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Abstract

The pek savannas of the southern Lao PDR are open forests or woodlands with the understorey more or less dominated by dwarf bamboo (*Arundinaria* spp.) known locally as pek (or chawd). Information in this paper is largely based on a visit to the region in November 1995. Twenty sites where pek was present were visited and herbarium specimens were collected of grass and legume species present, and later identified. Discussions were held with local farmers and officials regarding common names, uses and acceptability to livestock of species collected.

This paper provides information assembled on the grass and legume species occurring, and on response of *Arundinaria* spp. to various management options. A key is provided for the forty grass species found in pek savannas and each species is described and illustrated. Notes are provided on distribution and value to grazing livestock.

Keywords

bamboo, savanna, woodlands, *Arundinaria*, tropical grasses, herbaceous legumes

Introduction

The pek savannas of the Lao PDR are a natural grazing resource which is under increasing pressure for development for cattle, which are a prime source of income for smallholders. Savannas are uncommon in South-east Asia; the pek savannas are particularly unusual in that the understorey is, to a greater or lesser extent, one or more species of bamboo. Little has been published about pek savannas, their response to management practices or the importance of associate grasses in the diet of livestock. In this report we provide a summary of available information based on experience of the junior author, observations made over a two week study in relevant areas and discussions held with Provincial and District Officers in the Lao Department of Livestock and Fisheries. As well as providing a basis for future investigations, the report is intended as an aid to Lao extension workers in the identification of grasses commonly occurring in pek savannas. The two week study encompassed a total of 20 sites and abundance or otherwise of associate species is related to those sites (Figure 1, excluding site 2). The sites covered almost all areas of the country where pek savannas are a significant vegetation type, and at each site approximately one hectare (away from the road) was floristically surveyed.

Description

Pek savannas are characteristically open forest to woodland communities with an understorey dominated by one to three species of bamboo. There may also be a range of other grasses, but

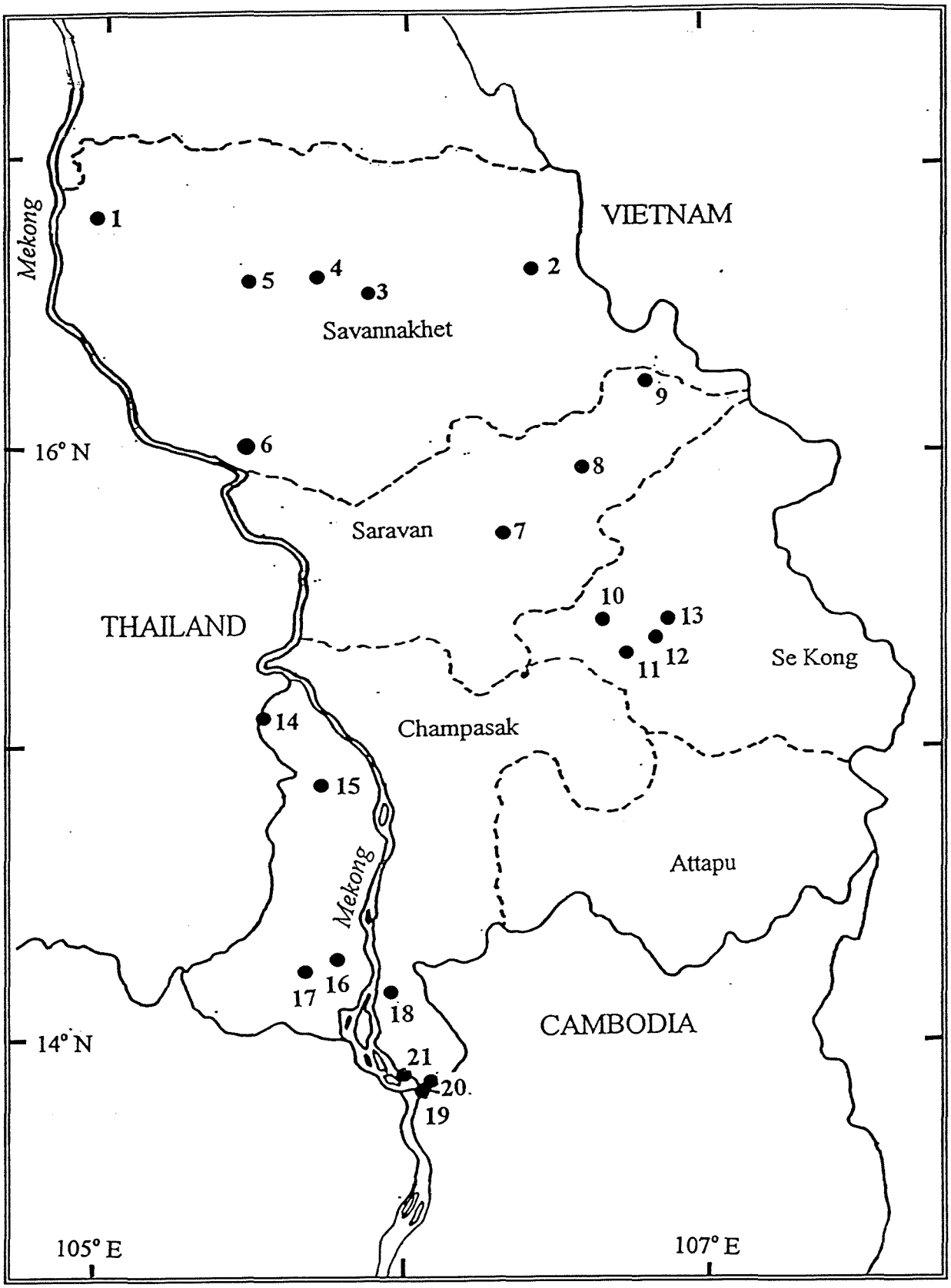

Figure 1. Sites visited in southern Lao PDR. Pek (*Arundinaria* spp.) was a significant to major component at all sites excluding Site 2.

in some situations other grasses may be almost entirely absent. There are three species known as pek - *Arundinaria ciliata, A. falcata* and *A. pusilla* (S. Midgley, pers. comm.). In Laos, two forms are recognised, 'pek noi' being less robust and 'chawd', also known as 'pek nyai', being more robust.

