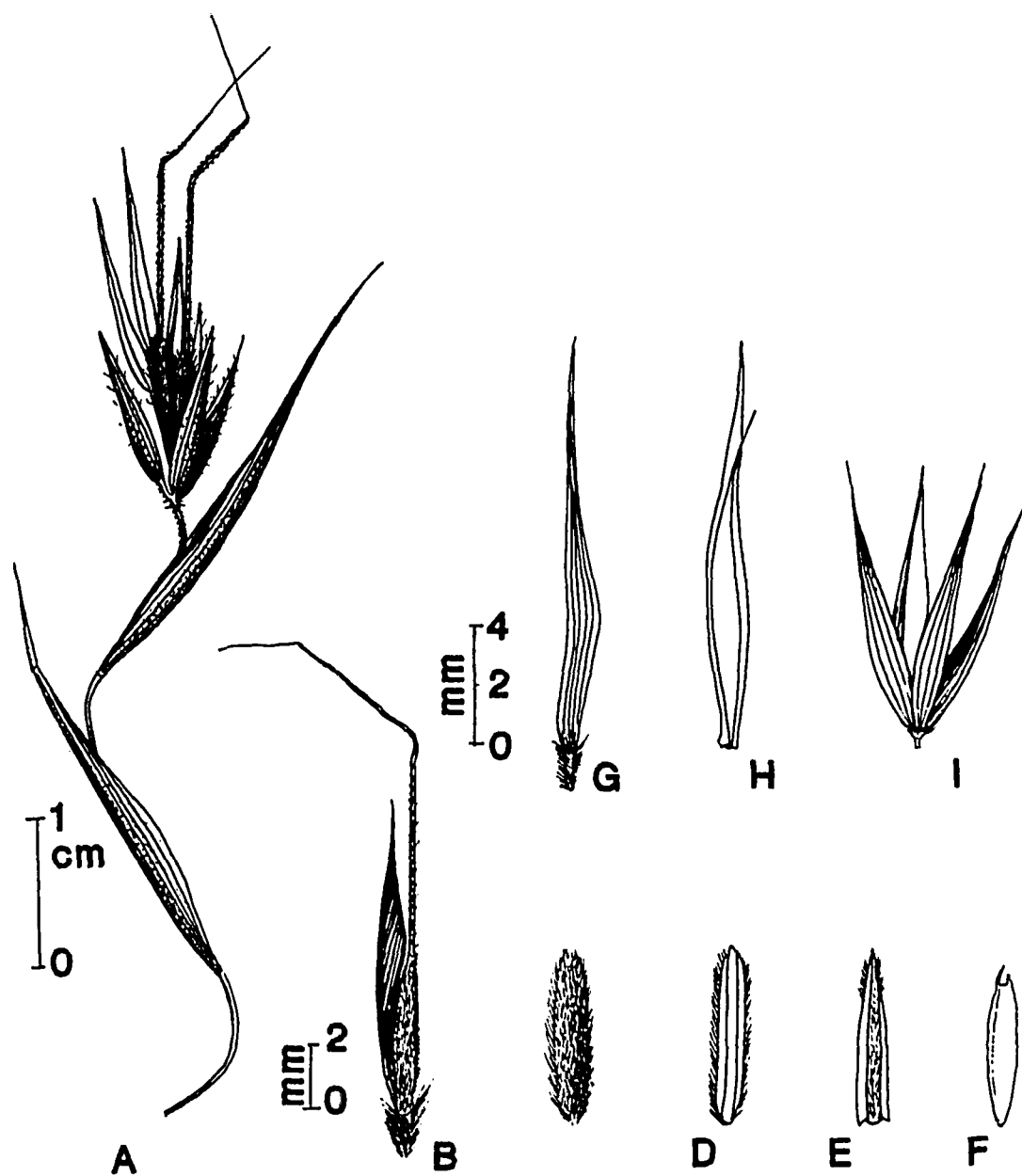


Figure 38. *Themeda caudata* (Nees) A. Camus
 A. raceme and spatheoles B. spikelet pair C-F. sessile
 spikelet C, D. lower glume E. upper glume F. caryopsis
 G-H. pedicelled spikelet I. involucral spikelets;
 (Tagawa et al. 370, BKF).

Thailand.- NORTHERN: Chiang Mai (Doi Chang); NORTH-EASTERN: Loei
(Phu Kradueng).

Distribution.- Widely distribution in tropics of the Old World,
extending from India to southeast Asia, Taiwan, Malesia and
Japan.

Ecology.- On dry slopes of hill savannah at ca. 700 m altitude.

Specimens.-Tagawa et al. 370 (BKF, GH, K).

Remarks.- *Themeda caudata* is easily confused with *T. villosa*, but
T. caudata has awned sessile spikelets while *T. villosa* has
awnless or imperfectly awned spikelets. However, there is
great variation of presence or absence of awns in the Indo-
Pacific region from Malaysia to Philippines and Indonesia.
Another simple character to separate the two species is the
sessile spikelets covered densely with dark brown hairs in
T. caudata and with yellow to rufous hairs in *T. villosa*.

4. *Themeda quadrivalvis* (Linn.) O. Ktze., Rev. Gen. Pl. 2: 794.1891;
Stapf in Prain, Fl. Trop. Afr. 9: 420.1919; Rhind, Grass. Burma:
72.1945; Greenwood, J. Arn. Arb. 30: 83.1949; Bor, Fl. Ind., Burm. &
Ceyl. 1: 252.1960; Lazarides, Phan. Monogr. 7: 78.1980; Patunkar,
Grass. Marathw.: 115.1980; Smitinand, Thai Pl. Names: 329.1980.
- *Andropogon quadrivalvis* Linn., Murr., Syst. Veg. ed. 13: 758.1774;
- *Anthistiria ciliata* Linn.f., Suppl.: 113.1781;
- *A. scandens* Roxb., Fl. Ind. 1: 253.1820;
- *Themada ciliata* (Linn.f.) Hackel in DC., Monogr. Phan. 6: 664.1889;
Hook.f., Fl. Brit. Ind. 7: 213.1897;

- *T. quadrivalvis* var. *helferi* Bor, Fl. Ind., Burm. & Ceyl. 1:

252.1960. Type. - Burma, Tenasserim, Helfer s.n. (K-holotype!).

Annual; culms tufted, terete at base, 30-100 cm tall, 2-5 mm thick near the base, nodes glabrous; sheaths compressed, keeled, 4-5 cm long, glabrous; ligule obtuse, 1 mm. *Leaf-blades* flat, linear-acuminate, 7-30 cm long by 3-6 mm wide, glabrous except at the joint, margins scabrid. *Inflorescence* a paniculate raceme; racemes 1.5-4 cm excluding awn, leafy and slightly drooping; spikelets arranged in a narrow flabelliform clusters; spatheoles thinly herbaceous, 2.5-4 cm long, winged, dense to sparsely with scattered tubercle-based hairs, particular on margins, keeled scabrid. *Involucral spikelets*, herbaceous, oblong-lanceolate, 4-5 mm long; membranous, sparse with rufous tubercle-based hairs near the apex; spikelet pairs inserted at about the same level. *Sessile spikelets* lanceolate, 4-5 mm long; callus 1-2 mm; lower glume coriaceous, glabrous or minutely strigose near the top, nerve obscured, margins inrolled, apex round; upper similar to lower glume, 3-nerved, lateral nerved channelled; lemma broadly lanceolate, 1-nerved, empty. Awn 3.5-5 cm; epaleate; anthers 1.5-2 mm long. *Pedicelled spikelets* narrowly lanceolate, 4-5 mm long, pedicel 1 mm long; similar to the involucral spikelet; lower glume herbaceous, many-nerved. (Fig. 39 & Plate 29).

Thailand.- NORTHERN: Chiang Mai (Pha Mawn); Chiang Rai; Kamphaeng Phet (Raheng, Doi Tung Cha).

Distribution.- From Africa to India, Burma (Type!), Southeast Asia and Malesia.

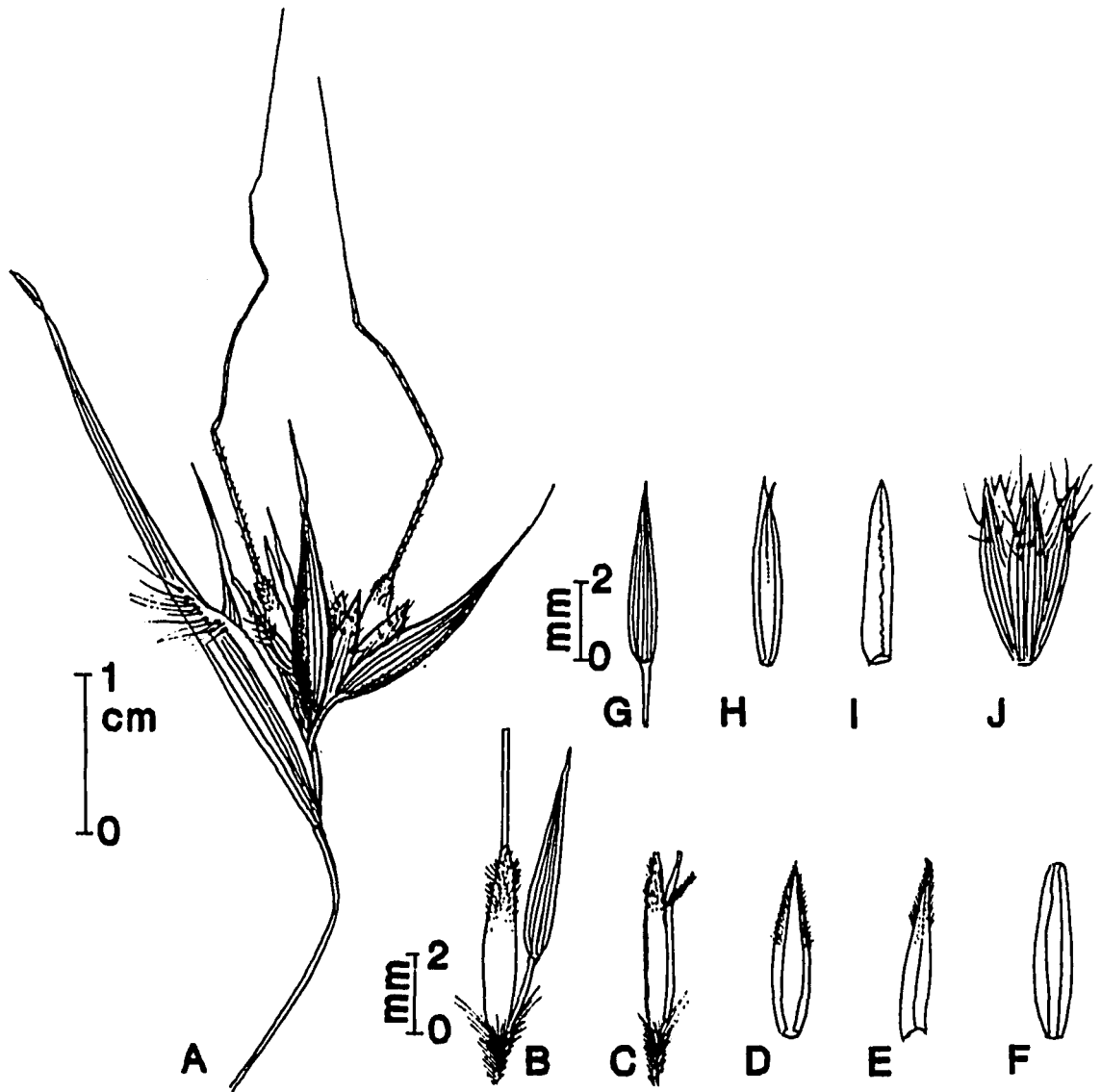


Figure 39. *Themeda quadrivalvis* (L.) O. Ktze.
 A. raceme and spatheole B. spikelet pair C-F. sessile
 spikelet C. lateral view of spikelet D. ventral view of
 lower glume E. upper glume F. lemma G. pedicelled
 spikelet H. lower glume I. upper glume J. involucrel
 spikelets; (Kerr 4589, BK).

Ecology.- In open wet places and by streamlet near rice fields, at 450-1800 m.

Vernacular name.- Yaa kai (Kamphaeng Phet, Laos).

Specimens.-Kerr 4589 (BK, K); Murata et al. 15827 (BKF); Prayad 461 (BK).

Remarks._ The grass is said to be a native of India and introduced elsewhere. It has been used for fodder in India but in Thailand the distribution seems to be scattered, and there is no record of uses. *Themeda quadrivalvis* is recognized by the thinly herbaceous spatheoles with densely to sparsely tubercle-based hairs, and the coriaceous lower glume with minutely strigose near the top.

5. *Themeda triandra* Forssk., Fl. Aegypt.-Arab.: 178.1775; Rendle, J. Linn. Soc. Bot. 36: 377.1904; Merr., Philip. J. Sci. 1: 340.1906; Stapf in Prain, Fl. Trop. Afr. 9: 416.1919; Camus & Camus, Fl. Gen. I.-C. 7: 359.1922; Rhind, Grass. Burma: 73.1945; Reeder, J. Arn. Arb. 29: 372.1948; Bor, Fl. Ind., Burm. & Ceyl. 1: 254.1960; in Dansk Bot. Arkiv 20,2: 176.1962; Froideville in Backer & van den Brink Jr., Fl. Jav. 3: 615.1968; Lazarides, Phan. Monogr. 7: 76.1980; Smitinand, Thai Pl. Names: 329.1980.

- *Anthistiria imberbis* Retz., Obs. Bot. 3: 11.1783;
- *A. glauca* Desf., Fl. Atlant. 2, t. 254: 380.1799;
- *A. australis* R. Br., Prodr. Fl. Nov. Holl. 1: 200.1810;
- *A. forskalii* Kunth, Rev. Gram. 1: 162.1829;

Type.- Egypt.-Arabia, Hadic (K-Isotype)

- *A. ciliata* Nees in *Linnaea* 7: 284.1832 (non Linn.f., 1781);
- *A. punctata* Hochst. ex A. Rich., *Tent. Fl. Abyss.* 2: 448.1851;
- *A. depauperata* Anderss., *Nov. Act. Upsal.* 3,2: 243.1856;
- *A. paleacea* Ball in *J. Linn. Soc. Bot.* 16: 734.1878;
- *A. vulgaris* Hack., *Nat. Pflanzenfam.* 2,2: 29.1887;
- *Stipa arguens* Thunb., *Prodr.*: 20.1794 (non Linn.f., 1762);
- *Calamina imberbis* (Retz.) Roem. et Schult., *Syst. Veg.* 2: 810.1817;
- *Themeda forsskalii* Hackel in DC., *Monogr. Phan.* 6: 659.1889;
- *T. imberbis* (Retz.) Cooke, *Fl. Bomb.* 2: 993.1908;
- *T. australis* Stapf in Prain, *Fl. Trop. Afr.* 9: 420.1919.

Perennial, culms subcompressed, 50-250 cm high, node glabrous; sheaths keeled, sparsely with tubercle-based hairs; ligule ciliolate, 1-2 mm. *Leaf-blades* lanceolate 30-50 cm by 3-8 mm wide, shallowly cordate at base, glabrous to sparingly hairy with tubercle-based hairs near the base. *Inflorescence* narrow, 30-50 cm; racemes 2-4.5 cm excluding awn, drooping, spikelets congested in clusters and flabelliform; peduncles of each racemes setose below the involucreal spikelets; spatheoles herbaceous, winged, 3-5 cm. *Involucreal spikelets* herbaceous to chartaceous, broadly elliptic, 6-12 by 2-3 mm, spikelets inserted more or less at the same level; the upper part ciliate and with scattered tubercle-based hairs; 9-11 nerved with 2 broadly winged, margin hyaline. *Sessile spikelets* oblong, 6-8 mm long by 2 mm wide; callus pungent, rufous, 2 mm long; glumes coriaceous, glabrous or only sparsely hairy at the back near the tip; lower glume with acute apex, faintly 7-9-nerved; upper glume with truncate apex, 3-5 nerved; lemma elliptic, 4-5 by 1-2 mm. *Awn* 2-6 cm; anthers 2-3

mm; stigmas 2-3 mm. *Pedicelled spikelets* lanceolate, 6-8 mm long, pedicel 2 mm long; lower glume elliptic-lanceolate, chartaceous, usually glabrous, similar to those of the involucre spikelets. (Fig. 40 & Plate 30).

Thailand.- NORTHERN: Chiang Mai (Doi Chiangdao, Doi Suthep, Fang, Pang Boh, Pha Mawn); Chiang Rai (Doi Tung); Sukothai (Ban Dan Lan Hoi); NORTH-EASTERN: Loei (Phu Kradueng); Sakol Nakhon (Na Kum); EASTERN: Roi Et (Kasetwisai); SOUTH-EASTERN: Prachin Buri (Aran Pratet).

Distribution.- Widespread in warm and tropical regions of the Old World, from Africa to Eastern Asia, Egypt (Type!), Syria, central-southeast Asia, Malesia, Australia (Queensland), and Hawaii.

Ecology.- Common in a very wide range of habitats; in savannah, mixed deciduous forests, oak and pine forests, from near sea level to 1200 m altitude.

Vernacular names.- Yaa faek, Yaa kai (Chiang Mai); Yaa phung chuu (Saraburi).

Specimens.- Adisai 184 (BK); Chaianan & Na Songkhla 321 (BKF); Fukuoka 4449 (BKF); Kantchai 1161 (BKF); Kerr 19581 (US); Koyama et al. 15685 (NY); Nanakorn 1241 (NY); O'Connor & Niyomdham 15712 (NY); Ploenchit 62 (BK, K); Smitinand 3990, 4388 (BKF); Smitinand & Abbe 6191 (BKF, K); Sorensen, Larsen & Hansen 1396 (BKF); Suradet 75 (BKF); Ying Yong 1018-82 (BK).

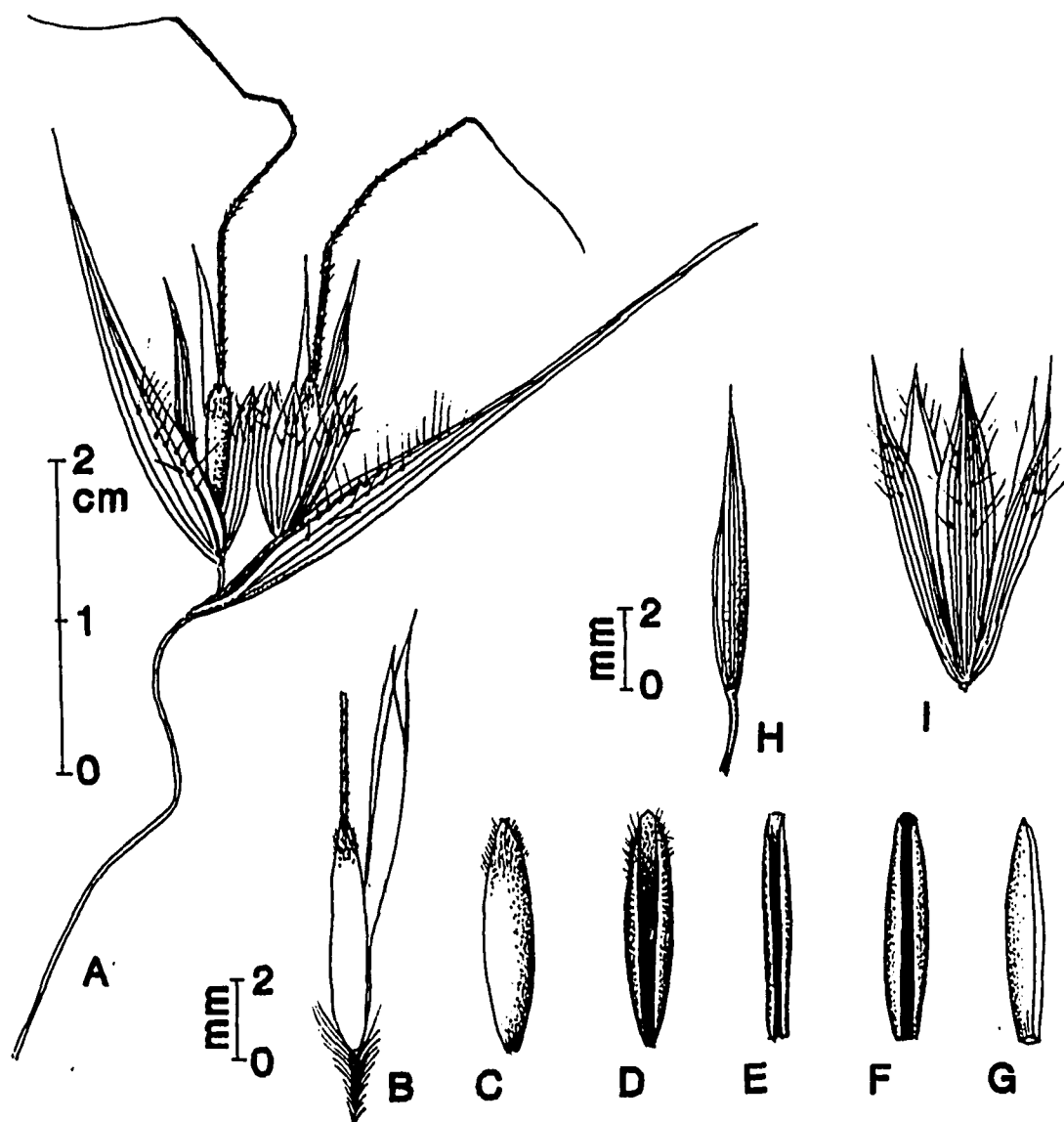


Figure 40. *Themeda triandra* Forssk.
 A. raceme and spatheoles B. spikelet pair C-G. sessile
 spikelet C, D. lower glume E. upper glume F. lemma
 G. palea H. pedicelled spikelet I. involucral spikelet;
 (Nanakorn 1241, NY).

Remarks.- The basis name of this grass was *Themeda polygama* Forssk. established by Kunth (1829) based on specimens *Anthistiria forskalii*. But there is no *T. polygama* in Forskal's work, therefore it must be error from reference cited or the type specimens must be lost. The name *T. polygama* Gmel. was found in Syst. Nat. 2: 149.1791, which referred to reference " Forssk. Fl. Aeg.-Arab.: 178.1775. and the only species in that work is *T. triandra* Forssk. The name *T. triandra* has long been recognized and is the most commonly known among botanists, therefore, it has been selected as a valid name for the species.

6. *Themeda villosa* (Poir.) A. Camus in Lecomte, Fl. Gen. I.-C. 7: 364.1922; Camus & Camus, Fl. Gen. I.-C. 7: 364.1922; Rhind, Grass. Burma: 73.1945; Senaratna, Grass. Ceyl.: 196.1956; Bor, Fl. Ind., Burm. & Ceyl. 1: 254.1960; in Dansk Bot. Arkiv 23,2: 166.1965; Froideville in Backer & van den Brink Jr., Fl. Jav. 3: 616.1968; Gilliland, Fl. Mal. 3: 301.1971; Lazarides, Phan. Monogr. 7: 78.1980; Smitinand, Thai Pl. Names: 329.1980.
- *Anthistiria villosa* Poir. in Lamk., Encycl. Meth. Bot., Suppl. 1 : 396.1814. Type.- Java, Commerson s.n. (K-Isotype!).
 - *Heterelytron scabrum* Jungh in Hoen. et de Vriese in Tijdschr. Nat. Ges. 7: 294.1840;
 - *Aristaria mutica* Hassk. in Tijdschr. Nat. Ges. 10: 117.1843;
 - *A. mutica* Steud., Syn. Pl. Glum. 1: 401.1855;
 - *Themeda gigantea* ssp. *villosa* Hackel in DC., Monogr.

Phan. 6: 675.1889; Craib, Fl. Siam Monocot.: 36.1913;

- *Androscepia mutica* Anderss. ex Hook., Fl. Brit. Ind. 7: 217.1896.

Perennial; culm tufted, stout, 1.5-2.5 m tall, 0.5-1.5 cm in diameter near the base, growing in clumps and some has prop roots; sheaths compressed, keeled, glabrous; ligule 1 mm. **Leaf-blades** flat, to tapering, apex linear-acuminate, 40-80 cm long by 8-12 mm wide, glabrous, margins and nerves scabrid. **Inflorescence** a large compound panicle, narrowly filiform, drooping, 70-150 cm; racemes 2-4 cm; spatheoles coriaceous, 2.5-4 cm long, glabrous, scabrous throughout. **Involucral spikelets** subcoriaceous, neuter, oblong, reddish-brown, 7-8 mm, glabrous without tubercle-based hairs; spikelet pairs inserted at different levels. **Sessile spikelets** 8-10 mm; callus 2 mm long, densely covered with yellow to rufous hairs; lower glume coriaceous, dark brown, elliptic-oblong, densely rufous-hairy on the back; upper glume winged, ciliate on upper part. Awn normally reduced; or if present imperfect, shorter than 2 cm long. **Pedicelled spikelets** reddish-brown 12-15 mm long, narrowly fusiform, acuminate; pedicels rufous-hairy, 2 mm long. (Fig. 41 & 28 C-D).

Thailand.- SOUTH-EASTERN: Kanchanaburi (Hard Palom); PENINSULAR:

Chumphon (Ban Pak Klong).

Distribution.- India, Ceylon, Burma, Indo-China to Indonesia.

Ecology.- In savannah and moist open places, at elevation ca 200 m.

Vernacular names.- Faek nam (Nakhon Si Thammarat); Faek thuean (Trang);

Yaa yuung (Songkhla).

Specimens.-Kerr 11392 (BK); Larsen 8844 (GH).

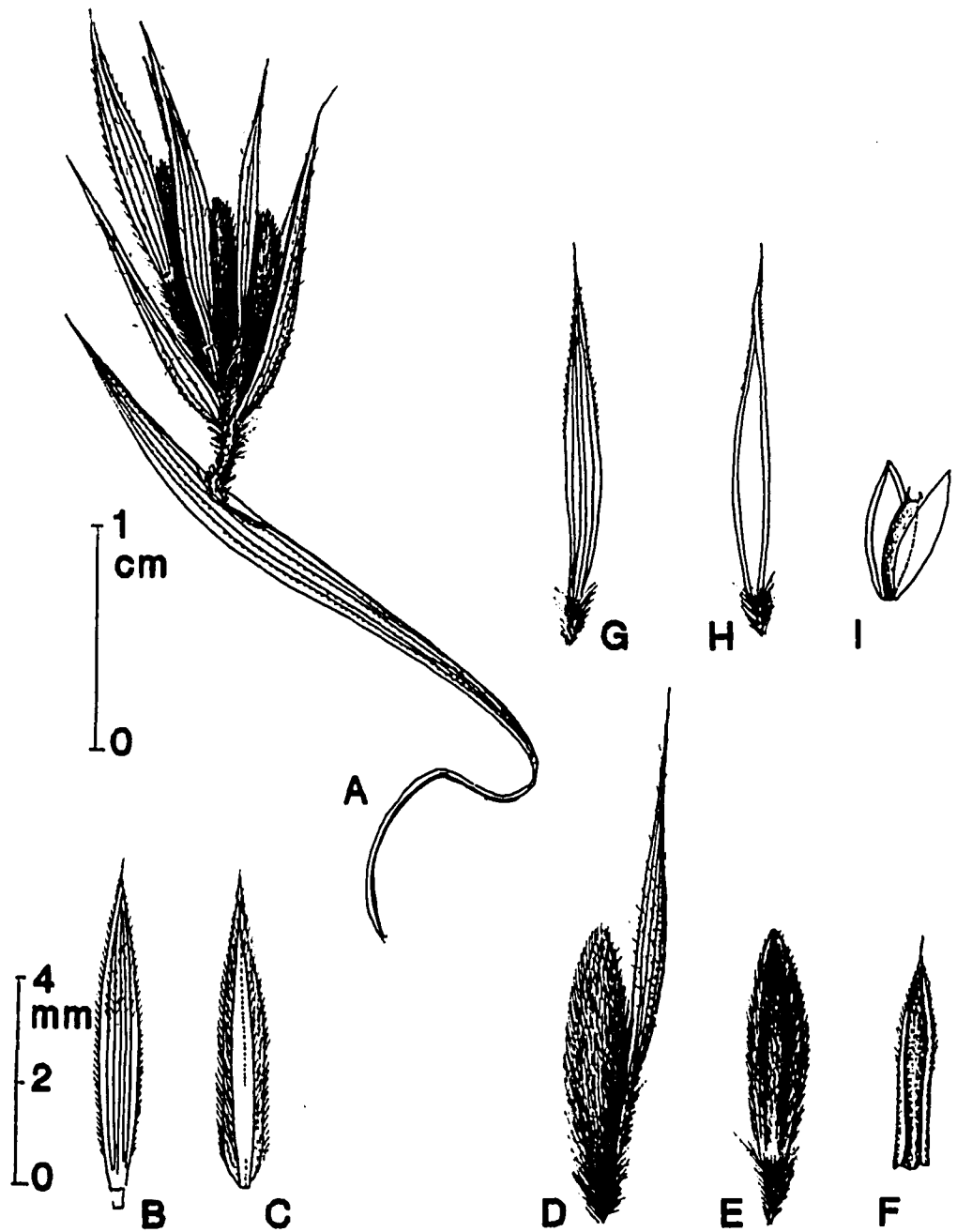


Figure 41. *Themeda villosa* (Poir.) A. Camus
 A. raceme and spatheole B, C. involucral spikelet
 D. spikelet pair E, F. sessile spikelet E. ventral
 view of lower glume F. upper glume G, H. pedicelled
 spikelet I. lemma, palea and caryopsis;
 (Larsen 8844, GH).

SUBTRIBE SACCHARINAE Griseb.

Saccharinae Griseb., Fl. Rumel. Bithyn. 2: 472.1844; Clayton, Gen. Gram.: 328.1986. - *Erianthinae* Griseb. in Nachr. Ges. Wiss. Gott. 3: 89.1868.

Inflorescence terminal (or terminal and from the upper nodes in *Pogonatherum*), of solitary, digitate or paniculate racemes with tough or fragile rhachis, and usually slender internodes. *Spikelets* paired (except triad with 2-sessile and one pedicelled in *Polytrias*), alike, one sessile the other pedicelled but both pedicelled if rhachis tough, usually dorsal compressed, often plumose, the callus rounded with cupuliform or truncate articulation. *Lower glume* mostly thin, convex, or flat on the back and 2-keeled (concave or grooved in *Microstegium*). *Lower floret* mostly represented by a barren lemma, occasionally male, rarely represented by a palea or absent; upper lemma lanceolate to oblong or sometimes cordate, entire or bilobed, with or without an awn, this usually glabrous.

Nine genera: *Eulalia*, *Eulaliopsis*, *Imperata*, *Microstegium*, *Miscanthus*, *Pogonatherum*, *Polytrias*, *Saccharum* and *Spodiopogon* with an estimated 30 species represented in Thailand.

EULALIA Kunth

- Eulalia* Kunth, Rev. Gram. 1: 160.1829; Clayton, Gen. Gram.: 333.1986.
 - *Pseudopogonatherum* A. Camus in Ann. Soc. Linn. Lyon. 68: 202.1921.
 - *Puliculum* Haines, Bot. Bihar Orissa: 1018.1924.

Note.- Name commemorating, Eulalie Delile, who made the drawings for Kunth's Revision des Graminees (1830).

Perennials or rarely *annual*, tufted; erect or decumbent with thickened or rhizomatous root-stock and ferruginous hairs at the base. *Leaf-blades* finally flat. *Inflorescence* a digitate or subdigitate spiciform raceme, silky-hairy, highly brownish color; rhachis with villous internodes and pedicels; spikelets in pairs, both alike and fertile, one sessile, the other pedicelled; florets 1 (-2); lower reduced to an empty lemma or suppressed; upper bisexual. *Spikelets* with obtuse callus; glumes equal, rigidly membranous to coriaceous; lower flattened on back or shallowly concave, normally 2-keeled, with incurved margins; upper 1-3-nerved, keeled. Lemmas hyaline; lower (when present) muticous; upper very short, 2-lobed, with a geniculate awn. Paleas small or absent. Lodicules minute, cuneate. Stigmas exerted at or near the apex. *Caryopsis* oblong; embryo as half as long.

A genus of ca. 30 species distributed chiefly in tropical and subtropical regions of the Old World, well represented in the Indo-China. In Thailand 10 species are recorded, including the 3 common species *E. contorta*, *E. speciosa*, and *E. trispicata*.

KEY TO THE SPECIES OF EULALIA IN THAILAND

1. Inflorescence a single raceme, densely rufous; spikelets
thinly membranous on upper part; plants 40-80 cm high;
leaf-blades linear-acuminate 6-15 cm long by 2-4 mm wide
E. monostachya
1. Inflorescence a digitate or subdigitate racemes; spikelets
mostly papyraceous; plant up to 250 cm high; leaf-blades up
to 100 cm long by 10 cm wide
2. Lower glume of the sessile spikelets dark purple color;
apex bilobes, the two lobes bearing long aristate awns,
awns dilate, 4-12 mm
E. smitinandiana
2. Lower glume of the sessile spikelets yellow, brown or
rufous color; apex acuminate, truncate or bilobed, with
or without an aristate awn
3. Plants annual; lower glume flat or convex at the back;
upper glume with a long slender aristate awn, awn 5-15 mm
4. Spikelets 1.5-2.5 mm long; aristate awn on upper
glume 7-15 mm long
E. contorta
4. Spikelets 2.5-3 mm long; aristate awn on upper glume
5-7 mm long
E. irritans
3. Plants perennial; lower glume flat, convex or 2-keeled
with shallow depressed between the keels; upper glume
with or without aristate awn
5. Upper glume of sessile spikelet with aristate awn,

awn 3.5-4 mm long. Inflorescence consisting of 2-4 racemes; spikelets 3.5-4 mm long; culms gracilis or almost glabrous at the base

E. bicornuta

5. Upper glume of sessile spikelet without aristate awn; Inflorescence consisting of up to 8 racemes; spikelets 3-6 mm long; culms glabrous to densely rufous at the base

6. Basal sheaths glabrous or almost glabrous; plants usually shorter than 100 cm tall; leaf-blades up to 25 cm long

7. Plants up to 50 cm tall; leaf-blades 7 cm long by 1-3 mm wide; awn 1.2 cm long

E. leschenaultiana

7. Plants 50-100 cm tall; leaf-blades 20-25 cm long by 3-3.5 mm wide; awn 2.4-3 cm

8. Spikelets broadly ovate-acuminate, 5-6 mm long, with dense long pale hairs in the basal half; lower glume 4-nerved

E. quadrinervis

8. Spikelets oblong-lanceolate, 3.5-4.2 mm long, upper half glabrous only setose-hairy near the base; lower glume 2-nerved

E. trispicata

6. Basal sheaths covered densely with golden to rufous hairs; plants up to 250 cm tall; leaf blades up to 100 cm long

9. Plants up to 2.5 m tall; leaf-blades up to

100 cm long by 10 mm broad. Inflorescence covered densely with mauve-purple hairs; spikelets 6 cm long; awn 2-2.5 cm long

E. siamensis

9. Plants 1-2 m high; leaf-blades 20-50 cm long by 3-9 mm broad. Inflorescence covered densely with yellow to reddish-brown hairs; spikelets 4-5.2 cm long; awn 1.2-2.0 cm long

E. speciosa

1. *Eulalia bicornuta* Bor in Kew Bull 1950: 258.1950; Fl. Ind., Burm. & Ceyl. 1: 155.1960. **Type.**- Burma, from Kaukkwe Valley, Myitkyina district, 22 Nov. 1912, J.H. Lace 6051 (K-holotype!).

Perennial; culms caespitose, 100 cm tall, gracilis, terete, glabrous; sheaths tight, glabrous except on lower part; ligule membranous, narrow, 1 mm. **Leaf-blades** linear-acuminate, 20 cm long by 2-4 mm wide, sparsely pubescent on both surfaces particularly beneath; **Inflorescence** consisting of 2-4 racemes, each 8-10 cm long; peduncle glabrous; rhachis fragile; rhachis internodes 3 mm long, pedicels 2.3 mm long, densely hairy along the margins. **Spikelets** similar, golden yellow-russet brown, aristate, 3.5-4 mm long; lower glume elliptic-oblong, 2-nerved, 2-keeled, smooth, or hairy at the middle; upper glume lanceolate-oblong, cymbiform, apex truncate, 3-nerved, slightly hairy at the edge; aristate awn, 2-3 mm long. Lower floret lemma hyaline, oblanceolate, 2.5 mm long; palea short, oblong, hyaline; upper floret lemma oblong, 2.5 mm long, 1-nerved, awn 7-9 mm. Stamens 3, dark purple; anther 2.25 mm long; style 2. (Plate 31).

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-EASTERN: Chuntabun Tharuang).

Ecology.- Scattered in savannah at 100-1300 m.

Distribution.- Burma (Type!), Thailand.

Specimens.-Kerr 9724 (K); Larsen 6260 (AAU); Smitinand 2101 (BKF); 2102 (K); 5012 (BKF, K), 10887 (AAU); Sorensen, Larsen & Hansen 6260 (K).

Remarks.- This grass is closely related to *Eulalia trispicata* and often found in the same habitat. *E. bicornuta* is separated by the presence of few racemes in an inflorescence, by the aristate awn and the 2-keeled lower glume. Another interesting character easily noticed during anthesis is the large dark brown to black stamens which show up clearly like spots on the racemes.

2. *Eulalia contorta* (Brongn.) O. Ktze., Rev. Gen. Pl. 2: 775.1891.
- *Pogonatherum contortum* Brongn. in Duperr., Voy. Coq. Bot.: 90.1831;
 - *Pollinia articulata* Trin. in Mem. Acad. Sci. Petersb. 2: 273.1832;
Hook.f., Fl. Brit. Ind. 7: 109.1896; Craib, Fl. Siam. Monocot.:
34.1913;
 - *Andropogon koretrostachys* Trin., l. c.: 273.1832;
 - *Pollinia setifolia* Nees in Hook., Kew J. Bot. 2: 101.1850;
 - *Andropogon asthenostachys* Steud., Syn. Pl. Glum. 1: 381.1854;
 - *Eulalia concinna* Nees ex Steud., l. c.: 412.1855;
 - *Erianthus articulatus* (Trin.) F. Muell., Fragm. Phyt. Austr. 8:
118.1872;
 - *Pollinia collina* Balansa in Morot, J. de Bot. 4: 81.1890;
 - *Pseudopogonatherum contortum* (Brongn.) A. Camus in Lecomte, Fl. Gen.
I.-C. 7: 255.1922; Rhind, Grass. Burma: 64.1945; Bor, Fl. Ind.,
Burm. & Ceyl. 1: 204.1960.
 - *P. collinum* (Balansa) A. Camus in Lecomte, Fl. Gen. I.-C. 7:
256.1922;
 - *P. setifolium* (Nees) A. Camus, l. c.: 256.1922;

- *Puliculum articulatum* (Trin.) Stapf ex Haines, Bot. Bihar and Orissa: 1018.1924;
- *Eulalia koretrostachys* (Trin.) Henr. in Blumea 4: 521.1941;
- *Pseudopogonatherum koretrostachys* (Trin.) Henr., l. c.: 521.1941.

Annual; culms slender, erect, tufted at base, 40-90 cm tall; nodes and sheaths glabrous; ligule tiny membranous, ciliolate, 0.2 mm. *Leaf-blades* filiform, involute, acuminate; 10-30 cm long by 1.5 mm wide; glabrous. *Inflorescence* a dense panicle, 4-10 spike-like racemes, subdigitately arranged, linear, 4-7 cm long; rhachis internodes 1.8 mm, creamy color, margins white ciliate, hairs longer at the top. *Spikelets* alike, all pedicel, narrowly oblong; reddish brown to dark brown, 1.5-2.5 mm long by 0.3 mm wide; white pilose particularly on the middle of the upper part, and on keels along the margins; callus obtuse, 0.2-0.4 mm, bearing stiff of silky-white hairs, half as long as the spikelet; pedicel 1.5-1.8 mm long; lower glume papyraceous, membranous at the summit, convex to flat on the back, apex minutely bidentate; upper glume ovate-lanceolate, keeled, villous along the trunk, aristate awn 7-15 mm; upper lemma hyaline narrowly oblong, awn geniculate, up to 20 mm long; the lower part ciliate, brown color, lighter above. (Plate 32).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); Tak (Wang Djao); NORTH-EASTERN: Loei (Wang Saphung); EASTERN: Buri Ram (Talung); Nakhon Ratchasima (Bua Yai); SOUTH-EASTERN: Chantaburi (Makham); CENTRAL: Chai Nat (Pang Hua Sue); SOUTH-WESTERN: Kanchanaburi (Sisawat).

Distribution.-India, Burma, throughout Southeast Asia, Southern China, Indo-China and extending to Australia.

Ecology.- In open dry dipterocarp forest at 540 m.

Specimens.-Beusekom et al. 3819 (BKF, K); 4374 (BKF); Kerr 1559b (BK, K); 8031, 8223 (K); Lindhard 24 (K); Put 4295 (K); Smitinand 3627 (BKF, K); 3995 (K); 4885 (BKF, K); Smitinand & Abbe 6179 (BKF, K); Smitinand & Turbang 10499 (BKF).

Remarks.- This species has remarkable minute spikelets, among the smallest in the Andropogoneae. In addition, it is recognized by the inflorescence, digitately arranged with linear racemes, the dense cover of creamy colored hairs contrasting with brown awns, and the spikelets with silky-white hairs on the callus.

3. *Eulalia irritans* (R. Br.) Kuntze, Rev. Gen. 2: 775.1891; Hitchc., Brittonia 2: 126.1936.

- *Saccharum irritans* R. Br., Prodr. Fl. Nov. Holl. 1: 203.1810;

Type.- Australia (K-phototype!).

- *Erianthus irritans* (R. Br.) Kunth, Rev. Gram. 1: 160.1829;

- *E. irritans* (R. Br.) F. Muell., Frag. Phyt. Austr. 8: 118.1872;

- *Pollinia irritans* (R. Br.) Benth., Fl. Austral. 7: 525.1878; Hack. in DC., Monogr. Phan. 6: 155.1889;

- *Pseudopogonatherum irritans* (R. Br.) A. Camus, Ann. Soc. Linn. Lyon 68: 205.1921; Bor, Fl. Ind., Burm. & Ceyl. 1: 205.1960.

Annual; culms purplish, erect, 60-100 cm tall; nodes and sheaths glabrous; ligule tiny membranous, ciliolate, 0.5 mm. **Leaf-**

blades involute, attenuate; 30-50 cm long by 2-4 mm wide; glabrous or sparsely pubescent only near the base. *Inflorescence* a panicle, 5-8 racemes, subdigitately arranged, 10-15 cm long; rhachis tardily disarticulating, rhachis internodes 2-2.5 mm, margins stiff-long-ciliate. *Spikelets* both alike and pedicelled; reddish brown to dark brown, 2.5-3 mm long by 0.4 mm wide, white pilose particularly on half of the lower part; callus 1-1.5 mm, bearing stiff of white hairs, half as long as the spikelet; short pedicel 1 mm, long pedicel 2-2.5 mm; lower glume convex to flat on the back, 2-nerved, apex minutely bidentate; upper glume keeled, 1-3 nerved, aristate awn 5-7 mm; upper lemma hyaline narrowly oblong, awn geniculate, 2.5-4 cm long; the lower part brown color, lighter above.

Thailand.- NORTHERN: Chiang Mai (Inthanond); Tak (Wang Djao); EASTERN:

Chaiphaphum (Kamang); SOUTH-WESTERN: Kanchanaburi, Ban Kao.

Distribution.- Burma, Indo-China to Australia (Type!).

Ecology.- Scattered in savannah on clayey soil, at 300-800 m.

Specimens.-Beusekom et al. 2290 (AAU, K); Hosseus 143 (K); Larsen 8171 (K).

4. *Eulalia leschenaultiana* (Decne.) Ohwi in Bull. Tokyo Sci. Mus. 18: 2.1947; Bor, Fl. Ind., Burm. & Ceyl. 1: 156.1960; Hsu in Taiwan 16: 320.1971; Fl Taiwan 5: 651.1978; Gilliland, Fl. Mal. 3: 241.1971.

- *Andropogon leschenaultianus* Decne., Herb. Timor. Descr: 29.1835.

Type.- East Indies, Isl. Timor (P-holotype, K-phototype!).

- *Pollinia cumingii* Nees in Hook., J. Bot 2: 98.1850.

- *Andropogon aureo-fulvus* Steud., Syn. Pl. Glum. 1: 373.1854.

- *Eulalia cumingii* (Nees) A. Camus in Lecomte, Fl. Gen. I.-C. 7:
250.1922; Bor, Fl. Assam 5: 343.1940.

Perennial; culms wiry, erect, with a short contracted rhizome, up to 50 cm tall; nodes glabrous; sheaths tight, glabrous or slightly fringed near the blade; ligule a shallow membrane, fimbriate, 0.5 mm. *Leaf-blades* linear-acuminate, 7 cm long by 1-3 mm wide; base abruptly narrowed, apex finely acuminate, midrib distinct only near the base, glabrous except at the joint of leaf-blade. *Inflorescence* consisting of 2-4 linear racemes, subdigitately arranged, densely white-hairy at the end of the peduncle, the rest brown-hairy; racemes 3-9 cm long; spikelet pairs alternately arranged along the flattened and angular brown-hairy axis; rhachis internode 2-2.5 mm long. *Sessile spikelets* with oblique, stiff hairs callus; lower glume oblong, truncate, the margins inflexed about the 2 nerves, setose-hairy on the back and along the margins and the truncate tip, long-hairy towards the base, 3-5 mm long; upper glume similarly truncate, setose-hairy on the back especially above the middle, 3-4 mm long; lower lemma reduced or if present, 2-nerved; palea nil; upper lemma delicately hyaline, 1-nerved, bilobed, 1.4 mm long; awn 10-12 mm long, geniculated; stamens 3; anthers reddish-brown, 2 mm long. *Pedicelled spikelets* similar to sessile spikelets.

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); PENINSULAR: Songkhla (Tepa, Hadd Yai, Suan Dtoon Falls).

Distribution.- India, Indo-China, Borneo, Philippines, East Indies (Type!) to Australia.

Ecology.- In open scrub jungle and dry dipterocarp forest at 50-450 m.

Specimens.-Kerr 2240, 14706 (K); Maxwell 84-432, 84-456 (BKF);

Sorensen, Larsen & Hansen 5885 (K).

5. *Eulalia monostachya* (Bal.) A. Camus in Lecomte, Fl. Gen. I.-C. 7: 254.1922; *Pollinia monostachya* Balansa in Morot, J, Bot. 4: 81.1890.

Annual; culms wiry, tufted at base, 40-80 cm tall; nodes and sheaths glabrous; ligule tiny fimbriate, 0.2 mm. *Leaf-blades* linear-acuminate, 6-15 cm long by 2-4 mm wide; base round, apex finely acuminate, midrib distinct only near the base, glabrous except at the joint of leaf-blade. *Inflorescence* a single raceme, 5-10 cm long by 1.5-4 mm wide; densely rufous; rhachis internode linear, villous, 2-2.5 mm long, hairs longer at the top. *Sessile spikelets* papyraceous, linear-oblong, 4.5-6 mm; convex to flat on the back, upper part thinly membranous, lower part densely rufous; apex truncate, the margins inrolled; upper glume hairy on the back; callus 0.5-1 mm, oblong-obtuse, densely villous, hairs 1/4 as long as the spikelet; lower lemma oblong, 1-1.5 mm; upper stipitate, awn 1.5-2 cm, ciliate on lower part of the column; stamens 3; anther plumose, 3-5 mm long, exserted at the top of the spikelets. *Pedicelled spikelets* similar to sessile spikelets. (Plate 33).

Thailand.- NORTH-EASTERN: Loei (Wang Saphung); EASTERN: Nakhon

Ratchasima (Bua Yai); CENTRAL: Prachin Buri (Aran Pratet,

Ban Keng); SOUTH-EASTERN: Chantaburi (Taruang); PENINSULAR:

Pattani, Songkhla.

Distribution.-Indo-China.

Ecology.- In savanah and in dry deciduous forest at 300 m altitude.

Specimens.-Haniff 2982(K); Kerr 7240 (K); 9729 (BK, K); 15757, 19854 (K); Put 1968, 4297 (K); 4299 (BK, K); Smitinand 3054 (BKF, K).

Remarks.- The single linear raceme on a long peduncle and densely rufous spikelets are the most remarkable characters of this species.

6. *Eulalia quadrinervis* (Hack.) Kuntze, Rev. Gen. Pl. 2: 775.1891; Bor, Fl. Ind., Burm. & Ceyl. 1: 156.1960; Koyama, Grass. Japan: 421.1987.

- *Pollinia villosa* Munro in Benth., Fl. Hongk.: 420.1861 (non Spreng, 1825). **Type.**- China. Hong Kong (K-isotype!).

- *P. quadrinervis* Hack. in DC., Monogr. Phan. 6: 158.1889.