'Pek noi' is a bamboo with short canes, 2-4 mm in diameter at the base, developed in clusters from strong underground rhizomes, which may be 30 mm or more in diameter and up to 50 cm beneath the soil surface. Canes may be up to 1.6 m tall in well developed pek grassland, but are much shorter in degraded grassland. Rhizomes are both horizontal and vertical, the clusters of canes developing from close to the tip of a vertical rhizome. The canes are tough, branching at aerial nodes. Leaves are up to 35 cm long, 20 mm wide, but shorter and narrower where the plant is poorly grown, rough on the upper surface. 'Pek noi' very rarely flowers; we heard of one report in Saravan Province of the species flowering in about 1985 in some districts. After flowering the plants die back but are reputed to survive, sprouting new canes.

'Pek noi', in common with some other bamboos, may be affected by a disease which results in a condition termed 'maki'. This is associated with a growth, which forms on the plant. The growth is edible and is collected by villagers; it is ground before being eaten. The 'maki' is also very attractive to rats. It is reported that when affected areas have been ploughed out for planting rice, rats are attracted to the rice as a result of the previous 'maki'.

'Chawd' is a much more robust species, with canes to 4 m tall and 30 mm wide at the base. When well grown, canes are usually in a dense bundle, arising from a limited area of ground.

Distribution and ecology

Pek savannas occur in Lao PDR from the northern border of Savannakhet Province (16° 30'N), south to the Cambodian border (13°48'N) and into Cambodia. To the west, they extend from the Thailand border to close to the border with Vietnam, to the east. We are not aware as to how far they extend into Cambodia and Thailand. They occur in upland situations and do not occur in lowland areas which are subject to prolonged flooding. It is uncertain to what extent they extend into montain areas - these are inaccessible and were not adequately surveyed. Site 2 (Figure 1) is a tall bamboo grassland, although it was reported that a large area of pek savanna is located *c.* 25 km to the north east. The highest altitude at which pek savannas were seen was site 9, altitude 500 m.

'Pek noi' and 'chawd' apparently have similar adaptations, although 'pek noi' is the more common species and frequently occurs as the sole bamboo in the savanna. The taller species may comprise up to about 30% of the grass vegetation on offer.

Pek is adapted to sandy soils derived from sandstone and sandy loams, and loams developed on basalts, with a pH ranging from 5.0 - 7.0. Pek savannas on basaltic soils were seen in Sekong (sites 12,13) and southern Champassak (site 21). However, no pek savannas were seen on the Bolovens Plateau, a basaltic upland which is probably of more recent origin than sites 12, 13 and 21.

The pek savannas occur both in extensive areas and in small areas between lower-lying areas of paddy or closed forest. Extensive areas are at sites 5, 9, 12-13 and sites 19-21. Areas of these sites are estimated at about 400 km^2, 600 km^2 and 900 km^2 respectively. In addition, a further 500 km^2 of pek savanna occurs in south-west Champassak, in several discrete areas (sites 16, 17). All these areas were in good condition at the end of the 1995 monsoon, with high dry

matter yields of pek. With the exception of site 5, none of these sites had been subjected to extensive grazing.

Pek occurs naturally only in shaded conditions, and in assocation with a limited range of tree species. The most frequent associate trees are 'koung' (*Dipterocarpus tuberculatus*[1]) and 'chik' (*Shorea obtusa*) (each of which occurred in 50% of sites examined), although 'hang' (*Quercus griffithii*), 'deng' (*Xylia griffithii*), 'sard' (*Dipterocarpus obtusifolius*) and 'seuak' (*Terminalia tomentosa*) also occur in some pek savannas. At site 9, 'paek' (*Pinus merkusii*) is the dominant tree. When trees are cut down, the productivity of pek decreases. 'Pek noi' soon disappears in full sunlight; 'chawd' can tolerate full sun, although yield is reduced. In undisturbed situations pek occurs in open forests with an estimated 60% shade to woodlands with 20% shade. Pek does not occur as a community in closed forest.

Savannas with the highest yield of forage dry matter (*e.g.* sites 12-13 and 19-21) were virtually 100% pek, with few or no other grass plants in the community and few shrubs (Plate 1). These areas had evidently been subjected to little or no grazing. The only occurrence of other grasses was in occasional bare areas where the soil was shallow. In areas which had apparently been subjected to grazing for some years there was an increase in diversity, with frequent large-leaved shrubs to *c.* 2 m, more grass species and less productive pek (Plate 2). However, low yield and sparse plants of pek may also be associated with low light and/or thin and infertile soils rather than overgrazing (*e.g.* sites 15, 18).

Legumes generally comprised a low proportion of the dry matter on offer, and in the most productive sites were totally absent or almost absent. On average, there were one or more species of three legume genera at each site. The most frequently encountered species were 'Thoa phi' (*Vigna dalzelliana*) (10 sites), the shrub 'loub euang' (*Dendrolobium lanceolatum*) (8 sites) and the genus *Crotalaria* (including *C. alata, C. albida, C. chinensis* and *C. acicularis*) (7 sites). *V. dalzelliana* is grazed by livestock and pods are collected by villagers for human consumption. There was some evidence that *D. lanceolatum* was grazed, but only sparingly. Species of the genus *Crotalaria* are frequently unpalatable to livestock and may contain toxic compounds; plants are so infrequent in pek communities that toxicity is unlikely to be a problem. Other species of legume encountered were *Aeschynomene americana, Alysicarpus vaginalis, Bauhinia* spp., *Clitoria linearis, Desmodium heterocarpon, D. reticulatum, D. styracifolium, D, velutinum, Dunbaria longiracemosa, D. rotundifolia, Flemingia procumbens(?), Phyllodium pulchellum, Pueraria phaseoloides, P. longicarpa (?) and Tadehagi triquetrum.* Species in the genera *Aeschynomene, Alysicarpus* and *Pueraria* are generally palatable to cattle; *Phyllodium* is unpalatable and *Flemingia* is generally unpalatable although it may be browsed by goats. *Desmodium* species may be grazed, and some are productive forages (including *D. heterocarpon*). The two taxa of *Bauhinia* were not identified to species; the tree is reputed to be palatable but the shrub is not. Cattle are reputed to graze the long flowerheads of *D. longiracemosa*, but not the leathery leaves. Grasses associated with pek will be discussed in another section.

Management

Grazing management practised on pek savannas is varied in intensity and generally uncontrolled. In south-east Champassak (sites 19-21) during the wet season smallholders leave their cattle in pek areas for only three hours each day, claiming that the cattle have had enough to eat after three hours and start to wander into the forest.

[1] Trees were identified to species, based on common Lao names.

Plate 1. Pek savanna in good condition, with robust pek in a near-monospecific sward (Site 13).

Plate 2. Pek savanna in poor condition, with serious shrub encroachment (Site3).

The dry season in Lao PDR varies in length from about four months in the east (site 2) to six months in the south (sites 19-21). During most of the dry season the pek is leafless, and over this period livestock prefer other grasses - either components of the grassland or roadside plants. For the first three months of the growing season pek is palatable to cattle, but becomes less palatable later in the monsoon, when it may be browsed, depending on availability of other feed.

Pek is tolerant of fire but is not tolerant of prolonged flooding. If an area is cleared for upland rice, pek may regrow from old rhizomes if the area is allowed to revert to bush after one year's paddy, but a longer period under cropping will result in the pek disappearing. When burnt or heavily grazed, occasional plants will produce long canes (to *c.* 2 m), well above the general level of the pek vegetation. These have very short leaf blades, with long hairs towards their bases.

Associate grasses

The incentive for carrying out this study was because grasses other than pek are believed to be a significant part of livestock diet, and there is a lack of knowledge of the native grasses in the country. In the following section we provide a simple key for identification of commonly found grasses in pek savannas, and descriptions of those species. In the limited time available for collection, and because of the lack of an accessible herbarium covering the region, it has not been possible to provide a key to all grass species which might be encountered in pek savannas. If a collected specimen is not similar to one of the illustrations, it can be assumed that it is not included in this publication (excluding *Imperata cylindrica*, which was not seen in flower and was therefore not illustrated). It should also be noted that species growing along roadsides were not included.

A simple key to common grasses (other than bamboos) of pek savannas.

1. Grasses with leafy panicles, a leaf or leaf sheath at each panicle branch (Figures 2, 3 and 4) 2
1a. Panicles not leafy 9

2. Short grasses, less than 50 cm tall *Schizachyrium brevifolium* (page 14)
2a. Tall-growing grasses, more than 1 m tall 3

3. Spikelets not awned 4
3a. Spikelets awned 5

4. Spikelets more than 10 mm long; stigmas very long (*c.* 20 mm) and prominently displayed *Chionachne koenigii* (page 11)
4a. Spikelets less than 5 mm long *Rottboellia cochinchinensis* (page 13)

5. Spikelets and bracts in dense clusters 6
5a. Spikelets in long racemes 7

6. Bracts around spikelets covered in brown hairs; inflorescences 1 m or more long *Themeda arundinacea* (page 15)
6a. Bracts covered with pale hairs; inflorescences much smaller *Themeda triandra* (page 15)

7. Racemes all paired *Andropogon ascinodis* (page 11)
7a. Racemes mostly single 8

8. Racemes *c.* 2 mm wide, rounded, not covered by the subtending bract *Schizachyrium sanguineum* (page 14)
8a. Racemes *c.* 4-5 mm wide, flattened, partly enclosed within the subtending bract sheath *Diectomis fastigiata* (page 13)

9. Grasses with spike-like inflorescences (Figure 5) 10
9a. Grasses with digitate inflorescences or open panicles 22

10. Spikelets concealed by long, silky hairs *Imperata cylindrica* (page 20)
10a. Spikelets not concealed by long, silky hairs 11

11. Inflorescences with awned spikelets or spikelets surrounded by long bristles, > 3 times length of spikelet 12
11a. Spikelets not awned and not with long bristles 18

12. Inflorescence erect, < 2 cm long, excluding the long awns *Germainia capitata* (page 19)
12a. Inflorescence neither awned nor with long bristles 13

13. Robust grass to 2m or more tall; awns >10 cm long *Heteropogon triticeus* (page 20)
13a. Grasses mostly <1.2 m and with awns <10 cm long 14

14. Spikelets not awned, surrounded by dense bristles which persist after the spikelet has fallen — *Setaria parviflora* (page 23)
14a. Spikelets awned, not surrounded by long bristles — 15

15. Awns > 5 cm long — *Heteropogon contortus* (page 19)
15a. Awns < 4 cm long — 16

16. Racemes in closely appressed pairs — *Apocopis courtallumensis* (page 32)
16a. Racemes always single — 17

17. Raceme with slender, delicate awns < 2 cm long — *Eulalia monostachya* (page 19)
17a. Racemes with well-developed awns *c.* 4 cm long — *Sehima nervosum* (page 22)

18. Inflorescences > 10 cm long — 19
18a. Inflorescences < 7 cm long — 20

19. Inflorescence a raceme, with spikelets alternate on either side of the rachis — *Mnisithea laevis* (page 21)
19a. Inflorescence a spike-like panicle, with minute spikelets, densely and unevenly arranged — *Sacciolepis myosuroides* (page 22)

20. Spikelets in an even row on one side of the rachis — 21
20a. Spikelets densely arranged, all round the inflorescence axis — *Sacciolepis indica* (page 21)