- *Pseudopogonatherum quadrinerve* (Hack.) Ohwi in Bull. Tokyo Sci. Mus. 18: 3.1947.

Perennial; culms densely tufted, slender, 50-100 cm tall, leafy above; sheaths glabrous to sparsely hairy; ligule short, membranous, 1 mm long. *Leaf-blades* 20-25 cm long by 3 mm wide, linear-acuminate; midnerve prominent, white; glabrous or sparsely hairy beneath, scaberulous with scattered pale-thin hairs above; margins scabrid. *Inflorescence* consisting of 2-6 racemes, subdigitately arranged, 6-12 cm long by 0.4-0.5 mm wide; creamy color; rhachis internodes and pedicels silky-villous, 3 mm long. *Spikelets* all similar; 5-6 mm long; lower glume broadly ovate-acuminate, flat on

the back, with dense long pale hairs in the basal half, keeled near the edge, 4-nerved, each pair joining upwards; upper glume hairy; apex slightly cleft, shortly aristate 1 mm long; lower floret reduced to its lemma, nearly as long as the glumes, narrow, margins ciliate; upper floret lemma bifid, awn 2.5-3 cm long.

Thailand.- NORTHERN: Chiang Mai (Chiang Dao); SOUTH-WESTERN:

Ratchaburi (Ban Pong).

Distribution.- India, Burma, Southern China (Type!), and Indo-China.

Ecology.- In open deciduous forest from 200-1600 m.

Specimens.-Kerr 20624 (BK, K); Smitinand, Poore & Robbins 7840 (K).

7. *Eulalia siamensis* Bor in Kew Bull. 1954: 499.1954; Bor, Fl. Ind., Burm. & Ceyl. 1: 157.1960. Type.- Thailand, Chiang Mai, Doi Suthep, 11 Nov. 1911, Kerr 2218 (K-holotype!, BK-isotype!).

Perennial, tufted, densely golden to rufous at base; culms up to 2.5 m high, terete, hard, peduncle below the inflorescence pilose; sheaths lax, sparsely pilose; ligule coriaceous, glabrous 2-2.5 mm. *Leaf-blades* linear-lanceolate, up to 1 m long by 1 cm wide, apex acuminate, base attenuate, pubescent on both surfaces particularly beneath; midnerve prominent, white; margins slightly scaberulous. *Inflorescence* consisting of 5-7 racemes, a terminal digitately arranged, 12-18 cm long, mauve purple-pilose above, lighter color beneath; rhachis articulated, hairy, 4 mm long. *Sessile spikelets* ovate-oblong, 6 mm long by 1.2 mm wide, bisexual; callus blunt, densely hairy, 0.5 mm long; lower glume narrowly elliptic, apex

bifid, 2-keeled, 2-nerved, densely villous on the basal half; upper glume 6.5 mm long, cymbiform, 3-nerved, apex aristate; lower floret neuter, lemma hyaline 5 mm, oblong-obtuse, margins ciliate; palea normally absent; upper floret bisexual, lemma 3.5 mm long, apex bifid; awn straw color, 2-2.5 cm long; palea reduced; stamens 3, anthers 4-5 mm long. *Pedicelled spikelets* similar to sessile spikelets, pedicel hairy on margins, glabrous on back, 2.5 mm long. (Plate 34).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Doi Chiang Dao); NORTH-EASTERN: Loei (Phu Kradueng);

Distribution.- Endemic to Northern and North-Eastern Thailand probably also occurring in Burma and Indo-China.

Ecology.- Common on hillslopes and in open dipterocarp-oak forest at the 400-1500 m.

Specimens.-Kerr 2218 Type! (BK, K); Khantchai 696 (BKF); Maxwell 87-1354 (BKF); Ploenchit 29 (BKF, K); Smitinand 2104 (BKF, K); 4000 (BKF): 5001, 6253 (K); Smitinand & Abbe 6206 (K); 6253 (BKF); Sorensen, Larsen & Hansen 5921 (K).

Remarks.- This species is an elegant grass, the plant is recognized by the base of the culm normally covered densely with golden-rufous hairs, its large leaves, and its stout inflorescence densely covered with long mauve purple hairs.

8. *Eulalia smitinandiana* Bor in Kew Bull. 1956: 256.1956;

Type.- Thailand, Phu Kradueng, Loei, 29 Oct. 1954, Smitinand 2053 (K-holotype!, BKF-isotype!).

Perennial, tufted, gracilis at base; culms wiry, 60-100 cm tall; sheaths glabrous or only hairy near the base; ligule thinly membranous, ciliolate, 0.2 mm. *Leaf-blades* linear-acuminate, 15-30 cm long by 1.5-3 mm wide, apex finely acuminate, base rounded, glabrous on both surfaces; midnerve not raised, sometimes obscured.

Inflorescence consisting of 2-4 racemes, digitately arranged, 5-8 cm long, raceme linear; rhachis internodes and pedicel linear, hairy along the margins, 2.5-3 mm long. *Sessile spikelets* oblong-elliptic, slightly oblique at base, 4.5-5 mm long by 0.8-1 mm wide, dark purple color; callus oblong, blunt, white hairy along the margins, 0.3 mm long. Lower glume smooth, shallowly grooved; hairy at the middle and along the marginal keels; apex bilobed, both prolonged into aristate awns; awn 4-12 mm, dilate; upper glume cymbiform, hairy at the middle along the keel; apex bifid, both with short aristate awn, 3-6 mm. Lower floret empty, lemma hyaline, 3.5 mm long, margins ciliate, palea absent; upper floret bisexual, lemma stipitate, awn 20-25 mm long; palea oblong 2 mm; stamens 3, anther dark brown, 2.5 mm long.

Pedicelled spikelets similar to sessile spikelets. (Plate 35)

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng).

Distribution.-Endemic to Thailand (Type!).

Ecology.- Common on rocky ground in open pine forest at 1300 m.

Specimens.-Larsen 6163 (K); Smitinand 2053 Type! (K); 3098 (BKF); 5013 (K); Tagawa et al. 765 (BKF).

Remarks._ A very distinct species distinguished by the lower glume of the sessile spikelet dark purple in color, bilobed, and the two lobes bearing long aristate awns.

9. *Eulalia speciosa* (Debeaux) Kuntze, Rev. Gen. Pl. 2: 775.1891;
 Bor, Fl. Ind., Burm. & Ceyl. 1: 157.1960; Koyama, Grass. Japan:
 421.1987.

- *Erianthus speciosus* Debeaux in Act. Soc. Linn. Bord. 32: 53.1878.

Type.- India, Khasi and Naga Hills, Manipur State (K-holotype!).

- *Pollinia speciosa* (Debeaux) Hack. in DC., Monogr. Phan. 6: 159.1889;

- *P. phaeothrix* Hack. in l.c.: 168.1889;

- *Eulalia phaeothrix* (Hack.) Kuntze, Rev. Gen. Pl. 2: 775.1891;

- *Pollinia birmanica* Hook.f., Fl. Brit. Ind. 7: 113.1896;

- *Eulalia birmanica* (Hook.f) A. Camus in Ann. Soc. Linn. Lyon 68:
 204.1922.

Perennial, tufted with short rhizome; base thickened, covered with a dense brownish-red hairs; culms 1-2 m tall, erect, glabrous, white-pubescent only below the inflorescence; ligule shortly membranous, ciliate, 0.2 mm. **Leaf-blades** linear-acuminate, 20-50 cm long by 3-9 mm wide; tufted at base; glabrous to glabrescent except white-pilose hairs near the base, apex gradually acute. **Inflorescence** bearing 4-8 spike-like racemes; 8-20 cm long by 4-6 mm wide, linear, spreading, suberect to oblique above; yellow to reddish-brown color; rhachis internodes 3-4 mm long, margins with white to yellowish hairs. **Spikelets** similar, linear-oblong, 4-5.2 mm long by 1-1.2 mm wide, flattened above, apex subacute; callus short, hairs 1/4 as long as spikelet; lower glume chartaceous to papyraceous, with pilose hairs towards the middle and the base; the margins folded with 2 keels, flat to slightly concave between keels, ciliate up to 2/3 from base; upper glume cymbiform, apex subobtuse, 3-nerved, pilose, the margins

ciliate. Lower floret empty, epaleate; lemma oblong, equalling the glume; upper floret bisexual, lemma narrowly-oblong, bilobed, awn geniculated, 1.2-2.0 cm long. *Pedicelled spikelets* similar but smaller and narrower than the sessile, pedicel 3-3.5 mm. (Plate 36).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Mae Taeng); NORTH-EASTERN: Loei (Phu Kradueng, Wang Saphung); EASTERN: Chaiyaphum (Kamang); SOUTH-WESTERN: Ratchaburi (Tung Luang).

Distribution.- India (Type!), Nepal, Burma, Southern China, Indo-China, Korea, Japan.

Ecology.- In open savannah and edges of *Quercus-Vaccinium* forest at 400-1300 m.

Specimens.-Beusekom et al. 4214 (K); Charoenphol, Larsen & Warncke 4703 (AAU, K); Dee 612, 613 (K); Kerr 1510, 6669 (K); Marcan 2749 (K); Sangkhachand 64 (BKF); Smitinand 2083(K); 2091(BKF, K); 2104A, 2110 (BKF); 3221, 3971(K); 4901 (BKF, K); 10129 (BKF); Smitinand & Abbe 6205 (K); Sorensen, Larsen & Hansen 5542 (K).

Remarks.- *Eulalia speciosa* is probably the most variable species in the genus. Many intermediate forms of this species were collected. The color of the inflorescence and spikelets was creamy white, yellow, light brown to rufous the indumentum at the base of the culm varied from densely rufous to glabrous; and the size of spikelets and length of hairs on spikelets also varied. The specimens of *E. burmanica* and *E. phaeothrix* at Kew are now combined in

E. speciosa by Dr. W.D. Clayton. However, the genus *Eulalia* has never been revised, and there is no publication to support this combination.

10. *Eulalia trispicata* (Schult.) Henr. in *Blumea* 3: 453.1940; Bor, *Fl. Ind., Burm. & Ceyl.* 1: 157.1960.

- *Andropogon tristachyus* Roxb., *Hort. Beng.*: 6.1814 (nom. nud.).

Type.- India, Calcutta (P-holotype, K-phototype!).

- *A. tristachyus* Roxb., *Fl. Ind.* 1: 261.1820 (non H.B.K., 1816).

- *A. trispicatus* Schult., *Syst. Veg.* 2: 452.1824.

- *Eulalia argentea* Brongn. in Duperr., *Voy. Coquille Bot.* 2,2: 92.1830.

- *Pollinia argentea* Trin. in *Bull. Acad. Sci. Petersb.* 1: 71.1836.

- *Erianthus hexastachyus* Hochst. in *Herb. Hohenacker*: 1847 (nom. nud.).

- *Andropogon hexastachyus* Steud., *Syn. Pl. Glum.* 1: 380.1854.

Perennial; culms densely tufted, 50-100 cm tall, base glabrous; sheaths subterete, glabrous; ligule membranous, shallow, 0.2-0.5 mm, hairy on the back. *Leaf-blades* linear-acuminate, 20 cm long by 3-5 mm wide; base subcordate, sparsely to densely tubercle-based hairs near the base; margins scaberulous upwards. *Inflorescence* consisting of 2-8 simple racemes, subdigitately arranged, 6-15 cm long, the tip of the axis hairy; rhachis-internode about 2 mm long, the joints densely setose-hairy along the margins. *Sessile spikelets* oblong-lanceolate, 3.5-4.2 mm long; callus short-hairy, oblique; lower glume yellow to brown, narrow, flat on the back and slightly hollowed

down the middle, glabrous but for a prominent tuft of setose-hairs near the base and some long hairs from the upper margins, 2-nerved and the margins inflexed; upper glume brownish, thin, 1-nerved, narrowly cymbiform, glabrous except setose-hairy on the margins and on nerve, densely tuft near the base, 4.2 mm long. Lower floret reduced to the lemma, narrowly oblong, rounded, delicately hyaline, nerveless, setose-hairy on the margins of the upper two-thirds, 4 mm long; palea nil; upper lemma hyaline, narrow, lobed for the upper two-thirds; awns 2.4-2.8 cm. *Pedicelled spikelets* similar to sessile, pedicels 2 mm long. (Plate 37).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); Lampang (Chae Hom); EASTERN: Buri Ram (Nang Rawng); Nakhon Ratchasima (Dan Chumphae); SOUTH-EASTERN: Chantaburi (Makham, Taruang); SOUTH-WESTERN: Prachuap Khiri Kant; PENINSULAR: Chumphon (Bang Son); Pattalung (Sak); Pattani; Satun (Tung Wa).

Distribution.- India (Type!), Ceylon, Burma and Indo-China.

Ecology.- In savannah, open deciduous forest and edges of evergreen forest, from lowlands up to 1300 m.

Specimens.- Haniff 2946 (K); Kerr 3091 (K), 3473, 7737 (AAU, K), 8215, 9724 (K); 11332 (BK, K); 13557, 13702, 13900, 17655, 19256 (K); Maxwell 85-223, 87-116 (BKF); Smitinand 3619, 3681 (BKF, K); 7158, 7161 (BKF); Smitinand & Abbe 6561 (K).

EULALIOPSIS Honda

Eulaliopsis Honda in Bot. Mag., Tokyo 38: 56.1924. - *Pollinidium* Stapf ex Haines, Bot. Bihar & Orissa :1020.1924.

Note.- *Eulalia* = a Latin name for a grass genus, -opsis = looking alike or appearance of: alluding to a resemblance to the genus *Eulalia*.

Perennials, with thickened golden woolly root-stock and long narrow rigid blades; ligule ciliate. *Inflorescence* a subdigitate racemes, spiciform. *Spikelets* in pairs, alike in shape and sex, one sessile, the other pedicelled on the fragile rhachis; sessile spikelet deciduous with the adjacent rachis internode and pedicel; pedicelled spikelet falling from its pedicel; rhachis internodes and pedicels slender, ciliate, bearded at base, glumes subequal. *Florets* 2; lower neuter; upper bisexual. *Sessile* and *pedicelled spikelets* pubescent; awned; callus obtuse; lower glume lanceolate, convex on back, 2-3-toothed, muticous, prominently nerved, hairy, with very narrow incurved margins; upper glume narrowly lanceolate, keeled, often aristulate, hairy on margins and keel; lower lemma hyaline, oblong, obtuse, nerveless, muticous, ciliate at apex or glabrous; upper lemma stipitate, awn from sinus; palea broad-ovate, entire, ciliate at apex, nerveless. Lodicules 2, minute, each with a tuft of long hairs. Stamens 3. Stigmas linear, exserted.

A genus of only 2 species with *E. sykesii* confined to India, and the widely distributed species *E. binata* recorded in Thailand.

Eulaliopsis binata (Retz.) C.E. Hubbard in Hook., Ic. Pl.: 3262.1935; Nakai in J. Jap. Bot. 17: 378.1941; Bor, Fl. Ind., Burm. & Ceyl. 1: 158.1960; Hsu in Taiwania 16: 321.1971; Fl. Taiwan 5: 654.1978; Roy, Fl. Ind. 4: 98.1984; Koyama, Grass. Japan: 442.1987.

- *Andropogon binatus* Retz., Obs. Bot. 5: 21.1789.

Type.- India, s.n. (K-holotype!).

- *Spodiopogon angustifolius* Trin. in Mem. Acad. Sci. Petersb. 6,2:

300.1832. Type.- Formosae, Herb H.F. Hance, R. Swinhoe 12585 (K-holotype!).

- *Andropogon notopogon* Steud., Syn. Pl. Glum. 1: 373.1854.

Type.- NW India, Herb Royle (K-holotype!).

- *A. involutus* Steud., l. c.:373.1854.

- *A. obvallatus* Steud., l. c.: 373.1854.

- *Ischaemum angustifolium* (Trin.) Hackel in DC., Monogr. Phan. 6: 241.1889.

- *Eulaliopsis angustifolia* (Trin.) Honda in Bot. Mag. Tokyo 38: 56.1924.

- *Pollinidium angustifolium* (Trin.) Haines, Bot. Bihar and Orissa: 1020.1924.

- *P. binatum* (Retz.) C.E. Hubbard in Kew Bull. 1932: 72.1932.

Perennial; culms 40-100 cm tall, erect, densely tufted with rootstock and basal sheaths at base; sheaths smooth, glabrous; ligule fringe of hairs, 0.4-0.5 mm. *Leaf-blades* 20-45 cm long, narrowly linear, base rounded, glabrous except pilose at base. *Inflorescence* consists of 2-4 subdigitate racemes, covered with yellow hairs; racemes up to 5 cm long by 4-6 mm wide. *Sessile spikelets* 4.5-5 mm

long, lanceolate-oblong; callus short, lower part densely with golden hairs; rhachis internodes 2-3 mm; lower glume 3.3-3.5 mm long, 3-4 toothed, 5-7-nerved, ciliate; upper glume 5-nerved, ciliate; lower lemma 3 mm long, lanceolate, male or neuter, 1-nerved; upper lemma, bidentate, ciliate, 3.4-4.0 mm long. *Awn* 5-8 mm long. *Pedicelled spikelets* similar to sessile spikelets; pedicel 2 mm.

(Fig. 42 & Plate 38).

Thailand.- NORTHERN: Chiang Mai (Mae Khachan Nuea).

Distribution.- India (Type!), Burma, southern China, Indo-China, Taiwan, Philippines and Japan.

Ecology.- Common by roadsides and in dry dipterocarp forest at ca. 350-700 m.

Specimens.-Kerr 1081 (K); Smitinand 4260 (BKF, K); Smitinand & Abbe 6189 (K); Sorensen, Larsen and Hansen 1370 (BKF, K), 2611 (K).

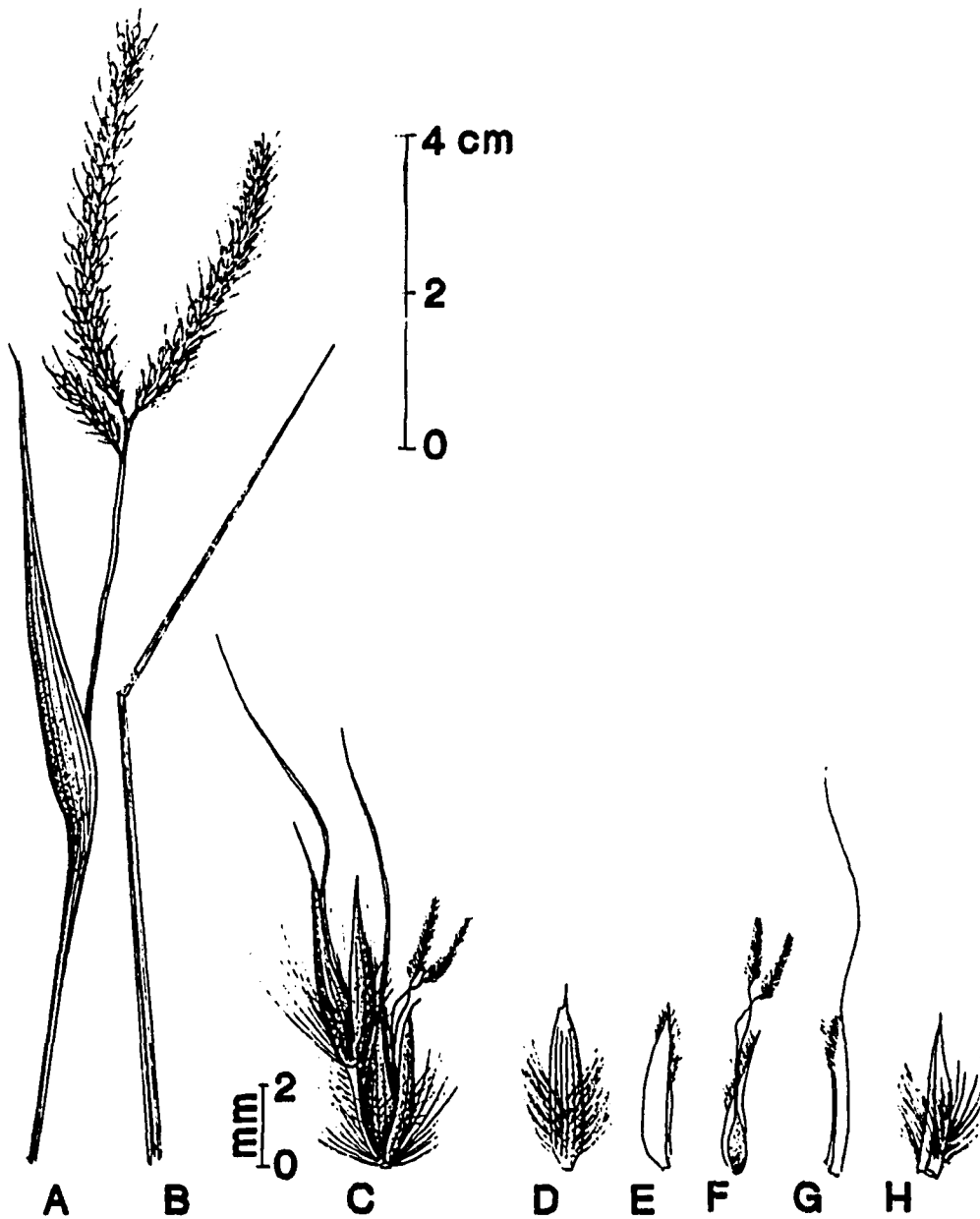


Figure 42. *Eulaliopsis binata* (Retz.) C.E. Hubbard
 A. habit, inflorescence and spatheole B. upper portion
 of leaf-blade C. spikelet pair D. dorsal view of lower
 glume E. lower lemma F. palea, ovary and stigmas
 G. upper lemma and awn H. upper glume;
 (Sorensen, Larsen & Hansen 1370, BKF).

IMPERATA Cirillo

Imperata Cirillo, Pl. Rar. Neap. 2: 26.1792; Clayton, Gen. Gram.: 333.1986. - *Lagurus cylindricus* Linn., Syst. Nat. ed. 10,2: 878.1759; - *Syllepis* Fourn., Mex. Pl. 2: 52.1886.

Note._ *Imperata* is a Latin name in commemorating Ferrante Imperato of Naples, a physician and naturalist who died in 1825. Cirillo is a name of an Italian botanist Cirillo, Domenico Maria Leone. He latinized his name Cyrillus which were miscited in many reference and must be avoided.

Perennial; strongly rhizomatous; culms mostly erect and unbranched, generally with few nodes; sheaths open, often hairy at the joint of leaf-base, basal sheaths reduced; ligule membranous, extremely variable. *leaf-blades* linear to lanceolate, mostly basal; *Inflorescence* a spike-like raceme, panicle solitary, terminal, cylindrical to conical; branches divided; rhachis often with numerous long hairs; pedicel tips cup-like. *Spikelets* all similar, unawned, unequally pedicellate, disarticulation below glumes; glumes equal to subequal, membranous, 3-9-nerved, callus densely hairy. *Florets* 2; lower reduced to sterile lemma, upper with palea and lemma, and a perfect flower; lemma hyaline, lanceolate to ovate, denticulate, 0-1-nerved; palea hyaline, broadly ovate, denticulate, 0-3-nerved; lodicules none; anthers 1-2, yellow to brown; stigmas elongate, purple to brown; styles connate to free; caryopses ovate to obovate, light to dark brown.

A genus of 9 species, occurring from the western Mediterranean to South Africa, through India, Southeast Asia, Pacific Islands and to Australia. It is also found in Northern Hemisphere in southern regions of the United States. In Thailand the most widely spread and variable species in the genus, *I. cylindrica* is very common.

KEY TO THE GENUS OF IMPERATA IN THAILAND

1. Stamen 1; panicle up to 50 cm long I. conferta

1. Stamens 2; panicle normally shorter than 20 cm long I. imperata

1. *Imperata conferta* (Presl) Ohwi, Bot. Mag. Tokyo 55: 549.1941;
Gilliland, Fl. Mal. 3: 222.1971; Gabel, Imperata: 62.1982.

- *Saccharum confertum* Presl, Rel. Haenk. 1: 346.1830;

Type.- Philippines, Luzon, Haenke s.n. (US-holotype)

- *Imperata exaltata* (Roxb.) Brongn. in Duperr., Voy. Coq. Bot.:
101.1831 (pro parte).

- *I. exaltata* var. *genuina* Hack., DC. Monogr. Phan. 6: 98.1889;

- *I. exaltata* ssp. *merrillii* Hack., Philipp. J. Sci. 1: 264.1906;

- *I. contracta* Hitch. in Standley & Calderon, Lista Prelim. Pl.
Salvad.: 273.1925.

Perennial; culms 70-120 cm tall, leaves arise from the base; sheath smooth, glabrous, overlapping at base; ligule membranous, 0.8-

1.2 mm long. *Leaf-blades* linear-lanceolate, 70-130 cm long by 10-17 mm wide, glabrous on both sides. *Inflorescence* a spike-like raceme, panicle contracted, nearly conical, up to 50 cm long by 5 cm across; the upper rhachis very thin and flexible, lower branches elongate and spreading; pedicels long and slender. *Spikelets* alike, oblong-acuminate, 2.6-3.2 mm long, dorsally woolly villous; callus short, densely long silky hairs, hairs 4-8 mm long; glume subequal, membranous, 3-5 nerved; lower floret empty, lemma 1.5-2.2 mm long; upper bisexual, lemma 1.5-2.2 mm; palea 0.9-1.3 mm long; anther 1, yellow to orange-brown, 1.6-2.2 mm long; stigmas plumose, purple, 2-3 mm long.

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); NORTH-EASTERN: Udon Thani (Mueng); SOUTH-WESTERN: Kanchanaburi (Wangka); PENINSULAR: Krabi.

Distribution.- The range extends from Thailand, the Malay peninsula through the Philippines (Type!), and other Pacific Islands.

Ecology.- In open areas, beaches, old clearings, and landslides; on sandy or clay soils; from near sea level up to 450 m.

Specimens.-Heckman 132 (K); Hosseus 502 (K); Sorensen, Larsen & Hansen 776 (K); Wichian 331 (K).

Remarks.- Four specimens collected from Thailand were identified as *I. conferta* by Dr. Bor at Kew. It is very difficult to clearly separate *I. conferta* from *I. cylindrica* in the field. The leaves and inflorescence are alike. The main distinguishing characters are that *I. conferta* has clearly only one anther and the inflorescence is of variable length

up to 50 cm, while *I. cylindrica* has two anthers and the inflorescence normally is shorter than 20 cm long. The range of both species overlaps; *I. cylindrica* ranges very widely eastwards from Asia to the Pacific Islands and Australia. *I. conferta* is distributed from southeast Asia to the Philippines and other Pacific Islands. It is likely that some hybridization may occur between the two species in the overlapping region. This may be partial explanation for the confusion and many taxa proposed for the genus *Imperata* in the literature.

Imperata cylindrica (Linn.) P. Beauv., Ess. Agrost.: 165.1812;

Bor, Fl. Ind., Burm. & Ceyl. 1: 169.1960; Gilliland, Fl. Mal. 3:

220.1971; Gabel, Gen. Imperata: 67.1982; Clayton, Gen. Gram.:

333.1986.

- *Lagurus cylindricus* Linn., Syst. Nat. ed. 10: 878.1759.

Type.- Europe (LINN-holotype, K-phototype!).

- *Saccharum cylindricum* (Linn.) Lamk., Encycl. Meth. Bot. 1: 594.1785.

- *S. laguroides* Pourr., Mem. Acad. Toulouse 3: 326.1788.

- *S. koenigii* Retz., Obs. Bot. 5: 16.1789.

- *S. thunbergii* Retz., l. c.: 16.1789.

- *Imperata arundinacea* Cirillo, Pl. Rar. Neap. 2: 26.1792.

- *Saccharum sisca* Cav., Icon 3: 47.1794.

- *Calamagrostis lagurus* Koel., Descr. Gram.: 112.1802.

- *Saccharum cylindricum* var. *europaeum* Pers., Syn. Pl. 1: 103.1805.

- *Imperata thunbergii* (Retz.) P. Beauv., Ess. Agrost.: 165.1812.

- *I. koenigii* (Retz.) P. Beauv., l. c.: 165.1812.
- *I. sieberi* Opiz, Natural. 10: 190.1825.
- *I. allang* Jungh. in Hoev. et De Vries, Tidjschr. 7: 295.1840.
- *I. koenigii* var. *major* Nees, Fl. Afr. Austr.: 90.1841.
- *I. pedicellata* Steud., Flora 29: 22.1846.
- *I. arundinacea* var. *glabrescens* Buse, Pl. Jungh.: 366.1854.
- *I. arundinacea* var. *indica* Anderss., Ofv. Vet. Akad. Forh. 12
: 160.1855.
- *I. arundinacea* var. *europaea* Anderss., l. c.: 160.1855.
- *I. arundinacea* var. *africana* Anderss., l.c. : 159.1855.
- *I. arundinacea* var. *koenigii* (Retz.) Benth., Fl. Hongk.: 419.1861.
- *I. arundinacea* var. *koenigii* subvar. *glabrescens* (Buse) Hackel,
DC. Monogr. Phan. 6: 95.1889.
- *I. cylindrica* var. *koenigii* (Retz.) Dur. & Schinz, Consp. Fl. Afr.
5: 694.1894.
- *I. arundinacea* var. *latifolia* Hook.f., Fl. Brit. Ind. 7: 106.1896.
- *I. arundinacea* var. *europaea* (Anderss.) Aschers. & Graebn., Syn.
Mitteleurop. Fl. 2: 37.1898.
- *I. angolensis* Fritsch, Bull. Herb. Boiss. 2,1: 1096.1901.
- *I. cylindrica* var. *koenigii* (Retz.) Pilger, Fragm. F. Phil.
: 137.1904.
- *I. cylindrica* var. *genuina* (Hack.) A. Camus, Rev. Bot. Appl. 5
: 110.1925.
- *I. cylindrica* forma *pallida* Honda, J. Fac. Sci. Univ. Tokyo Bot.
3,3: 374.1930.
- *I. cylindrica* var. *major* (Nees) C.E. Hubbard ex Hubb. & Vaughan,

Grass. Maur.: 96.1940.

- *I. cylindrica* var. *africana* (Anderss.) C.E. Hubbard in Imp. Agri.

Bur. Jt. Pub. 7: 10.1944.

- *I. cylindrica* var. *latifolia* (Hook.) C.E. Hubbard, l. c.: 14.1944.

Perennial, with whitish rhizomes; culm erect, 30-150 cm high; sheaths overlapping, smooth, glabrous or with few marginal hairs towards the throat; ligule membranous, ciliolate or glabrous, 1-1.8 mm. *Leaf-blades* linear-lanceolate, broadest at about the middle, up to 150 cm long by 5-22 mm wide, glabrescence above, glabrous beneath, margins scabrid. *Inflorescence* a spike-like raceme, subspiciform, densely silky wooly, 10-20 cm long, often longer; branches of the panicle ascending, lower branches 3-5 cm long. *Spikelets* alike, pedicelled, 1.8-2 mm; callus with long silky hairs 1-2 cm long; lower glumes lanceolate-acute, obscurely 3-nerved; upper glume narrower, obscurely 5-nerved, fringed at the top; lemma hyaline, denticulate, 2-3 mm long. Awn reduced; palea 1-2 mm long; stamens 2, orange to brown, 2-3 mm long; stigmas plumose, 3-5 mm long.

(Fig. 43 & Plate 39).

Thailand.- Throughout the country.

Distribution.- Widespread in Africa, Europe (Type!), Asian Tropics, Malesia, Australia and South America.

Ecology.- A well adapted weed, spreading aggressively by its rhizomes and by sexual reproduction. The plants is distributed in a wide variety of environmental conditions and in poor soils, abundant in open areas, roadsides and

abandoned fields, from near sea level to 2300 m alt.

Vernacular names.- Koe-hee (Karen-Mae Hong Son); laa-laang (Malay);
Laa-lae (Malay-Yala); Yaa Khaa (General).

Specimens.-Kerr 1097, 3784, 11597 (K); King 5427, 5480 (K); Koyama et al. 15230 (NY); Marcan 2302, 2312 (K); Nooteboom et al. 712 (K); Smitinand 8778 (K).

Remarks.- A specimen of *Lagurus cylindricus* in Herb. LINN was described by Linnaeus (1759) and is the type of *Imperata cylindrica*. Unfortunately, there is no evidence that Linnaeus cited this specimen elsewhere. Lamarck (1783) cited Linnaeus in his description of *Saccharum cylindricum*, therefore this name was valid. Cirillo (1792) was the first author to use the genus name *Imperata*. He cited Linnaeus's *L. cylindricus*, but used the specific name *Imperata arundinacea*. Later, Raeuschel (1797) in *Nomenclator Botanicus* was the first author to use the combination *Imperata cylindrica* but he did not cite Cirillo or Linnaeus. The name was therefore rejected and not valid. Beauvois (1812) accepted the generic names *Imperata* of Cirillo and cited the type specimen *L. cylindricus* of Linnaeus. He also clarified the concept of the genus *Imperata* through listing *Saccharum cylindricum* (Linn.) Lamk. as a synonym of *Imperata cylindrica* (Linn.) P. Beauv.

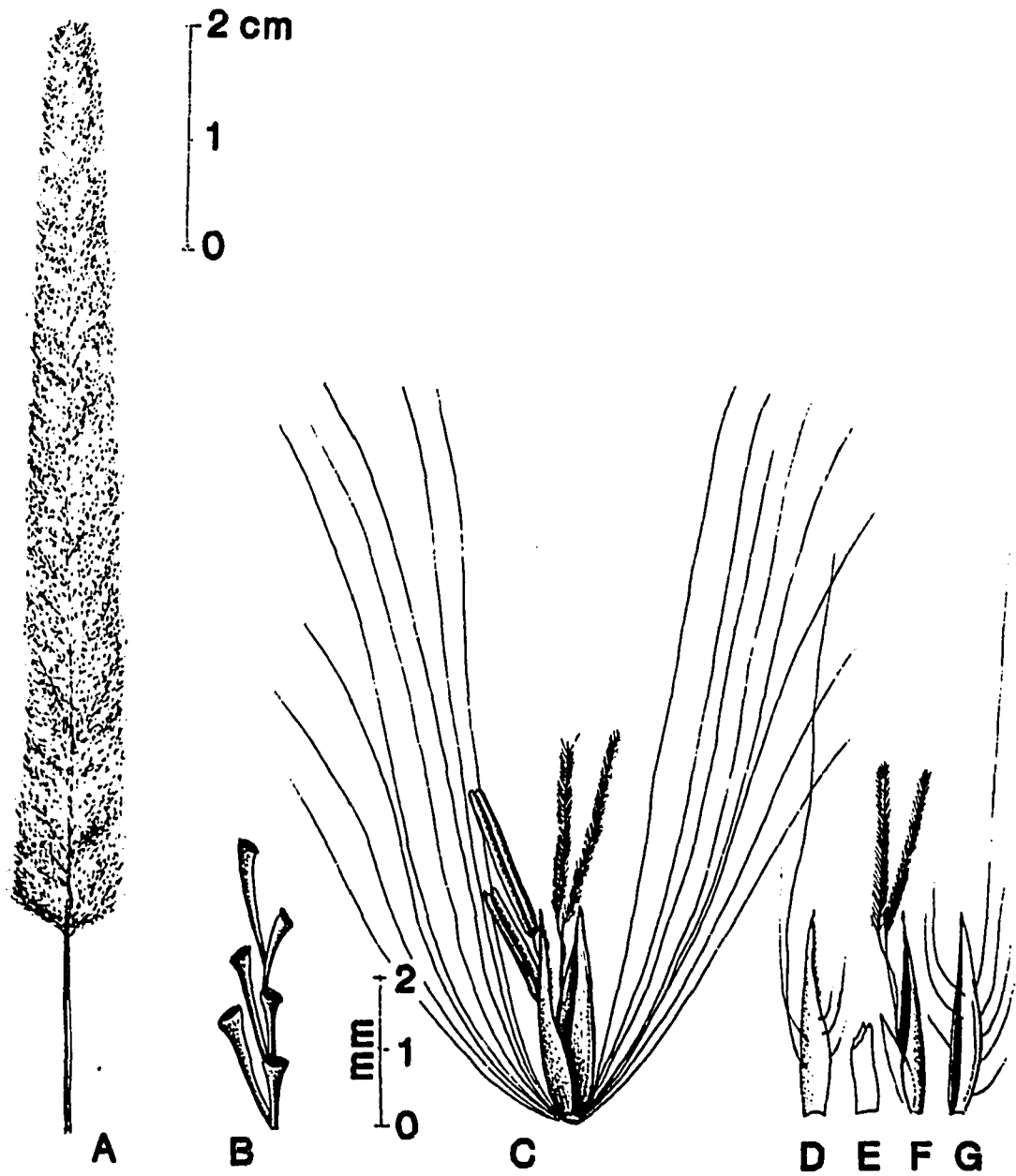


Figure 43. *Imperata cylindrica* (L.) P. Beauv.
 A. habit, inflorescence B. rhachis internodes and pedicels
 C. sessile spikelet D. lower glume E. lemma F. paleas
 and stigmas G. upper glume; (Koyama et al. 15230, NY).

MICROSTEGIUM Nees

Microstegium Nees in Lindley, Nat. Syst. ed. 2: 447.1836; Bor in Kew Bull. 7: 209,223.1952; Fl. Ind., Burm. & Ceyl.: 192.1960; Gilliland, Fl. Mal. 3: 246.1971; Clayton, Gen. Gram.: 335.1986.

- *Ephebopogon* Steud., Nom. Bot. ed. 2,1: 556.1840 (nom. nud.).
- *Leptatherum* Nees in Proc. Linn. Soc. 1: 92.1841.
- *Psilopogon* Hochst. in Flora 29: 117.1846.
- *Nemastachys* Steud., Syn. Pl. Glum. 1: 357.1854.
- *Ischnochloa* Hook.f. in Hook., Ic. Pl. 25: 2466.1896.
- *Coelarthron* Hook., Fl. Brit. Ind. 7: 163.1896.

Note.- come from Greek words, micros = small; stege = a roof or covering; referring to the small upper lemma.

Perennials or *annual* with decumbent culms; sheaths contracted at junction with blade; ligule short, membranous. Leaf-blades narrowed at base and sometimes petioled. *Inflorescence* a subdigitate, simple racemes, rarely solitary or scattered on a short axis, with jointed rhachis. *Spikelets* similar in sex and form, sitting on spiciform racemes; pedicelled spikelet falling from its pedicel; sessile spikelet falling with the adjacent rhachis internode and pedicel; rhachis internodes and pedicels flattened or inflated, glabrous or densely ciliate on margins; callus short, bearded. *Floret* 1 (-2); lower variously reduced or absent, if present male or rarely bisexual; upper bisexual. *Sessile spikelets*; glumes usually equal; lower flattened on back or slightly convex, 2-keeled, ciliate on keels upwards, 4-6-nerved with the nerves anastomosing at sides and apex,

usually with a deep longitudinal groove; upper cymbiform, membranous to chartaceous, 3-nerved, mucronate to aristulate. Lower lemma hyaline, ciliate on margins, or absent; palea membranous to chartaceous, nerveless or faintly 2-nerved, or absent. Stamens 3. Upper lemma with slender, perfect or imperfect awn, usually small to minute and notched, sometimes $3/4$ as long as spikelet and cleft to middle into 2 lanceolate lobes, rarely entire; palea usually small, ciliate. Stamens 3 or 2. Styles 2, long; stigmas exerted at or below apex; lodicules cuneate. Caryopsis terete; hilum basal, punctiform. *Pedicelled spikelets* similar to sessile spikelets.

A genus of 30 species widely distributed in Indo-Malaysia and eastern Asia. In Thailand 5 species *M. ciliatum*, *M. delicatulum*, *M. petiolare*, *M. vagans*, and *M. vagans* var. *scandens*, are recorded.

KEY TO THE SPECIES OF MICROSTEGIUM IN THAILAND

1. Plant petiolate, commonly rooting at lower nodes; leaf-blades with tubercle-based hairs on both surfaces; upper lemma well developed, split at the middle into two long, glabrous, triangular lobes. Spikelets 4.5-5 mm long. **M. petiolare**
1. Plant without petiole, with or without roots at lower nodes; leaf-blades glabrous or hairy; upper lemma small, shortly bi-lobed or entire, 1-2 mm long. Spikelet awned; spikelets 0.5-5 mm long lower glume without anastomosing veins

2. Inflorescence 0.5-2.8 cm; nodes glabrescent.

Spikelets 0.5-2.8 mm, lower glume oblong-obtuse

M. delicatulum

2. Inflorescence 3-12 cm long; nodes glabrous or hairy;

Spiklets 3-5 mm long

3. Anther 1-1.8 mm long; spikelets 3-3.5 mm long, pale;

nodes glabrous; lower glume lanceolate to lanceolate-oblong

M. ciliatum

3. Anther 2-2.5 mm long; spikelets 3-5 mm long, purplish;

nodes glabrous or hairy; lower glumes oblong or obovate-oblong

4. Nodes glabrous, with or without supporting roots.

Inflorescence up to 30 racemes; racemes 8-12 cm long;

spikelets 3-3.2 mm long. Plants grow elsewhere.

M. vagans

4. Nodes setose hairy, commonly with supporting roots

at lower nodes. Inflorescence 4-8 racemes; racemes

6-10 cm long; spikelets 4.5-5 mm long. Plants of

evergreen forest.

M. vagans var. scandens

1. *Microstegium ciliatum* (Trin.) A. Camus in Ann. Soc. Linn. Lyon, 68: 201.1921; Senaratana, Grass. Ceyl.: 170.1956; Bor in Fl. Ind., Burm. & Ceyl.: 193.1960; Gilliland, Fl. Mal. 3: 249.1971; Hsu, Fl. Taiwan 5: 672.1978; Lazarides, Phan. Monogr. 7: 56.1980; Roy, Fl. Ind. 4: 111.1984.

- *Pollinia ciliata* Trin. in Mem. Acad. Sci. Petersb. 6,2: 306.1832.

Type.- India, Wallich, s.n. in Herb. Hook. (K-holotype!).

- *Andropogon biaristatus* Steud., Syn. Pl. Glum. 1: 379.1854.

Type.- India, Wallich 8823 (K-holotype!).

- *Pollinia lancea* Nees ex Steud., Syn. Pl. Glum. 1: 410.1855.

- *P. laxa* Nees ex Steud., l. c.: 410.1855.

Type.- India, Wallich 8823 (K-holotype!).

- *P. wallichiana* Nees ex Steud., l. c.: 410.1855.

Type.- India, Wallich 8822 (K-holotype!).

- *P. monantha* Nees ex Steud., l. c.: 410.1855.

Type._ India, Wallich 8819 (K-holotype!).

- *Eulalia monantha* (Nees) O. Ktze., Rev. Gen. Pl. 2: 775.1891.

- *E. ciliata* (Trin.) O. Ktze., l. c.: 775.1891.

- *Pollinia gracilis* Ridl., Materials 3: 156.1907.

- *M. monanthum* (Nees ex Steud.) A. Camus in Ann. Soc. Linn. Lyon, 68: 200.1921.

- *Pollinia ciliata* var. *glabrata* Ridl., Flora 5:198.1925.

Type.- Malay Peninsular from Pahang, Selangor, Perak (K-holotype!).

- *M. biaristatum* (Steud.) Keng in Sinensia 3: 92.1932.

- *M. ciliatum* var. *laxum* (Nees ex Steud.) Reeder: 338.1948.

Culms scrambling, glabrous, often rooting at the lower nodes, often branched, up to 120 cm tall; nodes swollen, shortly sericeous; sheaths compressed, tight, glabrous or only few hairs on the back near the joint; ligule membranous, glabrous, 1 mm. *Leaf-blades* lanceolate-acuminate, up to 12 cm long by 1 cm wide, apex acuminate to a fine point, base cuneate, glabrous except for a few bulbous-based bristles near the base. *Inflorescence* consisting of 3-10 spike-like racemes, subdigitately arranged, up to 8 cm long; rhachis internode 2.5-3 mm, enlarged at the top, margins scabrid. *Sessile spikelets* with short callus, blunt with ring of setose hairs half the length of the spikelet; lower glume coriaceous, oblong, acute, back of the glume nearly glabrous, 2-keeled with a deep groove between the keel, 2-nerved, shallowly longitudinal grooved at the middle; margins inflexed, scabrid and ciliate at the top, 3-3.5 mm long; upper glume ovate, acute, glabrous except for the scabrid back of the nerve and the stiff-ciliate near the top, apex thinly aristate, 3.0 mm. Lower lemma small or lacking; upper lemma stipitate, 1-2 mm; awn 20 mm long; palea if present, oblong, acute, 0.6 mm long. Anther 1-1.8 mm long. *Pedicelled spikelets* similar to sessile spikelet, pedicels 2.5 mm. (Fig. 44 & Plate 40).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); EASTERN: Nakhon Ratchasima (Dan Chumpae); PENINSULAR: Pattalung (Khao Poo-Khao Yah NP.); Pang Nga (Khao Pawta Luang Kaew); Trang (Khao Soi Dao).

Distribution.- India (Type!), Ceylon, Burma, Indo-China, Malaysia to Indonesia.

Ecology.- Frequent in margin of evergreen forest in partly open areas.

Specimens.-Geesink et al. 7695 (K); Kerr 17640, 19198 (K).

Remarks.- The indumentum on the lower glume and on the rhachis internode varies in this species. The genus has never been revised, thus the description of this species is quite broad in the literature. The actual circumscription of this species need to be defined, perhaps varieties need to be recognized.



Figure 44. *Microstegium ciliatum* (Trin.) A. Camus
 A. habit, leaf-blades and inflorescence B. spikelet
 pair C. dorsal view of sessile spikelet D. upper
 glume, lower lemma, ovary and upper lemma with an awn;
 (Geesink et al. 7695, BKF).

2. *Microstegium delicatulum* (Hook.f.) A. Camus in Ann. Soc. Linn. Lyon. 68: 200.1921; Rhind, Grass Burma: 69.1945; Bor in Kew Bull. 2: 221.1952; in Fl. Ind., Burm. & Ceyl. 1: 194.1960.

- *Pollinia delicatula* Hook.f., Fl. Brit. Ind. 7: 117.1896.

Type.- Burma, Pegu, S. Kurz 1204 (K-holotype!).

Annual, straggling, decumbent, common with supporting roots; culms wiry, smooth, branching from lower nodes, 60-80 cm tall; nodes glabrescent; sheaths glabrous, tightly wrapped around the culm; ligule membranous, tiny, 0.4 mm long. *Leaf-blades* narrowly linear-acuminate, base cuneate; 8-10 cm long by 4-6 mm wide; sparsely with tubercle-based hairs on both surfaces particularly near the base; midnerve prominent, white, raised on lower surface; margins scabrid. *Inflorescence* a subdigitate panicle consisting of 2-4 racemes; 0.5-2.8 cm long; peduncle wiry; rhachis internodes and pedicels alike, glabrous, ciliate along the margins, broaden at the top, 1.5 mm long; both spikelets awned. *Sessile spikelets* oblong-obtuse, 2-2.5 mm long; callus short, bearded, hairs almost half as long as the spikelet; lower glume chartaceous, glabrous, nerve obscured, scabrid towards the apex, convex or shallowly channelled on the dorsal surface; upper glume, cymbiform, minutely scabrid on the keel and ciliate along margins on upper half, shortly mucronate, obscurely 3-nerved; lower floret reduced; upper bisexual; lemma extremely minute, upper shortly 2-lobed, stipitate; awn 6-8 mm long; stamens 3; anther 1-2 mm long. *Pedicelled spikelets* similar to sessile spikelet; pedicel 1-1.2 mm long.

Thailand.- EASTERN: Nakhon Ratchasima (Khao Yai).

Distribution.- Burma (Type!) and Thailand.

Ecology.- Prostrate in clearings by roadsides at 600 m altitude.

Specimens.-Phengkai 579 (BKF, K).

Remarks.- A small herb, recognized by its straggling habit, slender wiry culms, and its small inflorescence with tiny oblong-obtuse spikelets.

3. *Microstegium petiolare* (Trin.) Bor in Ind. For. Rec. Bot. 1:

3,87.1938; Bor in Fl. Ind., Burm. & Ceyl.: 194.1960; Lazarides,

Phan. Monogr. 7: 57.1980; Roy, Fl. Ind. 4: 111.1984.

- *Spodiopogon petiolaris* Trin. in Mem. Acad. Sci. Petersb. 6,2:

301.1832. Type.- Nepal, Wallich 8807 (K-holotype!).

- *Andropogon petiolaris* (Trin.) Steud., Syn. Pl. Glum. 1: 398.1854.

- *Pollinia lehmanni* Arn. et Nees in Nov. Act. Nat. Cur. 19,1:

186.1843.

- *Spodiopogon lehmanni* Griseb. in Goetting. Nachr.: 91.1868.

- *Ischaemum petiolare* (Trin.) Hack. in DC., Monogr. Phan. 6: 238.1889;

Hook.f. Fl. Brit. Ind. 7: 138.1896.