21. Leaf blades 5-6 mm wide; teeth on lemma with long, narrow bristles — *Eremochloa ciliatifolia* (page 17)
21a. Leaf blades *c.*2 mm wide; teeth on lemma prominent, but lacking bristles — *Eremochloa ciliaris* (page 17)

22. Spikelets not awned (Figures 6 and 7) — 23
22a. Spikelets awned — 30

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23a. Inflorescence an open panicle or with several racemes — 24

24. Spikelets with a single fertile floret — 25
24a. Spikelets with many fertile florets — 26

25. Leaf blades *c.* 15 mm wide; primary panicle branches in whorl — *Isachne globosa* (page 26)
25a. Leaf blades *c.* 5 mm wide; primary panicle branches single — *Panicum curviflorum* var. *suishaense* (page 27)

26. Leaf blades very broad (*c.* 20 mm) — *Centotheca lappacea* (page 23)
26a. Leaf blades < 10 mm wide — 27

27. Spikelets on very short stalks — 28
27a. Spikelets on long stalks — 29

28. Spikelets not overlapping — *Diplachne malayana* (page 25)
28a. Spikelets overlapping and crowded — *Eragrostis brownii* (page 25)

29. Spikelets almost as broad as long — *Eragrostis unioloides* (page 26)
29a. Spikelets much longer than broad — *Eragrostis tremula* (page 26)

30. Inflorescence a more or less open panicle (Figure 8) — 31
30a. Inflorecence with finger-like racemes (Figure 9) — 35

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32. Delicate annual, each spikelet with a single 3-awned floret — *Aristida cumingiana* (page 29)
32a. Rhizomatous perennial, spikelets 1-awned — *Chrysopogon aciculatus* (page 31)

33. Spikelets in groups of 3 (only central spikelet awned) at the ends of inflorescence branches — *Chrysopogon schmidianus* (page 31)
33a. Spikelets in groups of about 6-8, each group with 2 or 3 awns — 34

34. Lowermost inflorescence branches in a whorl; spikelets shiny black when ripe — *Sorghum nitidum* (page 32)
34a. Lowermost inflorescence branches solitary; spikelets pale when ripe — *Capillipedium cinctum* (page 29)

35. Inflorescence with 1-2 racemes — 36
35a. Inflorescence with 3-many racemes — 38

36. Spikelets solitary — *Apocopis courtallumensis* (page 32)
36a. Spikelets in pairs — 37

37. Spikelets of each pair similar — *Microstegium* sp. (page 35)
37a. Spikelets of each pair different — *Ischaemum barbatum* (page 35)

38. Awns straight; delicate annual <25 cm tall — *Gymnopogon delicatulus* (page 34)
38a. Awns geniculate; culms >50 cm tall — 39

39. Racemes about 15 cm long — *Eulalia trispicata* (page 34)
39a. Racemes less than 10 cm long — 40

40. Racemes brown, in a single whorl — *Pseudopogonatherum contortum* (page 36)
40a. Racemes white and silky, not in a single whorl — *Eulalia* sp. aff. *E. milsumi* (page 32)

Grasses with leafy panicles (Figures 2, 3 and 4)

Andropogon ascinodis
Description - plants are 0.8 to 2 m tall. The inflorescence is a leafy panicle *c.* 50 cm long, with paired racemes on slender peduncles borne in the axils of leafy bracts. The paired racemes are *c.* 40 mm long, each with densely-arranged spikelets, most of which bear geniculate awns. Awns are dark in the lower half, *c.* 25 mm long.

Adaptation - grows on sandy and dry skeletal soils in open forest. Quite common in pek savannas, although never a significant component of the vegetation. Grows on a range of soil types.

Grazing - grazed by cattle. Introduced to Thailand as a fodder.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - A widespread species in Indo-China. Also in southern and South-east Asia, and Africa.

References - Schmid 1958 (p. 204); Bor 1960 (p. 90); Lazarides 1980 (p. 18).

Chionachne ?koenigii
Vernacular names - Pong (Lao)

Description - a stout mostly single-culmed (in pek savannas) annual to 1.6 m or more tall. Leaves to 70 cm or more long, *c.* 10 mm wide, very sharp along the margins. *C. koenigii* is described as having leaves covered with prickly hairs (Bor 1960; Lazarides 1980), but specimens collected in Lao pek savannas had hairless leaves and lacked the prop roots typical of the species. Nodes shortly hairy. The inflorescence is a leafy panicle, the racemes single or paired, *c.* 4 cm long, carried on long peduncles, the spikelets *c.* 15 mm long. The stigmas are characteristically very long (up to 20 mm). They are dark purple or rarely white.

Adaptation - quite common in pek savannas. Also common in delta areas, growing on fertile alluvial soils.

Grazing - limited value as fodder

Uses other than for grazing - none.

Deleterious properties - *C. koenigii* is avoided by cattle because of the razor-sharp leaf margins and irritating hairs on leaves and leaf sheaths. The specimen illustrated lacked these hairs and such plants could be more acceptable to livestock.

Distribution - widely distributed in India, Sri Lanka, Myanmar, Malaysia and Indo-China, usually in moist situations.

References - Schmid 1958 (p. 149, as *C. barbata*); Bor 1960 (p. 262); Lazarides 1980 (p. 94).

Figure 2. A - *Schizachyrium sanguineum*; B - *Diectomis fastigiata*; C - *Chionachne ?koenigii*: D - *Rottboellia cochinchinensis*

Diectomis fastigiata

Description - an annual species growing to more than 1 m tall, few-stemmed when growing in pek savannas. Leaf blades are flat and narrow, hairless, *c.* 2 mm wide. The inflorescence is a leafy panicle, the racemes solitary, or sometimes in groups of 2 or 3, often largely enclosed within the subtending sheath. Racemes *c.* 4 cm long, 4 mm wide, flattened; spikelets with prominent geniculate awns *c.* 30 mm long along either side of the raceme.

Adaptation - grassland and open forest to woodland. Not adapted to heavy shade. Occurs on infertile sandy alluvial soils as well as on skeletal soils. Found occasionally in pek savannas.

Grazing - a good fodder grass when young.

Uses other than for grazing - none.

Deleterious properties - when the grass is mature, awns on the spikelets can be troublesome to grazing animals.

Distribution - occurs in the tropics of both hemispheres

References - Schmid 1958 (p. 202); Bor 1960 (p. 135); Hộ and Du'o'ng 1960 (p. 670); Lazarides 1980 (p. 33).

Rottboellia cochinchinensis

Description - an annual with prominent prop roots and culms from 0.8 - 3 m tall, the leaf blades hairless, up to 50 cm long, 10-25 mm wide, the sheaths often with prominent long and stiff hairs. The inflorescence is a leafy panicle, with single racemes *c.* 10 cm long; spikelets lacking awns. Distinguished from the related genus *Coelorhachis* by the pedicel of the pedicellate spikelet being joined to the rhachis internode.

Adaptation - a common species in disturbed sites including cultivation, plantations and stream banks but also in deciduous and secondary forests. It also occurs on quite fertile soils with high pH, including soils derived from limestone. It is rarely found in pek savannas.

Grazing - considered to be a moderately good forage and has also been made into hay or silage. In a pasture situation it forms coarse clumps, which tend to be less palatable to livestock than other grasses. Generally more palatable to water buffaloes than cattle. The only situation it was seen in pek savannas it was single-culmed and unproductive.

Uses other than for grazing - none.

Deleterious properties - can be a serious problem in rice fields.

Distribution - Native to tropical and subtropical regions of South-east Asia, Africa and Australia; introduced to the West Indies and America.

References - Schmid 1958 (p. 193); Bor 1960 (p. Lazarides 1980 (p. 66); Tothill and Hacker 1983 (all as *R. exaltata*)

Schizachyrium brevifolium

Description - a very delicate, erect, ascending or more-or less prostrate annual, with short, blunt leaves mostly 2-3 cm long. Racemes are very delicate, 10-15 mm long, enclosed within the leaf sheath for a long time, at length emerging.

Adaptation - usually in open sandy or rocky sites in dry forests and grasslands and alongside tracks. Indicative of low soil fertility. It is commonly found in degraded pek savannas, in bare areas between more robust species.

Grazing - an unproductive species reported to be of no significance as a fodder grass.

Uses other than for grazing - none.

Deleterious properties - none

Distribution - South-east Asia, tropical Asia, Africa and America.

References - Schmid 1958 (p. 200); Hộ and Du'o'ng 1960 (p. 662); Lazarides 1980 (p. 69).

Schizachyrium sanguineum

Vernacular names - Nga kamong (Lao)

Description - a robust grass to 1.5 m tall. Leaf blades long and narrow, *c.* 6 mm wide, hairless. Nodes hairless. The inflorescence is a leafy panicle, with slender single racemes 4 - 8 cm long, *c.* 2 mm wide. Spikelets bear fine awns *c.* 10 mm long.

Adaptation - occurs in open sites in dry deciduous forest and grassy savannas, commonly on skeletal soils.

Grazing - relished by stock at all times.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - throughout South-east Asia

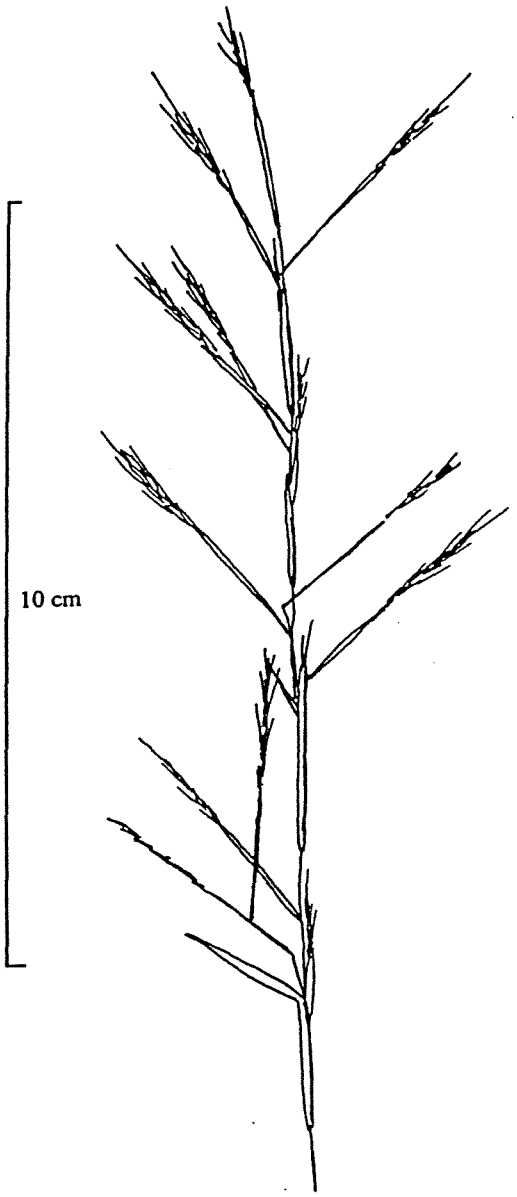

Figure 2. *Schizachyrium brevifolium*

and pan-tropical. Moderately common in pek savannas.

References - Schmid 1958, as *S. semiberbe* (p. 200); Bor 1960 (p. 216); Lazarides 1980 (p. 70).

Themeda arundinacea
Vernacular names - Cỏ lõ duói (Vietnam)

Description - a robust plant with erect culms to 3 m tall in pek savannas, sometimes up to 5 m tall, the inflorescence leafy, branching, and often 1 m or more long. Inflorescence with many clusters of bracts and spikelets, with 2 - 3 geniculate, black-based awns from each spikelet, the awns *c.* 8 cm long. The inflorescence bracts are densely covered with long, spreading, ginger-coloured hairs. Distinguished from *T. triandra* by its more robust habit and ginger-coloured hairs on the bracts.