Culms 0.6-1 m tall, decumbent, rooting at lower nodes; aerial roots sometimes very long; sheaths terete, margins scarcely ciliate; ligule membranous, truncate, 2-5 mm long, pubescent at the back. *Leaf-blades* broadly lanceolate, 14-20 cm long by 2.5-3.2 cm wide, apex acuminate, base cuneate; both surfaces with tubercle based hairs, sparsely above, densely beneath; margins scabrid; midnerve prominent, white; petiolate, petiole 3-15 mm long. *Inflorescence*

consisting of 2-5 subdigitate racemes, 3-8 cm long; rhachis internode slightly articulated, broader than petiole, cupular at the top, ciliate along the margins, 4-5.5 mm long. *Sessile spikelets* lanceolate-oblong, 4.5-5 mm long; lower glume scabrid, keeled, nerves obscured, margins ciliate near the apex; upper glume scabrid, keeled. Lower floret male; upper floret hermaphrodite; lower lemma ovate-oblong, 3-4.5 mm long; upper 2-triangular lobed, stipitate; awn 4-8 mm long. Anthers yellow to dark brown, 3 mm long. *Pedicelled spikelets* similar to sessile spikelets except at the lower part of the racemes sometimes much smaller and narrower, 2.5 mm long by 0.5 mm wide; pedicels 2.5-2.8 mm long. (Fig. 45 & Plate 41).

Thailand.- NORTHERN: Chiang Mai (Doi Inthanond); NORTH-EASTERN: Loei (Phu Luang).

Distribution.- India, Nepal (Type!), Burma, Indo-China and Sumatra.

Ecology.- In marshy areas and along the streams in evergreen forest at high elevation, 1300-1500 m.

Specimens.-Tagawa et al. 1568, 3040 (BKF).

Remarks.- The presence of petioles, although variable in length, is characteristic of this species and will separate it from its allies.

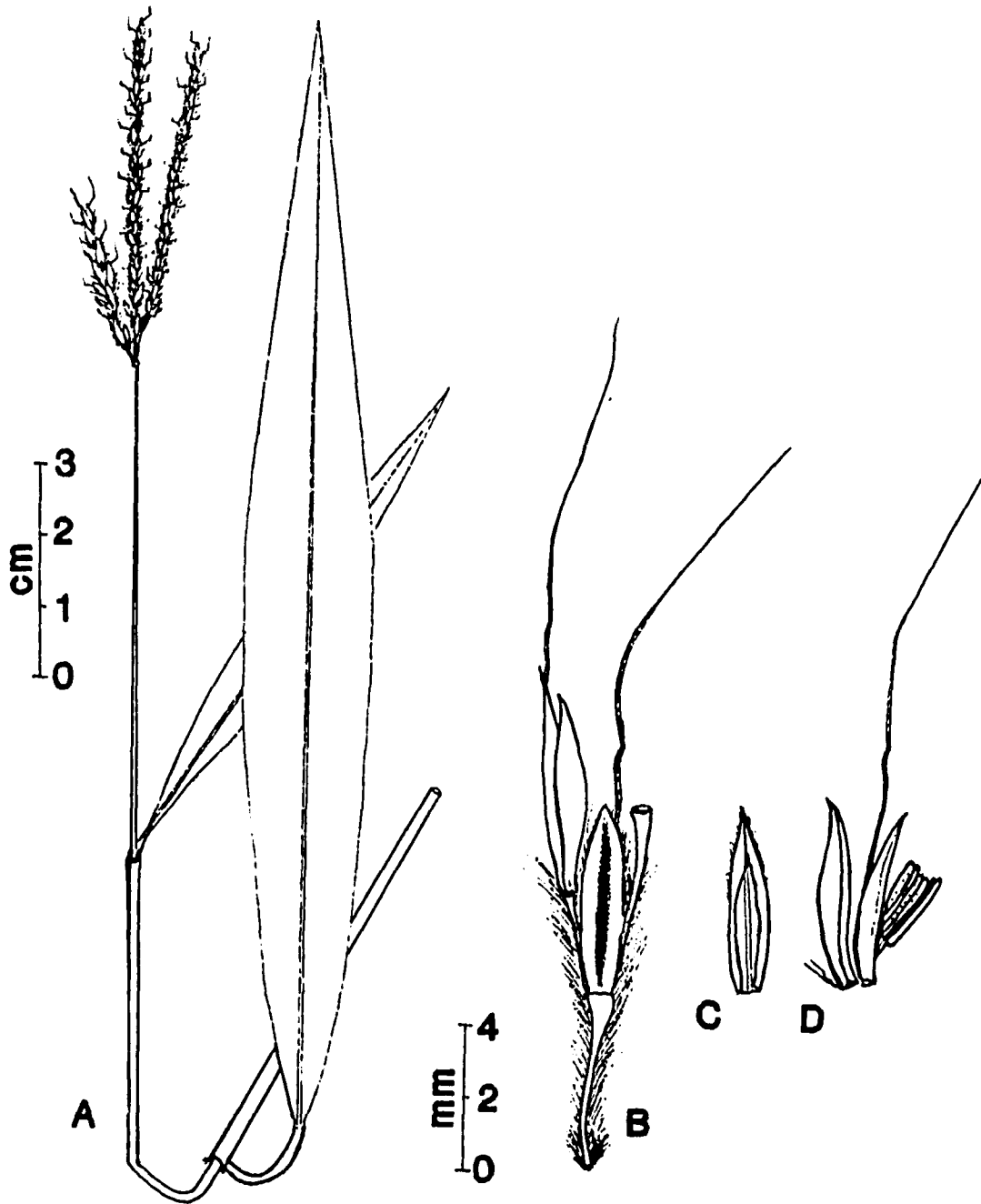


Figure 45. *Microstegium petiolare* (Trin.) Bor
 A. habit, leaf-blades and inflorescence B. spikelet
 pair C. ventral view of lower glume D. lower lemma,
 upper lemma with an awn, and stamens;
 (Tagawa et al. 3040, BKF).

4. *Microstegium vagans* (Nees ex Steud.) A. Camus in Ann. Soc. Linn. Lyon, 68: 200.1921; Bor in Fl. Ind., Burm. & Ceyl.: 195.1960.

- *Pollinia vagans* Nees ex Steud., Syn. Pl. Glum. 1: 410.1855.

Type._ Nepal, Wallich 8807B (K-holotype!).

- *Ephedopogon gratus* Nees et Meyen ex Steud., Nom. ed. 2,1: 556.1840.

- *P. montana* Nees ex Steud., l. c.: 409.1855.

Type.- Nepal, Wallich 8819 (K-holotype!).

- *Pollinia grata* Hack. in DC., Monogr. Phan. 6: 175.1889.

Type.- India, Syong/25 Oct. 1850, Herb. Hook.f. & Thompson (K-holotype).

- *Eulalia vagans* (Nees) O. Ktze., Rev. Gen. Pl. 2: 775.1891.

- *M. gratum* (Hack.) A. Camus in Ann. Soc. Linn. Lyon, 68: 201.1921.

Culms scrambling, often 1 m or more in length; nodes glabrous; sheaths tight, smooth from the node to just below the blade except near the joint; ligule membranous, fimbriate, 1 mm deep. *Leaf-blades* lanceolate, up to 15 cm long by 1 cm wide, often smaller, apex acute, base cuneate, soft-hairy on both surfaces, with occasional bulbous-based bristles, dark green, the midrib prominent, margins scaberulous. *Inflorescence* a spike like-racemes, up to 30 racemes, each 8-12 cm long, subdigitately arranged, peduncle glabrous; rhachis internodes 5 mm long, ciliate along the margins, the joints slightly longer than the pedicels. *Sessile spikelets* with short hairy callus, the hairs scarcely one-third the length of the lower glume; lower glume oblong, acute, 2-nerved, with the margins scaberulous and inflexed; the back depressed in the centre, 3-3.2 mm long; upper glume 3-nerved, ovate in outline, with a small aristate apex, margins flaps,

delicately hyaline, ciliate, scaberulous all over the back; lower lemma nil; upper lemma bilobed, stipitate; awn 7-10 mm long; palea 1 mm long. *Pedicelled spikelets* similar to sessile spikelets.

(Fig. 46 & Plate 42).

Thailand.- **NORTHERN:** Chiang Mai (Chiangdao, Doi Chang, Doi Suthep, Inthanond, Pang Boh); Chiang Rai (Phu Langka); Lampang (Thoen-Lee); Phrae (Mae Khaem Stream); **NORTH-EASTERN:** Loei (Phu Kradueng, Phu Luang); **EASTERN:** Chaiyaphum (Nam Phrom); **SOUTH-WESTERN:** Kanchanaburi (Hard Palom, Huay Ban Kau, Si Sawat, Sai Yoke); **PENINSULAR:** Chumphon (Luangsuan, Ta Ngaw); Nakhon Srithammarat (Lan Saka); Satul (Kuan Po).

Distribution.- India, Burma, Indo-China, Malaysia to Indonesia.

Ecology.- Scattered by roadsides, in open forests, deciduous forests and margins of evergreen forest, at 50-1300 m.

Specimens.-Beusekom et al. 3775, 4092, 4640 (K); Garrette 1031 (K); Hennipman 3564 (K); Hansen & Smitinand 12659 (K); Kerr 1638, 2300, 3508, 6570, 10234, 11451, 13840, 16232, 15378 (K); Larsen 6553, 8708, 8954 (K); Ploenchit 959 (K); Smitinand 1679, 2098, 2143, 3766, 8758 (K); Smitinand & Abbe 6173, 9276 (K); Sorensen, Larsen & Hansen 994 (K); Sukkri 88 (K); Tagawa et al. 2441 (K).

5. *Microstegium vagans* var. *scandens* Bor in Dansk Bot. Arkiv 20,2: 174.1962; Lazarides, Phan. Monogr. 7: 57.1980. **Type.**- Thailand, Chawng, Nakhon Si Thammarat, 24 Jan 58, Larsen 557 (AAU-holotype!).

Culms scrambling, branching above; nodes setose hairy, commonly with supporting roots at lower nodes; sheaths tight, indumentum vary from smooth and glabrous to sparsely to densely with tubercle-based hairs. *Leaf-blades* soft-hairy on both surfaces with occasional bulbous-based bristles near the base; 15 cm long by 1.5 cm wide. *Inflorescence* normally few, 3-6 racemes, 6-10 cm long, often with few sterile or obsolete pedicelled spikelets on lower part of the racemes; rhachis internodes setosely hairy. *Sessile spikelets* 4.5-5 mm long. *Pedicelled spikelets* similar to sessile spikelet but slightly narrower and lower glume with 2-keeled. (Fig. 46 & Plate 43).

Thailand.- SOUTH-WESTERN: Kanchanaburi (Huey Menam Noi); PENINSULAR: Nakhon Si Thammarat (Chawng).

Distribution.- India, Burma, Indo-China, Thailand (Type!), Malaysia to Indonesia.

Ecology.- In open shady places in evergreen forest.

Specimens.-Larsen 557 Type!, 9096 (K); Kerr 2300 (K).

Remarks.- Bor (1962) described the habit of this species as, "This variety is found in the gloom of the evergreen forest and the plant, obviously striving towards such light as is available has developed an elongated stem supported by remarkable branched rootlets from the lower nodes".

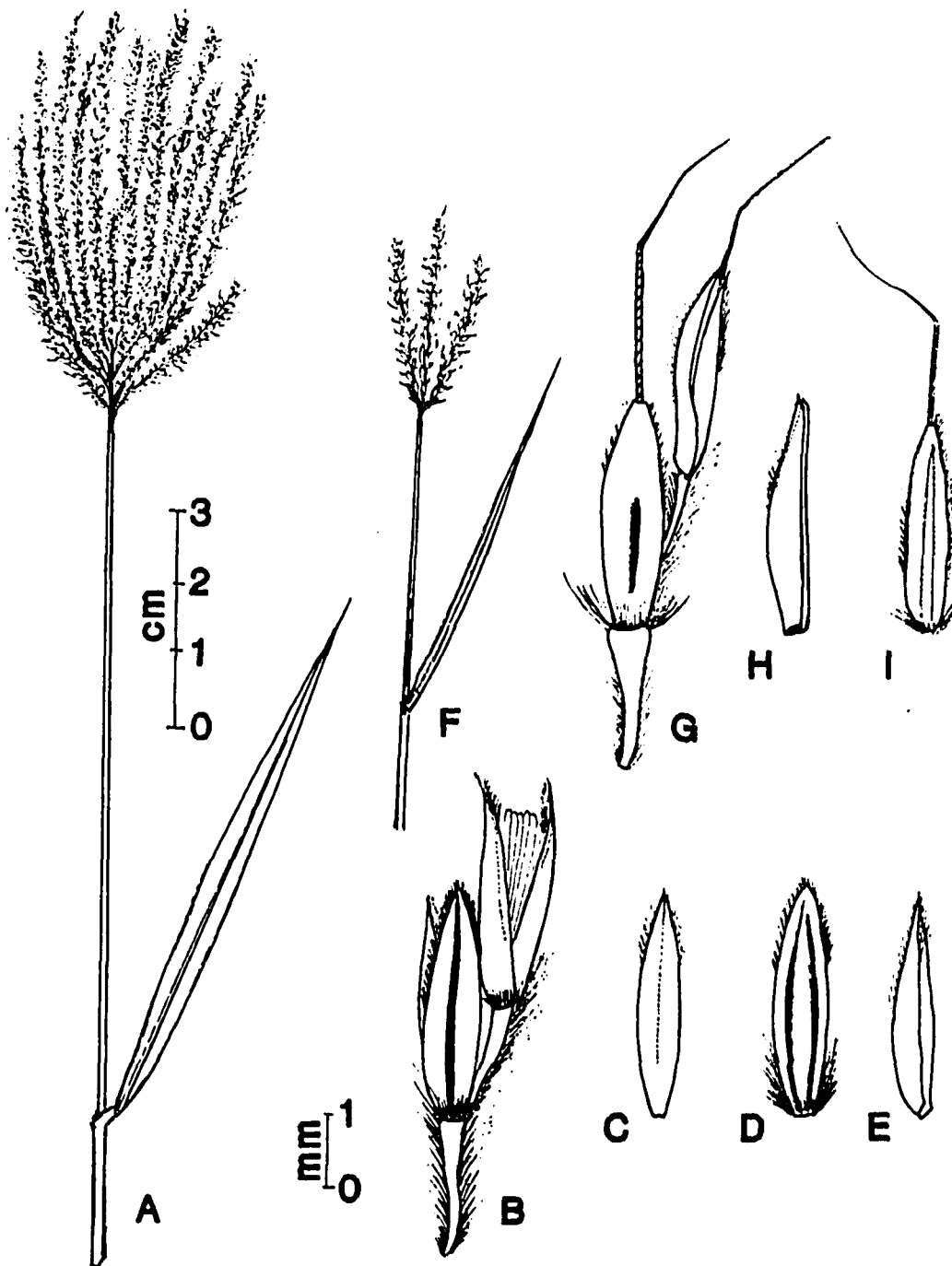


Figure 46. A-E. *Microstegium vagans* (Nees ex Steud.) A. Camus A. habit, inflorescence B. spikelet pair C-E. sessile spikelet C, E. upper glume, ventral and lateral view D. dorsal view of lower glume; (Smitinand 3766, BKF). F-I. *Microstegium vagans* var. *scandens* Bor F. habit, inflorescence G. spikelet pair H. upper glume I. lower glume; (Larsen 5096, BKF).

MISCANTHUS Anderss.

Miscanthus Anderss. in Oefvers. Kon. Vet.-Akad. Forh. 12: 165.1856;
Clayton, Gen. Gram.: 332.1986.

- *Imperata* subgen. *Triarrhena* Maxim., Prim. Fl. Amur.: 331.1859.
- *Saccharum* subgen. *Sclerostachya* Hack. in DC., Monogr. Phan. 6
: 121.1889.
- *Xiphagrostis* Cov. in Contrib. U.S. Nat. Herb. 9: 400.1905 (nom nud).
- *Miscanthidium* Stapf in Fl. Trop. Afr. 9; 89.1917.
- *Sclerostachya* (Hack.) A. Camus in Lecomte, Fl. Gen. I.-C. 7
: 243.1922.
- *Triarrhena* (Maxim.) Nakai in J. Jap. Bot. 25: 7.1950 (*Tiarrhena*).

Note.- Name from Greek words *Mischos* = a stalk, *anthos* = flower:
referring to both spikelets are stalked.

Perennials, reed-like, robust; ligule truncate, ciliolate-membranous. *Leaf-blades* flat. *Inflorescence* of corymbose or paniculate racemes; prominent plum-like panicles; racemes subsessile, with very tough glabrous rhachis. *Spikelets* paired, alike in sex and form; unequally pedicelled on the continuous rhachis of a raceme; each spikelet falling entire from its pedicel, surrounded by an involucre of long fine hairs from the short obtuse callus; glumes chartaceous to membranous, muticous; lower usually 2-4-nerved, with narrow loosely inflexed margins; upper 1-5-nerved. *Florets* 2; lower neuter, upper bisexual. Lemma hyaline, lower without palea; upper smaller than lower, 1-nerved, entire and muticous or more often 2-toothed with a delicate bent or flexuose awn from sinus. Palea small to minute,

hyaline, nerveless. Lodicules 2, cuneate, glabrous. Stamens 2 or 3. Styles 2, free; stigmas plumose. Caryopsis oblong; embryo half as long.

A genus of ca. 20 species distributed in eastern Asia, Indo-Malaysia and Polynesia; also in America and Australia as an introduced species. In Thailand *Miscanthus fuscus* is recorded.

Miscanthus fuscus (Roxb.) Benth. in J. Linn. Soc. Bot. 19: 65.1881.

- *Saccharum fuscum* Roxb., Fl. Ind. 1: 241.1820; Hook, Fl. Brit. Ind. 7: 120.1896; Craib, Fl. Siam Monocot.: 34.1913.

Type.- East India, Roxburgh; Herb Forsyth (K-holotype!).

- *Eriochrysis fusca* (Roxb.) Trin. in Mem. Acad. Sci. Petersb. 6,2 : 315,1832.

- *E. attenuata* Nees ex Steud., Syn. Pl. Glum. 1: 441.1855.

Type.- India, s.n. (K-holotype!).

- *Saccharum ridleyi* Hack., Oesterr. Bot. Zeitschr. 41: 6, 1891.

Type.- Malaysia, Perak, May 1890, Ridley 1189 (K-holotype!).

- *Sclerostachya fusca* (Roxb.) A. Camus in Lecomte, Fl. Gen. I.-C. 7: 243.1922; Kurz, Grass. Burma: 59.1945; Bor, Fl. Assam, 5: 313.1940; Fl. Ind., Burm. & Ceyl. 1: 217.1960; Smitinand, Thai Pl. Names: 302.1980.

- *S. ridleyi* (Hack.) A. Camus, Ann. Soc. Linn. Lyon. 71: 104.1925.

Culms 1.5-3 m tall, robust, reed-like, appressed-pubescent near the top; sheaths glabrous, longer than the internodes, margins ciliate; ligule rounded, 3 mm long, brown, membranous, ciliate. *Leaf-*

blades linear to sub-lanceolate, 1-1.5 m long by 2-4 mm wide, flat, rigid; apex acuminate, base contracted, erect, glabrous on both surfaces; margins very scabrid; median nerve prominent, white.

Inflorescence linear-oblong, 30-60 cm long; straight, densely plumose; common axis angular, pubescent, bearded at the nodes; primary branches often solitary; secondary branches fasciculate, long, simple or branching at the base, pubescent; racemes 6-10 cm long, slender, erect, spreading, somewhat glabrous; rhachis articulate but tough, filiform, rather flexuosus. *Spikelets* ovate-oblong, or obovate, 3 mm long by 1.5 mm broad, brown, 2-nate, one shortly pedicelled the other with a long pedicel, falling from the pedicel; callus with short grey hairs almost half as long as the spikelet; lower glume 3 mm long, sub-coriaceous, shining, obtuse, entire, margins narrowly inflexed, ciliate; back flat or slightly depressed above the middle, very glabrous, obscurely 2-3 nerved; upper glumes acute, keeled, glabrous, margins ciliate above, 1-nerved. Lower floret male or empty; lemma about 3 mm long, ovate-oblong, obtuse, nerveless, stiff ciliate at the apex, awnless. Upper floret bisexual; lemma 2.5 mm long, similar to lower lemma; margins long and rigidly ciliate; palea much smaller, ovate, ciliate; anther 1.5 mm long. (Fig. 47 & Plate 44).

Thailand.- NORTHERN: Chiang Rai (Doi Tham Tu Pu); Kamphaeng Phet (Raheng); EASTERN: Chaiyaphum (Chaturat); CENTRAL: Ang Thong (Mueng); Nakhon Nayok (Nang Rawng waterfall); SOUTH-WESTERN: Kanchanaburi (Hin Dat, Ta Salao).

Distribution.- Common in India, Ceylon, distributed to Burma and Indo-China.

Ecology.- Scattered along the edges of ricefield, and in open swampy areas at 50-150 m.

Vernacular names.- khaem (General); Khaem doi (Northern); Yaa saeng (Lop Buri); Yaa phong (Kanchanaburi); Yaa lakum, Yaa rakam (Ang Thong).

Specimens.- Flato 7784 (K); Gerrett 182 (K); Kerr 901, 2159 (BK, K), 19516, 20403 (K); Margelsdorf s.n. (K); Put 131 (K), 2574 (BK, K); Smitinand 6089, 6090 (BKF, K).

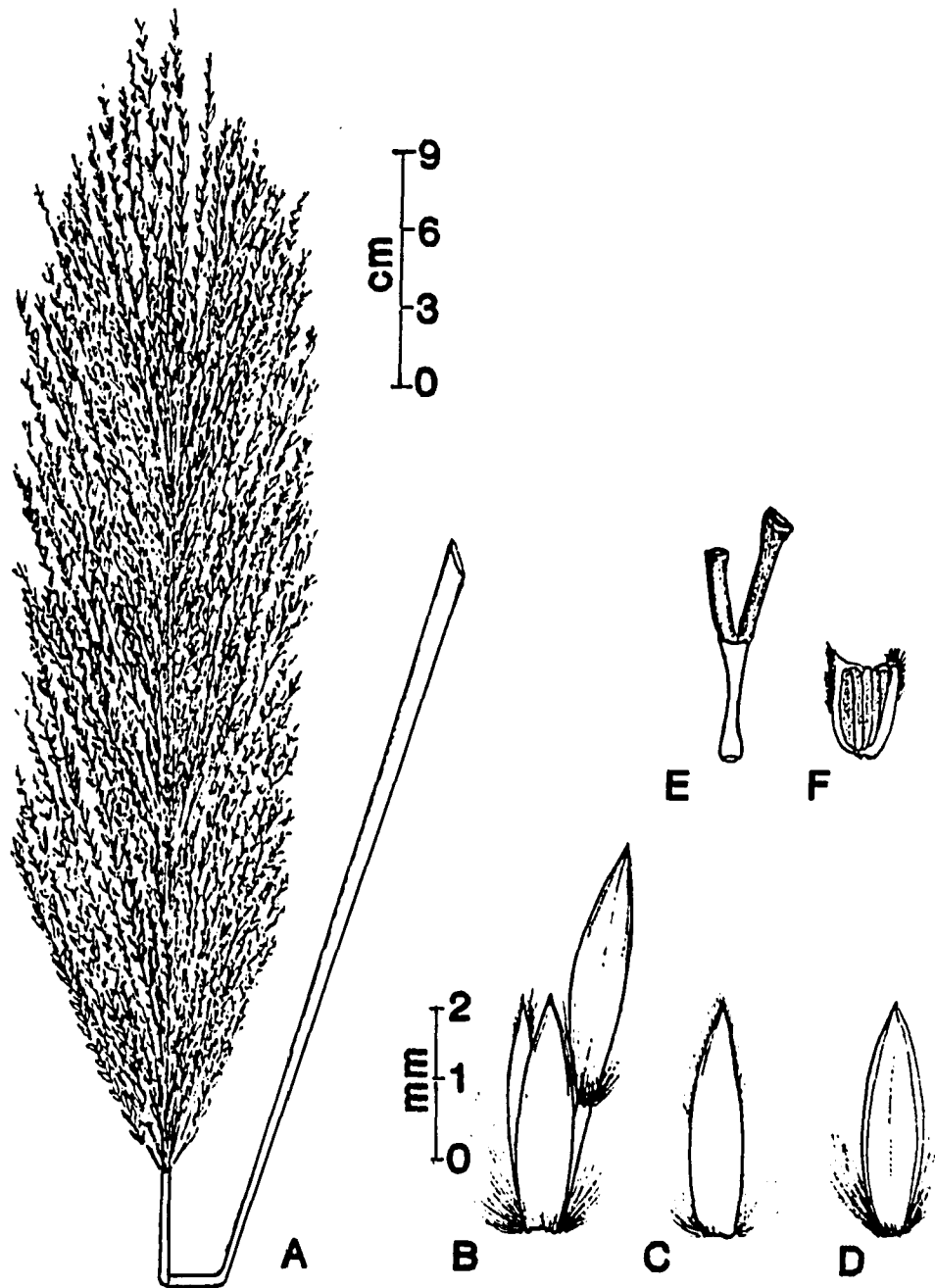


Figure 47. *Miscanthus fuscus* (Roxb.) Benth.
 A. habit, inflorescence B. spikelet pair C, D.
 lower glume dorsal and ventral view E. rhachis
 internode and pedicel F. palea and stamens;
 (Smitinand 6089, K).

POGONATHERUM P. Beauv.

Pogonatherum P. Beauv., Ess. Agrost.: 56.1812; Clayton, Gen. Gram.: 334.1986.

- *Homoplitis* Trin., Fund. Agrost.: 166.1822 (nom. superfl.).

- *Pogonopsis* Presl, Rel. Haenk. 1: 333.1830.

Note.- Name from Greek word pogon = beard, ather = the awns on an ear of corn: referring to the beard-like appearance of the fine awns.

Perennials, caespitose, with vigorous fibrous roots; culms erect, wiry; ligule membranous, very short. *Leaf-blades* narrow, flat or inrolled, margins scaberulous, with few setose hairs towards the throat. *Inflorescence* a simple, spiciform, raceme solitary; spikelets laterally compressed, paired, 2-awned; rhachis-internodes widened at apex, grooved, ciliate on margins. *Florets* 2; lower male in sessile spikelet, neuter in the pedicelled; upper bisexual in sessile and female in pedicelled spikelet. *Sessile spikelet* with an involucre long hairs callus; glumes subequal, thinly membranous to hyaline, notched and ciliate at apex, glabrous or hairy on surface; lower glume cartilaginous, rounded on back, 3-nerved, truncate; upper glume slightly longer than lower, strongly compressed, keeled, awned. *Lemmas* thinly membranous to hyaline; lower convex, muticous, nerveless or 1-nerved; upper convex, keeled, shortly and acutely 2-lobed, with an extremely slender apical long awn; palea nerveless, apex dentate ciliate, or often absent. *Lodicules* absent. *Stamens* 1-2. *Ovary* small; styles 2, free; stigmas exerted apically. *Caryopsis*

ellipsoid, flattened. *Pedicelled spikelets* similar to sessile but smaller and with shorter awns.

A genus of 3 species in Asia, distributed from India to eastern and southern Asia, Polynesia and north-eastern Australia. In Thailand 2 species, *P. crinitum* and *P. paniceum*, are recorded.

KEY TO THE SPECIES OF POGONATHERUM IN THAILAND

1. Spikelets 2.5-3 mm long; callus hairs of the pedicelled spikelets up to 2 mm long, lower floret male; upper floret with 2 stamens; awns 10-15 mm long

P. paniceum

1. Spikelets up to 2 mm long; callus hairs of the pedicelled spikelets 2-4 mm long; lower floret empty; upper floret with 1 stamen; awns 20-30 mm long

P. crinitum

1. *Pogonatherum crinitum* (Thunb.) Kunth, Enum. Pl. 1: 478.1833; Bor, Fl. Assam, 5: 348.1940; Fl. Ind., Burm. & Ceyl. 1: 200.1960.

- *Andropogon crinitus* Thunb., Fl. Jap.: 40.1784.

Type.- Japan, no locality cited, Herb. Thunberg Bot. Mus.

Uppsala (K-phototype!).

- *Homoplitis crinita* (Thunb.) Trin., Fund. Agrost.: 166.1820.

- *Andropogon monandrus* Roxb., Fl. Ind. 1: 264.1820.

- *Pollinia monandra* Spreng., Syst. Veg. 1: 288.1825.

- *Ischaemum crinitum* (Thunb.) Trin. in Mem. Acad. Sci. Petersb. 6,2:
298.1832.

Perennial; culms slender often wiry and reddish, 10-50 cm high; internode near the base up to 4 cm; nodes sparsely villous; sheaths slightly keeled, sparsely villous particularly at base; ligule thinly membranous, fimbriate. *Leaf-blades* narrowly lanceolate to lanceolate, usually inrolled, 2-5 cm long by 0.5-2 mm wide, narrowed at base. *Inflorescence* a solitary raceme, 1-3 cm long; peduncle very slender up to 10 cm long; rachis internodes 0.5-1 mm long, densely ciliate along the margins. *Sessile spikelets* narrowly oblong to lanceolate, 1-2 mm long; lower glume awned, truncate and ciliate apex, membranaceous, obscurely 2-nerved; upper glume, cymbiform, awned; awn straight in the upper part, 15-25 mm long; lower floret empty in the upper floret; upper lemma spatulate, awn 15-30 mm long; stamens often 1 rarely 2; caryopsis 0.4 mm. *Pedicelled spikelets* similar to sessile spikelets but smaller, callus woolly hairs 2-6 mm long; pedicel 0.6 mm. (Fig. 48 & Plate 45).

Thailand.- NORTHERN: Chiang Mai (Chiang Dao, Doi Suthep, Mae Klang, Mae Tak, Tat Noi); Phrae (Huay Hom Yai); EASTERN: Nakhon Ratchasima (Khao Yai); CENTRAL: Nakhon Nayok (Salika Waterfall); Saraburi (Muek Lek); SOUTH-EASTERN: Trat (Kaw Kut, Klong Ma Yom); SOUTH-WESTERN: Kanchanaburi (Sangka); PENINSULAR: Chumphon (Mueng, Ban Map Amarit); Nakhon Si Thammarat (Chawng); Phangnga (Kao Kataluwan, Kao Kata Kwam); Ranong (La Un); Satun (Adang); Songkhla (Rattaphum);

Surat Thani (Ban Kawp Kep); Trang (Khao Chong).

Distribution.- From India to Ceylon, Burma, Indo-China, Malesia and Japan (Type!).

Ecology.- Common in damp localities on sandy soils, by streams and in understory of deciduous forests, at 300-800 m.

Vernacular names.- Yaa phai yong (Trat); Yaa phai, Yaa yuung (Chiang Mai).

Specimens.- Beusekom et al. 1830 (K); Chermisrivatana 450 (BK); Den Hood 214 (BKF, K); Hambanonda 186 (BKF); Kerr 3724, 6814 (K), 11417 (BK), 13209, 14103 (K), 15152 (BK, K), 16523 (K), 18424 (BK, K); Khantchai 75, 387 (K), 1068 (BKF, K); Lakshnakara 833 (BK, K); Larsen, Smitinand & Warncke 415 (AAU, K); Llewelyn 17244 (K); Murata et al. 15399 (BKF); Phengkklai 81 (BKF, K); Shimizu et al. 27662 (BKF); Smitinand 2517, 5719 (K); Smitinand & Alsterlund 6756 (K); Sorensen, Larsen & Hansen 1016, 1872 (K); Suvatabandhu 489 (BK).

Remarks.- A very distinctive little grass, usually to be found growing in wet, shady places or among rock crevices along river banks. Easily recognized by its stout, solitary, yellowish panicles each spikelet with 2 long awns.

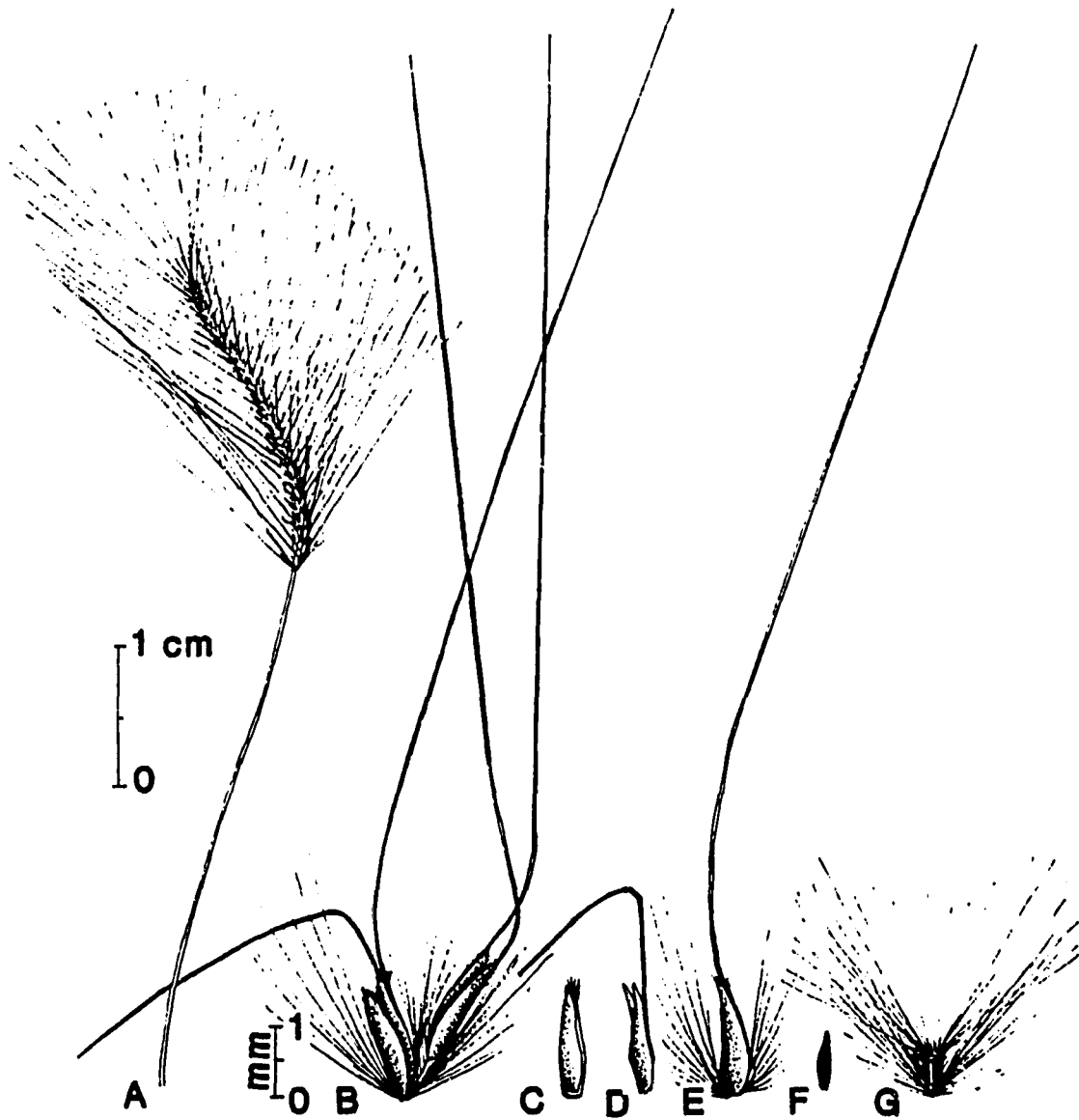


Figure 48. *Pogonatherum crinitum* (Thunb.) Kunth
 A. habit, inflorescence B. spikelet pair C-E. sessile
 spikelets C. lower glume D. upper lemma and awn E.
 upper glume with aristate awn F. caryopsis G. pedicel;
 (Murata et al. 15399, BKF).

2. *Pogonatherum paniceum* (Lamk.) Hackel in Allg. Bot. Zeit. 12: 178.1906; Bor, Fl. Assam, 5: 347.1940; Fl. Ind., Burm. & Ceyl. 1: 201.1960; Gilliland, Fl. Mal. 3: 251.1971.

- *Saccharum paniceum* Lamk., Encycl. Meth. Bot. 1:595.1785.

Type.- East India, Sonnarat (K-holotype!).

- *Pogonatherum saccharoideum* P. Beauv., Ess. Agrost.: 176,177.1812.

- *Perotis polystachya* Willd., Sp. Pl. 1: 324.1789.

- *Pogonatherum polystachyum* (Willd). Roem. et Schult., Syst. Veg. 2: 497.1817.

- *Pollinia polystachya* Spreng., Syst. Veg. 1: 288.1825.

Perennial; culms stout, hard, tufted at base, often yellow, 15-60 cm tall; internode near the base up to 8 cm; nodes hairy; sheaths lax, glabrous except for long setose hairs in the throat; ligule membranous, fimbriate, 1 mm. **Leaf-blades** lanceolate, flat or inrolled, apex acuminate, base cuneate, 3-6 cm long by 1-3 mm wide. **Inflorescence** 2-4 cm long, usually golden-hairy from the long spreading awns, rachis internodes 1-1.5 mm long. **Sessile spikelets** callus short, blunt, setose hairy; lower glume 2-nerved, hyaline, truncate, short setose-hairy near the tip, margins inflexed, the back minutely scabrid, 2.5 mm long; upper glume similarly, hyaline, upper part excurrent into a long awn, 15 long; lower floret absent, or if present, lemma delicately hyaline, nerveless, oblong, ovate, setose-hairy at the tip, 1.3 mm long; palea delicately hyaline, linear, 2-toothed; stamens 2, anthers yellow, 1mm; upper lemma delicately hyaline with a long kneed and twisted awn; awn 15-20 mm long; stamens 1. **Pedicelled spikelets** similar to sessile spikelets, usually 1-

flowered and female only; pedicel 1.-1.5 mm long.

(Fig. 49 & Plate 45).

Thailand.- NORTHERN: Chiang Mai (Bo Luang-Om Koi, Doi Suthep, Pang Mapha, Tat Noi); Chiang Rai (Fang); EASTERN: Chaiyaphum (Ban Nam Phrom); SOUTH-WESTERN: Kanchanaburi (ERawan Falls, Sai Yok, Sri Sawad).

Distribution.- India (Type!), Ceylon, Burma and Indo-China.

Ecology.- Common among rocks by streams and in wet places in deciduous and evergreen forests, at 150-1000 m.

Specimens.-Beusekom et al. 4076 (BKF); Geesink et al. 6907 (BKF, K); Hansen & Smitinand 12733 (K); Hansen, Seidenfaden & Smitinand 10788 (BKF); Hosseus 291, 421 (K); Kasem 100 (BK); Kerr 950 (K); Larsen 9262 (BKF, K); Smitinand 4317 (BKF, K); Smitinand & Abbe 6182 (K); Smitinand & Alsterlund 6758 (K); Sukkri 86 (K); Suvatabandhu 314 (BK).

Remarks.- This "Bamboo Grass" is now available in the Sunday Market in Bangkok. The grass is popularly grown as a pot plant in houses and also as Bamboo Bonsai.

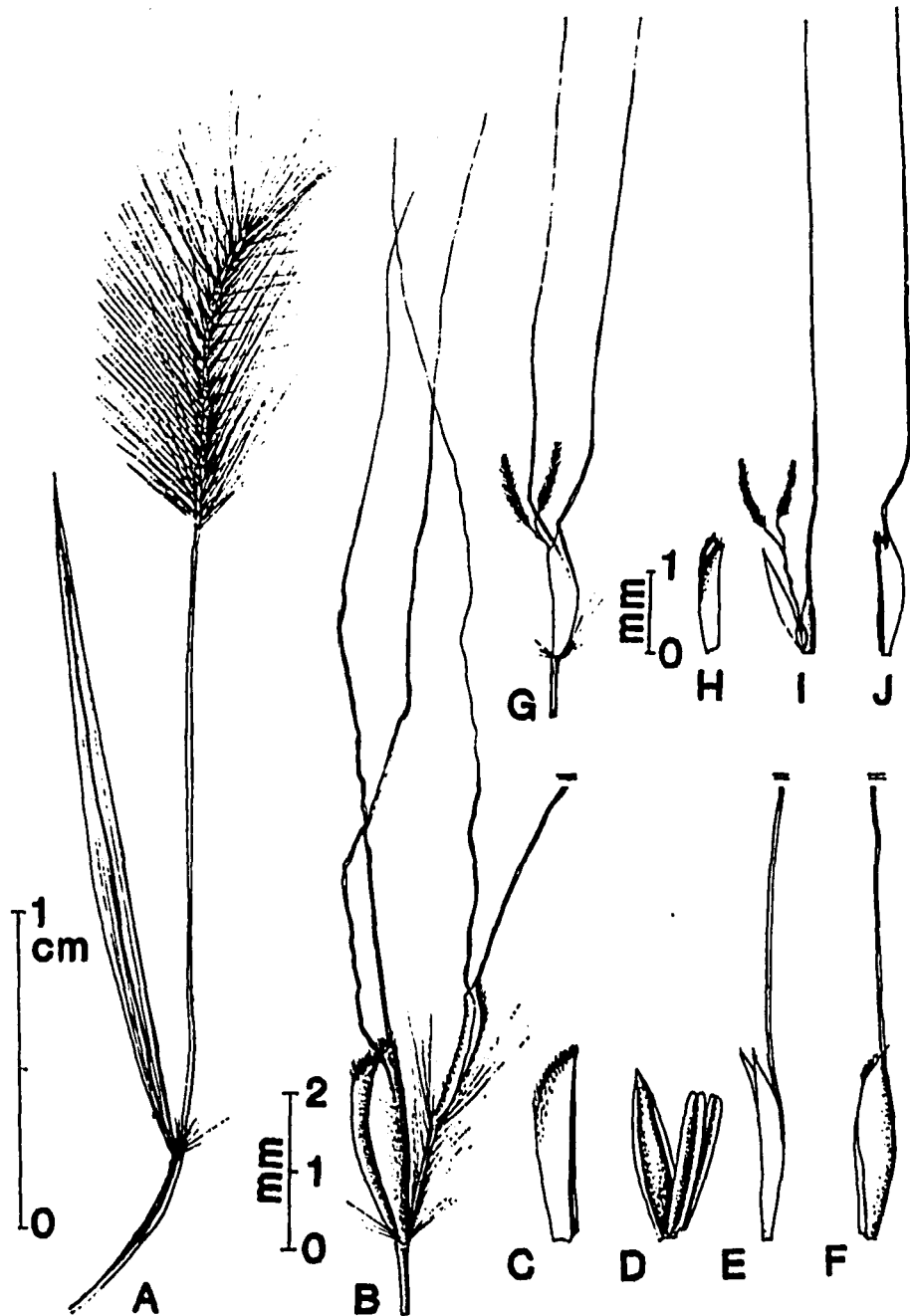


Figure 49. *Pogonatherum paniceum* (Lamk.) Hack.
 A. habit, leaf and inflorescence B. spikelet pair C.
 lower glume D. lower lemma and stamens E. upper lemma
 and awn F. upper glume with aristate awn G. pedicelled
 spikelet H. lower lemma I. palea, ovary and stigmas,
 and upper lemma with an awn J. upper glume with aristate
 awn; (Suvatabandhu 314, BK).

POLYTRIAS Hack.

Polytrias Hack. in Engler et Prantl, Nat. Pflanzenfam. 2,2: 24.1887.

Note.- Name from Greek words polys = many, trias = a group of three: referring to the groups of 3 spikelets.

Slender, decumbent *perennials*; culms glabrous; sheaths glabrous; ligule short, ciliate. *Leaf-blades* flat, linear-acuminate. *Inflorescence* a solitary brownish raceme, with many-jointed villous rhachis. *Spikelets* in threes, dorsally compressed, alike in shape and sex or sometimes dissimilar in sex, two sessile, the other pedicelled on the fragile rhachis of a spiciform raceme; pedicelled spikelet falling from its pedicel; sessile spikelets deciduous with the adjacent internode of rhachis and pedicel. *Floret* 1, bisexual or sometimes in the pedicelled spikelet male. *Sessile spikelets* membranous, muticous, truncate, dentate, hairy; lower glume 4-nerved, 2-keeled, with inflexed margins; upper 3-nerved, the laterals faint. Lemma thinly membranous, hyaline; lower lemma and palea wanting; upper with 2 hairy lobes and a geniculate awn from sinus. Palea smaller than lemma. Lodicules small, cuneate. Stamens 3. Styles 2, free; stigmas exerted from or near the apex. Caryopsis oblong to obovate, glabrous, obtuse; embryo rather large; hilum punctiform. *Pedicelled spikelets* awned, similar to sessile, but smaller.

A monotypic, tropical genus distributed from India to Polynesia, and common in Southeast Asia. In Thailand *P. ansura* is largely in the lowlands in a wide range of habitats and scattered up to 1600 m altitude.

- Polytrias amaura* (Buse) O. Ktze., Rev. Gen. Pl.: 788.1891.
- *Andropogon amaurus* Buse in Miq., Pl. Jungh.: 360.1854.
Type.- Java, s.n. (K-Phototype!).
 - *A. diversiflorus* Steud., Syn. Pl. Glum. 1: 370.1854.
Type.- India, s.n. (K-holotype!).
 - *A. firmandus* Steud., l. c.: 370.1854.
 - *Pollinia praemorsa* Nees in Steud., Synops. 1: 409.1854.
 - *Polytrias praemorsa* (Nees) Hack. in Engl. et Prantl, Nat. Pflanzenfam 2,2: 24.1887. Type.- Borneo, Bangarmassing, J. Motley 539 (K-holotype!).
 - *P. diversiflora* (Steud.) Nash in Torreyia 5: 110.1905.
 - *Eulalia praemorsa* (Nees) Stapf ex Ridley, Fl. Mal. Pen. 5: 197.1925.
 - *E. amaura* (Buse) Ohwi in Bull. Tokyo Sci. Mus. 18: 2.1947.

Perennial; culms decumbent, erect, 15-40 cm tall; often stoloniferous, stolon internodes 3-4 cm long, many branched above; nodes hairy to glabrescent, often dark purplish; sheaths glabrous or only few hairs at the joint, creamy to purplish; ligule a very shallow fimbriate membrane. *Leaf-blades* 2.5-6 cm long by 2-4 mm wide, apex acuminate, base subcordate, often purple; midrib and main nerves distinct; hairy with bulbous-based hairs on both surfaces when young especially near the base, margin minutely scaberulous. *Inflorescence* a terminal spike-like raceme, 3-5 cm long, fulvous setose-hairy all over; rachis internode 3 mm long, spikelets in triad at each node, 2 sessile and 1 pedicelled, the axis flattened and hairy on the margins. *Sessile spikelets* with a short callus; lower glume oblong-ovate, truncate, toothed, short-ciliate apex, obscurely 2 or 4-nerved, the

margins inflexed, flat on the back, setose-hairy all over; hairs up to 3.2 mm long; upper glume 3-nerved, cymbiform, blunt tipped, shortly setose-hairy on the keel and on the upper part, otherwise glabrous; lower lemma nil; upper lemma 1-nerved, stipitate, bilobed. *Awn* 1.3-1.5 cm; palea a suborbicular, 0.5 mm long; stigmas 2-4 mm long, commonly purplish. *Pedicelled spikelets* awned, similar and more or less the same size as sessile spikelets; pedicel 1.5-2.5 mm.

(Fig. 50 & Plate 46).

Thailand.- EASTERN: Nakhon Ratchasima (Khao Yai); CENTRAL: Bangkok (Bangkhen, Dusit Zoo); SOUTH-WESTERN: Kanchanaburi (Sai Yoke, Thong Pha Phum); PENINSULAR: Phuket.

Distribution.- India, Burma, China, Indo-China and Malesia.

Ecology.- On sandy ground, open waste land and by roadsides, also commonly planted as a lawn-grass.

Vernacular name.- Yaa phraek daeng (Bangkok, General).

Specimens.-Beusekom et al. 3949 (BKF, K); Collins, s.n./ 1927 (K); Dee, s.n./ 15 Oct. 53 (BKF); Fukuoka 7080 (BKF); Iwatsuki 243 (BKF); Kerr 3895 (K), 6728 (BK), 13786 (K); Larsen 8659, 9609, 9610 (K); Nanakorn 1231 (BKF, NY); Put, s.n./ 13 Feb. 32 (BK); Smitinand 4533 (K); Sorensen, Larsen & Hansen 1970 (BKF, K).