Adaptation - common and widespread in grasslands and savannas.

Grazing - young growth is grazed, but plants soon become stemmy and unattractive to livestock.

Uses other than for grazing - stems are used in building walls of houses.

Deleterious properties - the "seeds" are sharply pointed at the base and readily work their way into clothing and skin.

Distribution - India and throughout South-east Asia.

References - Schmid 1958 (p. 233); Bor 1960 (p. 250); Hộ and Du'o'ng 1960 (p. 669); Lazarides 1980 (p. 76).

Themeda triandra
Vernacular names - kangaroo grass (Australia)

Description - an erect plant to 1.8 m tall. Leaf blades narrow, *c.* 5 mm wide, hairless. Inflorescence of several clusters of leafy bracts and spikelets with 2 - 3 awns to 8 cm long from each cluster, the awns thick and dark at the base, geniculate. Bracts have long pale hairs close to margins.

Adaptation - adapted to savannas and grasslands, generally on lighter soils. Occasionally found as scattered plants in pek savannas. Tolerant of some shade, but not adapted to degraded soils

Grazing - a palatable and nutritious grass, especially when young, but may die out if overgrazed or burnt too frequently,

Uses other than for grazing - none.

Deleterious properties - none.

Figure 4. A - *Themeda arundinacea*; B - *Themeda triandra*; C - *Andropogon ascinodis*

Distribution - widely distributed in savannas, woodlands and grasslands in South-east Asia and wetter areas of African and Australian tropics and subtropics, where the species also extends into temperate latitudes.

References - Schmid 1958 (p. 230-231); Bor 1960 (p. 254); Ho and Du'o'ng 1960 (p. 669); Lazarides 1980 (p. 76).

Grasses with spike-like inflorescences (Figure 5)

Eremochloa ciliaris
Description - a short-lived perennial with basal leaves, and culms to 50 cm tall. Leaf blades are *c.* 25 cm long, 2 mm wide, hairless. Nodes hairless. The inflorescence is a characteristically curved, 1-sided raceme *c.* 4 cm long, borne on a long peduncle.

Adaptation - occurs in open forest on sandy, skeletal soils; also on margins of swamps. Sometimes forms small, locally dominant communities in less-shaded situations in pek savannas

Grazing - reported to be worthless as fodder.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - South-east Asia.

References - Schmid 1958 (p. 184); Bor 1960 (p. 146); Hộ and Du'o'ng (p. 650); Lazarides 1980 (p. 37).

Eremochloa ciliatifolia
Description - a short-lived perennial with culms to 40 cm tall. Leaves are basal, 6-10 cm long, 4-6 mm wide, with blunt tips. The inflorescence is a 1-sided raceme, straight or slightly curved, the teeth on the lemmas with long and prominent purple bristles.

Adaptation - occurs in open forest on sandy, skeletal soils; also on margins of swamps. Occasionally found in pek savannas, where there is less competition from pek and taller grasses.

Grazing - reported to be worthless as fodder.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - throughout South-east Asia - more widespread than *E. ciliatifolia*.

References - Schmid 1958 (p. 183, as *E. helferi*); Bor 1960 (p. 146); Lazarides 1980 (p. 37).

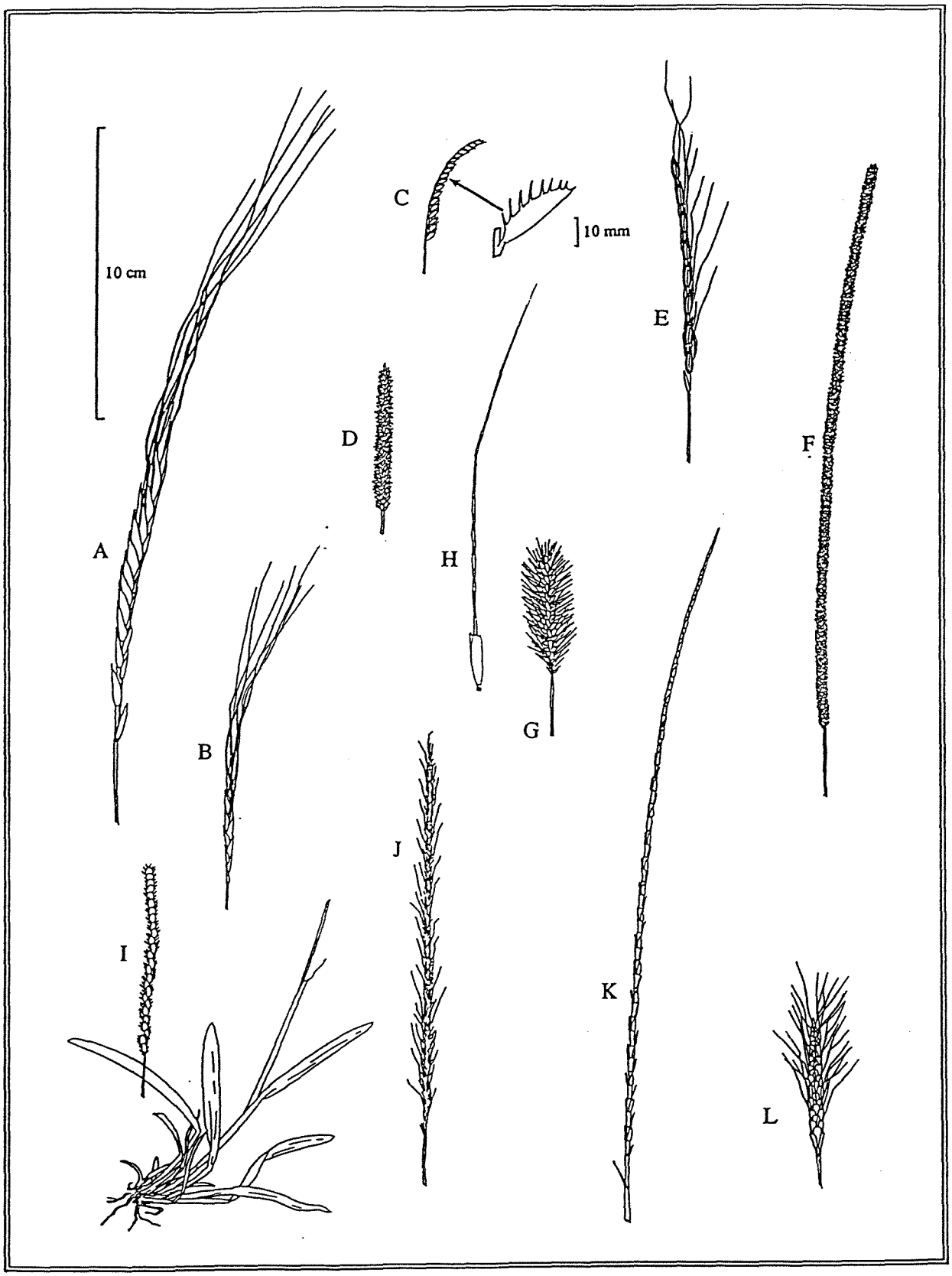

Figure 5. A - *Heteropogon triticeus*; B - *Heteropogon contortus*: C - *Eremochloa ciliaris*: D - *Sacciolepis indica*; E - *Sehima nervosum*; F - *Sacciolepis myosuroides*; G - *Setaria parviflora*; H - *Germainia capitata*; I - *Eremochloa ciliatifolia*; J - *Eulalia monostachya*; K - *Mnisethea laevis*; L - *Apocopis courtallumensis*

Eulalia monostachya
Description - plants to 70 cm tall, sparsely leaved. Nodes hairless. Leaf blades *c.* 20 cm long, 3 mm wide, hairless. Inflorescence a single raceme *c.* 13 cm long, rusty-brown owing to the long brown hairs covering the spikelets, which bear geniculate awns *c.* 15 mm long.

Adaptation - a common species in open forests and savannas, on sandy soils. Frequently found in pek savannas.

Grazing - when young, likely to be palatable to livestock, but not a species of any grazing significance.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - Indo-China and Thailand.

References - Schmid 1958 (p. 166); Lazarides 1980 (p. 40).

Germainia capitata
Description - an erect, slender perennial to *c.* 90 cm tall, leafy at the base. Leaf blades are long and narrow, up to *c.* 40 cm long, 3-9 mm wide, covered on the under side with silky appressed hairs (visible under a lens). Leaf sheaths and lower nodes finely hairy. The inflorescence is a single short raceme *c.* 15 mm long. The 2-3 fertile spikelets each bear a very long, geniculate awn.

Adaptation - rarely found in pek savannas; a similar but more delicate species (probably *G. khasyana*) may be found as a locally dominant species in areas with less shade and subject to flooding.

Grazing - not important as a fodder grass.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - occurs in South-east Asia, Indonesia, Papua-New Guinea, Polynesia, China and rarely in Australia.

References - Schmid 1958 (p. 235); Lazarides 1980 (p. 42); Tothill and Hacker 1983 (p. 251).

Heteropogon contortus
Vernacular names - Nga nong (Lao); Dị thảo vặn, Cỏ Lông-heo (Vietnam); speargrass, black speargrass (Australia)

Description - a perennial species to 80 cm tall, well-tillered and leafy early in the season, but becoming stemmy at flowering. Leaf blades are up to 30 cm long, almost hairless, folded towards the base. The inflorescence is a raceme with a long peduncle - several may arise from upper leaf sheaths of a single culm. The spikelets have long, black awns.

Adaptation - adapted to light and medium-textured soils. A common species in Laos, quite often occuring as a minor component in pek savannas. It appears to be less shade-tolerant than the related *H. triticeus*; plants are markedly less robust and more sparsely tillered when growing in the shaded conditions of pek savanna than when in full sunlight.

Grazing - in Australia it is regarded as a valuable grazing grass in native subtropical and tropical rangelands. Overgrazing can result in its being replaced by unpalatable species such as *Aristida* spp.

Uses other than for grazing - none.

Deleterious properties - the sharp seed bases can penetrate hides of sheep, and, in the most severe cases, can cause death. Cattle are less likely to suffer injury.

Distribution - south and South-east Asia and tropics and subtropics of Australia, Africa and the Americas.

References - Schmid 1958 (p. 221); Bor 1960 (p. 163); Hộ and Du'o'ng (p. 650); Lazarides 1980 (p. 46); Tothill and Hacker 1983, (p. 259).

Heteropogon triticeus
Vernacular names - giant speargrass(Australia)

Description - a robust annual or short-lived perennial species, sometimes with prop roots, and with culms from 1.2 to 3 m tall from a strongly flattenned, leafy base. Leaf blades are to 60 cm or more long, narrow, hairless. Nodes hairless. One to several racemes are borne separately on long peduncles in upper leaf axils. These are similar to those of *H. contortus*, but much larger, 12-20 cm long. The spikelets bear black awns 10-15 cm long.

Adaptation - grows in a range of situations, from dry hillsides to near streams and paddy fields. Tolerant of infertile soils. It is frequently found as a minor component of pek savannas. It has a more tropical adaptation than the related *H. contortus*.

Grazing - reputed to be palatable to livestock

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - South and South-east Asia and tropical Australia.

References - Schmid 1958 (p.221); Bor 1960 (p. 165); Lazarides 1980 (p. 46); Tothill and Hacker 1983 (p. 260).