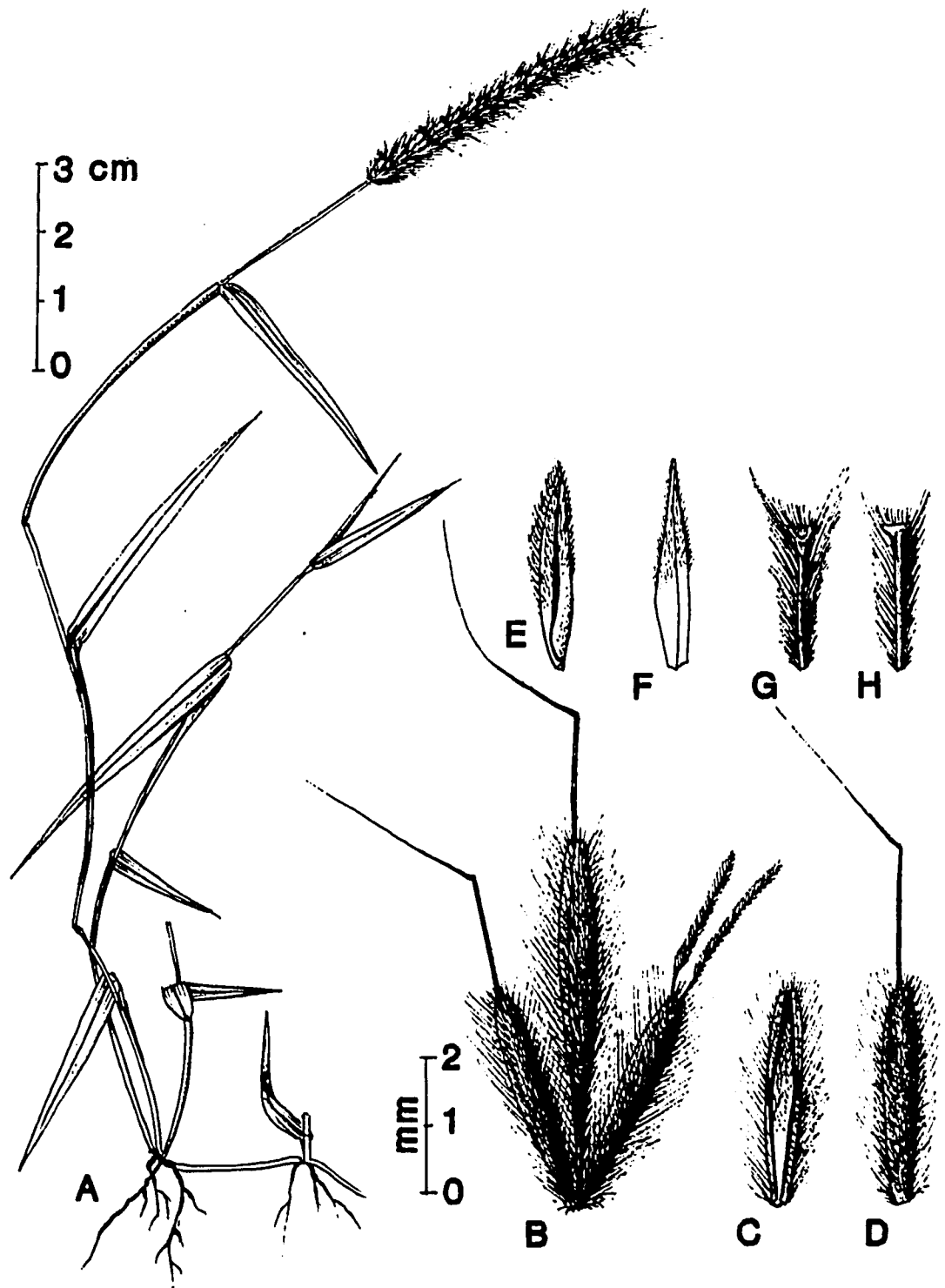


Figure 50. *Polytrias amaura* (Beuse) O. Ktze.
 A. habit B. spikelet pair; consisting of one pedicelled
 and two sessile spikelets C. ventral view of lower glume
 D. dorsal view of lower glume E. lemma F. palea G, H.
 pedicels; (Nanakorn 1231, BKF).

SACCHARUM Linn.

Saccharum Linn., Sp. Pl.: 54.1753; Benth. in J. Linn. Soc. Bot. 19: 65.1881; Clayton, Gen. Gram.: 330.1986.

- *Erianthus* Michaux, Fl. Bor. Am. 1: 54.1803.
- *Saccharifera* Stokes, Bot. Mat. Med. 1: 131.1812 (nom superfl).
- *Ripidium* Trin., Fund. Agrost.: 169.1822 (non Bernhardi, 1800).
- *Andropogon* subgen. *Lasiorrhachis* Hack. in DC., Monogr. Phan. 6: 471.1889.
- *Lasiorrhachis* (Hack.) Stapf in Hook., Ic. Pl. 32: 3124.1927.
- *Narenga* Bor in Ind. For. 66: 267.1940.

Note.- Name from a Greek word *saccharon* = sugar: in allusion to the sweet juice of the grass.

Perennials, robust; culms solid, smooth, glossy. *Leaf-blades* usually linear, flat. *Inflorescence* a large panicle, often silvery-silky from the long hairs at base of the spikelet and plume-like. *Spikelets* similar, enveloped in long hairs, in pairs, one sessile, the other pedicelled on the jointed fragile rhachis of paniced spiciform racemes; pedicelled spikelet falling from its pedicel; sessile spikelet deciduous with the adjacent internode of rhachis and pedicel. Florets 2; lower neuter; upper bisexual. *Sessile and pedicelled spikelets*; glumes equal, membranous to subhyaline, often chartaceous to subcoriaceous towards base; lower glume with inflexed margins, in the sessile spikelet usually with an even number of nerves; upper glume 1-3-5 nerved. Lemmas hyaline; upper with a terminal bristle-like usually straight awn or mucronate

or mucicous, or absent. Paleas often minute or absent. Lodicules 2, cuneate, with a blunt tooth on one or each margin. Stamens 3. Stigmas laterally exerted. Caryopsis terete, oblong to subglobose.

A genus of 12-15 species distributed in tropical and subtropical regions of chiefly the Old World, extensively cultivated in the New World and elsewhere. In Thailand 6 species are recorded including sugar cane, *S. officinarum*, the most economically important member; *S. arundinaceum* often grows in large clumps and is widespread in wet places in the lowlands at 100-300 m altitude; and wild cane, *S. spontaneum*, a very robust perennial with vigorous rhizomes, is frequent in open moist places from near sea level up to 1500 m.

KEY TO THE SPECIES OF SACCHARUM IN THAILAND

1. Cultivated species with thick stem and broad leaves, up to 6 cm broad; high sugar content. Internode with 2-8 staggered rows of root-eyes. Main axis of the inflorescence and its branches glabrous; rhachis tough; glumes glabrous

S. officinarum
1. Wild species, without sugar content; internode with 1-2 rows or without root-eyes. Main axis of the inflorescence and its branches glabrous or appressed silky pilose; rhachis fragile; glume glabrous or hairy
 2. Spikelets awned, plant less than 2.5 m high
 3. Inflorescence narrow, 15-45 cm long; peduncle glabrous below the panicle. Spikelets 4.5-5 mm long, callus densely with

golden brown hairs, awn up to 2 cm long, pedicel enlarge,
cupular at the top

S. longisetosum

3. Inflorescence plumose, 20-25 cm long; peduncle with appressed
silky hairs below the panicle. Spikelets 2.5-3 mm long,
callus densely silky hairy, awn 6-8 mm long, pedicel filiform

S. rufipilum

2. Spikelets awnless, plant 2-4 m high or more

4. Peduncle glabrous below the panicle, main axis of the
inflorescence grey or silvery, spikelets 2.5-2.7 mm long.
Leaf-blades broadly-lanceolate, up to 50 mm wide; root-eyes
arranged in single-row

S. arundinaceum

4. Peduncle hairy below the panicle, main axis of the
inflorescence and its branches glabrous or appressed silky
pilose. Leaf-blades linear-acuminate, 4-6 mm broad; root-
eyes obscured or arranged in 2-rows

5. Inflorescence densely silky hairy; panicle plumose, up to
90 cm long. Spikelets 3-6 cm long, upper lemma bi-lobed.
Plants up to 3 m or more, internodes with 2-rows of root-
eyes

S. spontaneum

5. Inflorescence purplish to greyish purple in color; panicle
narrow, 30-45 cm long. Spikelets 2.5-3 cm long, upper
lemma obtuse or truncate. Plants up to 2.5 m high,
internodes with obscured root-eyes.

S. porpyrocoma

1. *Saccharum arundinaceum* Retz., Obs. Bot. 4: 14.1786; Bor, Fl. Assam 5: 320.1940; Gilliland, Fl. Mal. 3: 226.1971; Smitinand, Thai Pl. Names: 293.1980.

- *Erianthus arundinaceus* (Retz.) Jeswiet in Arc. Suikerind. Ned.-Ind.: 399.1925.

- *Saccharum bengalense* Retz., Obs. Bot. 5: 16.1789.

- *S. exaltatum* Roxb., Fl. Ind. 1: 245.1820.

- *S. procerum* Roxb., l. c.: 243.1832; Bor, Fl. Assam 5: 320.1940.

A very large grass growing in clumps; culms up to 6 m tall, smooth, glabrous, silky villous at base; nodes smooth and glabrous; internodes long; sheaths glabrous, striate, stout; ligule a truncate membrane. *Leaf-blades* broadly-lanceolate, up to 1.5 m long by 5 cm wide, apex tapering to a very fine point, midrib large at the base up to 1/3 the width of the blade, villous at the base only for a short distance on the midrib; margins very scabrid; upper leaves much reduced and often filiform. *Inflorescence* a large panicle up to 60 cm long, grey or silvery; axis glabrous; branches tufted, alternate or sub-verticillate; spikelets alike, rhachis internodes 3.5-4 mm long. *Sessile spikelets* 2.5-2.7 mm long; awnless, callus densely hairy as long as the spikelet; lower glume chartaceous with a few villae on the back and overtop the spikelet; upper glume glabrous. Lower floret male or neuter; lemma hyaline, as long as the spikelet, epaleate; upper floret bisexual, lemma hyaline half the length of the spikelet; palea quadrangular, small, half as long as the lemma, ciliate. *Pedicelled spikelets*; glumes dorsally villous, pedicels 2-2.5 mm long. (Plate 47).

Thailand.- NORTHERN: Chiang Mai (Chiang Dao); Kampheng Phet (Raheng); Phrae (Mae Khaem); Tak (Doi Musor); NORTH-EASTERN: Sakon Nakhon (Phu Phan); SOUTH-EASTERN: Chantaburi (Ban Ang, Khao Ploy Waen, Makham); CENTRAL: Bangkok; Nakhon Nayok (Khao Yai).

Distribution.- Eastern Asia from Arabia to Central Asia, southern China, southeast Asia, Indo-China to Philippines, Indonesia and New Guinea.

Ecology.- By river banks, in old clearings and open forest near roadsides, frequent at 200-1150 m altitude.

Vernacular names.- Khaem (General); Ta-po (Karen-Mae Hong Son); Traeng (Khmer-Surin); Pong (Northern); Samong, Yaa khamong (Chanthaburi).

Specimens.- Beusekom 4691 (K); Kerr 900, 9600, 18056 (K); Marcan 2145 (K); Sangkhachand 222 (K); Shimizu et al. 18048, 18418 (BKF); Smitinand 8486 (K); Sorensen, Larsen & Hansen 1164, 6062 (K).

Remarks.- Apparently a wild species, in Thailand the plants can be found in large pure stands for a long distances on sandy wet soils along the river banks.

2. *Saccharum longisetosum* (Anderss.) Naray. ex Bor in Fl. Assam

5:461.1950.- *Erianthus longisetosus* Anderss. in Oefers. K. Vet. Akad. Forh. Stockh: 163.1855; Bor in Fl. Assam 5:324.1950.

Type.- India, Silhet (K-holotype!).

Culms 2-2.5 m tall, terete, reed-like, simple or branched

from a stout rhizome, smooth and glabrous; sheaths rather loose, strongly striate, covered with appressed tubercle-based hairs and hairy at the junction with the blade; ligule rounded and shortly ciliate. *Leaf-blades* flat, lanceolate, 30-100 cm long, up to 1.5 cm wide, tapering to a fine tip from a gradually narrowed base, smooth and glabrous on both surfaces or with short appressed hairs; margins very scabrid. *Inflorescence* a panicle, 15-45 cm long, consisting of many long, densely packed, drooping racemes; covered with pale, reddish or golden brown soft hairs; rhachis internodes slender, 4-5 mm long; ciliate with long hairs along the margins, hairs 3-8 mm long. Spikelets similar, 4.5-5 mm long, golden brown in color; callus bearded, hairs up to 8 mm long; disarticulating from the pedicels, rather pale at the tips. *Sessile spikelets* oblong-lanceolate; lower glume chartaceous, usually glabrous, margins closely appressed and rather membranous, 2-4-nerved; apex truncate or two-toothed; nerves often anastomosing; upper glume, 1-nerved; margins hyaline, ciliate, glabrous; apex apiculate or rarely very shortly awned. Lower floret empty; lemma oblong, hyaline, ciliate. Upper floret bisexual; lemma very variable, about 3.5 mm long; awn up to 2 cm long; palea small, hyaline, oblong, truncate. *Pedicelled spikelets* with long hairs from the lower portion of the dorsal surface of the glumes, pedicels slightly thickened upward, cupular at the top, 4-5 mm long. (Plate 48).

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Wang Tao); Mae Sarieng (Bo Luang, Pang Mapha); NORTH-EASTERN: Loei (Phu Kradueng, Phu Luang).

Distribution.- India (Type!), Burma to Indo-China.

Ecology.- Scattered at borders of evergreen forest and savannah, on sandstone at 600-1300 m altitude.

Specimens.- Beusekom et al. 4616 (BKF); Chermisrivatana 460 (BK); Hansen & Smitinand 12732 (AAU, K); Hansen, Seidenfaden & Smitinand 11062 (K); Hennipman 3565 (K); Kerr 20147 (K); Sorensen, Larsen & Hansen 982 (K), 1074 (BKF, K), 6821 (K).

3. *Saccharum officinarum* Linn., Sp. Pl.: 54.1753; Bor, Fl. Assam 5: 320.1940; Smitinand, Thai Pl Names: 293.1980.- *S. sinensis* Roxb., Fl. Ind. 1: 239.1820. Type.- "No type specimen of *S. officinarum* exists" Munro (1862), and Mukherjee (1954).

Culms 2-6 m tall, erect, thick with high sugar content, glabrous or with appressed hairs below the panicle, waxy at least below the nodes, simple or branched; internodes with 2-8 staggered rows of root-eyes; sheaths pubescent towards the throat or at first covered with appressed hairs; ligule very short, membranous, ciliate. *Leaf-blades* flat, broad, rigid, linear-lanceolate, 1.5 m long by 6 cm broad, apex acuminate, base cuneate, spreading, drooping at the tip, scabrous, particularly above and on the margins; median nerve thick, white above. *Inflorescence* a very large panicle, ovate-pyramidal, spreading, dense; main axis glabrous, node bearded, smooth; primary branches slender, 5-10 cm long more or less verticillate, filiform, pubescent at the base, glabrous; minutely scaberulous at the top, bearded towards the nodes, base shortly naked; secondary branches simple, distant; rachis internodes and pedicels fragile, equalling

the spikelet, slightly enlarged at the top, glabrous. *Spikelets* similar, linear-oblong, pale or almost brownish, muticous, 3.5-4 mm long, papyraceous-membranous, acute, entire; margins broadly but laxly inserted, nerve obscured or nerveless; upper glume 3.5-4 mm long, membranous, lanceolate, acute 1-3-nerved, keels scabrous above, glabrous or ciliate. Lower floret empty; lemma almost as long as the spikelet, lanceolate, acute, hyaline, membranous, nerveless; upper floret hermaphrodite; lemma reduced or absent; palea lanceolate, ciliate at the apex.

Thailand.- Cultivated on a large scale throughout the country.

Distribution.-Cultivated throughout the tropical and subtropical countries, not known from wild habitats.

Ecology.- Lowlands to highlands in sandy soils with good drainage.

Vernacular.- Ka-thee (Karen-Mae Hong Son); Oi (General); Oi lao, Oi khom, Oi dam, Oi daeng (Central); Am-po (Khmer); Sugar Cane.

Specimens.-Kerr 7979 (K).

Remarks.- Sugar cane, *S. officinarum*, is cultivated, and there are many hybrids and varieties of this species which are placed in this study under the parent species.

4. *Saccharum porphyrocoma* (Hance) Hack., Monogr. Androp.: 120.1889.

- *Saccharum narenga* Wall Cat. no. 8856.

Type.- India, Herb. Wallich Cat. no 8856 (K-holotype!).

- *Eriochrysis narenga* Nees ex Steud., Syn Pl. Glum. 1: 411.1854.

- *E. porphyrocoma* Hance, J. Bot. 14: 294.1876.

- *Narenga porphyrocoma* (Hance) Bor, Fl. Assam 5: 316.1940.

Culms 2-2.5 m tall, erect, somewhat slender, rounded, appressed silky below the panicle and on the nodes; sheaths often little shorter than the internodes, tubercular, scabrous with long hairs near the throat and on the margins or hairy all over; ligule rounded, ciliolate, 2-3 mm long. *Leaf-blades* linear-acuminate, 30-60 cm long by 6 mm broad, narrow at the base, flat, glabrous above, with tubercle-based hairs below and very scabrid, the upper reduced and subulate; median nerve strong; margins very scabrid. *Inflorescence* a narrow dense panicle, almost linear, erect, wooly, purplish to greyish purple, 30-45 cm long; main axis robust, glabrous, minutely scaberulous, bearded at the nodes; primary branches 2-4 nate, filiform, appressed, often simple at the base; glabrous, secondary branches alternate; rhachis internodes fragile, about 1/3 shorter than the spikelet and equalling the pedicel, clavate, hairy at the base. *Spikelets* similar, awnless, broadly oblong, 2.5-3 mm long; lower glume flat, glabrous at the top, margins ciliolate at the base; the upper membranous, keeled, obtuse, margins ciliate towards the top, obscurely 3-nerved. Lower floret empty; lemma 2.5-3 mm long, oblong, obtuse, ciliate, nerveless. Upper floret bisexual, lemma 2-3 mm long, linear-oblong, obtuse or truncate, emarginate, nerveless, ciliate; palea about as long as the ovary. (Plate 49).

Thailand.- NORTHERN: Chiang Mai (Doi Tam Tu Pu); EASTERN: Nakhon Ratchasima (Pak Tong Chai).

Distribution.-Common in India and widely distributed in the tropical

parts of southeast Asia and Indo-China.

Ecology.- Edges of open deciduous forest, at 200 m.

Specimens.-Gerrett 182 (K); Kerr 8134 (BK, K).

Remarks.- This species was not included in the genus *Saccharum* in the revision by Mukherjee (1954), but it was included in *Saccharum* by Clayton (1986).

5. *Saccharum rufipilum* Steud., Syn. Pl. Glum. 1: 409.1854; Bor, Fl.

Assam 5: 462.1940.- *Erianthus fulvus* Nees ex Steud., Syn. Pl. Glum. 1: 409. 1854; Bor, Fl. Assam 5: 323.1940. **Type.**- Nepal, s.n. 1821 (K-holotype!).

Culms 1-2 m high, robust, many nodes, with silky appressed hairs below the panicle; sheaths striate, glabrous except towards the collar where the pubescence is silkily appressed, nodes sometimes bearded; ligule rotund-truncate, 1-2 mm long, fuscous, membranous, long-ciliate. *Leaf-blades* linear from a slightly narrowed base, setaceous-acuminate, 30-70 cm long, 8-16 mm broad, flat, rigid, glabrous except at the base, glaucous, scabrous below, smooth, green above; margins scabrid; median nerve prominent. *Inflorescence* a panicle, erect, short, oblong, 20-25 cm long, very dense at first, mauve-purple, fading to a fulvous color, decompound; common axis villous; primary branches solitary, up to 7 cm long, spikelets crowded; joints 8-10; pedicels filiform, villous, half as long as the spikelets or more. *Sessile spikelets* 2.5-3 mm long, lanceolate, brownish; callus hairs 1 cm long, pale towards the top; lower glume chartaceous, membranous, the hyaline tip abruptly acuminate, entire; margins inflexed below the

apex or not; back flat, very glabrous, 2-nerved, 2.5 mm long; upper glume rather longer, 2.5-3 mm long, acute or 2-mucronulate, glabrous; margins ciliate. Lower floret empty; lemma 3 mm long, linear-lanceolate, acute, ciliate; palea absent. Upper floret bisexual; lemma 2 mm long, ovate-lanceolate, glabrous, 1-nerved; awn 6-8 mm long; palea as long as the glume or shorter or entirely absent. Pedicelled spikelets similar to the sessile spikelets but lower glume sometimes with spinose hairs. Caryopsis obovate, ellipsoid brown to golden in color, 1.5 mm long. (Plate 50).

Thailand.- NORTHERN: Chiang Mai (Doi Angkang).

Distribution.-India, Pakistan (Kashmir), Nepal (Type!), Thailand.

Ecology.- On hillslopes, in open at 1500 m altitude.

Specimens.-Sadakorn 303 (BK).

Remarks.- Represented by a single specimen, this grass is a new record for Thailand. The specimen matches exactly the type specimen at Kew.

6. *Saccharium spontaneum* Linn., Mant. Alt.: 183.1771; Bor, Fl. Assam 5: 320.1940; Gilliland, Fl. Mal. 3: 224.1971; Smitinand, Thai Pl Names: 293.1980.

- *Imperata spontanea* (Linn.) P. Beauv. Ess. Agrost.: 8.1812.

Type.- Malabar, J.G. Koenig/ s.n. (K-holotype!).

- *Saccharum canaliculatum* Roxb., Fl. Ind. 1: 246.1832.

- *S. insulare* Brongn. in Duperr., Voy. Coq. Bot.: 99.1831.

- *S. propinquum* Steud., Syn. Pl. Glum. 1: 406.1855.

- *S. semidecumbens* Roxb., l. c.: 236.1832.

Rhizomes thick; culms 1-4 m tall, erect, with several nodes, solid, smooth, waxy, glabrous, with silky appressed hairs below the panicle; sheaths auricled, glabrous, except sometimes towards the throat and along the margins; ligule ovate, membranous. *Leaf-blades* narrowly linear-acuminate, 45-170 cm long by 4-5 mm broad, erect, rigid, coriaceous, glaucous, apex cuneate to a fine tip, very glabrous excepts at the base; margins scabrid, often involute. *Inflorescence* a lanceolate shaped panicle, dense, somewhat contracted; main axis slender, fragile, silky, almost glabrous except for appressed hairs at the summit; primary branches slender, 5-10 cm long, the lower 4-5-nate, the upper 1-2-nate; secondary branches simple or branched, filiform, silkily-hairy; rhachis internodes and pedicels ciliate, 1.5-3 mm long. *Spikelets* similar, awnless, lanceolate-acuminate, 3-6 mm long, sparsely hairy at the base, muticous; callus silky hairy, hairs twice to several times the length of the spikelet. Lower glume membranous above, sub-indurated and coriaceous at the base, entire or 2-toothed, margins smooth or ciliate, narrowly inturred, glabrous on the back, 2-nerved; upper glume equalling the lower, almost of the same texture, broadly lanceolate, acuminate, often mucronate, keel, margins ciliate, 1-nerved. Lower floret empty; lemma ovate-lanceolate, 3-6 mm long, acute or somewhat obtuse, ciliate, nerveless. Upper floret bisexual; lemma variable, often reduced, nerveless, ciliate or not; palea very small; lodicules ciliate on the margins, often with one long hairs. *Pedicelled spikelets* often more acute than the sessile. (Plate 51).

Thailand.- NORTHERN: Phrae (Mae Khaem Stream).

Distribution.- Eastern Asia, India, Burma, southeast Asia, Indo-China, Malaysia, Philippines, Indonesia (Type!), and New Guinea.

Ecology.- In open wet places and by stream banks at 200-450 m.

Vernacular names.- Khaem dok khaao, Kaaa luang (Chiang Mai); Khaa-long (Shan-Chiang Mai); Phong, Lao (General); Oi lao (Lop Buri); Wild Cane.

Specimens.-Beusekom et al. 4691 (BKF); Kerr 2518, 4000 (K); Put 2567 (K); Sorensen, Larsen & Hansen 5926 (K).

Remarks.- A highly polymorphic species well adapted to different ecological habitats. It is the most widely distributed species of *Saccharum* resulting from resistance to diseases and ecological factors. Hence, it has been used widely as a parent stock in breeding cultivated sugarcanes.

SPODIOPOGON Trin.

Spodiopogon Trin., Fund. Agrost.: 192.1822; Clayton, Gen. Gram.:

330.1896. - *Eccoilopus* Steud., Syn. Pl. Glum. 1: 123.1854.

Note.- spodos = ashes, pogon = beard: perhaps referring to the color of the spreading hairs below the spikelets.

Perennials, stout, often rhizomatous; culms solid; ligulemembranous, bearded at base. *Leaf-blades* linear to lanceolate, flat, sessile or petioled, with narrowed or sagittate or rounded base, velvety to pubescent on lower surface. *Inflorescence* a much branched panicle, spikelet-bearing towards the ends of the branchlets. *Spikelets* all alike, bisexual, awned, paired or the terminal triads, one sessile and the others pedicelled at each joint of a fragile rachis, ovate, terete long-hairy at base; rachis internodes and pedicels, spatulate, densely hairy along the margins, upper part enlarged cup-like. *Florets* 2; lower male or neuter; upper bisexual. *Sessile spikelet* deciduous with adjacent rachis internode and pedicel of pedicelled spikelet, with short bearded callus; glumes coriaceous; lower with 5-9 equally longitudinal nerves, without a median, glabrous or hairy; upper larger, cymbiform, 3-many-nerved, keeled on median nerve, stiffly hairy on margins. *Lemmas* hyaline, 3-nerved; lower as long as spikelet and similar to upper glume; upper bilobed with a perfect awn from sinus. *Palea* absent or if present hyaline, stiffly ciliate on margins, as long as lemma; stamens 3 or reduced; lodicules 2, unequally 2-lobed with the larger lobe ciliate. *Caryopsis* fusiform, laterally compressed; embryo 1/2 - 1/3 as long; hilum basal,

punctiform. *Pedicelled spikelets* deciduous from its pedicel; glumes sometimes with aristate apex.

A genus of ca. 7 species distributed chiefly in temperate regions of Asia, with one species in the Middle East. In Thailand a species *Spodiopogon lacei* is recorded from a restricted locality in the north at 900-1600 m altitude.

Spodiopogon lacei Hole in Indian For. Rec. 5,6: 185.1915; Kurz, Grass. Burma: 60.1945; Bor, Fl. Ind., Burm. & Ceyl. 1: 246.1960; Lazarides, Pharn. Monogr. 7: 18.1980. Type.- Burma, Maymyo, Lace 4372, 6075 (Herb. Dehradun-holotype, K-isosyntype!).

Perennial; loosely tufted; culms solid, erect, slender, up to 2.5 m high; nodes glabrous, shining; sheaths of lower leaves often longer than the internodes, of the upper leaves usually shorter, terete around the culm, glabrous; ligule membranous, truncate-fimbriate, 1-2 mm long. *Leaf-blades* linear, acute, narrowed at base, widest at about the middle, 20-40 cm long by 15-22 mm wide; scattered with bulbous-based hairs on both surfaces, margin scabrid; base hairy and strongly sagittate with 2-linear-deltoid lobes up to 3.5 cm long; midrib raised beneath; petiolate, petiole up to 15 cm long, dorsally rounded and channelled above. *Inflorescence* a terminal panicle, ovate to lanceolate, 17-25 cm long; branches subverticillate; racemes capillary, each bearing 3-9 spikelets; rhachis internodes 3-3.5 mm; spikelets paired both similar and awned, 4-5.5 mm long by 1 mm wide; callus short, obtuse, bearded. *Sessile spikelets* lanceolate,

membranaceous, 3-7 nerved, densely hairy on lower part, apex obtuse or emarginate; lower lemma thinly membranous, nerves obscured; upper bilobed, stipitate; awn geniculate, 10-15 mm long; palea ovate-lanceolate, hyaline, 3 mm long. *Pedicelled spikelets* similar to sessile spikelets; pedicels 2.5-3 mm long. (Fig. 51 & Plate 52).

Thailand.- NORTHERN: Chiang Mai (Chiang dao).

Distribution.- India, Burma and Indo-China.

Ecology.- Commonly scattered in the open and on slopes of limestone hills at 900-1600 m altitude.

Vernacular name.- Yang-dia-chaе (Karen-Mae Hong Son); Yaa kann (Northern).

Specimens.-Abbe & Smitinand 9318 (BKF, K, NY); Kerr 6654 (BK, K); Nanakorn 1251 (BKF, NY); Smitinand & Anderson 7363 (BKF, K); Smitinand, Poore & Robbins 7839 (BKF, K); Sorensen, Larsen & Hansen 1746 (K).

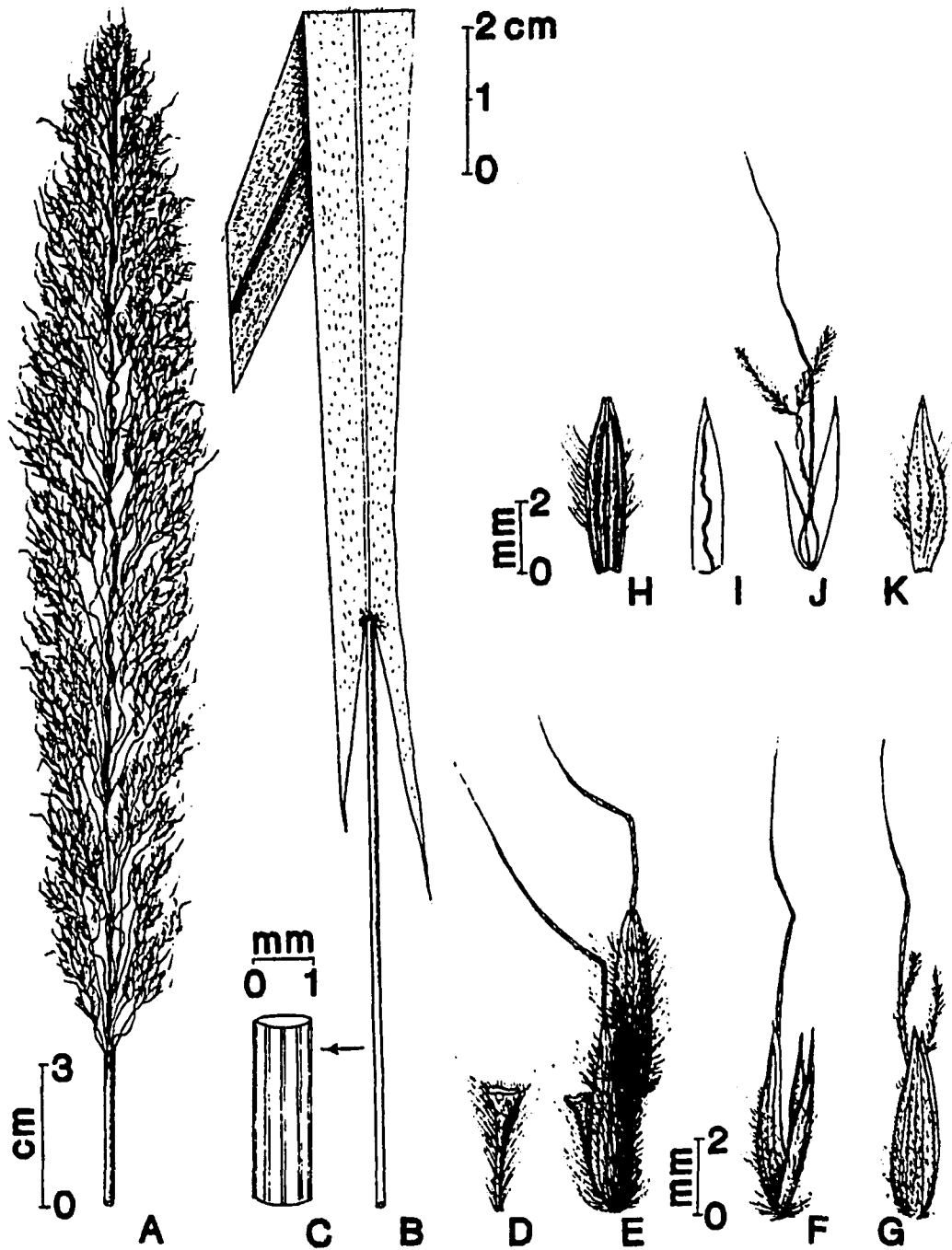


Figure 51. *Spodiopogon lacei* Hole

A. habit, inflorescence B. leaf-blade C. X-section of petiole D. pedicel E. spikelet pair F-K. sessile spikelet F. lateral view G. dorsal view H. lower glume I. lower lemma J. paleas, stigmas, and upper lemma with an awn K. upper glume; (Nanakorn 1251, BKF).

LIST OF PLATES

Note.- Pictures in the plates showing a background grid, each square of the grid has a side of 1 mm length. Abbreviations in this work are in the same format as follow:

ar = aristate awn
aw = awn
ca = callus
lm = lemma
lo = lodicule
lw = lower glume
pa = palea
pd = pedicel
ps = pedicelled spikelet
ra = rhachis internode
sm = stigma
ss = sessile spikelet
st = stamen
up = upper glume

SUBTRIBE ANDROPOGONINAE

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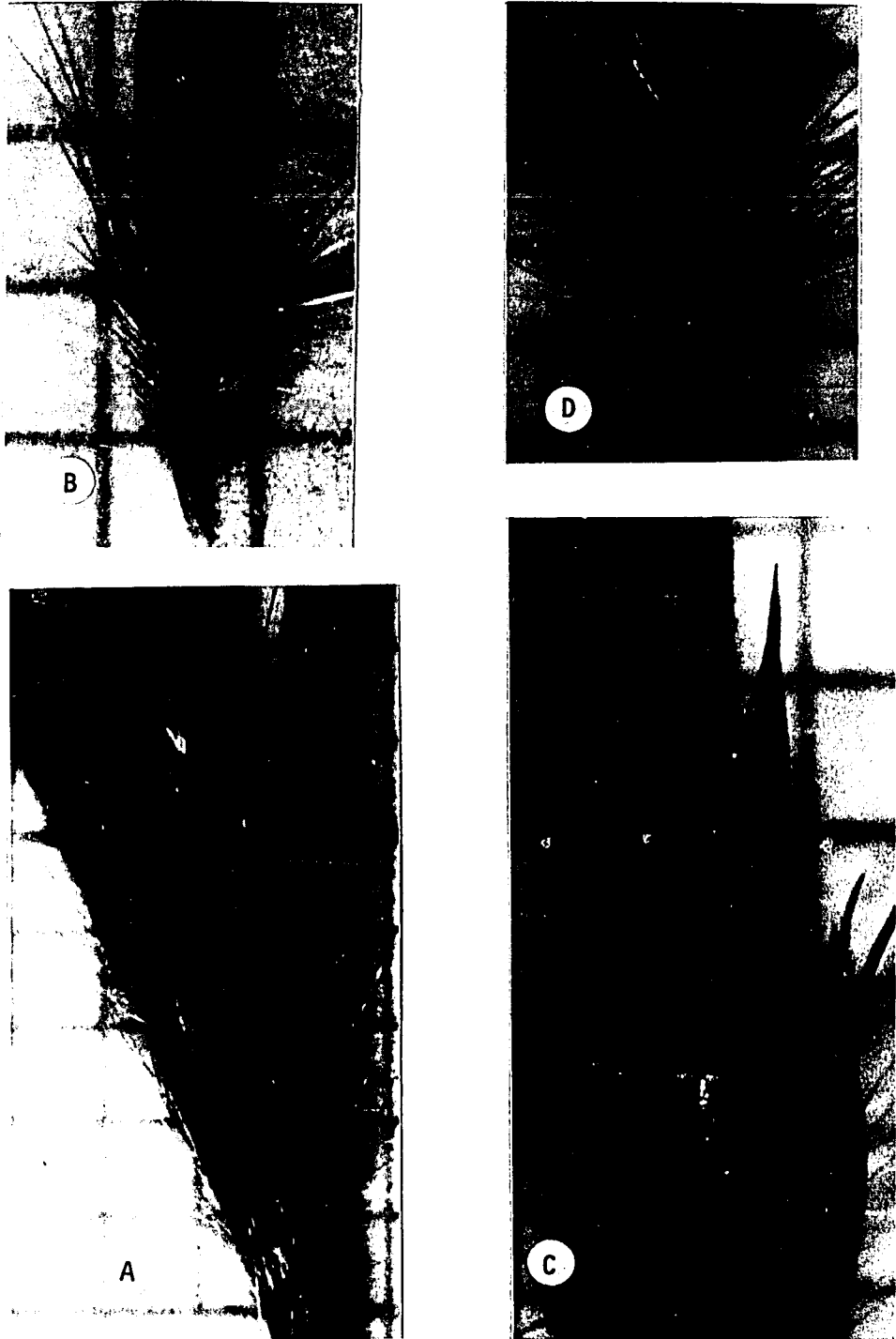


Plate No. 1. A, B. *Andropogon ascinodis* C.B. Clarke
 A. habit, spikelets in raceme B. rhachis internode
 C, D. *Andropogon fastigiatus* C. lateral view of sessile
 spikelet D. ventral view of rhachis internode.

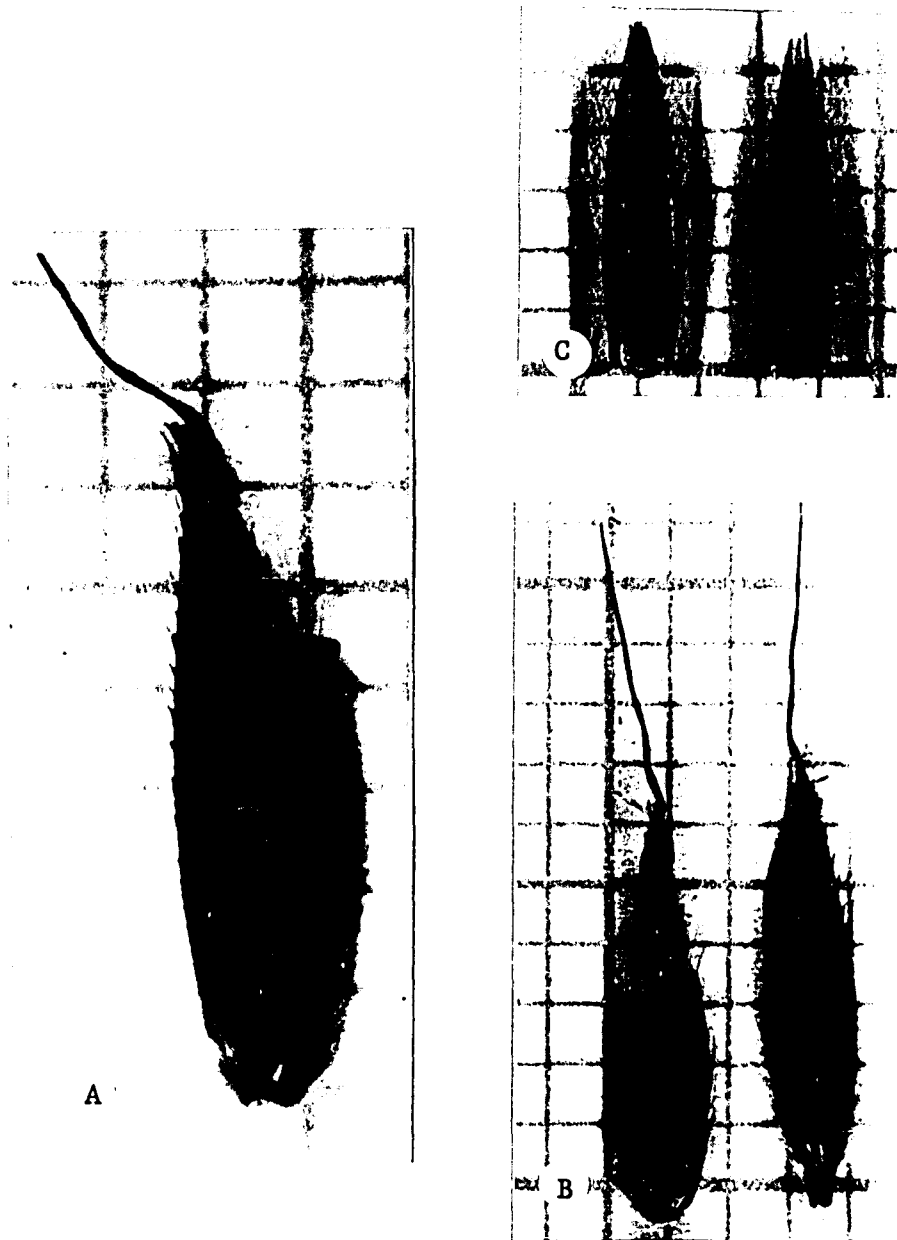


Plate No. 2. *Arthraxon castratus* (Griff.) Naray. ex Bor
 A. habit, lateral view of spikelet
 B. dorsal view and lateral view of spikelets
 C. ventral view and dorsal view of lower glume



Plate No. 3. *Arthraxon hispidus* (Thunb) Makino
A, B. habit, spikelets in raceme

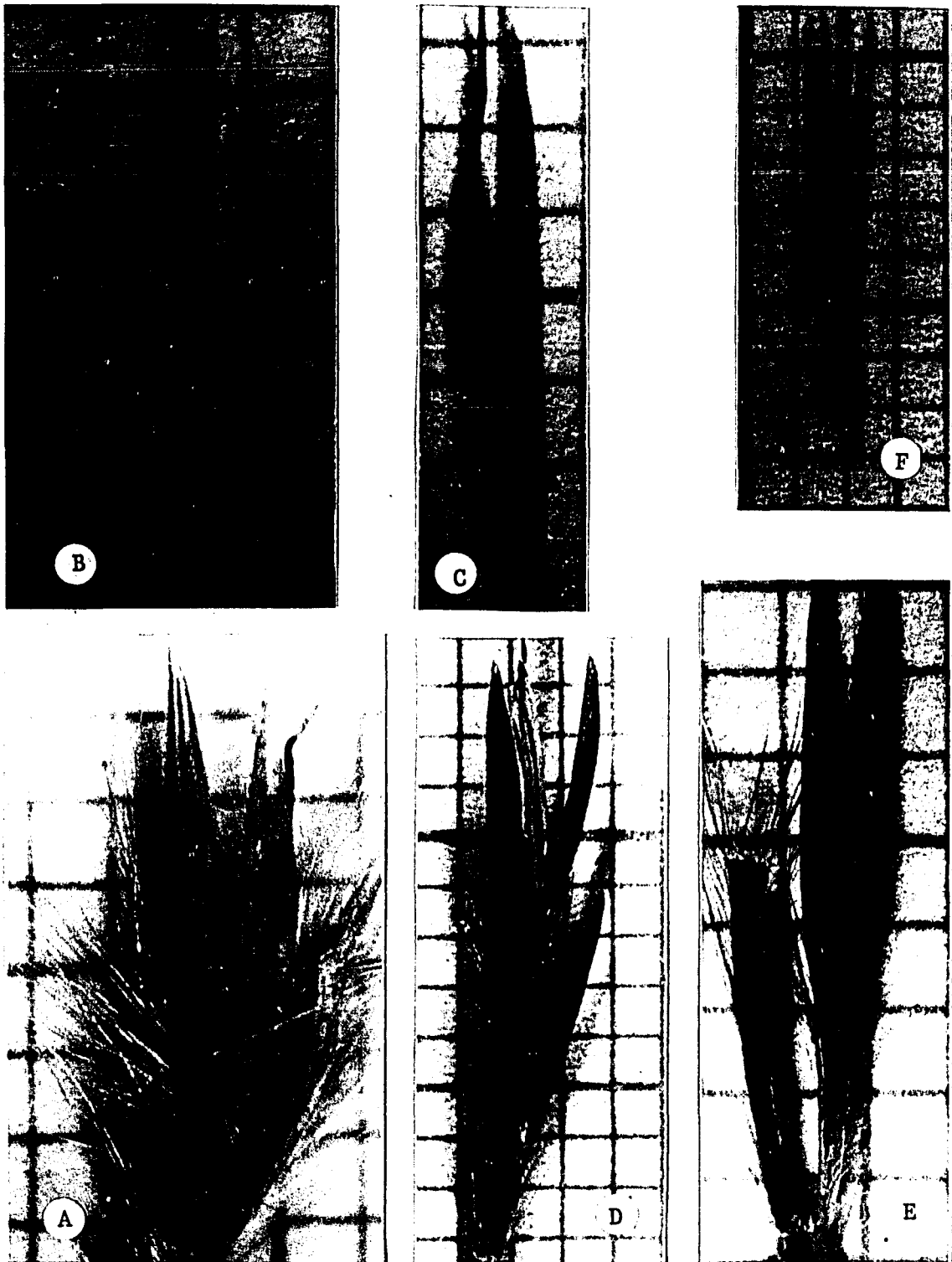


Plate No. 4. A-C. *Arthraxon lanceolatus* var. *meeboldii* (Stapf) Welzen A. habit, spikelets in raceme B. pedicelled spikelet C. sessile spikelet D-F. *Arthraxon lanceolatus* (Roxb.) Hochst. D. habit, spikelets in raceme E-F. pedicelled spikelet

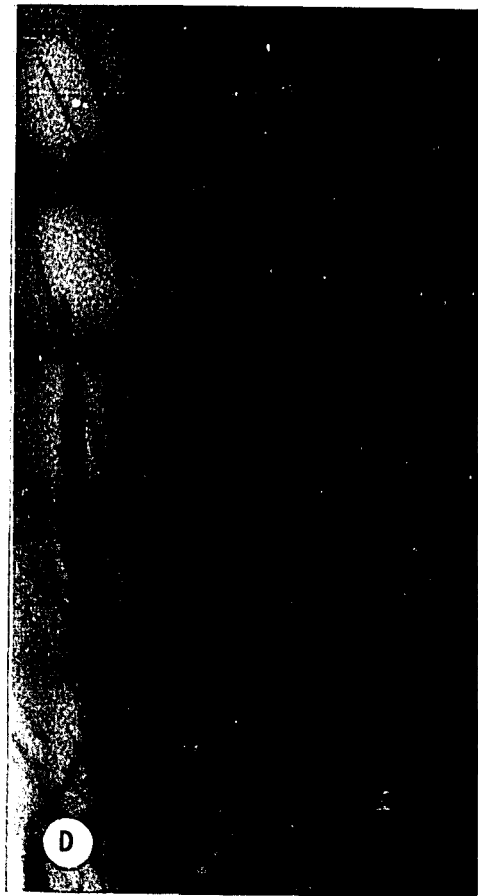
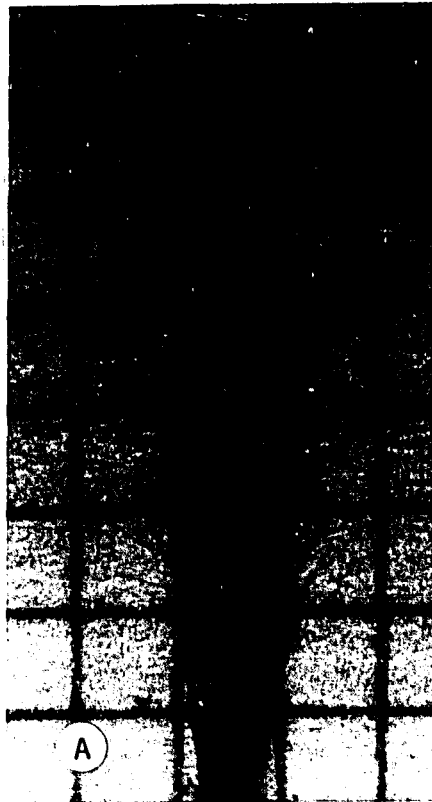
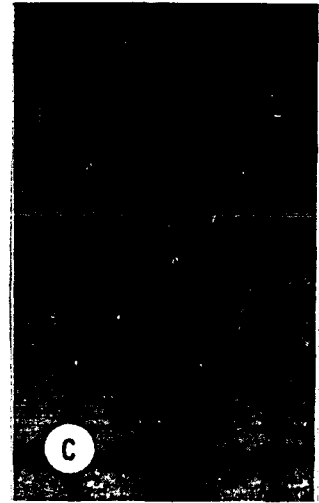
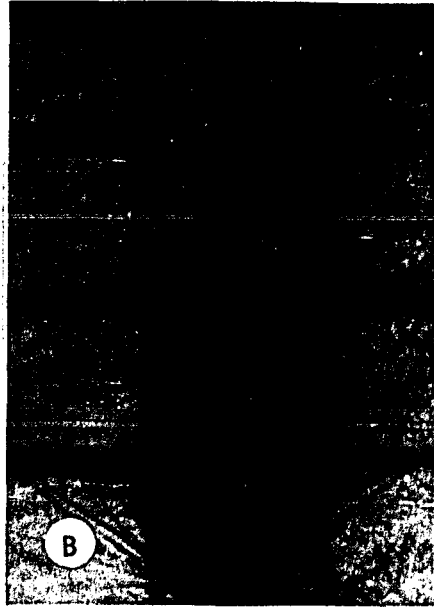


Plate No. 5. A, B. *Arthraxon microphyllum* (Trin.) Hochst.
 A. habit, spikelets in raceme B. sessile spikelet
 C, D. *Arthraxon lancifolius* (Trin.) Hochst., habit,
 spikelets in raceme.

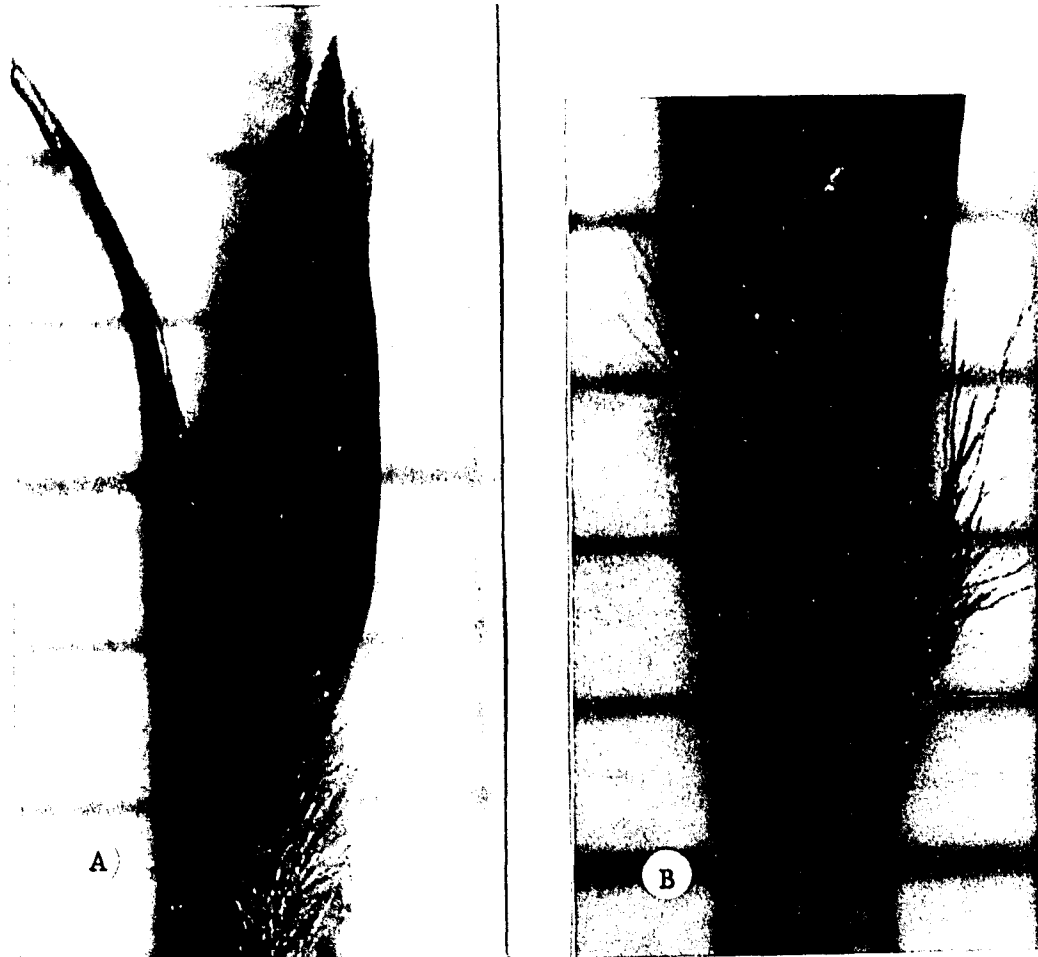


Plate No. 6. *Cymbopogon annamensis* (A. Camus) A. Camus
A. spikelet pair; lateral view of sessile spikelet with
awn and dorsal view of pedicelled spikelet B. sessile
spikelet, dorsal view of lower glume



Plate No. 7. *Cymbopogon calcicola* Hubbard
A. habit, spikelet in raceme B. sessile spikelet,
dorsal view of lower glume x 20

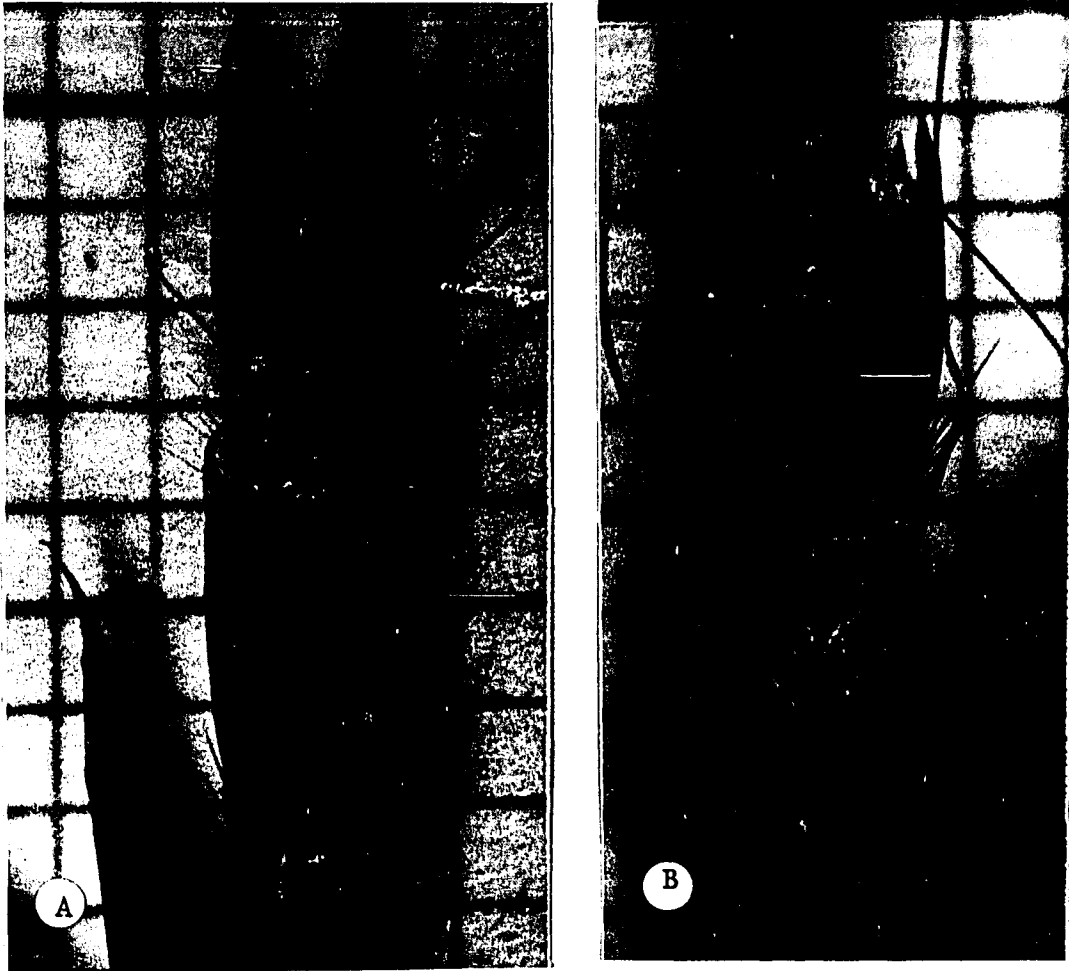


Plate No. 8. *Cymbopogon calciphilus* Bor
A, B. habit, spikelets in raceme

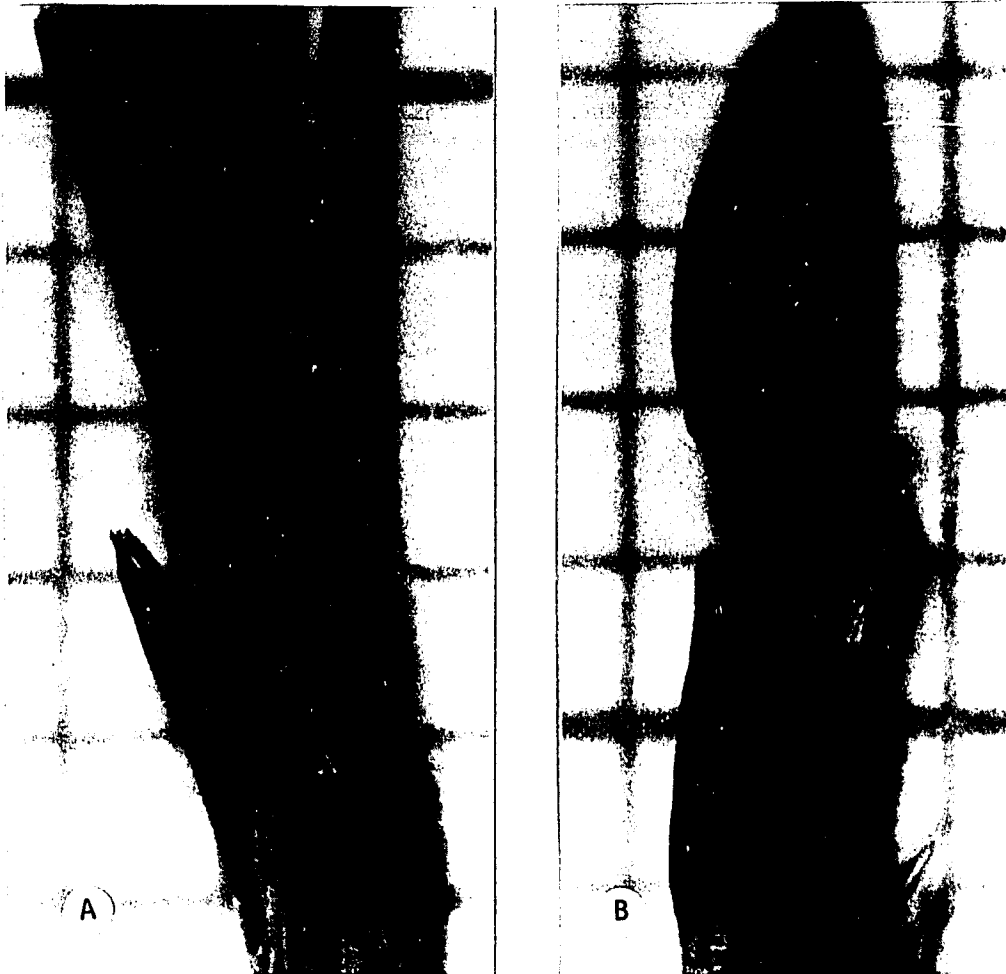


Plate No. 9. *Cymbopogon cambogiensis* (Bal.) Camus & Camus
 A, B. habit, spikelets in raceme A. sessile spikelet
 dorsal view of lower glume B. pedicelled spikelet,
 dorsal view of lower glume.

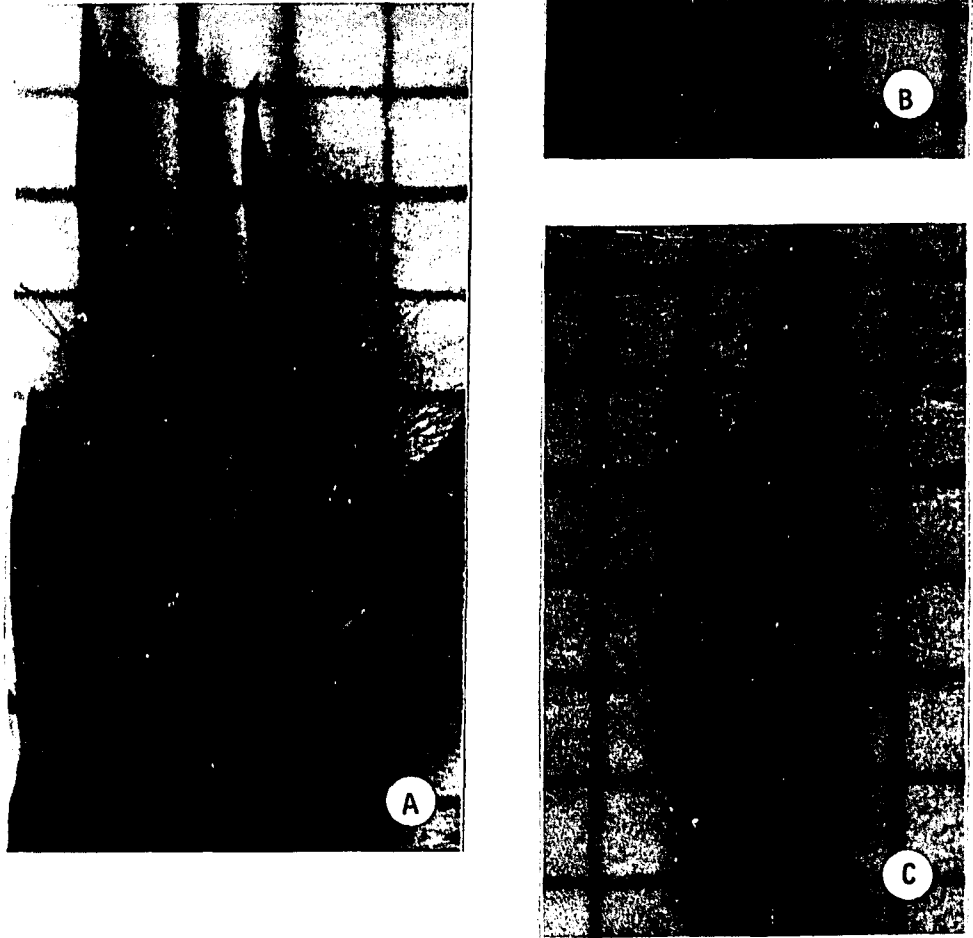


Plate No. 10. *Cymbopogon citratus* (DC.) Stapf
A. habit, spikelets in raceme B. dorsal view of
sessile spikelet C. spikelet pair, sessile and
pedicelled spikelet.

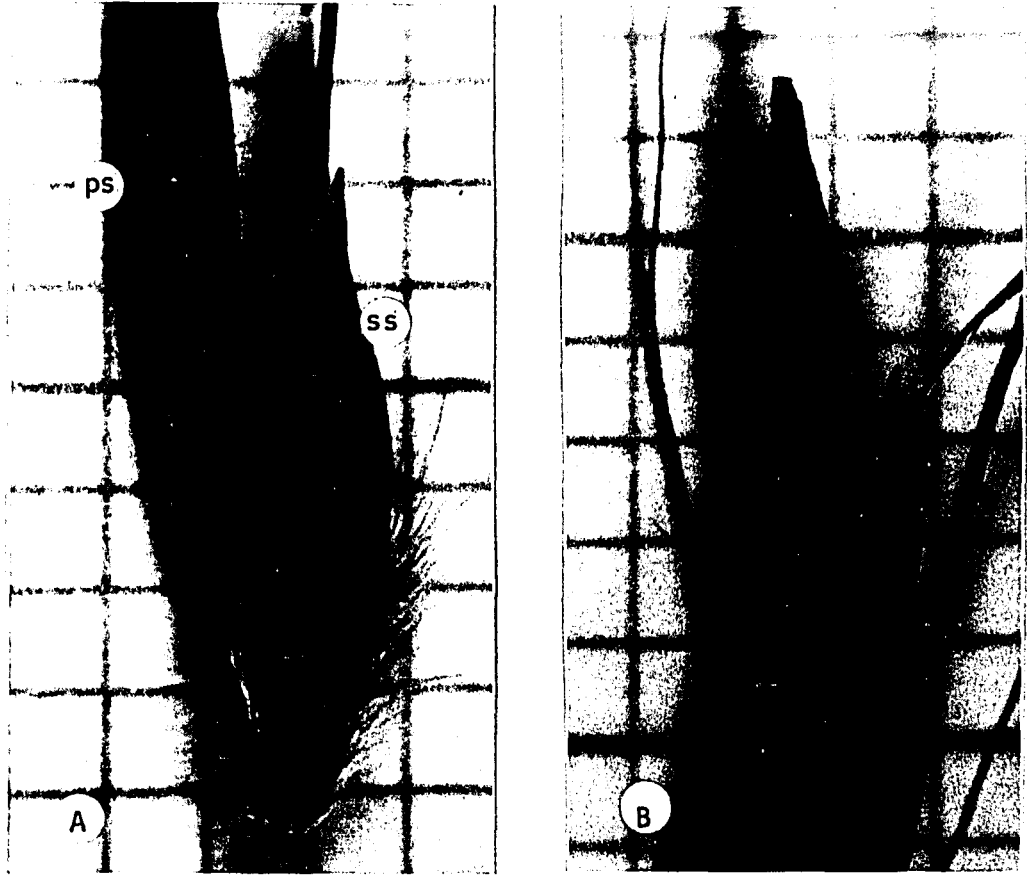


Plate No. 11. *Cymbopogon flexuosus* (Nees ex Steud.) Wats.
 A. spikelet pair, pedicelled and sessile spikelet
 B. pedicelled spikelet, dorsal view of lower glume

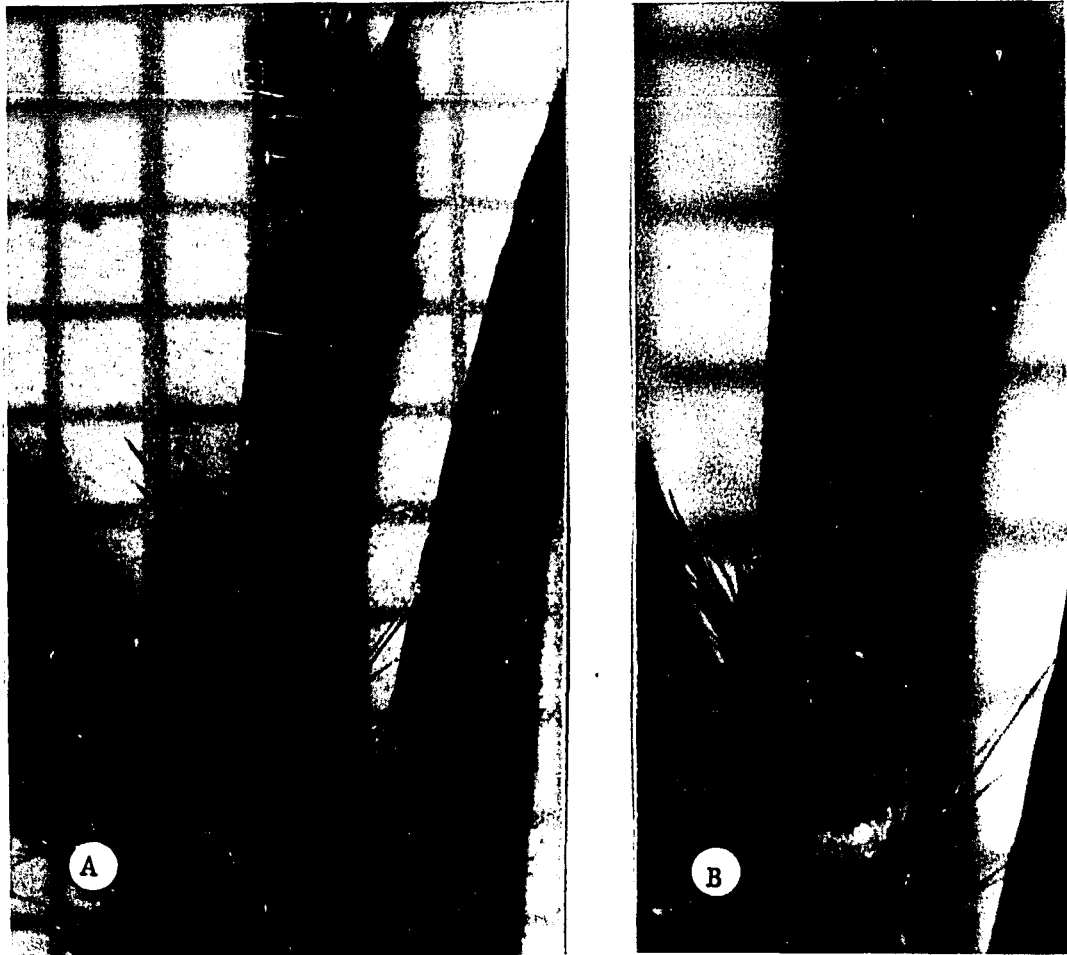


Plate No. 12. *Cymbopogon khasianus* (Munro ex Hack.) Bor
A. habit, spikelets in raceme B. sessile spikelet,
dorsal view of lower glume x 20

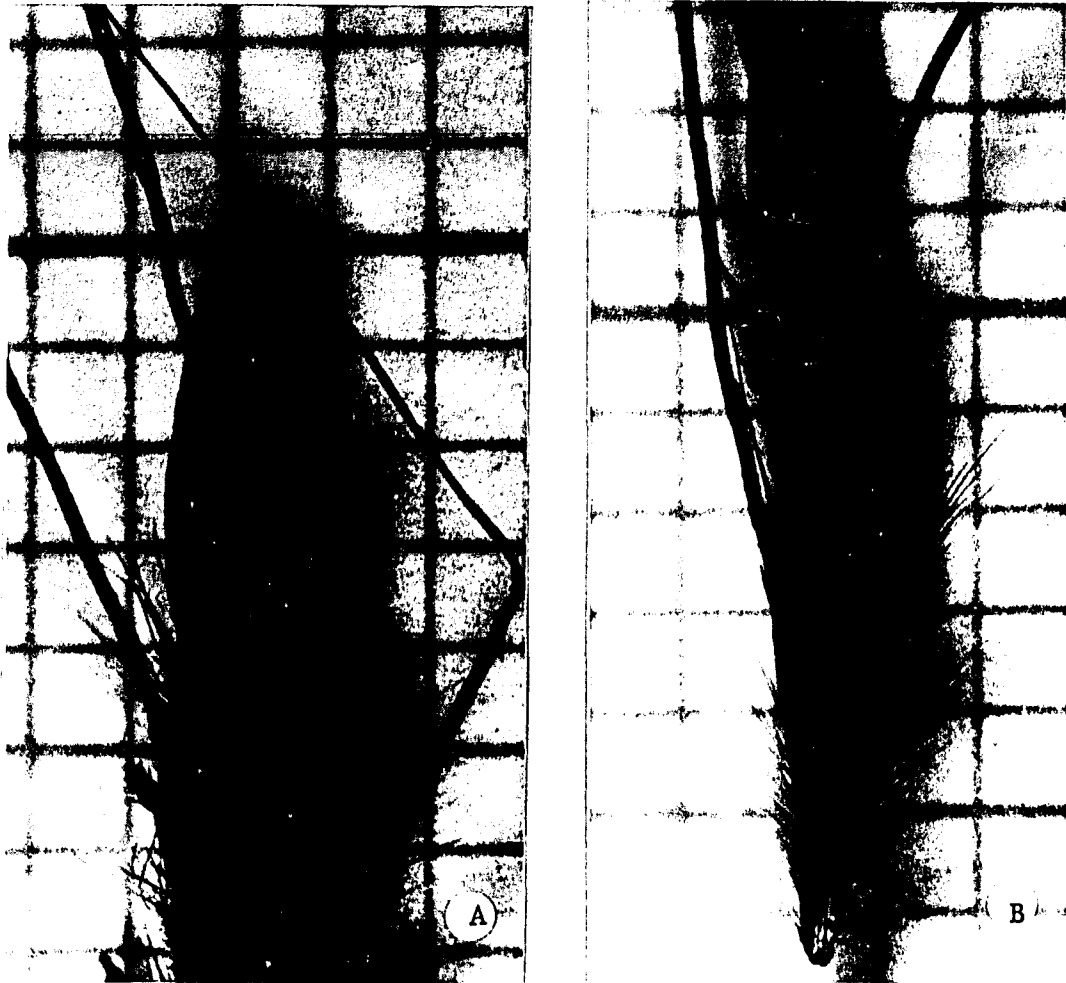


Plate No. 13. *Cymbopogon martinii* (Roxb.) Wats.
A. habit, spikelets in raceme B. sessile spikelet,
dorsal view of lower glume.



Plate No. 14. *Cymbopogon nardus* var. *confertiflorus*
 (Steud.) Bor A. habit, spikelets in raceme B. sessile
 spikelet, dorsal view of lower glume C. sessile and
 pedicelled spikelet.

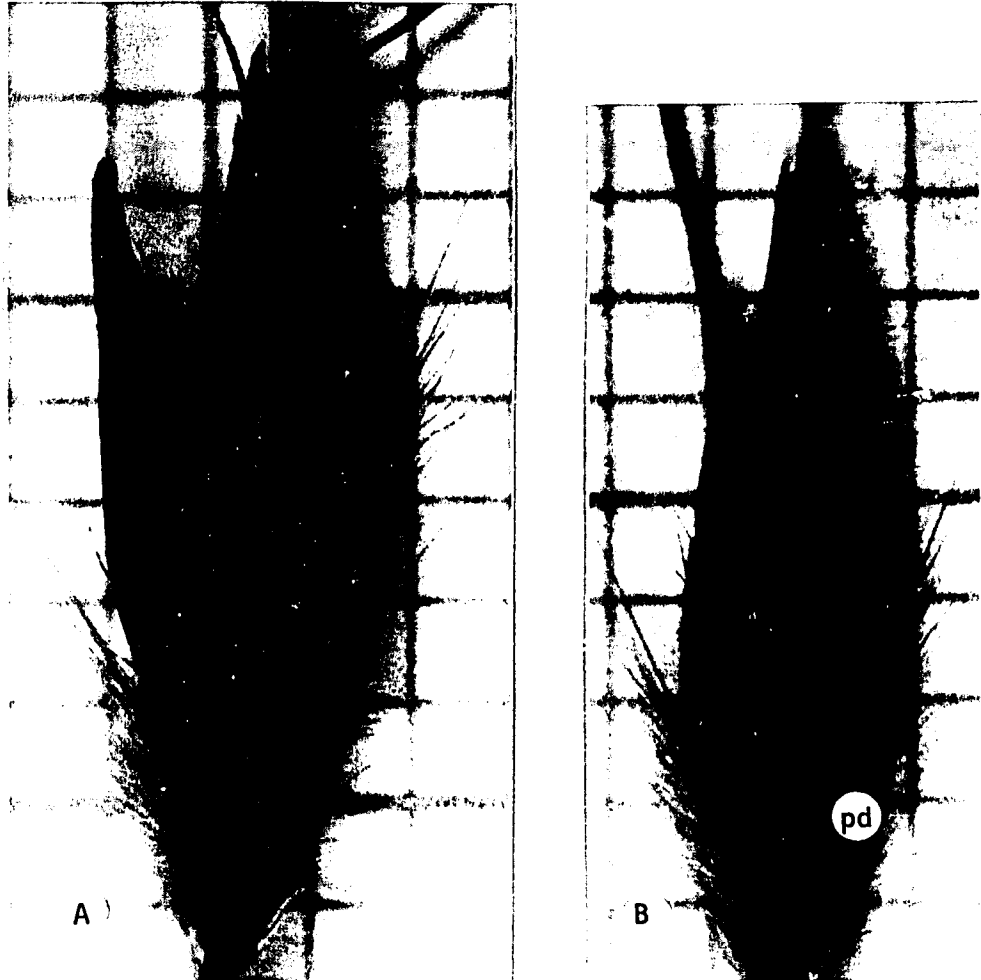


Plate No. 15. *Cymbopogon traninhensis* (A. Camus) Soenarko
A. spikelet pair, pedicelled and sessile spikelet
B. pedicelled spikelet, dorsal view of lower glume

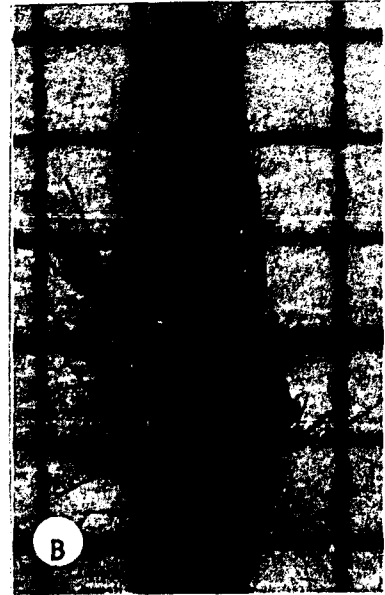
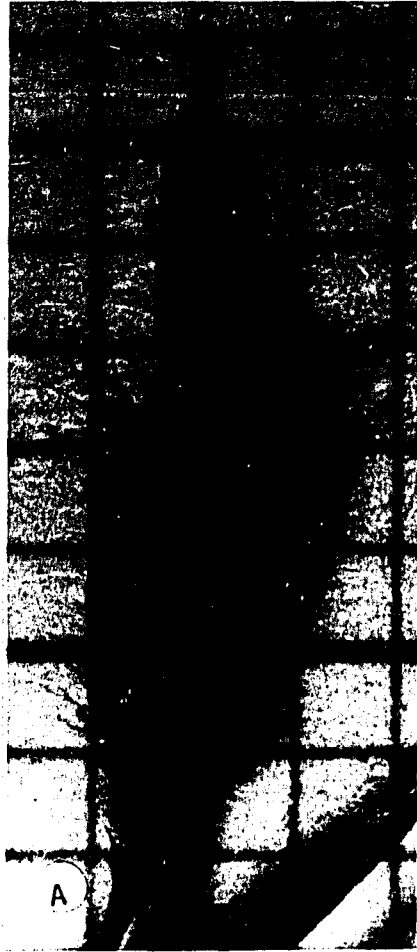


Plate No. 16. *Cymbopogon winteranus* Jowitt
 A. habit, spikelets in raceme B. sessile spikelet,
 dorsal view of lower glume C. pedicelled spikelet,
 dorsal view of lower glume

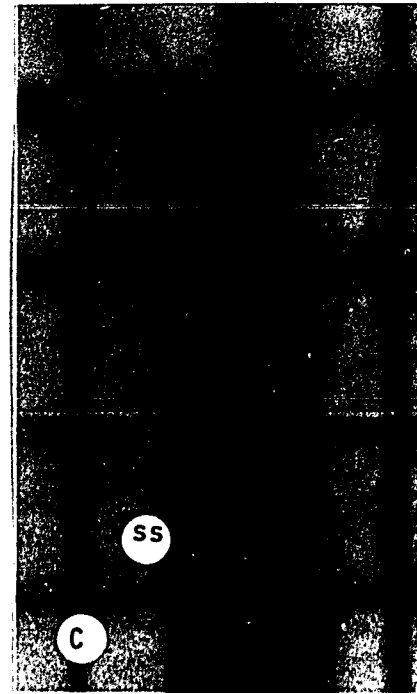


Plate No. 17. A. *Schizachyrium sanguineum* (Retz.) Alst., habit, spikelets in raceme B, C. *Schizachyrium brevifolium* (Sw.) Nees, habit, spikelets in raceme.

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30.	<i>T. triandra</i> Forssk.	312

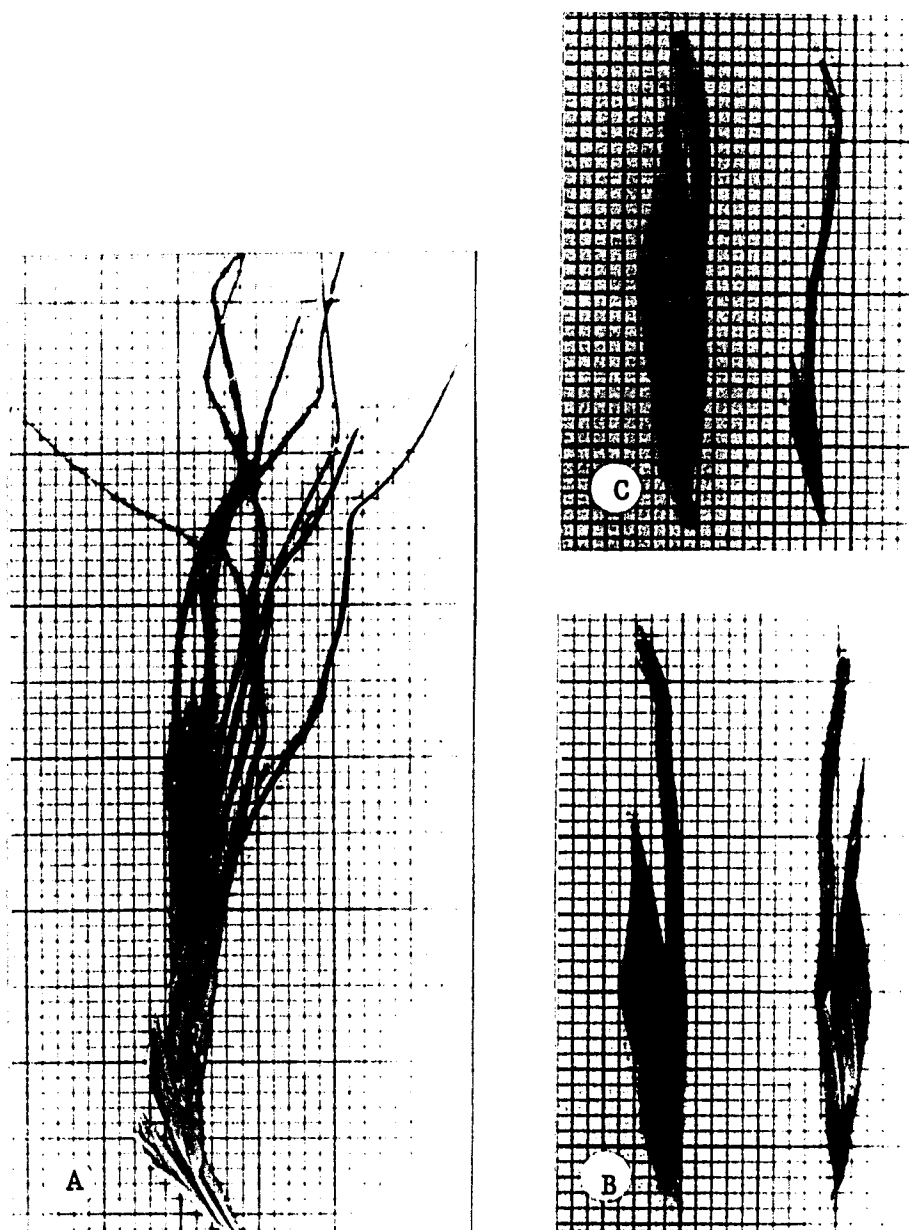


Plate No. 18. A, B. *Heteropogon triticeus* (R. Br.)
 Stapf ex Craib A. habit, inflorescence B. spikelet
 pair, sessile spikelet with awn and pedicelled spikelet
 C. spikelets comparison of *H. triticeus*, left and
H. contortus (L.) P. Beauv., right.

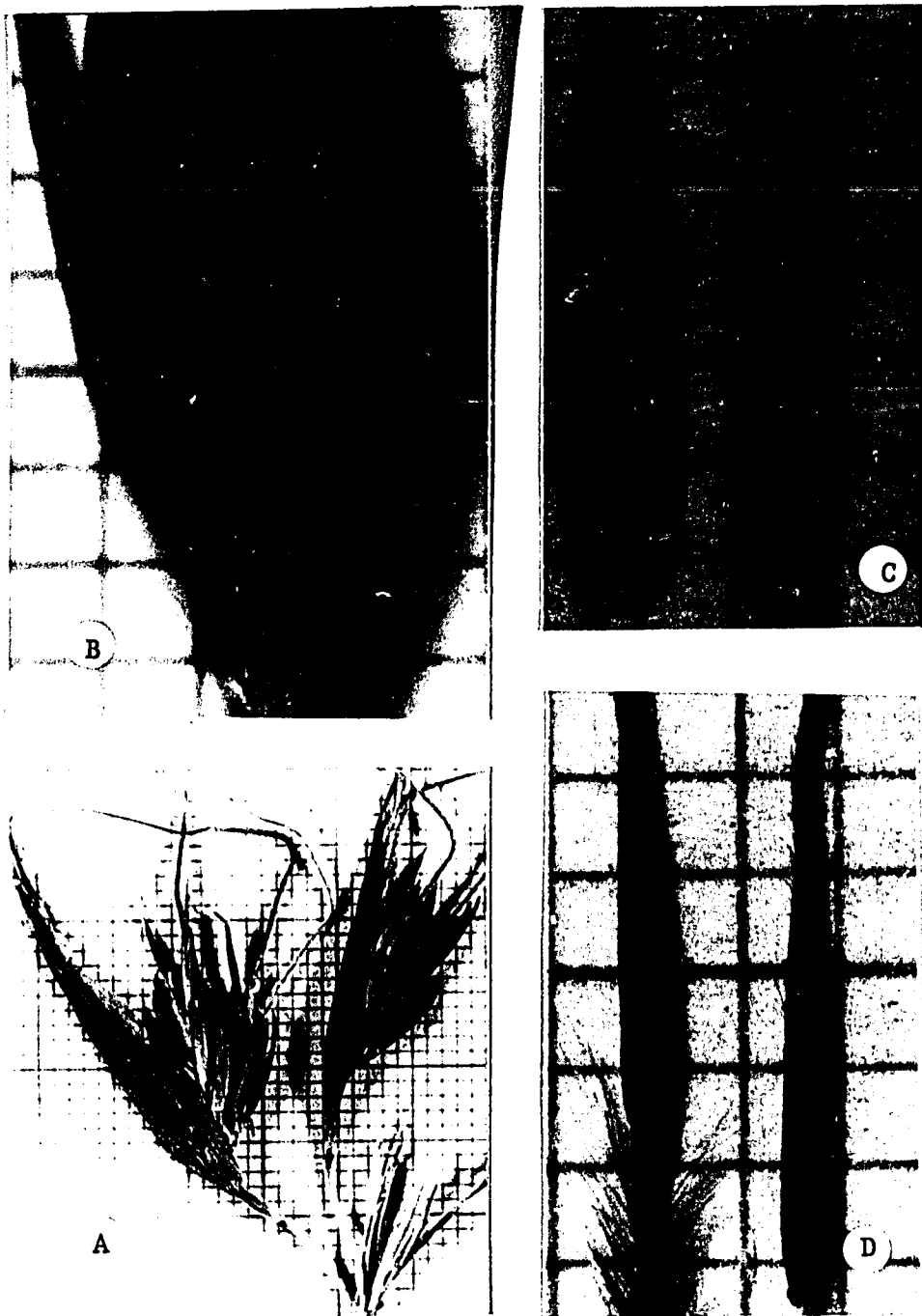


Plate No. 19. *Hyparrhenia diplandra* (Hack.) Stapf
 A. habit, inflorescence B. spikelets in raceme
 C. sessile spikelet, upper glume and lower glume
 D. pedicelled spikelets.



Plate No. 20. *Hyparrhenia newtonii* var. *newtonii*
W.D. Clayton A. habit, spikelets in raceme B. dorsal
view of sessile spikelet C. lateral view of pedicelled
spikelet with raceme-base.

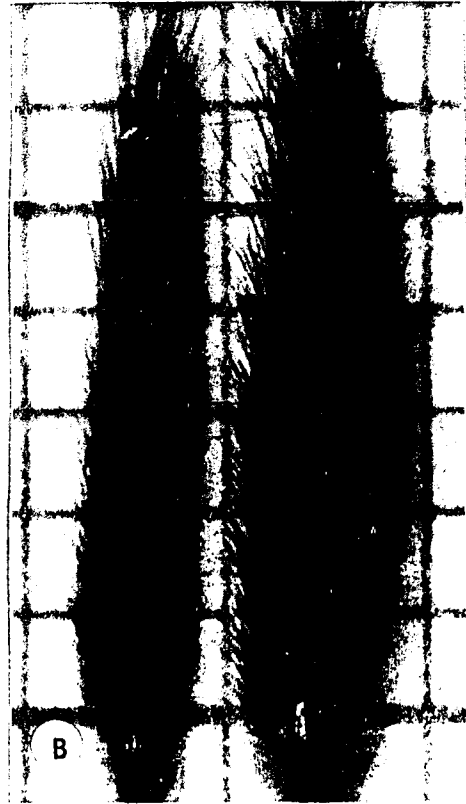


Plate No. 21. *Hyparrhenia nyassae* (Rendle) Stapf
 A. habit, spikelets in raceme B. dorsal and ventral
 view of sessile spikelet C. raceme-base



Plate No. 22. *Hyparrhenia rufa* var. *siamensis* W.D. Clayton
A, B. habit, spikelets in raceme.

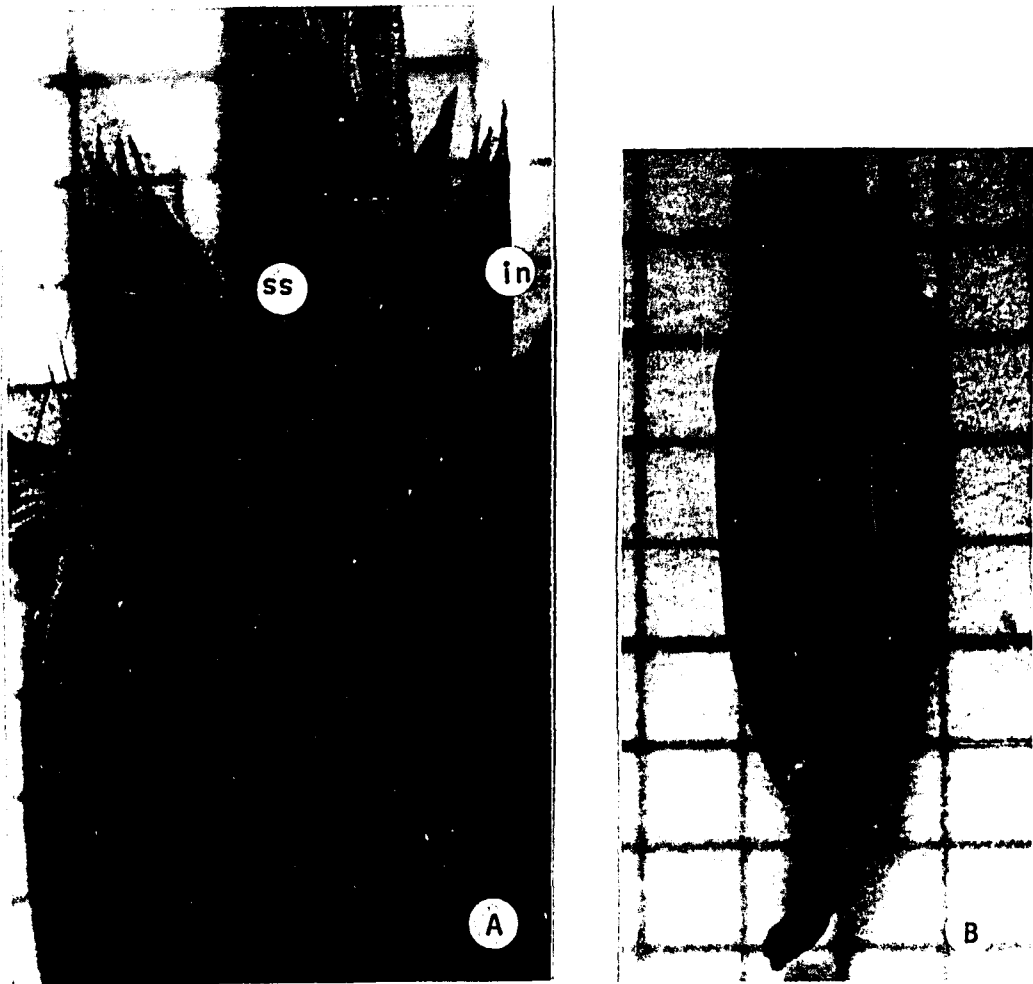


Plate No. 23. *Iseilema siamensis* C.E. Hubbard
A. habit, spikelets in raceme B. involucre spikelets.

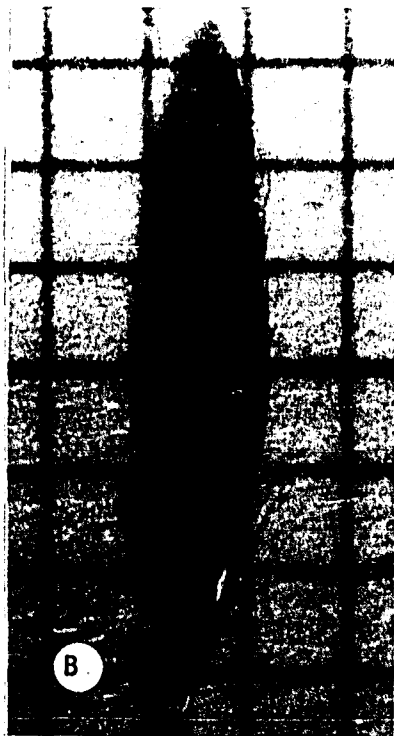
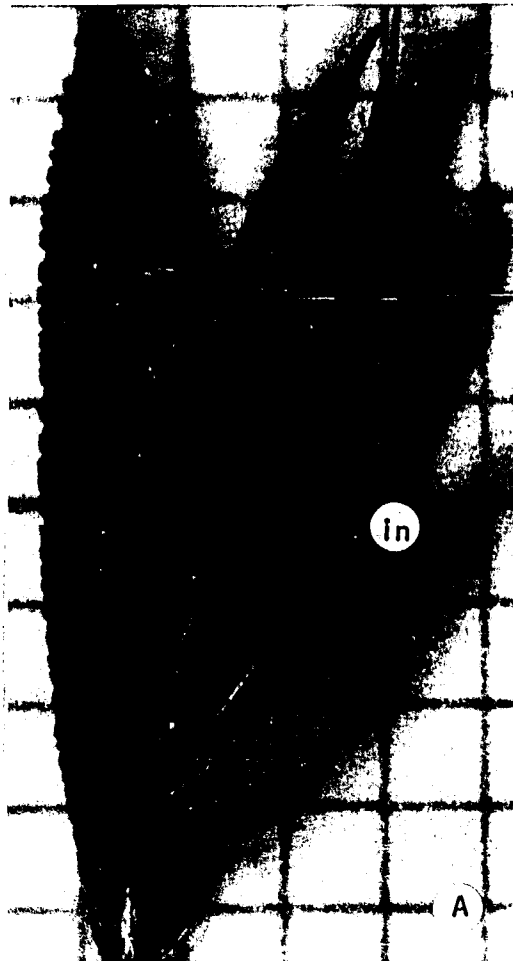
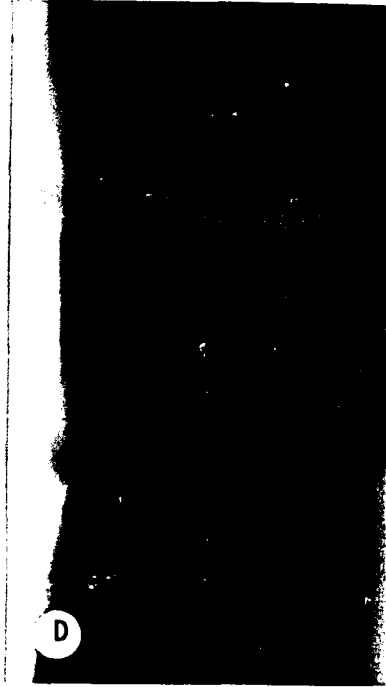


Plate No. 24. *Iseilema thorelii* A. Camus
 A. habit, spikelets in raceme B. involucrel
 spikelets C, D. tubercle glands on spatheole ridge.

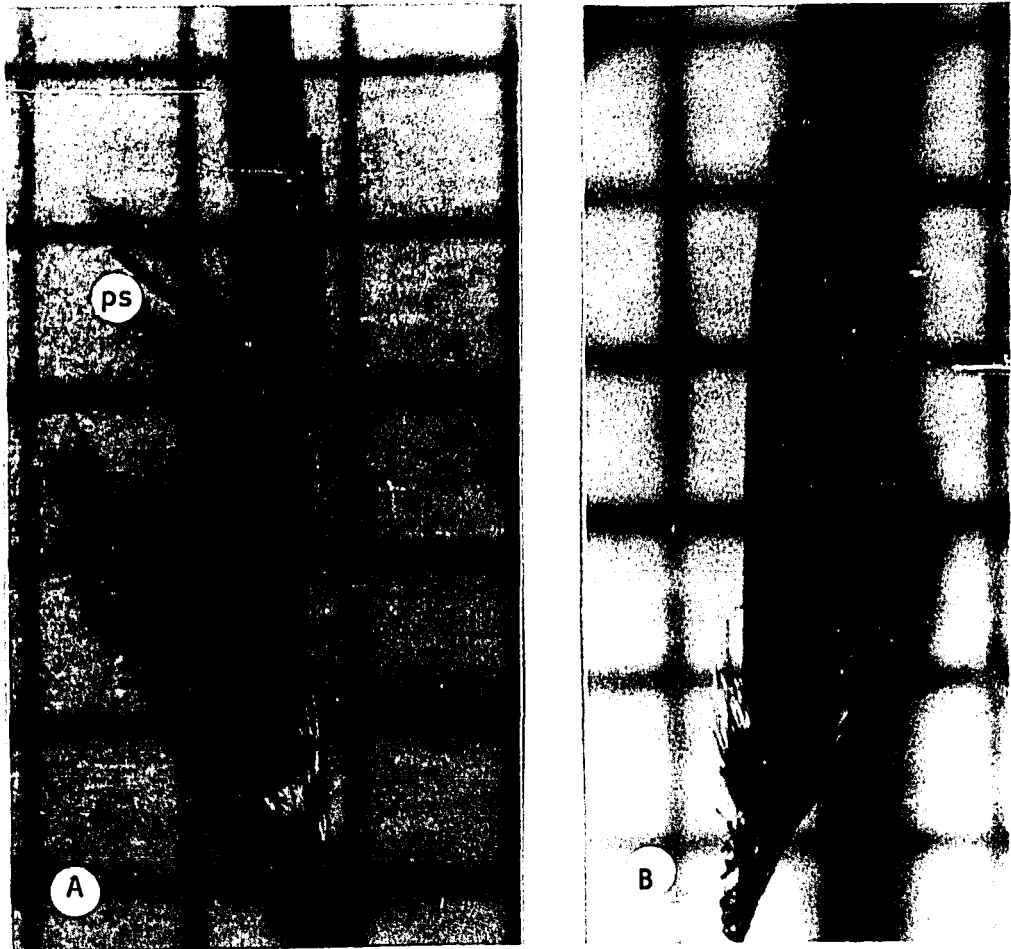


Plate No. 25. *Pseudanthistiria burmanica* Hook.f.
A. habit, spikelet pair B. sessile spikelet, dorsal
view of lower glume.

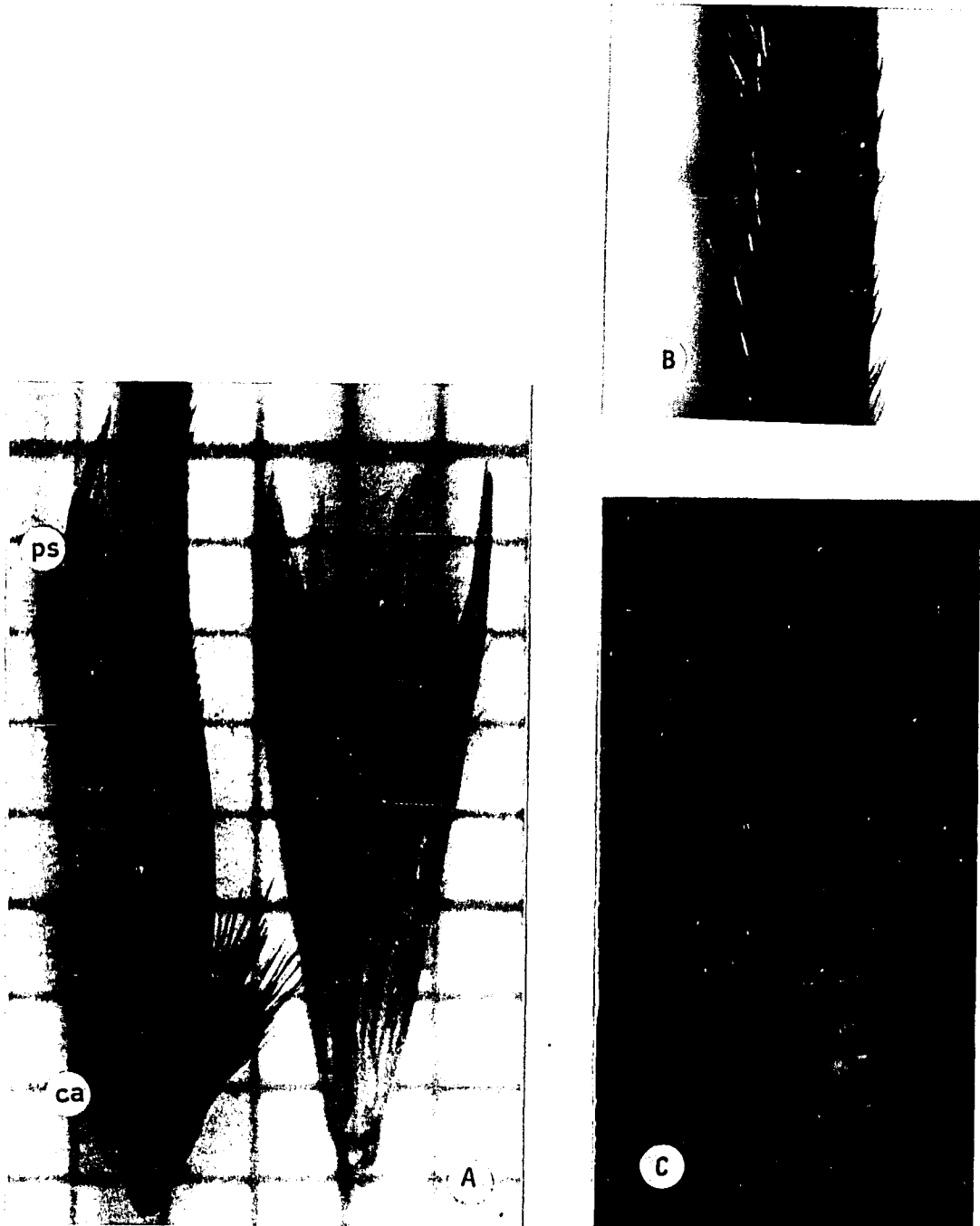


Plate No. 26. *Themeda arguens* (L.) Hackel
 A. habit; sessile spikelet, pedicelled spikelet and callus,
 left; involucral spikelets, right B. awn, hirsute hairs
 C. tubercle-based hairs on spatheole.

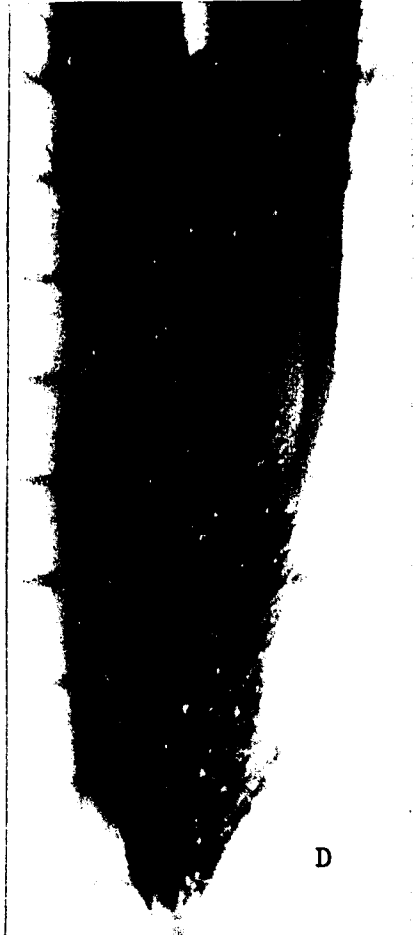
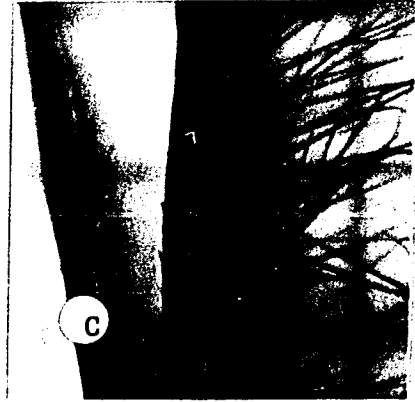
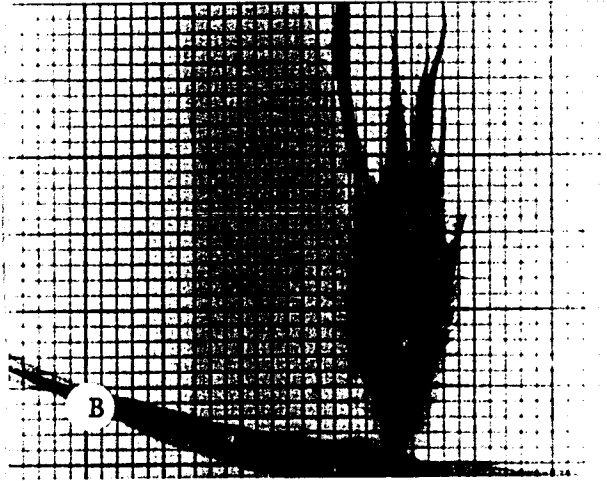


Plate No. 27. *Themeda arundinacea* (Roxb.) Ridley
 A. habit, spikelet in raceme B. involucral spikelets
 C. tubercle-based hairs on involucral spikelets.
 D. sessile spikelet.

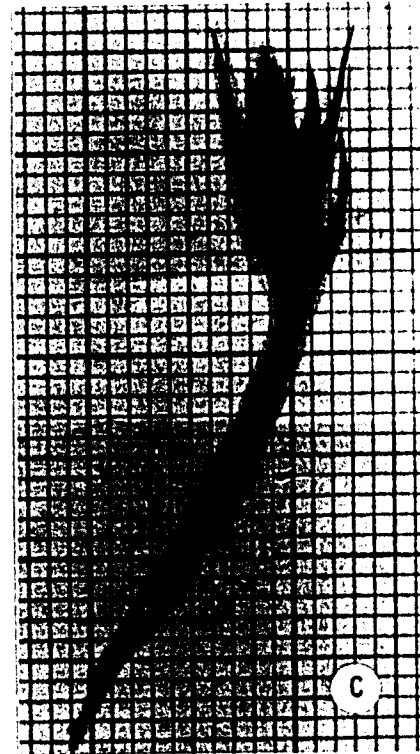
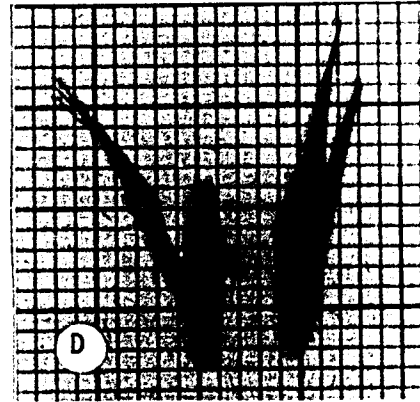
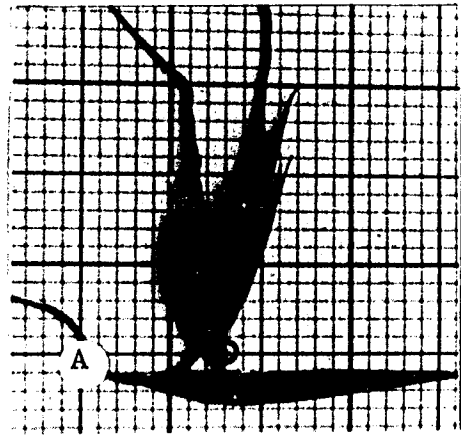


Plate No. 28. A, B. *Themeda caudata* (Nees) A. Camus
 A, B. habit, spikelet in raceme C, D. *T. villosa* (Poir.)
 A. Camus C. habit, spikelet in raceme D. spikelet
 pair, sessile and pedicel spikelets.

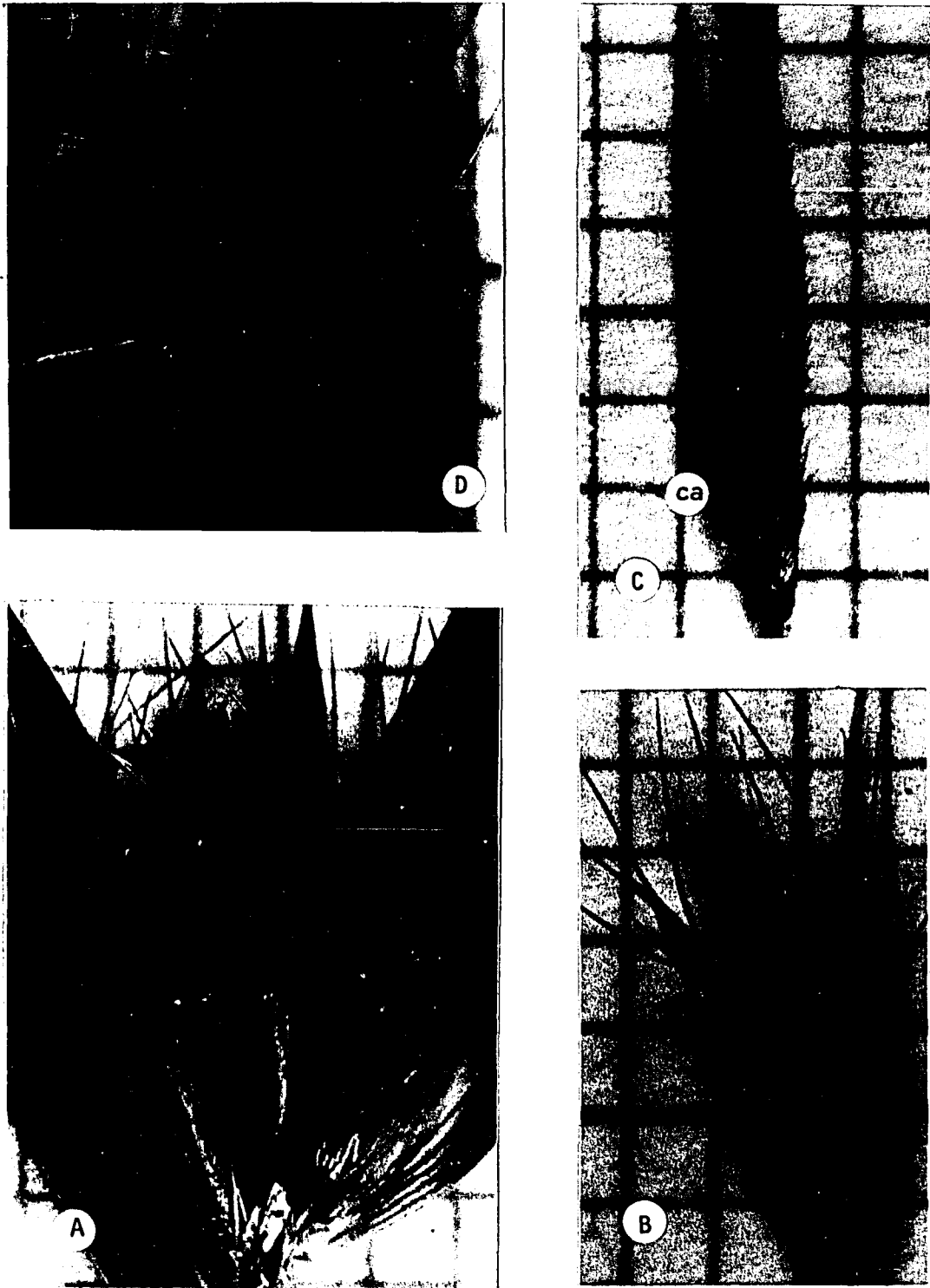


Plate No. 29. *Themeda quadrivalvis* (L.) Kuntze
 A. habit, spikelet in raceme B. involucre spikelets
 C. spikelet pair, sessile and pedicel spikelets
 D. tubercle-based hairs on petiole and tiny spicules on ridge.

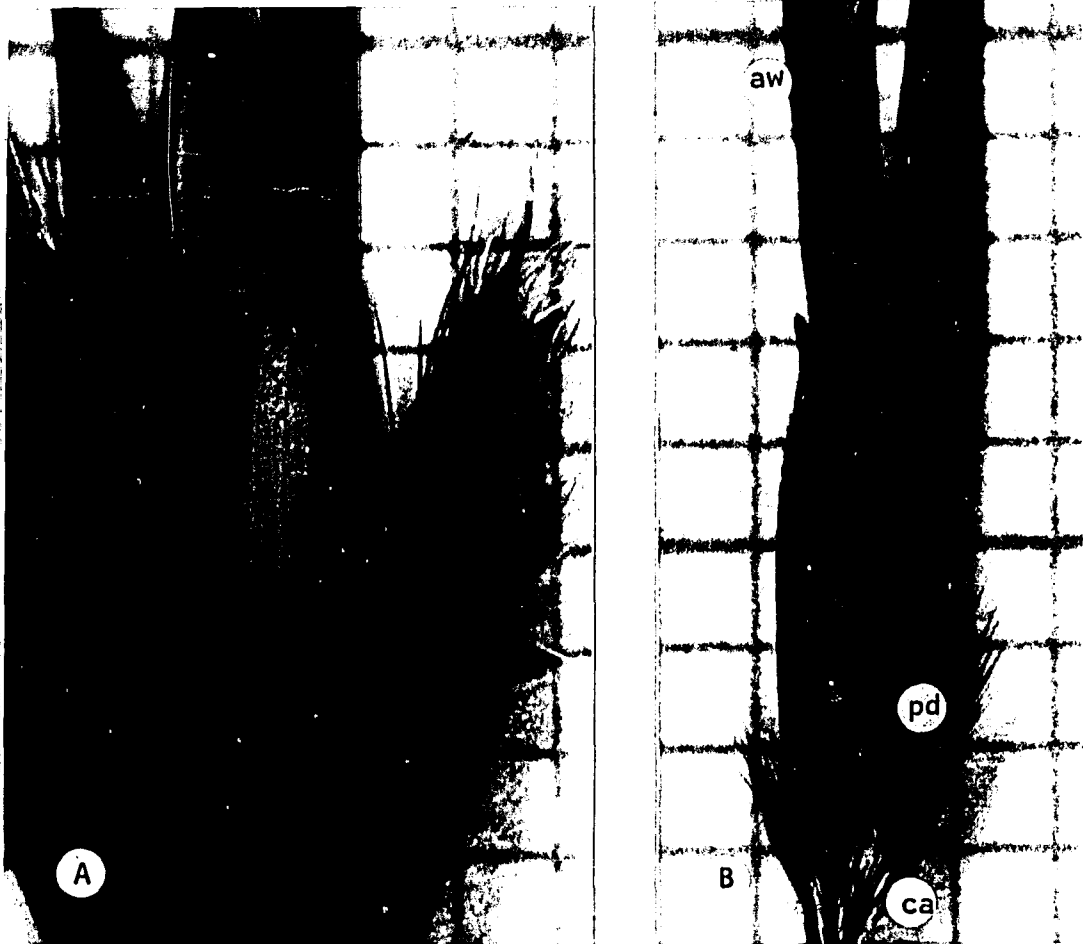


Plate No. 30. *Themeda triandra* Forssk.
A. habit, spikelets in raceme B. spikelet pair,
sessile and pedicel spikelets.

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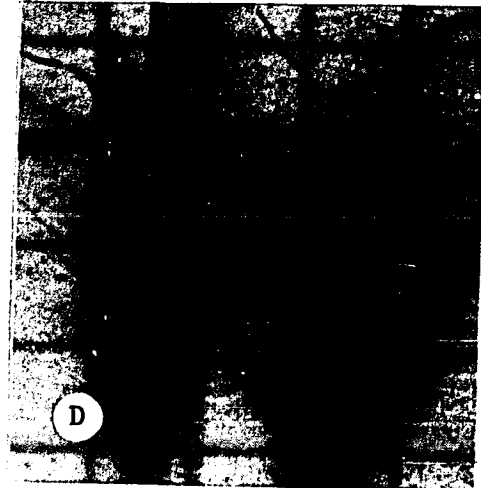
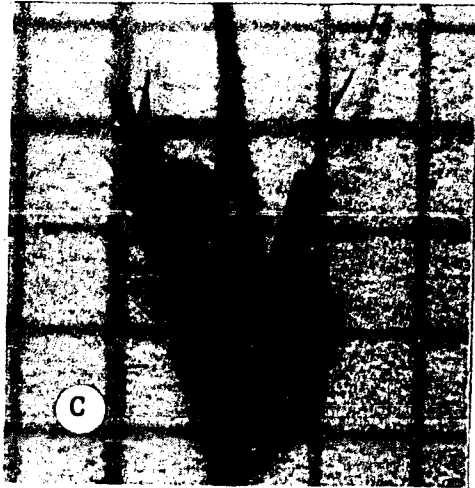


Plate No. 31. *Eulalia bicornuta* Bor
 A, B. habit, spikelets in raceme C. lateral view of
 sessile spikelet D. left; dorsal view of pedicelled
 spikelet; right, sessile spikelet with an adjoining
 pedicel.

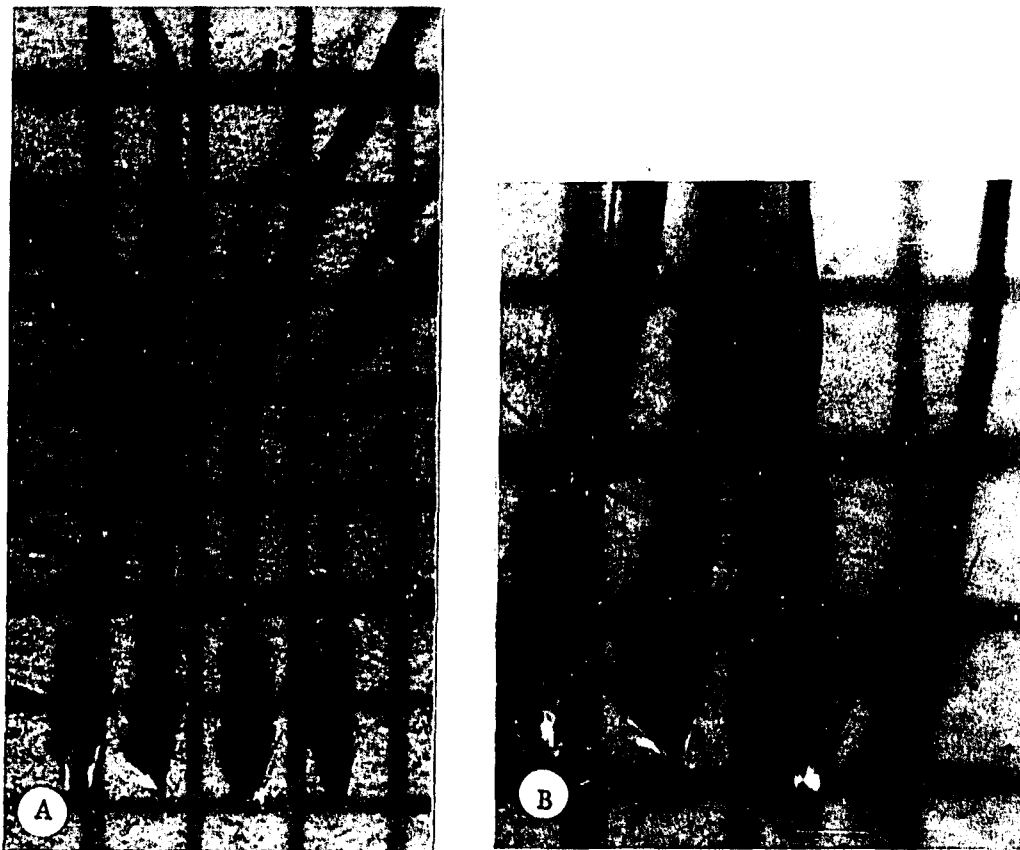


Plate No. 32. *Eulalia contortum* Kuntze
A. habit of spikelets: dorsal and ventral view
B. spikelets X 20.

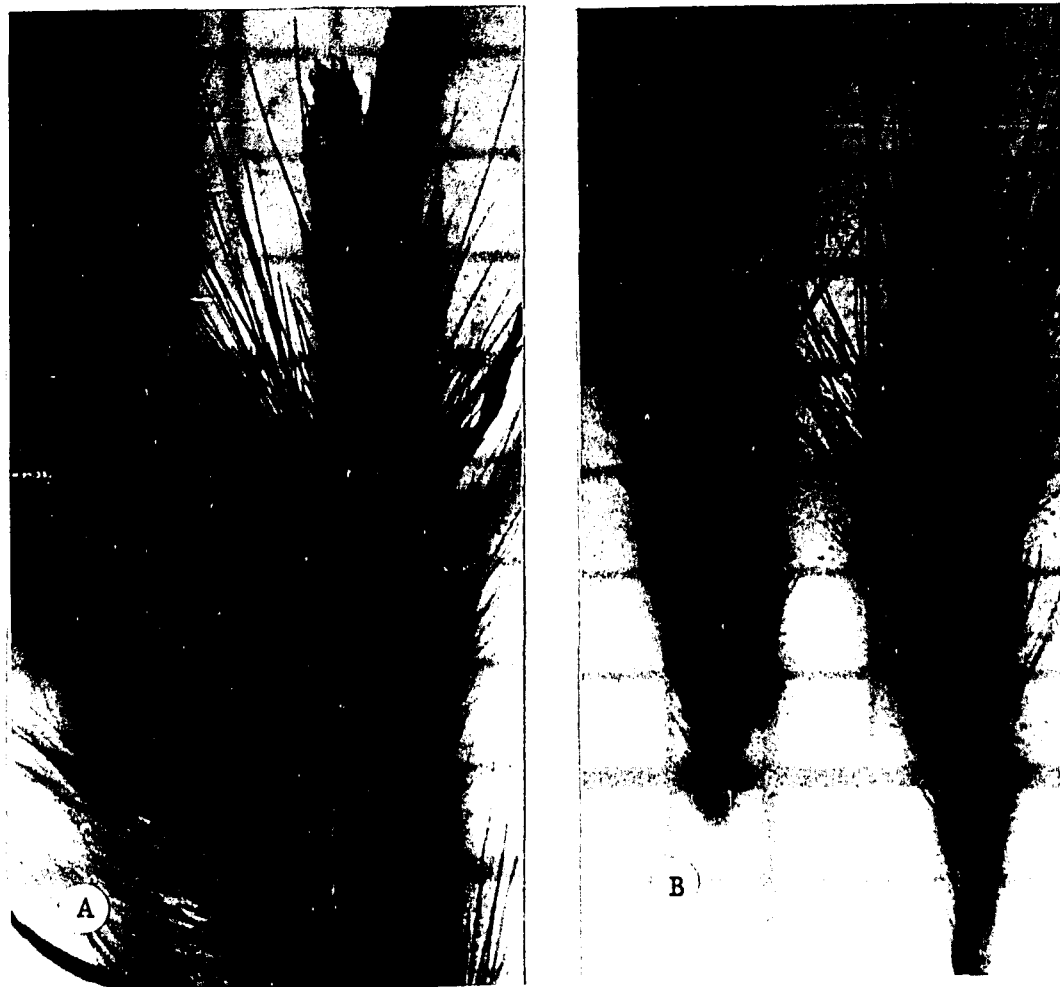


Plate No. 33. *Eulalia monostchyus* (Bal.) A. Camus
A. habit of spikelets in raceme B. left; lateral view
of sessile spikelet; right, dorsal view of pedicelled
spikelet.

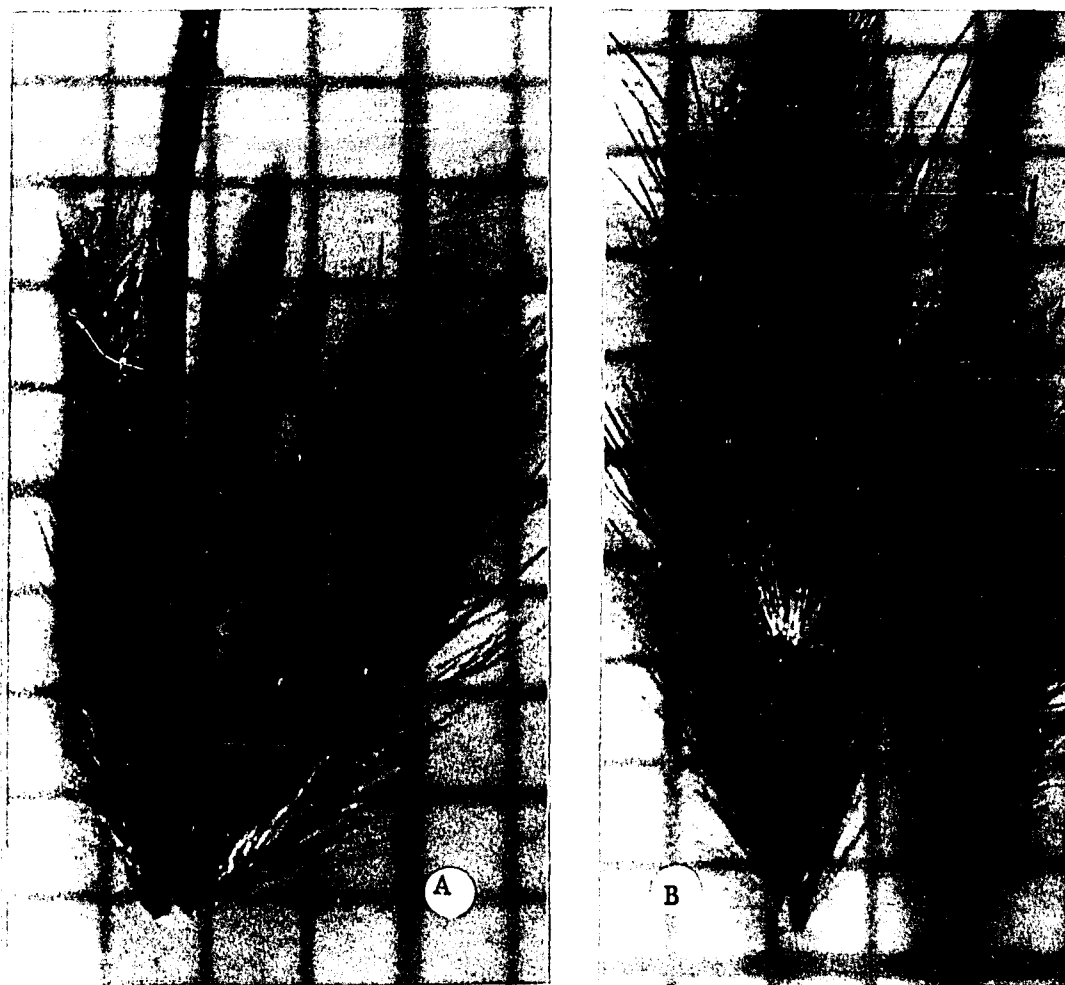


Plate No. 34. *Eulalia siamensis* Bor
A. lateral view of sessile spikelet B. left, ventral
view of pedicelled spikelet with pedicel; right, dorsal
view of sessile spikelet.



Plate No. 35. *Eulalia smitinandiana* Bor
 A. habit, spikelets in raceme B-D. sessile spikelets
 B. dorsal view C. ventral view D. left; dorsal view;
 right lateral view.

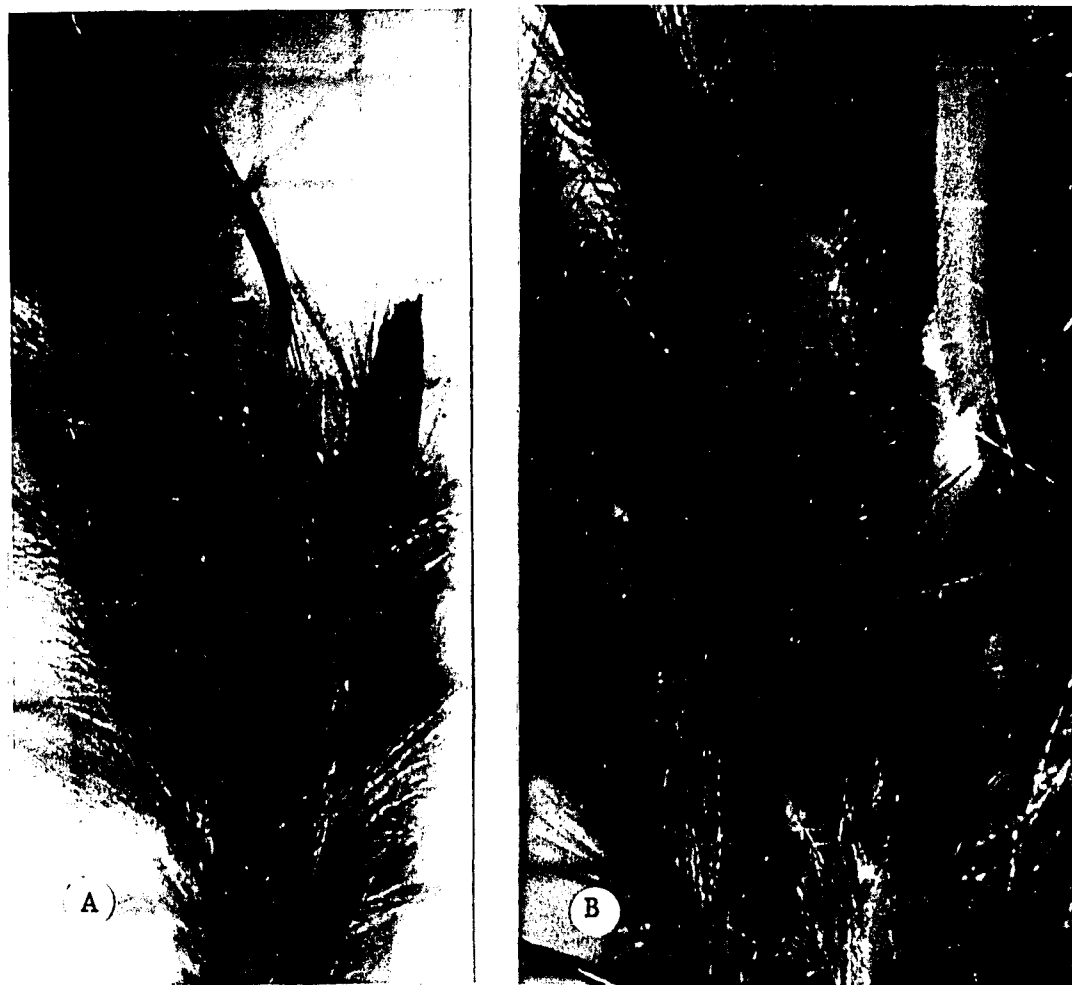


Plate No. 36. *Eulalia speciosa* (Debeaux) O. Ktze.
A. habit, spikelets in raceme B. dorsal view of
sessile spikelet, x 20.

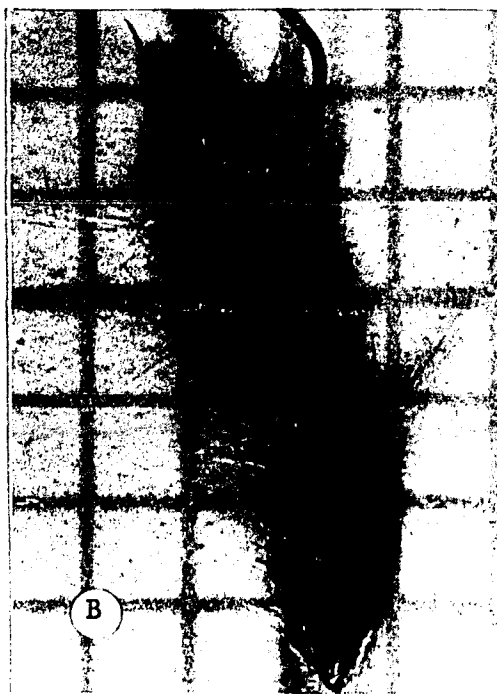


Plate No. 37. *Eulalia trispicata* (Schult.) Henr.
A. habit, spikelets in raceme B. spikelet pair
C. dorsal view of sessile spikelet, x 20.

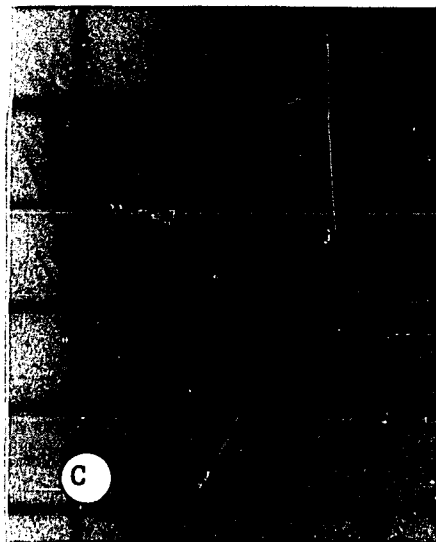
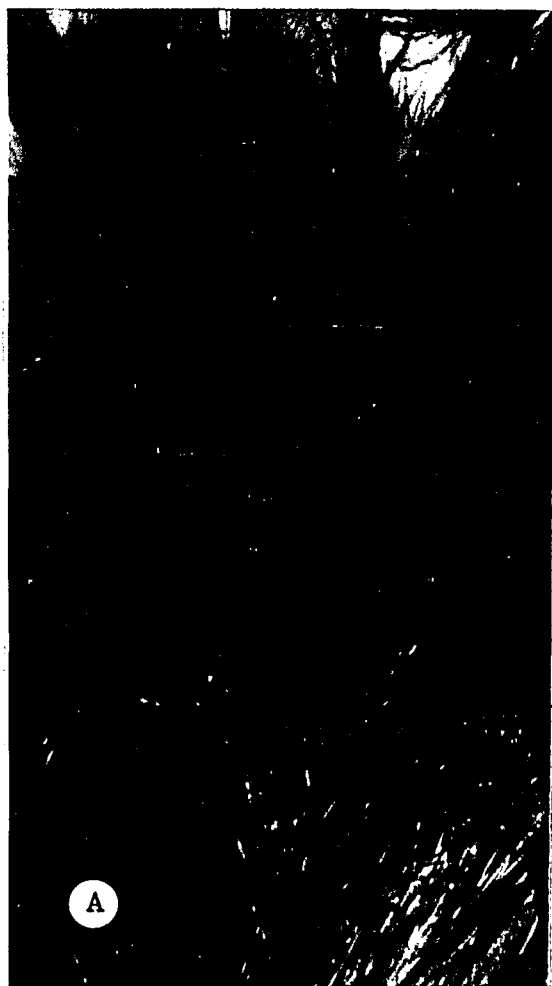


Plate No. 38. *Eulaliopsis binata* (Retz.) C.E. Hubbard
A. habit, spikelets in raceme, x 20 B, C. spikelet pair

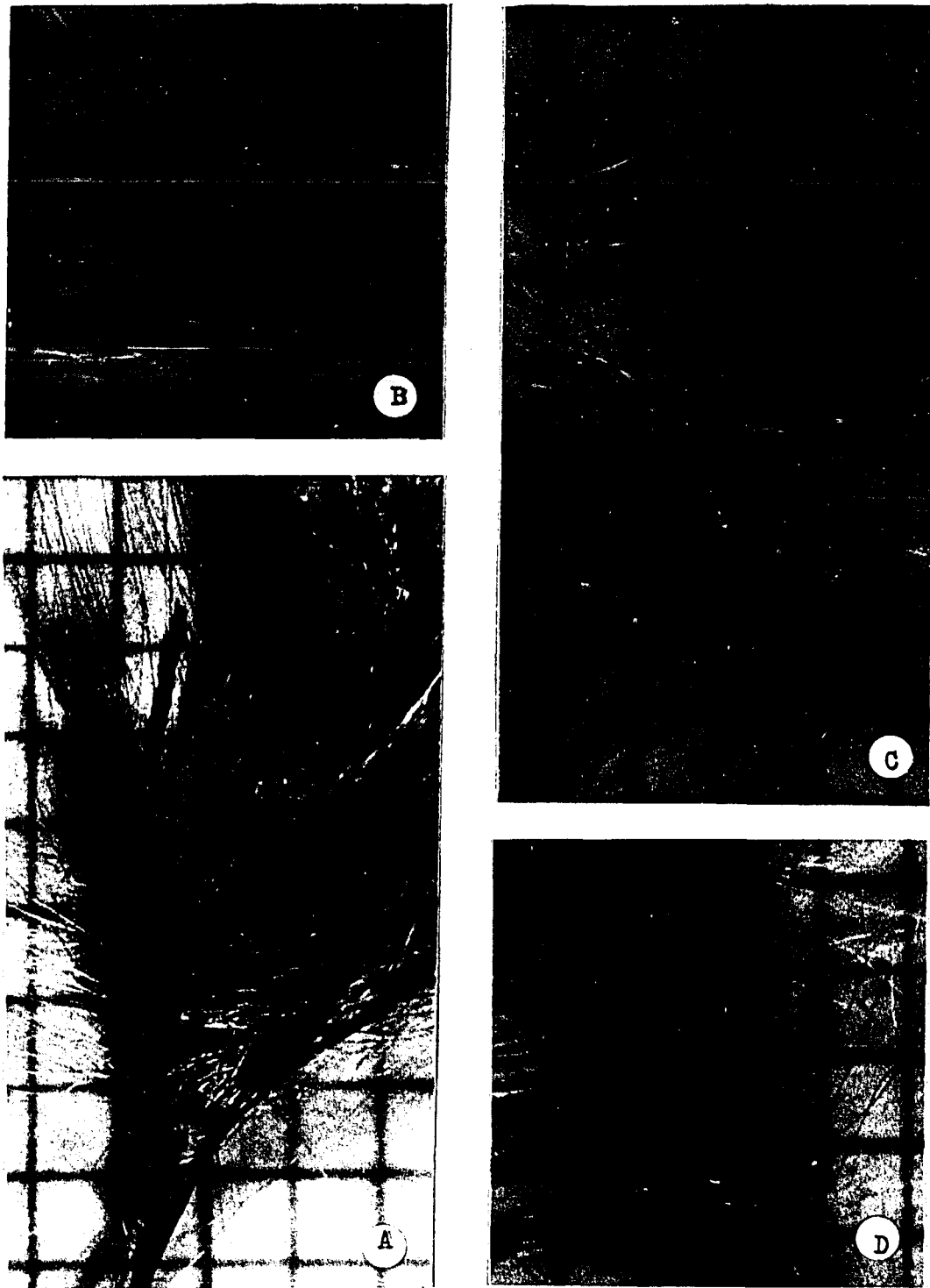


Plate No. 39. *Imperata cylindrica* (L.) P. Beauv.
A. habit, spikelets in raceme B. sessile spikelet,
C. pedicelled spikelet D. rhachis internode, short
and long pedicel.

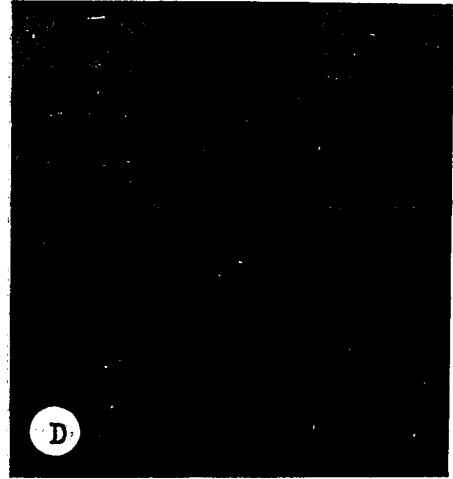
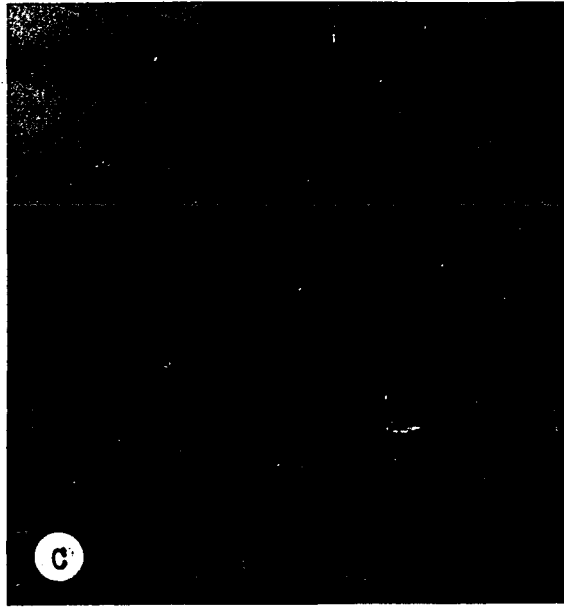


Plate No. 40. *Microstegium ciliatum* (Trin.) A. Camus
 A, B. habit, spikelets in raceme C. pedicelled spikelet
 D. sessile spikelet

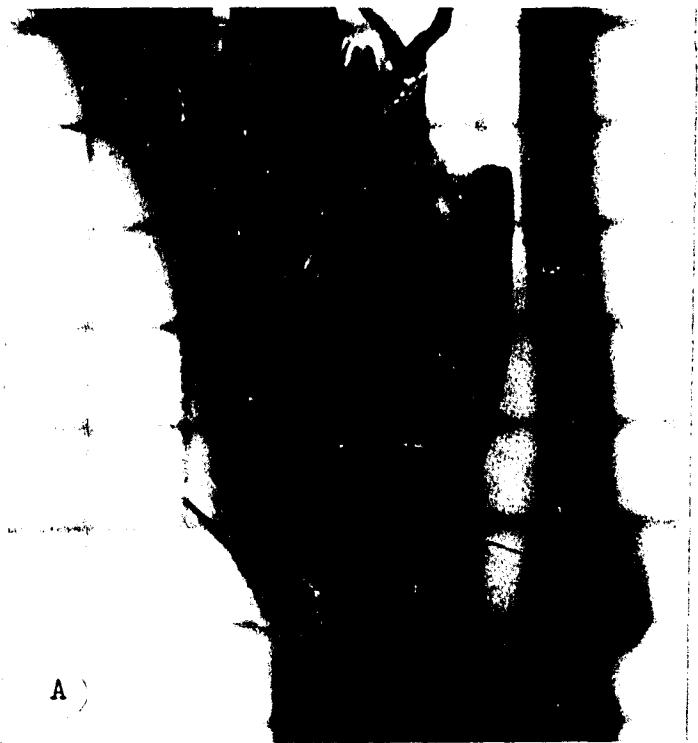


Plate No. 41. *Microstegium petiolare* (Trin.) Bor
 A. habit, spikelets in raceme B. left, ventral view of
 sessile spikelet with rhachis internode; middle, dorsal
 view of sessile spikelet and lateral view of pedicelled
 spikelet; right, lateral view of sessile spikelet.

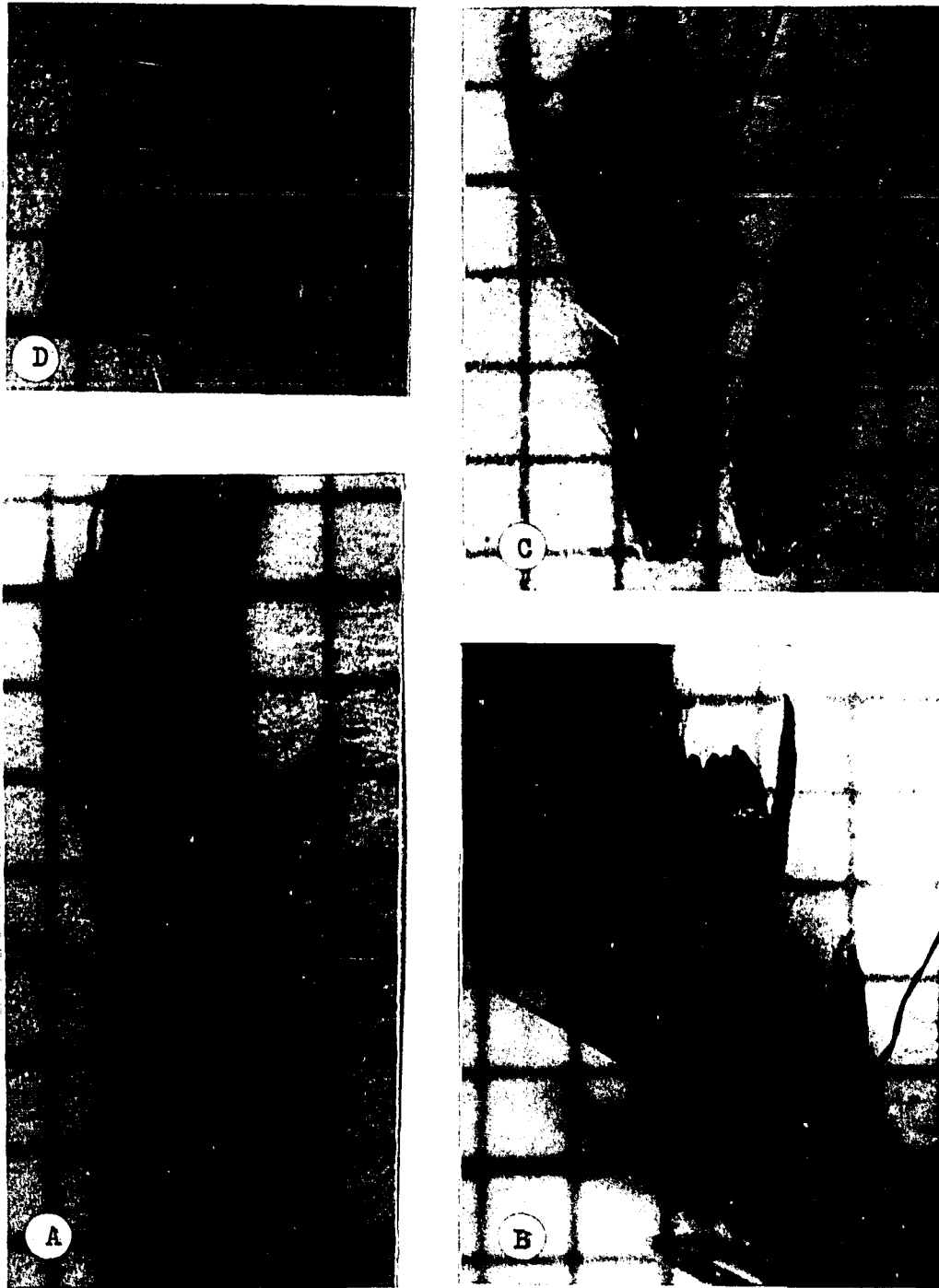


Plate No. 42. *Microstegium vagans* (Nees ex Steud.) A. Camus
 A, B. habit, spikelets in raceme C. left, dorsal view of
 sessile spikelet and lateral view of pedicelled spikelet;
 right sessile spikelet D. from left to right; lemma, awn,
 stigmas and ovary, and palea.

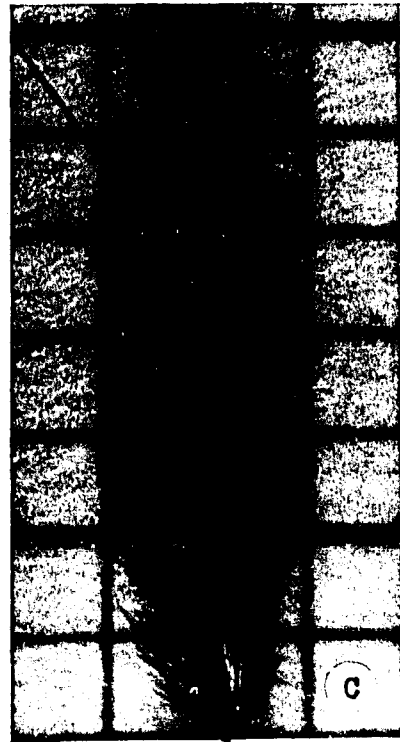


Plate No. 43. *Microstegium vagans* var. *scandens* Bor
A. habit, spikelets in raceme B. pedicelled spikelet
C. sessile spikelet.

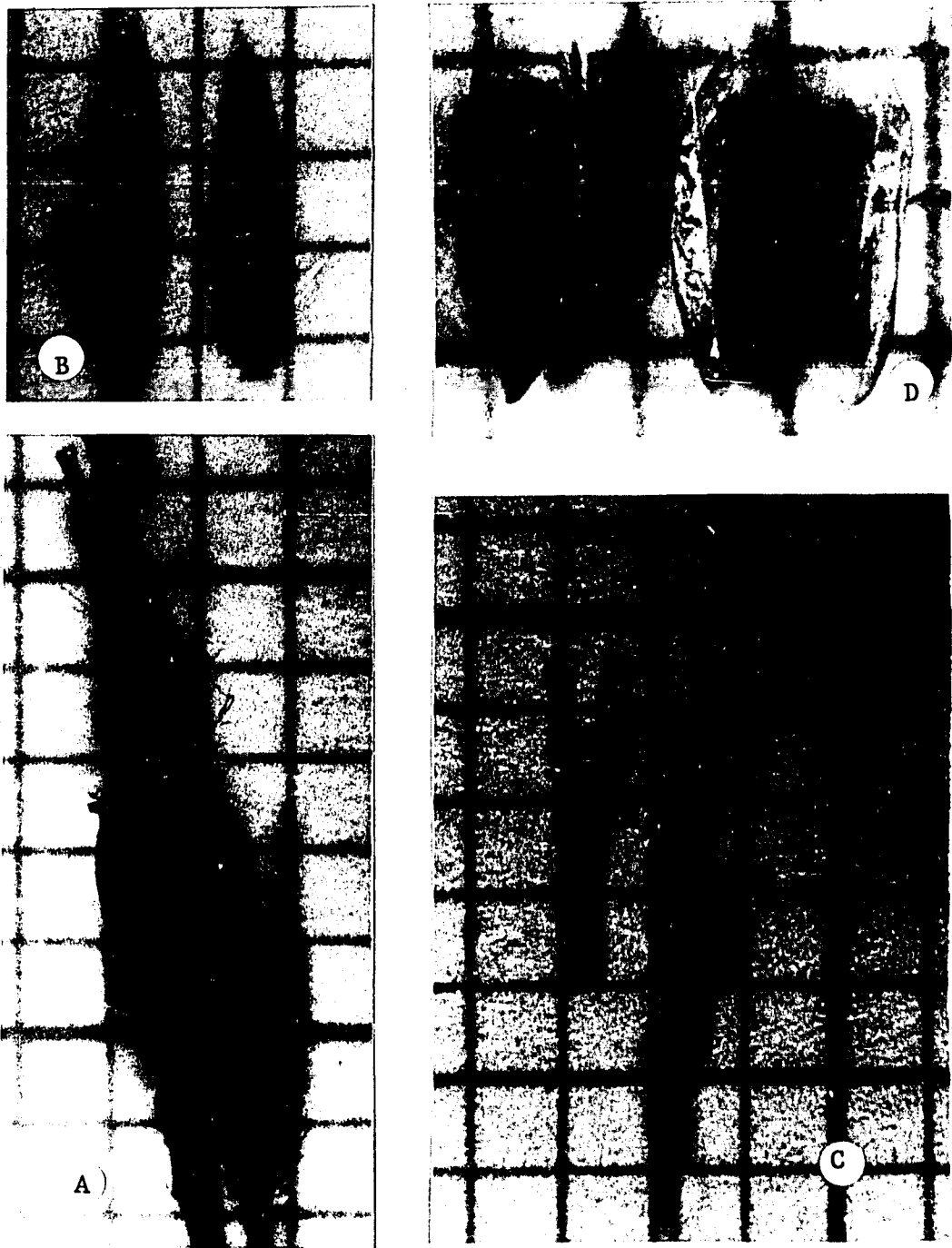


Plate No. 44. *Miscanthus fuscus* (Roxb.) Benth.
 A. habit, spikelets in raceme B. spikelet dorsal
 and ventral view C. main axis; rhachis internode,
 and short and long pedicel D. palea enclosing stamens.

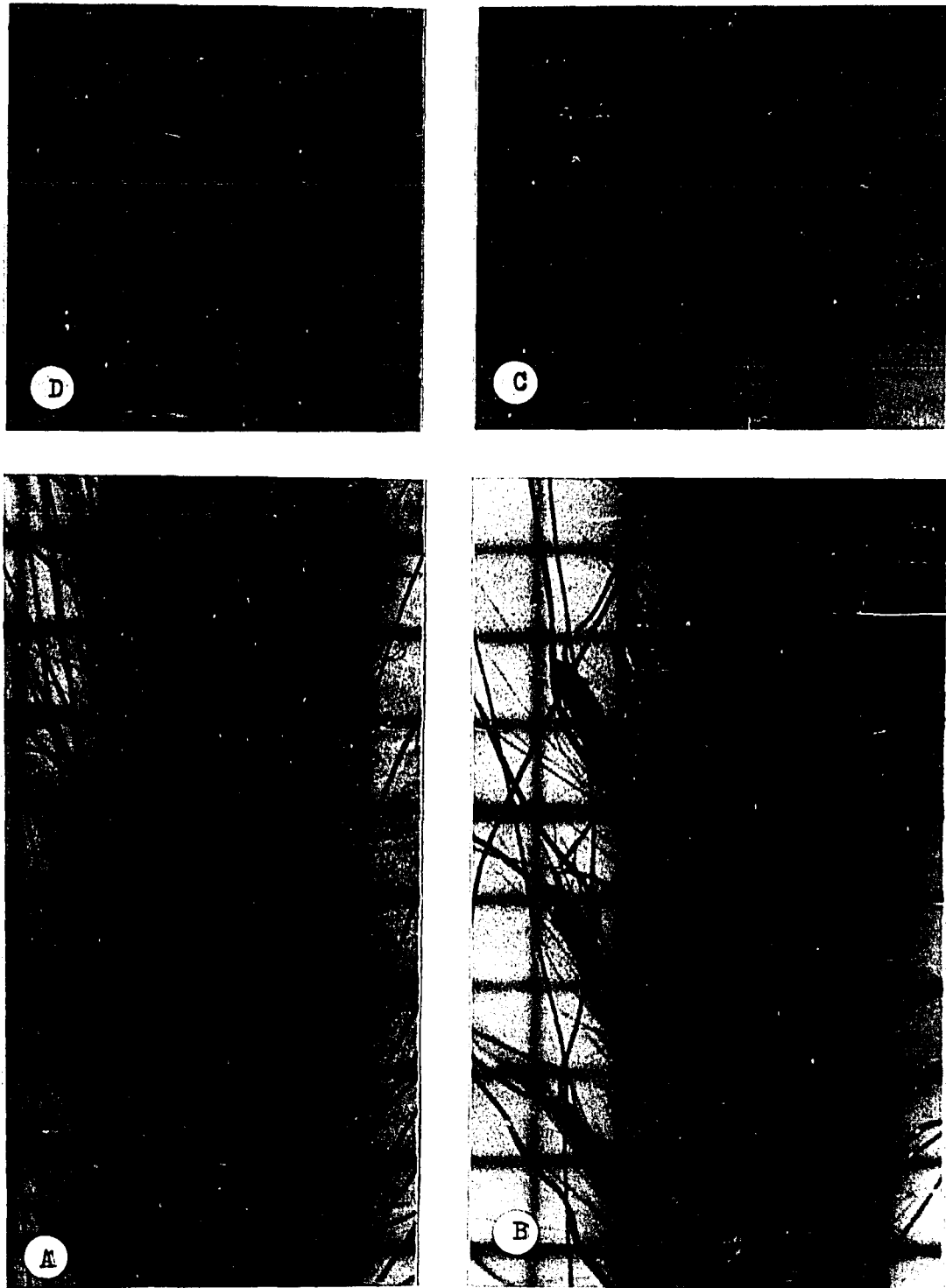


Plate No. 45. A. *Pogonatherum crinitum* (Thunb.) Kunth,
 A. habit, spikelets in raceme B, C. *P. paniceum* (Lamk.)
 Hack. B. habit C. sessile and pedicelled spikelet
 D. left, *P. crinitum*; right, *P. paniceum* spikelet.

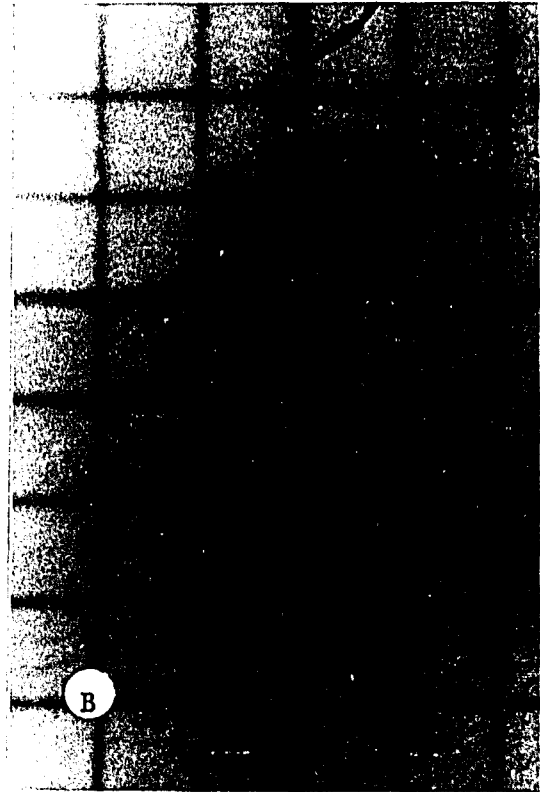
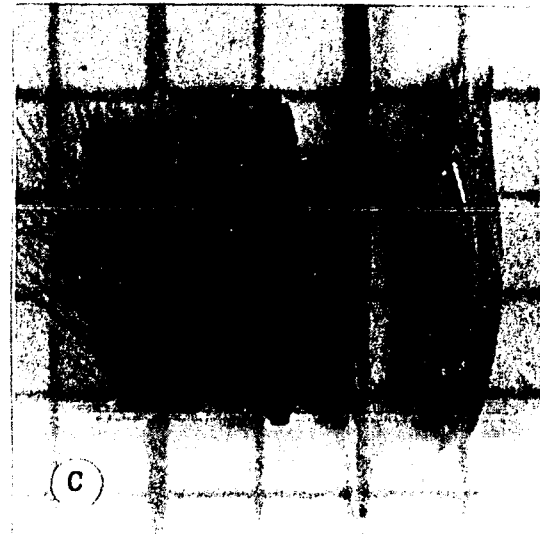
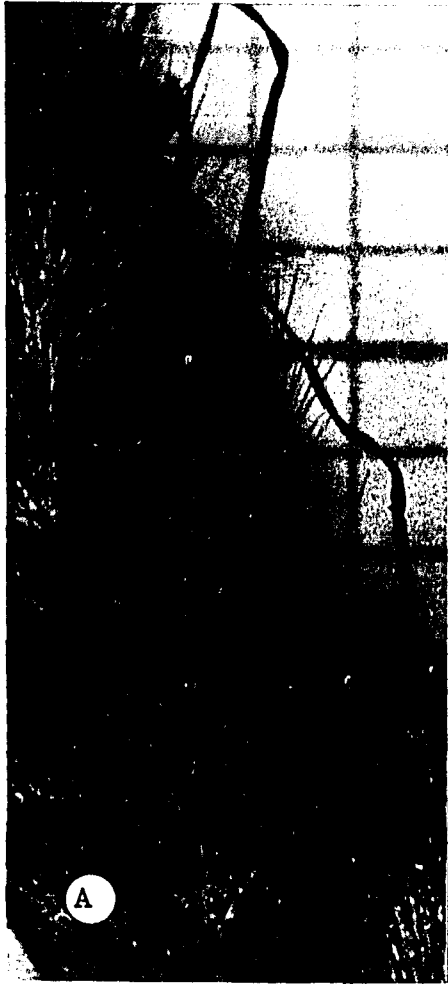


Plate No. 46. *Polytrias amaura* (Beuse) O. Ktze.
 A. habit, spikelets in raceme B. dorsal view of
 sessile spikelet C. from left to right; lower
 glume, stamens, upper lemma and awn, and upper glume.

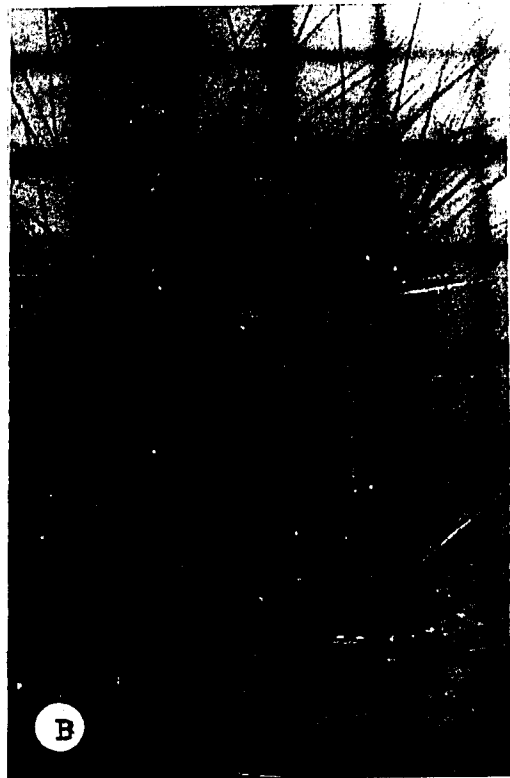
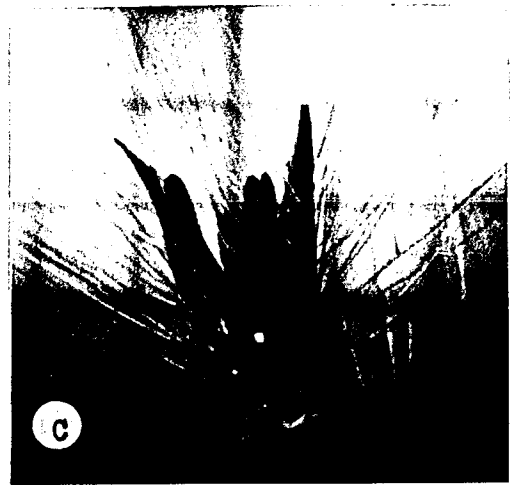
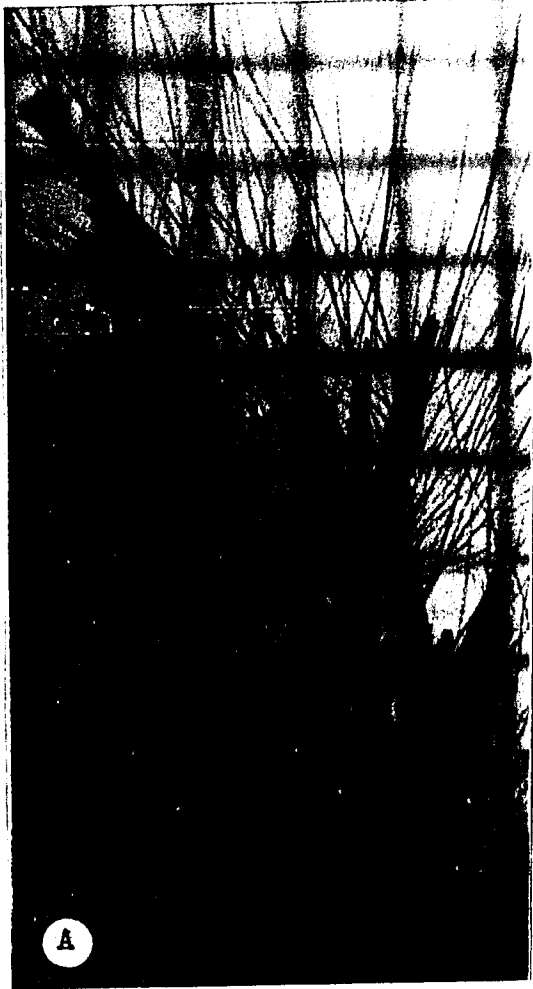


Plate No. 47. *Saccharum arundinaceum* Retz.
A. habit, spikelets in raceme B. pedicelled spikelet
C. sessile spikelet.

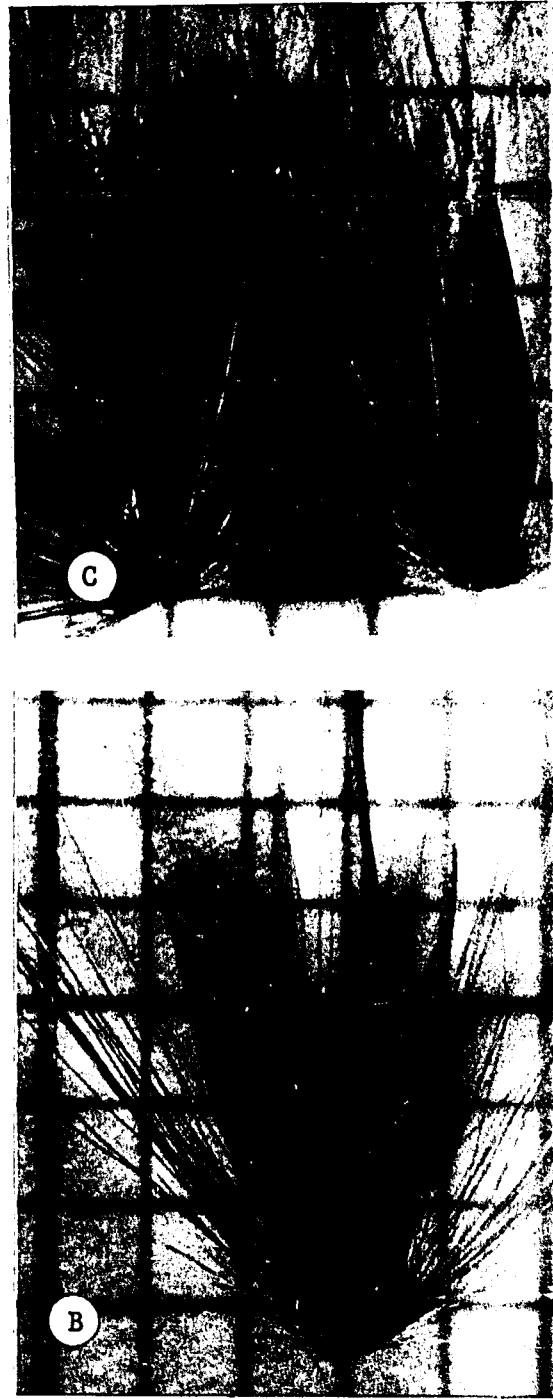


Plate No. 48. *Saccharum longisetosum* (Anderss.) Naray.
 ex Bor A. habit, spikelet pair B. pedicelled spikelet
 C. left, sessile spikelet with rhachis internode and pedicel;
 right, pedicelled spikelet.

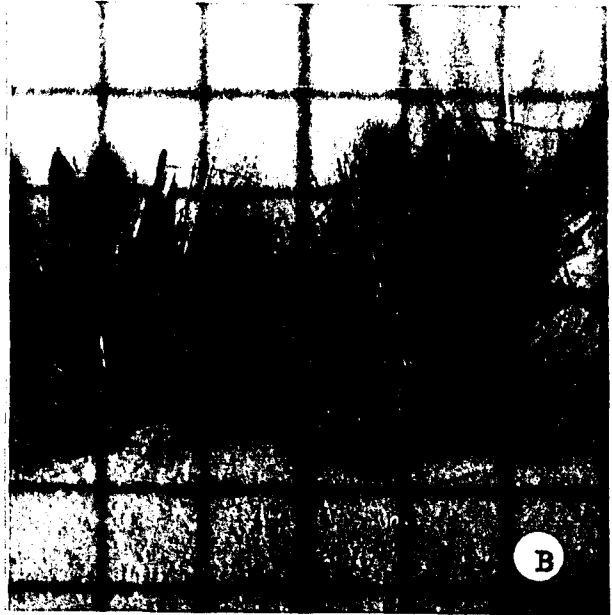


Plate No. 49. *Saccharum porpyrocoma* (Hance) Hack.
 A. habit, spikelet pair B. left, pedicelled spikelet
 right, sessile spikelet C. sessile spikelet and pedicel.

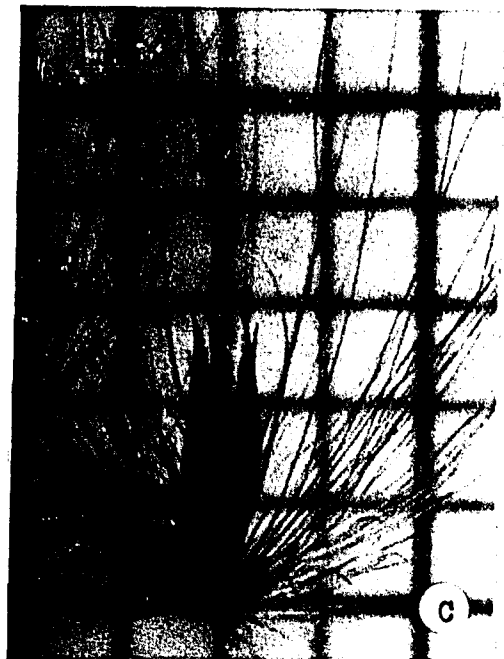
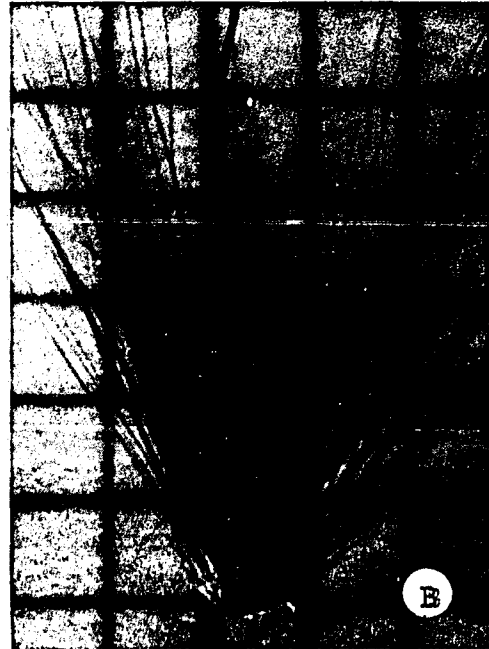


Plate No. 50. *Saccharum rufipilum* Steud.
A. habit, sessile spikelet with rhachis internode and pedicelled B. dorsal view, sessile spikelet
C. lateral view, pedicelled spikelet.

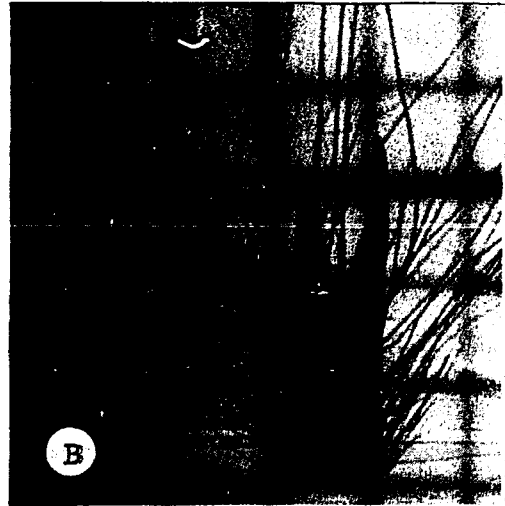


Plate No. 51. *Saccharum spontaneum* Linn.
 A. habit, spikelet in raceme B. sessile spikelet
 with rhachis internode and pedicelled C. pedicelled
 spikelet

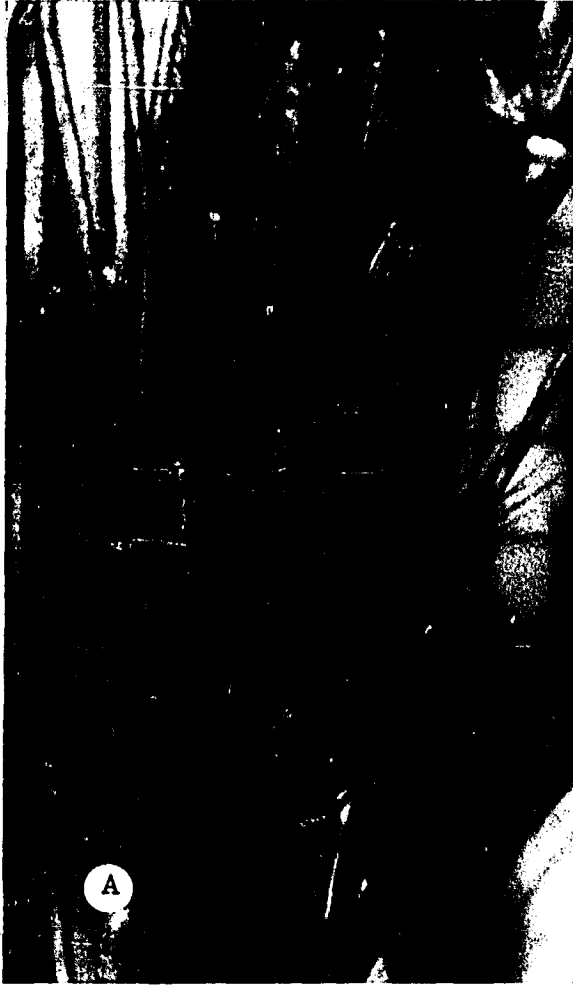


Plate No. 52. *Spodiopogon lacei* Hole
 A. habit, spikelets in raceme B. spikelet pair; left,
 dorsal view; right, ventral view with rhachis internode
 and pedicel C. capillary racemes.

SPECIMENS STUDIED

1. *Andropogon ascinodis* C.B. Clarke

Kerr 8251/ 10 Jan 24, Surin	BK, K
Kerr 9779/ 26 Dec 24, Krabin, Prachin Buri	K
Maxwell 88-57, Doi Suthep, Chiang Mai	AAU
Smitinand 4004/ 12 Dec 58, Doi Suthep, Chiang Mai	BKF, K
Smitinand & Abbe 6186/ 30 Nov 69, Doi Suthep, Chiang Mai	BKF, K

2. *Andropogon burmanicus* Bor

Charoenphol, Larsen & Warncke 4879/ 10 Nov 70	
Phu Kradueng, Loei	AAU, BKF, K, NY
Kerr 8108/ 25 Dec 23, Pak Thong Chai, Nakhon Ratchasima	K
Kerr 9395/ 25 Nov 24/ Khao Saming, Nakhon Ratchasima	K
Put 4232/ 31 Oct 31, Bua Yai, Nakhon Ratchasima	K

3. *Andropogon distachyus* L.

Put 4465A/ 21 Dec 31, Doi Chiangdao, Chiang Mai	K
---	---

4. *Andropogon fastigiatus* Sw.

Charoenphol, Larsen & Warncke 4890	AAU, K
Godefroy-Lebeuf s.n.	K
Kerr 2243	BK, K
Kerr 4609	BK, K
Kerr 8069	K
Kerr 16209	K
Larsen 8135/ 11 Nov 61, Bankao, Kanchanaburi	K
Larsen 8302/ 18 Nov 61, Pattavee, Kanchanaburi	K
Nanakorn 1252/ 17 Nov 89, Phataem Historic Park, Ubol.	BKF, NY
Smitinand & Abbe 6174	K
Sorensen, Larsen & Hansen 5890	K

5. *Andropogon polypticus* (Steud.) A. Camus

Tagawa 1039/ 3 Dec 65, Phu Kradueng, Loei	BK, K
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6. *Arthraxon castratus* (Griff.) Naray. ex Bor

Beusekom et al. 4289/ 15 Dec 71, Kamang, Chaiyaphum	BKF
Kerr 9780	BK, K
Smitinand s.n. /17 Sept. 1954 (BKF 26382);	BKF
Smitinand, Poore & Robbins 7803/ 10 Nov 62, Doi Chiang Dao, Chiang Mai	BKF
Sorensen, Larsen & Hansen 1800/ 28 Feb 58, Fang, Chiang Rai	K

- Sorensen, Larsen & Hansen 6145/ 22 Nov 58,
Ban Si Than, Loei BKF, K
Tagawa et. al. 548/ 28 Nov 65, Phu Kradueng, Loei BKF
Yongboonkird 110 BK
7. *Arthraxon hispidus* (Thunb.) Makino
- Anderson 3877/ 11 Nov 76, Doi Inthanond, Chiang Mai BKF, UC
Beusekom et al. 3594/ 9 Nov 71, Huay Ban Kau, Kanchanaburi BKF, K
Beusekom et al. 3872/ 19 Nov 71, Erawan NP., Kanchanaburi BKF, K
Fukuoka 6151 BKF
Kerr 2774/ 27 Oct 12, Doi Suthep, Chiang Mai K
Kerr 9421/ 26 Nov 24, Khao Saming, Chantaburi K, NY, UC
Kerr 16404 BK, K
Maxwell 86-11/ 12 Jan 86, Khao Chong, Trang BK
Murata et al. 155 BKF
Murata et al. 12320 BKF
Murata et al. 13324 BKF
Murata et al. 13858 BKF
Schimizu 14673 BKF
Smitinand 2048/ 24 Oct 54, Phu Kradueng, Loei BKF, K
Smitinand 3665/ 28 Nov 56, Pong Nam Rawn, Chantaburi BKF
Smitinand 4975/ 25 Nov 58, Phu Kradueng, Loei K
Sorensen, Larsen & Hansen 592/ 24 Jan 58,
Chawang, Nakhon Si Thammarat C, K
Sorensen, Larsen & Hansen 598/ 24 Jan 58,
Chawang, Nakhon Si Thammarat BKF
Suvatabandhu 385a BK
8. *Arthraxon lanceolatus* (Roxb.) Hochst.
- Charoenphol et al. 4891 AAU, BKF
Kerr 4628 BK, K
Kerr 8049 BK, K
Put 4465/ 21 Dec 31, Doi Chiang Dao, Chiang Mai K
Smitinand 2031/ 16 Oct 54, Phu Kradueng, Loei BKF, K
Smitinand, Poore & Robbins 7844/ 11 Nov 62,
Doi Chiang Dao, Chiang Mai BKF
Sorensen, Larsen & Hansen 1257/ 16 Dec 58
Doi Chiang Dao, Chiang Mai BKF, K
Sorensen, Larsen & Hansen 2400/ 21 Mar 58,
Phu Kradueng, Loei BKF
Yongboonkird 147 BK
9. *Arthraxon lanceolatus* var. *meeboldii* (Stapf) Welzen
- Ploenchit 471 BK
10. *Arthraxon lancifolius* (Trin.) Hochst.
- Beusekom et. al. 3510/ 8 Nov 71, Huay Ban Kau,
Kanchanaburi BKF, K, US

- Beusekom et. al. 3752/ 13 Nov 71, Huay Ban Kau,
Kanchanaburi BKF, K
Charoenphol et al. 4600/ AAU, BKF, K
Haniff, s.n./ 16 Dec 18 K
Kerr 849/ 30 Oct 07, Doi Suthep, Chiang Mai K
Kerr 6595 BK, K
Larsen et. al. 4600/ 7 Sept 70, Phu Kradueng, Loei BKF
Maxwell 87-1399/ Nov 87, Doi Suthep, Chiang Mai AAU
Put 3427/ 11 Nov 30, Doi Angka, Chiang Mai K
Put 4547/ 25 Dec 31, Doi Chiangdao, Chiang Mai K
Smitinand 6987/ 22 Oct 60, Nang Rawng, Nakhon Nayok BKF, K, GH
Smitinand (BKF 22237)/ 7 Dec 60, Doi Musor, Tak BKF, K
Smitinand & Anderson 7235/ 2 Dec 61, Chiang Dao, Chiang Mai BKF
Smitinand & Phengklai 6049/ Nov 86, Mae Chaem, Chiang Mai K
Sorensen, Larsen & Hansen 6256/ Nov 58, Phu Kradueng, Loei BKF, K
Sorensen, Larsen & Hansen 33406/ s.n. BKF
11. *Arthraxon microphyllum* (trin.) Hochst.
Garett 840/ 23 Nov 33, Doi Angka, Chiang Mai BKF, K, NY
12. *Cymbopogon annamensis* (A. Camus) A. Camus
Kerr 7948/ 23 Nov 23, Nakhon Ratchasima BK, K
Kerr 8130 AAU, BK, K
Put 4245 BKF, K
Thorel s.n. P
13. *Cymbopogon calcicola* Hubbard
Haniff 4074, s.n./ 16 Dec. 1918 K
14. *Cymbopogon calciphilus* Bor
Kerr 13478/ 6 Nov 27, Hua Hin, Prachuap Khiri Khan BK, K
Kerr 19876/ 14 Dec 30, Phra Taen, Kanchanaburi K
Kerr 19998/ 5 Feb 31, Phu Wieng, Khon Kaen K
Kerr 20596/ 8 Nov 31, Tung Luang, Phetchaburi K
Larsen 8335/ 19 Nov 61, Tha Ki Len, Kanchanaburi BKF, GH
Marcan 2437/ 9 Nov 28 Kao Tao, Prachuap, Khiri Khan K
Put 4319/ 7 Nov 31, Lat Bua Kao, Nakhon Ratchasima K
Smitinand 2028/ 16 Oct 54, Phu Kradueng, Loei K
Smitinand 3870/ 26 Nov 57, Kanburi, Kanchanaburi K
Smitinand & Abbe 6168/ 21 Nov 59, Thoen-Lee, Lampang BKF
Smitinand & Abbe 6169/ 29 Nov 59, Thoen-Lee, Lampang K
15. *Cymbopogon cambogiensis* (Bal.) Camus & Camus
Kerr 11391 K
Kerr 19586/ 9 Aug 30, Aran Pratet, Prachin Buri BK, K
Kerr 19677 BK, K
Larsen 8989 K

- Larsen 10027/ 13 Jun 63, Makham, Chantaburi BKF, K
16. *Cymbopogon citratus* (DC.) Stapf
Kerr 20648 BK, K
17. *Cymbopogon clandestinus* (Nees ex Steud.) Stapf
BK 33204/ s.n. BK
18. *Cymbopogon flexuosus* (Nees ex Steud.) Wats.
Collins 1892/ 22 Nov 27, Sriracha, Chon Buri K
Iwatsuki et al. 9738/ 15 Sept 67, Pa Hom Pok, Chiang Rai BKF
Iwatsuki et al. 11144/ 25 Sept 67, Doi Tung, Chiang Rai BKF
Kerr 6956/ 31 Mar 23, Sriracha, Chon Buri K
Kerr 11799/ 3 Feb 27, Kao Talu, Ranong K
Kerr 14057/ 13 Jan 28, Betong, Satun K
Maxwell 71-693 AAU
Maxwell 72-587 AAU
Maxwell 75-1044 AAU
Shimizu et al. 10087/ 14 Sept 67, Chiang Dao, Chiang Mai BKF
Smitinand 7079 BKF
Smitinand & G.S. 10629/ 10 Jan 69, Doi Saket, Chiang Mai BKF
19. *Cymbopogon khasianus* (Munro ex Hack.) Bor
Kerr 1554b/ 12 Nov. 1911, Doi Suthep, Chiang Mai BK, K
20. *Cymbopogon martinii* (Roxb.) Wats.
Hambanonda 328 a,b/ 27 Mar 67, Bangkok BKF
Kerr 10192/ 11 Jan 26, Si Sawat, Kanchanaburi K
21. *Cymbopogon microstachys* (Hook.) Soenarko
Hansen & Smitinand 12252/ 12 Feb 66,
Koh Lanta Yai, Phuket BKF, K
Kerr 8013/ 16 Dec 23, Dong Pya Yen, Chai Nat K
Kerr 16074 BK, K
Larsen 8939 BKF, K
22. *Cymbopogon nardus* var. *confertiflorus* (Steud.) Bor
Smitinand 2064/ Nov 54, Phu Kradueng, Loei BKF
23. *Cymbopogon traninhensis* (A. Camus) Soenarko
Smitinand & Abbe 6263/ 7 Dec 59,
Chiang Dao, Chiang Mai BKF, K
Smitinand & Anderson 7258/ 2 Dec 61,
Chiang Dao, Chiang Mai BKF, K

- Smitinand, Poore & Robbins 7838/ 1 Nov 62
Chiang Dao, Chiang Mai BKF, K
24. *Cymbopogon winteranus* Jowitt
- Kerr 6351/ 18 July 22, Doi Angka, Chiang Mai K
Nuupukdee 171 BKF
Put 2392/ 14 Feb 29, Tung Song, Surat Thani K
Smitinand 5708/ 6 Apr 59, Koh Kut, Trat BKF, K
25. *Eulalia bicornuta* Bor
- Kerr 9724/ 20 Dec 29, Chuntabun, Tharuang K
Larsen 6260 AAU
Smitinand 2101/ 12 Nov 54, Phu Kradueng, Loei BKF, K
Smitinand 5012/ 29 Nov 58, Phu Kradueng, Loei BKF, K
Smitinand 10887 BKF
Sorensen, Larsen & Hansen 6260/ 27 Nov 58
Phu Kradueng, Loei K
26. *Eulalia contorta*
- Beusekom et al. 3819/ 16 Nov 71, Sisawat, Kanchanaburi BKF, K
Kerr 1559b/ 11 Nov 11, Doi Suthep, Chiang Mai K
Kerr 8031/ 17 Dec 23, Pang Hua Sue, Chai Nat K
Kerr 8223/ 7 Jan 24, Talung, Buri Ram K
Lindhard 24/ 8 Jan 04, Wang Djai, Tak K
Maxwell 74-1021 AAU
Put 4295/ 3 Nov 31, Bua Yai, Nakhon Ratchasima K
Smitinand 3627/ 22 Nov 56, Makhm, Chantaburi BKF, K
Smitinand 3995/ 12 Dec 57, Doi Suthep, Chiang Mai K
Smitinand 4885/ 20 Nov 58, Wang Saphung, Loei BKF, K
Smitinand & Abbe 6179/ 30 Nov 69, Doi Suthep, Chiang Mai BKF, K
27. *Eulalia irritans*
- Beusekom et al. 2290/ 4 Dec 69
Inthanond, Chiang Mai AAU, K
Hosseus 143/ 4 July 05, Wang Djao, Tak K
Larsen 8171/ 9 Nov 61, Ban Kao, Kanchanaburi K
28. *Eulalia leschenaultiana* (Decne.) Ohwi
- Kerr 2240/ 14 Nov 11, Doi Suthep, Chiang Mai K
Kerr 14706/ 23 Mar 18, Tapa, Songkhla K
Maxwell 86-929 AAU
Sorensen, Larsen & Hansen 5885/ 25 Oct 58
Doi Suthep, Chiang Mai K
29. *Eulalia monostachya* (Bal.) A. Camus
- Haniff 2982/ 15 Dec 17 K

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| Kerr 7240/ 17 July 23, Pattani | K |
| Kerr 9729/ 21 Dec 24, Taruang, Chantaburi | BK, K |
| Kerr 15757/ 8 Apr 28, Songkhla | K |
| Kerr 19854/ 11 Nov 30, Bang Keng, Prachin Buri | E |
| Put 1968/ 16 Oct 28, Aran Pratet, Prachin Buri | K |
| Put 4297/ 3 Nov 31, Bua Yai, Nakhon Ratchasima | K |
| Put 4299/ 3 Nov 31, Bua Yai, Nakhon Ratchasima | BK, K |
| Smitinand 3054/ 17 Oct 55, Wang Saphung, Loei | BKF, K |
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| 30. <i>Eulalia quadrinervis</i> (Hack.) O. Ktze | |
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| Kerr 20624/ 9 Nov 31, Ban Pong, Ratchaburi | BK, K |
| Smitinand, Poore & Robbin 7840, Chiang Dao, Chiang Mai | K |
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| 31. <i>Eulalia siamensis</i> Bor | |
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| Kerr 2218/ 11 Nov 11, Doi Suthep, Chiang Mai (Type!) | BK, K |
| Khantchai 696/ 29 Sept 57, Doi Suthep, Chaing Mai | BKF |
| Maxwell 75-435 | AAU |
| Ploenchit 29/ 3 Sept 49, Doi Suthep, Chiang Mai | BKF, K |
| Smitinand 2104/ 12 Nov 54, Phu Kradueng, Loei | BKF, K |
| Smitinand 5001/ 29 Nov 58, Phu Kradueng, Loei | K |
| Smitinand 6253/ 7 Dec 59, Chiang Dao, Chiang Mai | K |
| Smitinand & Abbe 6206/ 2 Dec 59, Doi Suthep, Chiang Mai | K |
| Sorensen, Larsen & Hansen 5921/ 26 Oct 58
Doi Suthep, Chiang Mai | K |
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| 32. <i>Eulalia smitinandiana</i> | |
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| Smitinand 2053/ 29 Oct 54, Phu Kradueng, Loei (Type!) | K |
| Smitinand 3098/ 29 Oct 55, Phu Kradueng, Loei | K |
| Smitinand 5013/ 29 Nov 58, Phu Kradueng, Loei | K |
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| 33. <i>Eulalia speciosa</i> (Debeaux) O. Ktze. | |
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| Beusekom et al. 4214/ 13 Dec 71, Kamang, Chaiyaphum | K |
| Charoenphol, Larsen & Warncke 4703/ 7 Nov 70
Phu Kradueng, Loei | AAU, BKF, K |
| Dee 612/ 16 Oct 52, Phu Kradueng, Loei | K |
| Dee 613/ 16 Oct 52, Phu Kradueng, Loei | K |
| Kerr 1510/ 23 Oct 10, Doi Suthep, Chiang Mai | K |
| Kerr 6669/ 13 Nov 22, Mae Taeng, Chiang Mai | K |
| Marcant 2749/ 10 Nov 31, Tung Luang, Ratchaburi | K |
| Smitinand 2083/ 1 Nov 54, Phu Kradueng, Loei | K |
| Smitinand 2091/ 3 Nov 54, Phu Kradueng, Loei | BKF, K |
| Smitinand 2210/ 28 Nov 54, Phu Kradueng, Loei | K |
| Smitinand 3971/ 11 Dec 57, Doi Suthep, Chiang Mai | K |
| Smitinand 4901/ 21 Nov 58, Wang Saphung, Loei | BKF, K |
| Smitinand & Abbe 6205/ 2 Dec 59,
Doi Suthep, Chiang Mai | BKF, K |
| Sorensen, Larsen & Hansen 5542/ 9 Oct 58
Doi Suthep, Chiang Mai | BKF, K |

34. *Eulalia trispicata* (Schult.) Henr.

Haniff 2946/ 14 Dec 17	K
Kerr 3091/ 14 Jan 14, Chae Hom, Lampang	K
Kerr 3473/ 14 Nov 14, Doi Suthep, Chiang Mai	AAU, K
Kerr 7737/ 8 Sept 23, Pattani	AAU, K
Kerr 8215/ 5 Jan 24, Nang Rawng, Buri Ram	K
Kerr 9724/ 20 Dec 24, Taruang, Chantaburi	K
Kerr 11332/ 9 Jan 1927, Bang Son, Chumphon	BK, K
Kerr 13557/ 23 Dec 27, Padang Besar	K
Kerr 13702/ 28 Dec 27, Satun	K
Kerr 13900/ 5 Jan 28, Tung Wa, Satun	K
Kerr 17655/ 21 Dec 29, Dan Chumphae, Nakhon Ratchasima	K
Kerr 19256/ 1 May 30, Sak, Pattalung	K
Maxwell 74-1065	AAU
Smitinand 3619/ 22 Nov 56, Makham, Chantaburi	BKF, K
Smitinand 3681/ 29 Nov 56, Makham, Chantaburi	BKF, K
Smitinand & Abbe 6561/ 15 Mar 60, Prachuap Khiri Kant	K

35. *Eulaliopsis binata* (Retz.) C.E. Hubbard

Kerr 1081/ 5 Apr 10, Doi Suthep, Chiang Mai	K
Smitinand 4260/ 19 Feb 58, Mae Khachan Nue, Chiang Mai	BKF, K
Smitinand & Abbe 6189/ 30 Nov 69, Doi Suthep, Chiang Mai	K
Sorensen, Larsen and Hansen 1370/ 19 Feb 58, Chiang Mai	BKF, K
Sorensen, Larsen and Hansen 2611/ 10 Apr 58, Doi Suthep, Chiang Mai	K
Ying Yong 836-82/ 8 Mar 82, Huay Kaew, Chiang Mai	BK

36. *Heteropogon contortus* (L.) P. Beauv. ex Roem. et Schult.

Beusekom et al. 3789/ 15 Nov 71, Si Sawat, Kanchanaburi	BKF, K
Bradley 39/ 1872	GH, US
Burkill 1238/ 25 Nov 57, Kanchanaburi	BKF
Collins 1909/ 23 Nov 27, Nah Khli, Chon Buri	K
Geesink et al. 5631/ 31 May 73, Doi Ka, Tak	AAU, BKF
Gondon 305/ 31 Jan 80, Tarutao, Satun	AAU
Hosseus 108a/ 14 Oct 04, Wang Djao, Tak	K
Kerr 1267/ 21 Jul 10, Doi Suthep, Chiang Mai	K
Kerr 4610/ 18 Dec 20, Doi Tung Cha	K
Kerr 7073/ 22 June 23, Bangkok	K
Kerr 7976/ 10 Dec 23, Kaeng Koi, Saraburi	K
Kerr 11702/ 8 Nov 26, Phetchaburi	K
Kerr 15976/ 28 Jul 28, Santale, Kamphaeng Phet	K
Kerr 19559/ 13 Jul 30, Kao Tak, Kanchanaburi	K
Kerr 19765/ 19 Oct 30, Kao Tawng, Kanchanaburi	K
Kloss, s.n./ Oct.16, Lat Bua Kao, Nakhon Ratchasima	K
Larsen 8303/ 18 Nov 61, Kanchanaburi	GH
Larsen, Smitinand & Warncke 370/ 12 July 66	AAU
Larsen, Smitinand & Warncke 1596/ 14 Aug 66 Huay Yang, Ratchaburi	K
Lindhard, s.n./ Jan 04, Raheng, Kamphaeng Phet	K

Marcan 2229/ 5 Nov 27, Hua Hin, Prachuap Khiri Kant	K
Marcan 2313/ 24 Feb 28, Koh Pai	K
Maxwell 71-46	AAU
Maxwell 71-692	AAU
Maxwell 74-598	AAU
Maxwell 75-408	AAU
Maxwell 86-517	BKF
Maxwell 86-1025/ 1 Dec 86, Laem Promtep, Phuket	AAU, BKF
Murata et al. 15610/ 1 Oct 71, Ban Pha Mawn, Chiang Mai	BKF
Murata et al. 16553/ 20 July 73, Nakhon Sawan	BKF
Murata et al. 16554/ 20 July 73, Nakhon Sawan	BKF
Murata et al. 16825/ 20 July 73, Nakhon Sawan	BKF
Murata et al. 16833/ 23 July 73, Huay Mae Lamao, Tak	BKF
O'Connor & Niyomdham 15733/ 11 Mar 79, Pran Kratai, Sukhothai	BKF, NY
Parry 38/ 19 Dec 69, Sawankhaloke, Sukhothai	K
Put 1967/ 16 Oct 28, Aran Pratet, Prachin Buri	K
Put 2173/ 29 Nov 28, Hua Wai, Nakhon Sawan	K
Shimizu et al. 19378/ 18 Oct 79, Bo Luang, Chiang Mai	BKF
Smitinand 1472/ 19 July 52, Hua Hin, Prachuap Khiri Kant	BKF
Smitinand 1613/ 26 May 54, Ngao, Lampang	BKF, K
Smitinand 2032/ 16 Oct 54, Phu Kradueng, Loei	BKF, K
Smitinand 3063/ 17 Oct 55, Wang Saphung, Loei	BKF, K
Smitinand 4001/ 12 Dec 57, Doi Suthep, Chiang Mai	BKF, K
Smitinand 4264/ 19 Feb 58, Mae Khachan Nuea, Chaing Mai	BKF, K
Smitinand & Abbe 6190/ 30 Nov 59 Doi Suthep, Chiang Mai	K
Smitinand & Abbe 9241D/ 29 Nov 59, Thoen, Lampang	BKF, NY
Sorensen, Larsen & Hansen 1371/ 19 Feb 58, Chiang Mai	BKF
Sorensen, Larsen & Hansen 1822/ 2 Mar 58, Phayao	BKF
Sorensen, Larsen & Hansen 2417/ 22 Mar 58, Phu Kradueng, Loei	BKF
Sorensen, Larsen & Hansen 4437/ 26 July 58, Doi Suthep, Chiang Mai	BKF, K
Sorensen, Larsen & Hansen 5886/ 25 Oct 58 Doi Suthep, Chiang Mai	K
Tagawa et al. 1036/ 3 Dec 65, Phu Kradueng, Loei	AAU, BKF
Tagawa et al. 2203/ 15 Dec 65, Mae Klang, Chiang Mai	BKF, K, GH

37. *Heteropogon triticeus* (R. Br.) Stapf ex Craib

Beusekom et al. 4411/ 18 Dec 71, Kamang, Chaiyaphum	BKF
Bradley 38/ 1872	GH
Hennipman 3095/ 21 Nov 65, Doi Mosor, Tak	BKF
Kerr 833/ 13 Oct 09, Doi Suthep, Chiang Mai	K
Kerr 8091/ 23 Dec 23, Nakhon Ratchasima	K
Kerr 20602/ 5 Nov 31, Thung Luang, Phetchaburi	K
Khantchai 695/ 27 Sept 57, Chiang Dao, Chiang Mai	BKF, K
Lindhard 31/ 8 Jan 04, Wang Djao, Tak	K
Maxwell 74-1024	AAU
Ploenchit 1962/ 27 Nov 62, Phu Phan, Sakol Nakhon	BKF
Put 1959/ 15 Oct 28, Watana, Prachin Buri	K

- Shimizu et al. 18232/ 11 Oct 79, Nam Nao, Phetchabun BKF
 Smitinand 3683/ 29 Nov 56, Makham, Chantaburi BKF
 Smitinand 3991/ 12 Dec 57, Doi Suthep, Chiang Mai BKF, K
 Smitinand 4902/ 21 Nov 58, Wang Saphung, Chiang Mai BKF
 Sorensen Larsen & Hansen 3373/ 12 May 58,
 Doi Suthep, Chiang mai BKF
 Sorensen Larsen & Hansen 5772/ 16 Oct 58,
 Doi Suthep, Chiang Mai BKF
 Tagawa et al. 2316/ 16 Dec 65, Mae Klang, Chiang Mai BKF
38. *Hyparrhenia diplandra* (Hack.) Stapf
- Adisai 348/ 18 Feb 63, Phu Wieng, Khon Kaen BK
 Beusekom et al. 4242/ 14 Dec 71, Kamang, Chaiyaphum K
 Larsen 2280 BKF, K
 Nanakorn 878/ 11 Nov 84, Phu Khiew, Chaiyaphum NY
 Smitinand 1787/ 23 Mar 54, Phu Kradueng, Loei BKF
 Smitinand 2107/ 15 Nov 54, Phu Kradueng, Loei BKF, K
39. *Hyparrhenia newtonii* (Hack.) Stapf
- Nanakorn 880/ 11 Nov 84, Phu Khiew, Chaiyaphum BKF, NY
 Smitinand 2081/ 1 Nov 54, Phu Kradueng, Loei BKF, K
 Smitinand 3763 BKF, K
 Smitinand 4982/ 27 Nov 58, Phu Kradueng, Loei BKF, K
 Sorensen, Larsen & Hansen 6264/ 27 Nov 58
 Phu Kradueng, Loei BKF, K
40. *Hyparrhenia nyassae* (Rendle) Stapf
- Smitinand 4006/ 12 Dec 57, Doi Suthep, Chiang Mai BKF, K
41. *Hyparrhenia rufa* var. *siamensis* W.D. Clayton
- Kerr 2253 BK, K
 Kerr 6672/ 13 Nov 22, Mae Taeng, Chiang Mai BK, K
 Kerr 8923 BK
 Kerr 8932/ 16 Jan 24, Sangka, Surin K
 Nanakorn 1235/ 15 Dec 88, Lampang-Chiang Mai BKF, NY
 Nanakorn 1244/ 20 Dec 88, Chiang Mai-Chiang Rai BKF, NY
 Smitinand 2614/ 5 May 55, Lom Kao, Phetchabun BKF, K
 Smitinand 3915/ 6 Dec 57, Doi Suthep, Chiang Mai BKF, K
 Smitinand 4005/ 12 Dec 57, Doi Suthep, Chiang Mai BKF, K
 Smitinand 8756/ 12 Mar 65, Khun Khong, Chiang Mai BKF, K
 Smitinand 11790/ 28 Dec 72, Kamphaeng Phet K
 Smitinand & Abbe 6188/ 30 Nov 59,
 Doi Suthep, Chiang Mai BKF, K
 Smitinand & Phengklai 8693/ 9 Mar 65, Pang Boh, Chiang Mai BKF
 Sorensen, Larsen & Hansen 2569 BKF, K
 Sukkri 83/ 2 Mar 66, Doi Suthep, Chiang Mai K
 Tagawa et al. 2573/ 18 Dec 65, Inthanond, Chiang Mai BKF
 Tagawa et al. 3035/ 20 Dec 65, Inthanond, Chiang Mai BKF

- Yongboonkird 475/ 23 Apr 73, Khun Tan, Lampang BK
42. *Imperata cylindrica* (Linn.) P. Beauv.
- Anderson 4047/ 4 Dec 76, Inthanond, Chiang Mai UC
 Kerr 1097/ 11 Apr 10, Doi Suthep, Chiang Mai K
 Kerr 3784/ 26 Sept 19, Bangkok K
 Kerr 11597/ 22 Jan 27, Ta Ngam, Chumphon K
 King 5427/ 5 June 63, Nakhon Sawan K
 King 5480/ 5 June 63, Kamphaeng Phet K
 Koyama et al. 15230/ Klong Naka, Ranong NY
 Marcan 2302/ 11 Dec 27, Bangkok K
 Marcan 2312/ 24 Feb 28, Koh Pai K
 Nootboom et al. 712/ 11 Jan 69, Doi Pui, Chiang Mai K
 Smitinand 8778/ 13 Mar 65, Khun Klong, Chiang Mai K
43. *Imperata conferta* (Presl) Ohwi
- Heckman 132/ 5 Sept 76, Mueng, Udon Thani K
 Hosseus 502/ 26 Mar 05, Doi Suthep, Chiang Mai K
 Sorensen, Larsen & Hansen 776/ 28 Jan 58, Krabi K
 Wichian 331/ 9 May 46, Wangka, Kanchanaburi K
44. *Iseilema siamensis* Hubbard
- Kerr 7980/ 14 Dec 23, Chaibadan, Chai Nat BK, K
 Put 2131/ 26 Nov 28, Takli, Nakhon Sawan BKF, K
45. *Iseilema thorelii* A. Camus
- Kerr 8144/ 29 Dec 23, Katok, Nakhon Ratchasima K
 Kerr 8227/ 8 Jan 24, Talung, Buri Ram K
 Kerr 9730/ 21 Dec 24, Taruang, Chantaburi BK, K
 Put 1135/ 2 Oct 27, Ban Nawng Bua, Saraburi K
 Put 1981/ 16 Oct 28, Aran Pratet, Prachinburi BKF, K
 Smitinand 5814/ 2 Jun 59, Nakhon Sawan BKF
 Sorensen, Larsen and Hansen 2151/ 16 Mar 58,
 Pimai, Nakhon Ratchasima BKF
46. *Miscanthus fuscus* (Roxb.) Benth.
- Flato 7784/ 29 July 59, Mueng, Nakhon Nayok K
 Gerrett 182/ 10 Aug 24, Doi Tham Tu Pu, Chiang Rai K
 Kerr 901 BK, K
 Kerr 2159 BK, K
 Kerr 19516/ 11 July 30, Ta Salao, Kanchanaburi K
 Kerr 20403/ 26 Jan 31, Chaturat, Chaiyaphum K
 Margelsdorf (US. 5655)/ 1955, Sukhothai K
 Put 131/ 14 July 26, Hin Dat, Kanchanaburi K
 Put 2574/ 27 July 26, Angtawng BK, K
 Smitinand 6089/ 29 July 59, Nang Rawng, Nakhon Nayok BKF, K
 Smitinand 6090/ 29 July 59, Nang Rawng, Nakhon Nayok BKF, K

47. *Microstegium ciliatum* (Trin.) A. Camus
 Geesink et al. 7695/ 28 Feb 74, Khao Pawta Luang Keow, Pangnga K
 Kerr 17640/ 20 Dec 29/ Dan Chum Phae, Nakhon Ratchasima BK, K
 Kerr 19198/ 28 Apr 30/ Khao Soi Dao, Trang K
 Maxwell 86-527/ 30 July 86, See Ban Pote, Pattalung BKF
 Sorensen, Larsen & Hansen 6553/ 26 Dec 58 Doi Suthep BKF
48. *Microstegium delicatulum* (Hook.f.) A. Camus
 Phengklai 579/18 Dec 62, Khao Yai, Nakhon Ratchasima K
49. *Microstegium petiolare* (Trin.) Bor
 Tagawa et al 1568/ 5 Dec 65, Phu Luang, Loei BKF
 Tagawa et al 3040/ 20 Dec 65, Inthanond, Chiang Mai BKF
50. *Microstegium vagans* (Nees ex Steud) A. Camus
 Beusekom et al. 2584/ 17 Dec 69,
 Mae Sarieng, Mae Hong Son BKF
 Beusekom et al. 3775/ 14 Nov 71,
 Huay Ban Kau, Kanchanaburi BKF, K
 Beusekom et al. 4092/ Nam Phrom, Chaiyaphum K
 Beusekom et al. 4640/ 5 Jan 72,
 Mae Khaem Stream, Phrae K
 Garrette 1031/ 31 Dec 35, Angka, Chiang Mai BKF, K
 Hansen & Smitinand 12659/ Doi Chong, Chiang mai BKF, K
 Hennipman 3564/ 9 Jan 16, Phu Luang, Udon Thani K
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 Kerr 6570/ 5 Nov 22, Doi Chiang Dao, Chiang Mai K
 Kerr 10234/ 17 Jan 26, Si Sa Wat, Kanchanaburi K
 Kerr 11451/ 15 Jan 27, Ta Ngaw, Chumphon K
 Kerr 13840/ 2 Jan 28, Kuan Po, Satun K
 Kerr 16232/ 20 Dec 28, Lung Suan, Chumphon K
 Kerr 15378/ 25 Apr 28, Lan Saka, Nakhon Si Thammarat K
 Larsen 6553/ 26 Dec 58, Doi Suthep, Chiang Mai K
 Larsen 8708/ 14 Dec 61, Sai Yoke, Kanchanaburi K
 Larsen 8954/ 25 Dec 61, Hard Pha Lom, Kanchanaburi K
 Ploenchit 82/ 18 Oct 49, Doi Suthep, Chiang Mai BKF, K
 Smitinand 959/ 9 Dec 55, Doi Chiang Dao, Chiang Mai BKF, K
 Smitinand 1679/ 27 June 54, Phu Lungka, Chiang Rai K
 Smitinand 2098/ 9 Nov 54, Phu Kradueng, Loei K
 Smitinand 2143/ 21 Dec 54, Phu Kradueng, Loei K
 Smitinand 3766/ 8 Feb 57, Doi Suthep, Chiang Mai BKF, K
 Smitinand 8758/ 12 Mar 65, Pang Boh, Chiang Mai K
 Smitinand & Abbe 6173/ 29 Nov 59, Thoen, Lampang K
 Smitinand & Abbe 9276/ 2 Dec 59, Doi Suthep, Chiang Mai K
 Sorensen, Larsen & Hansen 994/ 10 Feb 58
 Doi Suthep, Chiang Mai K

- Sukkri 88/ s.n., Chiang Mai K
 Tagawa et al. 2441/ 17 Dec 65, Ban Yang, Chiang Mai K
51. *Microstegium vagans* var. *scandens* Bor
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 Larsen 9096/ 1 Jan 62, Huay Mae Nam Noi, Kanchanaburi K
 Kerr 2300/ 14 Jan 12 K
52. *Parahyparrhenia siamensis* W. D. Clayton
 Kerr 13715, Satun BK, K
53. *Parahyparrhenia tridentata* Clayton
 Phengkklai 252/ 20 Dec 61, Kanchanaburi K
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54. *Pogonatherum crinitum* (Thunb.) Kunth
 Beusekom et al. 1830/ 22 Oct 69
 Khao Yai, Nakhon Ratchasima K
 Chermisrivatana 450/ 5 Mar 66, Doi Suthep, Chiang mai BK
 Den Hood 214/ 29 Apr 46, Wang Ka, Kanchanaburi BKF, K
 Hambanonda 186/ 5 Apr 64, Khao Yai, Nakhon Ratchasima BKF
 Kerr 3274/ 5 July 14, Doi Suthep, Chiang Mai K
 Kerr 6814/ 2 Apr 23, Khao Chong, Trang K
 Kerr 11417/ 13 Jan 27, Ban Map Amarit, Chumphon BK, K
 Kerr 13209/ 8 Aug 27, Ban Kawp Kep, Surat Thani K
 Kerr 14103/ 16 Jan 28, Adang, Satun K
 Kerr 15152/ 13 Apr 28, Chawng, Nakhon Si Thammarat BK, K
 Kerr 16523/ 3 Jan 29, La Un, Ranong K
 Kerr 18424/ 3 Mar 30, Kao Kataluwan, Phangnga BK, K
 Khantchai 75/ 12 Mar 61, Sangka, Kanchanaburi K
 Khantchai 387/ 28 Feb 57, Chiang Dao, Chiang Mai K
 Khantchai 1068/ 12 May 59, Chumphon BKF, K
 Lakshnakara 833/ 28 Apr 31, Toh Noi BK, K
- Larsen, Smitinand & Warncke 415/ 14 July 66
 Muek Lek, Saraburi AAU, K
 Llewelyn 17244/ Feb 50, Khao Chong, Trang K
 Murata et al. 15399/ 30 Sept 71, Mae Klang, Chiang Mai BKF
 Phengkklai 81/ 26 Mar 61, Huay Hom Yai, Phrae BKF, K
 Shimizu et al. 27662/ 18 Dec 79, Rattaphum, Songkhla BKF
 Smitinand 2517/ 16 Feb 55, Klong Ma Yom, Trat K
 Smitinand 5719/ 6 Apr 59, Kaw Kut, Trat K
 Smitinand & Alsterlund 6756/ 19 Apr 60, Tat Noi, Chiang Mai K
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 Doi Suthep, Chiang Mai K
 Sorensen, Larsen & Hansen 1872/ 3 Mar 58
 Mae Tak, Chiang Mai K
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55. *Pogonatherum paniceum* (Lamk.) Hackel.

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Geesink et al. 6907/ 24 May 74, Nam Phrom, Chaiyaphum	BKF, K
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Hansen, Seidenfaden & Smitinand 10788, 19 Jan 64 Bo Luang, Chiang Mai	BKF
Hosseus 291/ 28 Dec 04, Doi Suthep, Chiang Mai	K
Hosseus 421/ 5 Feb 05, Doi Suthep, Chiang Mai	K
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Smitinand 4317/ 23 Feb 58, Fang, Chiang Rai	BKF, K
Smitinand & Abbe 6182/ 30 Nov 59, Doi Suthep, Chiang Mai	K
Smitinand & Alsterlund 6758/ 19 Apr 60, Tat Noi, Chiang Mai	K
Sukkri 86/ s.n., Doi Suthep, Chiang Mai	K
Suvatabandhu 314/ 8 Mar 56, Doi Suthep, Chiang Mai	BK

56. *Polytrias amaura* (Buse) O. Ktze.

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Dee, s.n./ 15 Oct. 53, Dusit Zoo, Bangkok	BKF
Fukuoka 7080/ 31 Jan 66, Bangkok	AAU, BKF
Iwatsuki 243/ 13 Nov 65, Bangkhen, Bangkok	BKF
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Kerr 6728/ 25 Dec 22, Bangkok	BK
Kerr 13786/ 8 Mar 29, Phuket	K
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Larsen 9609/ 6 Feb 62, Thong Pha Phum, Kanchanaburi	K
Larsen 9610/ 6 Feb 62, Thong Pha Phum, Kanchanaburi	K
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Put, s.n./ 13 Feb. 32, Bangkok	BK
Smitinand 4533/ 13 Apr 58, Bang Khen, Bangkok	K
Sorensen, Larsen and Hansen 1970/ 7 Mar 58, Bangkok	BKF, K

57. *Pseudanthistiria burmanica* Hook.f.

Kerr 13847/ 2 Jan 28, Ban Udai, Satun	K
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Sorensen, Larsen & Hansen 225/ 13 Jan 58, Makham, Chantaburi	BKF, K

58. *Saccharum arundinaceum* Retz.

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Kerr 9600/ 10 Dec 24, Makham, Chantaburi	K
Kerr 18056/ 11 Jan 30, Khao Ploy Waen, Chantaburi	K
Marcant 2145/ 24 Apr 27, Bangkok	K
Sangkhachand 222/ 14 Sept 54, Ban Ang, Chantaburi	K

- Shimizu et al. 18048/ 9 Oct 79,
 Khao Yai, Nakhon Ratchasima BKF
 Shimizu et al. 18418/ 12 Oct 79, Doi Musor, Tak BKF
 Smitinand 8486/ 20 Dec 63, Phu Phan, Sakon Nakhon K
 Sorensen, Larsen & Hansen 1164/ 16 Feb 58
 Chiang Dao, Chiang Mai K
 Sorensen, Larsen & Hansen 6062/ 8 Nov 58, Chiang Mai K
59. *Saccharum longisetosum* (Anderss.) Naray. ex Bor
- Beusekom et al. 4616/ 26 Dec 71, Phu Kradueng, Loei BKF
 Cherm-sirivatana 460 BK
 Hansen & Smitinand 12732/ 25 Feb 68
 Pang Mapha, Mae Sarieng AAU, K
 Hansen, Seidenfaden & Smitinand 11062/ 4 Feb 68
 Bo Luang, Mae Sarieng K
 Hennipman 3565/ 9 Jan 66, Phu Luang, Loei K
 Kerr 20147/ 13 Feb 31, Phu Kradueng, Loei K
 Sorensen, Larsen & Hansen 982/ 10 Feb 58
 Doi Suthep, Chiang Mai K
 Sorensen, Larsen & Hansen 1074/ 13 Feb 58,
 Wang Tao, Chiang Mai BKF, K
 Sorensen, Larsen & Hansen 6821/ 2 Feb 59
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60. *Saccharum officinarum* Linn.
- Kerr 7979/ 14 Dec 23, Chaibadan, Chainat K
61. *Saccharum porphyrocoma* (Hance) Hack.
- Gerrett 182/ 10 Aug 24, Doi Tam Tu Pu, Chiang Rai K
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62. *Saccharum rufipilum* Steud.
- Sadakorn 303/ Doi Angkang, Chiang Mai BK
63. *Saccharium spontaneum* Linn
- Beusekom et al. 4691/ Mae Khaem stream, Phrae BKF
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 Kerr 4000/ 8 Feb 20, Bangkok K
 Maxwell 87-152/ 5 Feb 87, Chaiya, Surat Thani AAU
 Put 2567/ 26 Dec 29, Ang Thong K
 Sorensen, Larsen & Hansen 5926/ 27 Oct 58
 San Kampheng, Chiang mai K
64. *Schizachyrium brevifolium* (SW.) Nees
- Beusekom & Phengklai 2562/ 15 Dec 69,
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Kerr 896/ 14 Nov 09, Doi Suthep, Chiang Mai	K
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Kerr 19244/ 30 Apr 30, Sala, Phatthalung	K
Kerr 19812/ 9 Nov 30, Ban Keng, Prachinburi	BK, K, NY
Larsen 8198/ 13 Nov 61, Ban Kao, Kanchanaburi	GH, K
Lindhard 19/ 8 Jan 04, Raheng, Kamphaengphet	K
Maxwell 74-1013, 7 Dec 74, Sahn Lan, Saraburi	AAU
Put 4298	K, US
Put 4546/ 25 Dec 31, Doi Chiang Dao, Chiang Mai	K
Smitinand 2042/ 16 Oct 54, Phu Kradueng, Loei	BKF, K
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Smitinand 11792/ 28 Dec 72, Mueng Kao, Kampheng Phet	BKF
Smitinand & Abbe 6183/ 30 Nov 59, Doi Suthep, Chiang Mai	BKF, K
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65. *Schizachyrium exile* Stapf

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66. *Schizachyrium sanguineum* (Retz.) Alst.

Beusekom et al. 4568/ 24 Dec 71, Phu Kradueng, Loei	BKF, K
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Phu Kradueng, Loei	AAU, BKF, K
Gondon 202/ 5 Jan 79, Trang	AAU
Kerr 2227/ 11 Nov 11, Doi Suthep, Chiang Mai	K
Kerr 8252/ 10 Jan 24, Surin	BK, UC
Kerr 9785/ 27 Dec 24, Watana, Prachinburi	BK, K
Kerr 13701/ 20 Dec 27, Satun	K
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Lindhard, s.n./ Jan 1904, Raheng, Kamphaeng Phet	K
Marcan 2746/ 9 Nov 31, Bo Fai, Phetchaburi	K
Smitinand 2052/ 29 Nov 54, Phu Kradueng, Loei	BKF, K
Smitinand 4003/ 12 Dec 57, Doi Suthep, Chiang Mai	BKF, K
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Phu Kradueng, Loei	BKF, K
Tagawa et al. 559/ 28 Feb 65, Phu Kradueng, Loei	BKF
Tagawa et al. 780/ 29 Feb 65, Phu Kradueng, Loei	BKF
Tagawa et al. 4568	BKF

67. *Spodiopogon lacei* Hole

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Nanakorn 1251/ 16 Jan 89, Chiang Dao, Chiang Mai	BKF, NY
Smitinand & Abbe 9318/ 5 Dec 59, Chiang Dao, Chiang Mai	BKF, K, NY
Smitinand & Anderson 7363/ 4 Dec 61, Chiang Dao, Chiang Mai	BKF, K
Smitinand, Poore & Robbins 7839/ 11 Nov 62, Chiang Dao, Chiang Mai	BKF, K
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68. *Themeda arguens* (L.) Hackel

Beusekom 3603/ 9 Nov 71, Huay Ban Kao, Kanchanaburi	K
Bradley 45/ 1872 s.n.	GH
Iwatsuki et al. 11143/ 25 Sept 67, Doi Tung, Chiang Rai	BKF
Kerr 7956/ 8 Dec 23, Kaeng Koi, Saraburi	K
Kerr 11090/ 9 Nov 26, Phetchaburi	K
Kerr 11322/ 9 Jan 27, Bang San, Chumphon	K
Kerr 13520/ 9 Nov 27, Hua Hin, Prachuap Khiri Kant	K
Larsen 8146/ Huay Ban Kao, Kanchanaburi	K
Larsen 8298	GH, K
Maxwell 76-960, Khao Khiew, Chon Buri	AAU, BK
Maxwell 86-960/ 21 Nov 86, Palien, Trang	AAU
Murata et al. 16987	BKF

69. *Themeda arundinacea* (Roxb.) Ridley

Bunpheng 902/ 14 Jan 65, Phu Kradueng, Loei	BK, BKF, K
Iwatsuki et al. 11145/ 25 Sept 67, Doi Tung, Chiang Rai	BKF
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Kerr 6670/ 13 Nov 22, Mae Taeng, Chiang Mai	K
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Kerr 9778/ 26 Dec 24, Watana, Prachin Buri	K
Kerr 11387/ 12 Jan 27, Ban Pak Klong, Chumphon	K
Kerr 14688/ 22 Mar 28, Tepa, Songkhla	K
Kerr 19944/ 26 Jan 31, Chaturat, Chaiyaphum	K
Kerr 20070/ 11 Feb 31, Phu Kradueng, Loei	K
Khantchai 673/ 24 Dec 57, Doi Suthep, Chiang Mai	BKF
Koyama et al. 15667/ 3 May 79, Sukhothai	BKF, NY
Marcan 2586/ 10 Nov 30, Bang Keng, Prachin Buri	K
Maxwell 74-1018/ 7 Dec 74, Sahn Lan, Saraburi	AAU
Ploenchit 1974/ 29 Nov 62, Phu Phan, Sakon Nakhon	BKF
Shimizu et al. 8807/ 3 Sept 67, Phu Kradueng, Loei	BKF
Shimizu et al. 8882/ 4 Sept 67, Phu Kradueng, Loei	BKF
Shimizu et al. 20202/ 22 Oct 79, Doi Chang, Chiang Mai	BKF
Smitinand 902	BKF
Smitinand 2106/ 15 Nov 54, Phu Kradueng, Loei	BKF, K
Smitinand 10164/ 16 Jan 67, Phu Ruea, Loei	BKF
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Sorensen, Larsen & Hansen 4731	GH, K
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- Sukkri 80/ 4 Mar 66, Doi Suthep, Chiang Mai BKF, K
 Tagawa et al. 9268/ 5 Sept 67, Khun Tan, Lamphum BKF
 Tagawa et al. 10518/ 19 Sept 67, Doi Suthep, Chiang Mai BKF
 West & Maxwell sn./ Jan. 1986 NY
70. *Themeda caudata* (Nees) A. Camus
- Tagawa et al. 370/ 27 Nov 65, Phu Kradueng, Loei BKF, GH, K
71. *Themeda quadrivalvis* (Linn.) O. Ktze.
- Kerr 4589 BK, K
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72. *Themeda triandra* Forssk.
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 Smitinand 3990/ 12 Dec 57, Doi Suthep, Chiang Mai BKF
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 Smitinand 6294/ 5 Jan 60, Phetchabun K
 Smitinand & Abbe 6191, 30 Nov 59, Doi Suthep, Chiang Mai BKF, K
 Sorensen, Larsen & Hansen 1396/ 20 Feb 58,
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73. *Themeda villosa* (Poir.) A. Camus

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LITERATURE CITED

- Ahmad, S. & Stewart, R. R. 1958. Grasses of West Pakistan, Part 1: Panicoideae. The Society at the Biological Laboratories, Government college, Lahore, Pakistan. 152 pp.
- Anderson, N. J. 1856. Monographiae Andropogonearum 1: Anthistiricae. Nov. Act. Soc. Sci. Upsal. Ser. 3(21): 229-255.
- Arber, A. 1965. The Gramineae, a study of cereal, bamboo and grass. Wheldon & Wesley, New York. 480 pp.
- Avdulov, N. P. 1928. Systematic karyology of the family Gramineae. Proc. All. Russ. Bot. Congr.: 65-67.
- Beauvois, A. M. F. J. Palisot de. 1812. Essai d'une nouvelle agrostographie ou nouveaux genera des graminees. Imprimerie de Fain, Paris. 256 pp.
- Backer, C. A. & Bakhuizen van den Brink, Jr., R. C. 1968. Flora of Java. Vol. 3. Wolters-Noordhoff, Groningen. 495-641.
- Barnard, C. M. & Potter, L. D. 1984. New Mexico Grasses. (A vegetative key). University of New Mexico Press, Albuquerque. 157 pp.
- Bentham, G. 1881. Notes on Gramineae. J. Linn. Soc., Bot. 19: 14-134.
- Bentham, G. & Hooker, J. D. 1883. Genera plantarum. Vol. 3.

- L. Reeve, London. 1074-1215.
- Bhat, R. V. & Karnick, M. G. 1952. Chemical pulps from Heteropogon contortus. Indian For. 78: 331-338.
- Bharucha, F. R. & Satyanarayan. Y. 1954. A new species of Arthraxon from Purandhar. J. Bombay Nat. Hist. Soc. 52: 481.
- Blackburn, F. 1984. Sugar-cane. Longman, London. 414 pp.
- Blake, S. T. 1944. Monographic studies in the Australian Andropogoneae. Government Printer, Brisbane. 61 pp.
- Booth, W. E. 1964. Agrostology. Edwards Brothers, Ann Arbor Michigan. 222 pp.
- Bor, N. L. 1940. Flora of Assam. Vol. V. (reprint 1982). Taj Offset Press, Delhi, India. 480 pp.
- _____. 1952. The genus Microstegium in India and Burma. Kew Bull.: 209-223.
- _____. 1960. Grasses of Burma, Ceylon, India and Pakistan (excluding Bambuseae). Vol. 1. Pergamon Press, London. 767 pp.
- _____. 1962. Studies in the Flora of Thailand. 8. Dansk Bot. Arkiv 20(2): 139-178.
- _____. 1965. Studies in the Flora of Thailand. 26. Dansk Bot. Arkiv 23(2): 141-168.

- Bor, N. L. 1966. Studies in the Flora of Thailand. 38. Dansk Bot. Arkiv 23(3): 307.
- _____. 1968. Studies in the Flora of Thailand. 43. Dansk Bot. Arkiv 23(4): 465-471.
- Brown, W. V. 1948. A cytological study in Gramineae. Am. J. Bot. 35: 382-395.
- Brown, W. V. & Emery, W. H. P. 1958. Leaf anatomy in grass systematics. Bot. Gaz. 119: 170-178.
- Burkill, L. H. 1966. A dictionary of the economic products of the Malay Peninsula. Vols. 1 & 2. Ministry of Agriculture and Co-operatives, Kuala Lumpur, Malaysia. 2444 pp.
- Camus, E. G. & Camus, A. 1922. in Lecompte, H. Flore Générale de L' Indo-Chine. Tom 7. Fasc. 3. (Eriocaulonacées A' Graminées). Paris. 202-236.
- _____. 1922. in Lecompte, H. Flore Générale de L' Indo-Chine. Tom 7. Fasc. 4. (Eriocaulonacées A' Graminées). Paris. 337-480.
- Celarier, R. P. 1956. Cytotaxonomy of the Andropogoneae I. Cytologia 21: 272-291.
- Celarier, R. P. & Harlan, J. R. 1957. Annual report of progress in forage crops research in Oklahoma. Mimeographed, Stillwater.

- Chase, A. 1959. First book of grasses: the structure of grasses explained for beginners. Smithsonian Publication Press. Washington, D.C. 127 pp.
- Chase, A. & Niles, C. D. 1962. Index to grass species. Vols. 1-3. G.K. Hall, Boston.
- Chung, In-Cho, 1965. Korean Grasses. Chicago Natural History Museum, Chicago. 186 pp.
- Cirillo, D. 1792. Plantarum rariorum regni neapolitani. Detoni, Neapoli.
- Clarke, C. B. 1889. On the plants of Kohima and Muneypore. J. Linn. Soc., Bot. 25: 83-90.
- Clayton, W. D. 1966. Study in the Gramineae IX. Andropogoneae. Kew Bull. 20(2): 257-273.
- _____. 1967. Study in the Gramineae XII. Parahyparrhenia, Hyperthelia and Exothecca. Kew Bull. 20(3): 433-449.
- _____. 1969. A revision of the genus Hyparrhenia. Kew Bull. Add. ser.2: 1-196.
- _____. 1972a. Study in the Gramineae XXIX. Andropogoneae. Kew Bull. 27(3): 447-450.
- _____. 1972b. Study in the Gramineae XXXI. The awned genera of Andropogoneae. Kew Bull. 27(3): 457-474.

- Clayton, W. D. 1973. Study in the Gramineae XXXIII. The awnless genera of Andropogoneae. Kew Bull. 28(1): 49-58.
- _____. 1987. Andropogoneae. in Grass systematics and evolution, Soderstrom, T., Hilu, K., Campbell, S. & Barkworth, M. (eds) Smithsonian Institution Press; Washington, D.C. 307-309.
- Clayton, W. D. & Renvoize, S. A. 1986. Genera Graminum: Grasses of the World. Her Majesty's Stationary Office, London. 389 pp.
- Clifford, H. T. 1969. Attribute correlations in Poaceae. Bot. J. Linn. Soc. 62: 59-67.
- Clifford, H. T. & Watson, L. 1977. Identifying Grasses: Data, methods and illustrations. University of Queensland Press. St. Lucia, Queensland. 146 pp.
- Clifford, H. T. 1987. Spikelet and floral morphology. in Grass systematics and evolution, Soderstrom, T., Hilu, K., Campbell, S. & Barkworth, M. (eds) Smithsonian Institution Press; Washington, D.C. 21-30.
- Clyde, F. R. 1969. Bibliography to floras of Southeast Asia: Burma, Laos, Thailand (Siam), Cambodia, Vietnam (Tonkin, Annam, Cochinchina), Malay Peninsula and Singapore. Department of Botany, Smithsonian Institution; Washington, D.C. 191 pp.
- Cope, T. A. 1982. Flora of Pakistan. Vol. 143. Poaceae. Pakistan

Agricultural Research Council, Islamabad. 678 pp.

Craib, W. G. 1913. Contributions to the Flora of Siam.

Monocotyledons. Aberdeen University Studies. 61.

University of Aberdeen Printed, Aberdeen, Scotland. 31-38.

_____. 1931. The Flora and Vegetation of Thailand. Mid-Pacific
Mag. 41(4): 328-335.

Craib, W. G. & Kerr, A. F. G. 1932-1939. Florae Siamensis

Enumeratio. 2. The Bangkok Times Press, Bangkok. 476 pp.

Dahlgren, R. M. T. & Clifford, H. T. 1982. The Monocotyledons.

(A comparative study). Academic Press, New York.

Dahlgren, R. M. T. & Rasmussen, F. N. 1983. Monocotyledon

evolution, characters and phylogenetic estimation.

Evolutionary Biology 16: 255-395.

Dahlgren, R. M. T., Clifford, H. T. & Yeo, P. F. 1985. The families

of monocotyledons: Structure, evolution and taxonomy.

Springer-Verlag, New York. 520 pp.

Darlington, C. D. & Wylie, A. P. 1955. Chromosome Atlas of Flowering

Plants. Macmillan Company, New York. 519 pp.

DeSelm, H. R. 1975. Key and descriptions to andropogon grasses of

the genera Andropogon, Bothriochloa, Schizachyrium and

Dichanthium in Southeastern United States. Dept. of

Botany, Univ. of Tennessee, Knoxville. 47 pp.

- De Jussieu, A.L. 1789. *Genera Plantarum*. Parisiis. 498 pp.
- De Wet, J. M. J. 1958. Additional chromosome numbers in Transvaal grasses. *Cytologia* 19: 97-103.
- _____. 1960. Cytogeography of *Themeda triandra* in South Africa. *Phyton* 15: 37-42.
- Emery, W. H. P. & Brown, W. V. 1958. Apomixis in the Gramineae, tribe Andropogoneae: *Heteropogon contortus*. *Madrano* 14: 238.246.
- Engler, A. 1964. *Syllabus der Pflanzenfamilien*. Vol. 2. Gebruder Borntraeger, Berlin. 666 pp.
- Erdtman, G. 1971. *Pollen Morphology and Plant Taxonomy*. Hafner Publishing Company, New York. 193-194.
- Faegri, K. & Iversen, J. 1964. *Textbook of Pollen Analysis*. Villadsen og Christensen, Copenhagen. 195-197.
- Fedorov, A. A. 1969. *Chromosome numbers of flowering plants*. Academy of Science of USSR. 493-573.
- Gabel, M. L. 1982. *A Biosystematic Study of the Genus Imperata (Gramineae: Andropogoneae)*. Ph.D. Thesis, Iowa State University, Ames, Iowa, USA. 90 pp.
- Gilland, H. D., Holtum, R. S. and Bor, N. L. 1971. *Flora of Malaya*. Vol. 3. *Grasses of Malaya*. Lim Bian Han, Singapore. 319 pp.

- Gledhill, D. 1990. *The Names of Plants*. 2nd ed. Cambridge University Press, Cambridge. 202 pp.
- Gould, F. 1983. *Grass Systematic*. 2nd ed. McGraw-Hill Book Company, New York. 397 pp.
- Gould, F. & Soderstrom, T. R. 1974. Chromosome numbers of some Ceylon grasses. *Can. J. Bot.* 52: 1075-1090.
- Griffiths, D. A. 1983. *Grasses & Sedges of Hong Kong*. Urban Council of Hong Kong. 138 pp.
- Hackel, E. 1889. *Andropogoneae*. in A. de Candolle, *Monographiae Phanerogamarum*. Vols. 1 & 2. Masson, Parisiis.
- Hambanonda, C. 1963. *Studies in Gramineae (Thai grasses)*. Unpublished M.Sc. thesis, University of Aberdeen, Aberdeen, Scotland. 82 pp.
- Hansen, B. 1978. *Flora of Thailand: abbreviation of books-titles to be followed in flora-contribution*. Herbarium, University of Copenhagen, Copenhagen. Denmark. 7 pp. (unpublished).
- Harrington, H. D. 1977. *How to Identify Grasses and Grasslike plants*. Swallow Press, Chicago. 142 pp.
- Hemadri, K. 1980. *Grasses of Junnar and its surrounding Poona District (Maharashtra State)*. Bisen Singh Mahendra Palsingh, India. 130 pp.

- Henderson, M. R. 1974. *Malayan Wild Flowers (Monocotyledons)*.
Art Printing Works, Kuala Lumpur. 294-354.
- Henrard, J. T. 1935. Identification of Malaysian grasses.
Blumea 1(2): 350-411.
- Hilu, K. W. & Wright, K. 1982. Systematics of Gramineae: A cluster
analysis study. *Taxon* 31: 9-36.
- Hitchcock, A. S. 1971. *Manual of Grasses of the United States*,
vols. 1 & 2 (2nd. ed., revised by Agnes Chase). Dover
Publications, New York. 1051 pp.
- Holmgren, P. K., Keuken, W. & Schofield, E. K. 1981. Index
Herbariorum. Part 1. *The Herbaria of the World*, 7th ed.
Bohn, Scheltema & Holkema, Utrecht. 452 pp.
- Hooker, J. D. 1897. *Flora of British India*, vol. 7 (Cyperaceae,
Gramineae and general Index). Gilbert & Rivington,
London. 842 pp.
- Hsu, Chien-Chang, 1975. *Taiwan Grass*. Taiwan Provincial Education
Association, Taipei. 884 pp.
- _____. 1978. *Flora of Taiwan*. 5. Epoch Publishing,
Teipei. 1166 pp.
- Hubbard, C. E. 1973. Graminales. in Hutchinson, J. *Families of
flowering plants*. 3rd. ed. Oxford University Press,
Oxford. 871-903.

- Hubbard, C. E. 1984. Grasses: A guide to their Structure, Identification, Uses and Distribution in the British Isles (Revised by J.C.E. Hubbard). Penguin Books, London. 476 pp.
- Hunziker, J. H. & Stebbins, G. L. 1989. Chromosomal evolution in the Gramineae. in Grass systematics and evolution, Soderstrom, T., Hilu, K., Campbell, S. & Barkworth, M. (eds) Smithsonian Institution Press; Washington, D.C. 179-187.
- Iwanami, Y., Sasakuma, T. & Yamada, Y. 1983. Pollen: Illustrations and Scanning Electronmicrographs. Kodansha, Tokyo. 198 pp.
- Jacques-Felix, H. 1962. Les Graminees (Poaceae) d'Africa tropicale (generalites, classification description des genres). Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, Paris. 345 pp.
- Janiki Ammel, E. K. 1941. Intergeneric hybrids of Saccharum. J. Genetics. 41: 217-253.
- Kellogg, E. A. & Campbell, C. S. 1987. Phylogenetic analyses of the Gramineae. in Grass systematics and evolution, Soderstrom, T., Hilu, K., Campbell, S. & Barkworth, M. (eds) Smithsonian Institution Press; Washington, D.C. 310-322.
- Keng, Y. L. 1933. Grass of China. Vols. 1,2. Ph.D. Thesis, George Washington University; Washington, D.C., USA. 311 pp.

- Kerr, A. F. G. 1931. The Flora and Vegetation of Thailand.
Mid-Pacific Mag. 41(4): 328-335.
- Koyama, T. 1987. Grasses of Japan and its Neighboring Regions: An
Identification Manual. Kadansha, Japan. 570 pp.
- Kumar, V. & Subramaniam, B. 1987. Chromosome atlas of flowering
plants of the Indian subcontinent. Vol. 2 (Monocotyledons).
Botanical Survey of India, New Delhi. 566-655.
- Kunstadter, P., Sabhasri, S. & Smitinand, T. 1978. Flora of a
forest fallow farming environment in northwestern Thailand.
J. Nat. Res. Council Thailand 10: 1-45.
- Larsen, K. 1963. Studies in the Flora of Thailand. 14. Cytological
studies in vascular plants of Thailand. Dansk. Bot.
Arkiv 20(3): 213-244.
- Lazarides, M. 1980. Phanerogamarum Monographiae. 12. The tropical
grasses of Southeast Asia (excluding Bamboos). Strauss &
Cramer, Hirschberg, Germany. 225 pp.
- Lee, Y. N. 1966. Manual of Korean Grasses. Ewha Womans University
Press, Seoul, Korea. 300 pp.
- Macfarlane, T. D. & Watson, L. 1982. The classification of Poaceae
Subfamily Pooideae. Taxon 31: 178-203.
- Mehra, K. L., Subramanyam, K. N. & Swaminathan, M. S. 1962.
Cytogenetical studies in some members of Andropogoneae.

- J. Ind. Bot. Soc. 41: 491-502.
- Metcalfe, C. R. 1960. Anatomy of the Monocotyledons. I. Gramineae. Oxford University Press, London. 731 pp.
- Moffet, A. A. & Hurcombe, R. 1949. Chromosome numbers of South African grasses. *Heredity* 3: 369-373.
- Mukherjee, S. K. 1954. Revision of the genus Saccharum. *Bull. Bot. Soc. Bengal* 8: 143-148.
- Nair, P. K. K. 1970. Pollen morphology of Angiosperms: A historical and phytogenetic study. Lucknow Scholar Publishing House, India. 60-61.
- Nanakorn, W. 1989. Species enumeration of the Thai Gramineae. The Forest Herbarium, Royal Forest Department, Bangkok. 61 pp. (unpublished).
- Ohwi, J. 1941. Gramina Japonica. *Acta Phytotaxonomica et Geobotanica* 11(3): 145-193.
- Ohwi, J. 1965. Flora of Japan. Smithsonian Institution press; Washington, D.C. 1067 pages.
- _____. 1971. Contributions to the Flora of Southeast Asia. 5. Gramineae and Cyperaceae of Thailand. *Tonan Ajia Kenkyu (Southeast Asian Studies)* 9(2): 194-211.
- Olorode, O. 1974. Chromosome numbers in Nigerian grasses. *Cytologia* 39: 429-435.

- Patunkar, B. W. 1980. Grasses of Marathwada. Sadhana Press,
Jodhpur. 297 pp.
- Pilger, R. 1954. Das System der Gramineae. Bot. Jahrb. 76: 281-384.
- Price, S. 1959. Cytological studies in Saccharum and allied genera.
V. Chromosome numbers in Saccharum, Erianthus, Narenga,
and Sclerostachya from Thailand and Vietnam. Cytologia
24: 342-347.
- Purseglove, J. W. 1972. Tropical Crops. 1. Monocotyledons.
Longman Group, London.
- Raeuschel, E.A. 1797. Nomenclator Botanicus. Feind, Lipsiae.
- Reeder, J. R. 1948. The Gramineae-Panicoideae of New Guinea. Ph.D.
Thesis, Harvard University, Cambridge, Massachusetts.
124 pp.
- Renvoize, S. A. 1982. A survey of leaf-blade anatomy in grasses. 1.
Andropogoneae. Kew Bull. 37: 315-321.
- Rhind, D. 1945. The Grasses of Burma. Baptist Mission Press,
Calcutta. 99 pp.
- Ridley, H. N. 1925. Flora of the Malay Peninsular. Vol. 5.
L. Reeve, London. 186-272.
- Roberty, G. 1960. Monographie Systematique des Andropogonees du
globe. Boissiera 9: 1-455.

- Roshevits, R. Yu 1931. Grasses: An Introduction to the Study of Fodder and Cereal Grasses. (English translation 1980). Smithsonian Institution Press; Washington, D.C. 635 pp.
- Roxburgh, W. 1832. Flora Indica (descriptions of Indian plants). Carey, W. (ed) Today & Tomorrow's Printers & Publishers, New Delhi. 234-278.
- Roy, G. P. 1984. Grasses of Madya Pradesh. Botanical Survey of India. Department of Environment publication, Allahabad. 180 pp.
- Senaratna, J. D. J. E. 1956. The grasses of Ceylon. Government Press, Peradeniya, Ceylon. 209 pp.
- Santisuk, T. 1988. An account of the vegetation of Northern Thailand. Geological Research. Vol.5. Franz Steiner Verlag Wiesbaden, Stuttgart. 101 pp.
- Santos, J. V. 1986. Guide to Philippine flora and fauna. Vol 4. Natural Resources Management Center, Manila. 47-144.
- Sharma, M. 1967. Pollen morphology of Indian Monocotyledons. J. Palyn. Soc. Ind.: 37-38.
- Smith Jr., J. P. 1971. Taxonomic revision of the genus Cymbopogon. in Iowa State J. Sci. 45(3): 319-385.
- Smitinand, T. 1980. Thai plant names. Funny Publishing, Bangkok. 377 pp.

- Smitinand, T. 1989. Thailand. in Campbell, D. G. & Hammill, D. (eds) Floristic inventory of tropical countries (The status of plant systematic, collections, and vegetation, plus recommendations for the future). The New York Botanical Garden, New York. 63-82
- Soderstrom, T., Hilu, K., Campbell, C., Barkworth, M., 1987. Grass Systematics and Evolution. Smithsonian Institution Press, Washington, D.C. 473 pp.
- Soenarko, S. 1977. The genus Cymbopogon Sprengel (Gramineae). Reinwardtia 9(3): 225-375.
- Sreekumar, P. V. 1986. A study on the grass flora of Kerala State, India. Ph.D. thesis, University of Madras, India. 435 pp.
- Stafleu, F. A. (ed.). 1978. International Code of Botanical Nomenclature. Bohn, Scheltema and Holkema, Utrecht.
- Stapf, O. 1906. The oil-grasses of India and Ceylon (Cymbopogon, Vetiveria and Andropogon spp.). Bull. Misc. Inf. R. Bot. Gard. 82: 297-363.
- _____. 1917-1934. Gramineae. in Prain, D. (ed.) Flora of Tropical Africa. Vol. 9(1-6). L. Reeve, London. 1132 pp.
- Stearn, W. T. 1983. Botanical Latin, 3rd. ed. David & Charles, Vermont, USA. 566 pp.
- Symonds, T. J. 1886. Indian Grasses, 2nd ed. Higginbotham, Madras,

India. 99 pp.

Tateoka, T. 1954. Karyotaxonomy in Poaceae. II. Somatic chromosomes of some grass species. *Cytologia* 19: 317-328.

_____. 1959. Chromosomes of five Indian and Ceylonese grass species. *Curr. Sci.* 28: 78-79.

_____. 1965. Chromosome numbers in some East African grasses. *Amer. J. Bot.* 52: 864-869.

Tothill, J. C. & Hacker, J. B. 1973. *The Grasses of Southeast Queensland*. University of Queensland Press. St. Lucia. 300 pp.

Trinius, C. B. & Reprecht, F. J. 1839-42. *Species Graminum*. Ser. VI, Tom. V. *Academiae imperialis scientiarum, Petropoli*.

Tsvelev, N. N. 1976. *Grasses of the Soviet Union*. Vols. 1 & 2. (English translation 1983). Smithsonian Institution Press; Washington, D.C. 1196 pp.

Veldkamps, J. F. 1971. Notes on Malesian grasses. 5. *Blumea* 19(1): 61-64.

Welzen, P. C. van. 1981. A taxonomic revision of the genus *Arthraxon* Beauv. (Gramineae). *Blumea* 27(1): 255-300.

Wycherley, P. & Ahmed, A. B. M. Y. 1974. *Grasses in Malayan plantations*. Rubber Research Institute of Malaysia, Kuala Lumpur. 176 pp.

Youngner, V. B. & McKell, C. M. 1972. The Biology and Utilization
of Grasses. Academic Press, New York. 426 pp.