Imperata cylindrica (not illustrated)
Vernacular names - Sbeou (Cambodia); Cỏ tranh (Vietnam); blady grass (Australia)

Description - a strongly rhizomatous grass with long, erect leaves, to *c.* 1.8 m tall. The inflorescence is spike-like, the spikelets small and covered with long, silky, white hairs, enabling them to be carried long distances in the wind. In contrast to other grasses discussed in

this booklet, which flower towards the end of the monsoon, *I. cylindrica* is reported to flower and seed in April-May.

Adaptation - adapted to a wide range of soil types. Often seen as a minor component of grazed pek savannas, but more characteristically a species of full sunlight. Tolerant of fire and cultivation.

Grazing - grazed when young, but becomes unpalatable as it matures. In many parts of South-east Asia, burning is practised to maintain palatable herbage.

Uses other than for grazing - a good species for thatching and can be made into paper. Reputed in the Philippines to have medicinal properties.

Deleterious properties - seeds are widely dispersed by wind and colonise bare areas and cultivation. Rhizomes are difficult to kill, making this a well-known weed throughout the region. Repeated burning to maintain young growth of *I. cylindrica* results in dominant stands of this species.

Distribution - South and South-east Asia, East and Southern Africa, tropical and subtropical Australia.

References - Schmid 1958 (p. 153); Bor 1960 (p. 169); Hộ and Du'o'ng 1960 (p. 650); Lazarides 1980 (p. 49); Tothill and Hacker 1983 (p. 279).

Mnesithea laevis

Description - an erect perennial to 1 m tall. Leaf blades are up to 35 cm long, 2-5 mm wide, hairless. Nodes minutely hairy. The inflorescence is a long and slender spike, *c.* 15 cm long, with the spikelets embedded in the rachis, and not awned.

Adaptation - grows in patches in grassland, savanna and open forest on sandy soils, or heavy soils with disturbance.

Grazing - not noted in literature.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - South and South-east Asia. Common in southern Indo-China.

References - Schmid 1958 (p. 194, as *Rottboellia laevis*); Bor 1960 (p. 197); Lazarides 1980 (p. 59).

Sacciolopis indica

Vernacular names - Indian cupscale grass (Australia)

Description - a very variable annual or short-lived perennial, growing to *c.* 60 cm tall. Leaf blades are mostly up to 15 cm long, 5 mm wide and hairless. Nodes hairless. The inflorescence is a dense spike-like panicle 4-7 cm long. This species is quite similar to *Setaria*

parviflora, but the inflorescence does not have the prominent bristles that are characteristic of *Setaria.*

Adaptation - adapted to a wide range of habitats, from rice fields and garden cultivation to grassland, savanna and marshes. Commonly found in degraded pek savanna.

Grazing - grazed to some extent, but generally an unproductive species.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia, Polynesia, northern Australia; introduced to Africa and America.

References - Schmid 1958 (p. 350); Bor 1960 (p. 357); Hộ and Du'o'ng (p. 674); Lazarides 1980 (p.139); Tothill and Hacker 1983 (p. 367).

Sacciolepis myosuroides
Description - an erect plant to *c.* 1.1 m, apparently annual. Leaf blades are up to *c.* 25 cm long, 5 mm wide, hairless. The inflorescence is a very narrow spike-like panicle up to 25 cm long, and 3-4 mm wide, with minute spikelets.

Adaptation - grows on infertile sandy soils and in moist and swampy situations. Less common than *S. indica*, and rarely found in pek savannas.

Grazing - grazed to some extent.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - South and South-east Asia, and in tropical Australia.

References - Schmid 1958 (p. 348); Bor 1960 (p. 358); Hộ and Du'o'ng (p. 674); Lazarides 1980 (p.139); Tothill and Hacker 1983 (p. 367).

Sehima nervosum
Vernacular names - rat's tail grass (Australia)

Description - a tufted erect perennial to *c.* 1 m tall, not leafy. Leaf blades up to 30 cm long, *c.* 3 mm wide, hairless. Nodes hairless. The iflorescence is a 1-sided raceme with large spikelets, 8-10 mm long, and long, geniculate awns. Readily distinguished from *Heteropogon contortus* by the prominent nerves on the spikelets and shorter awns.

Adaptation - a major component of grasslands and savannas, occurring on infertile sandy or skeletal soils. Quite common as a minor component of pek savannas.

Grazing - in Australia, considered to be a grass of poor quality (Tothill and Hacker 1983), although Bor (1960) and Lazarides (1980) state that it is an excellent fodder grass

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - widespread in South-east Asia, East Africa and northern Australia..

References - Schmid 1958 (p. 172); Bor 1960 (p. 218); Lazarides 1980 (p. 71); Tothill and Hacker 1983 (p. 373).

Setaria parviflora
Vernacular names - Queensland pigeon grass (Australia)

Description - an annual to 60 cm tall, with tillers flattened at the base. Leaf blades are up to 30 cm long, 6 mm wide, hairless. The inflorescence is a spike-like panicle *c.* 4 cm long, the spikelets almost obscured by spreading brownish or purplish hairs *c.* 6 mm long which remain attached to the inflorescence after the spikelets have fallen. This species was previously known as *S. pallide-fusca.*

Adaptation - widespread; frequently found where the soil has been disturbed (*e.g.* along roadsides). In pek savannas quite commonly found as occasional, sparsely-tillered plants.

Grazing - likely to be grazed but, in shaded conditions, not a productive species.

Uses other than for grazing - none.

Deleterious properties - occurs as a weed in cultivation.

Distribution - south and South-east Asia, and tropical Africa and Australia.

References - Bor 1960, as *S. pallide-fusca* (p. 363); Lazarides 1980 (p. 141, 142); Tothill and Hacker 1983, as *S. pallidefusca* (p. 376).

Grasses with digitate inflorescences or open panicles, spikelets lacking awns (Figures 6 and 7)

Centotheca lappacea
Description - leafy perennial, with culms from 0.3 - 1 m in height. Leaf blades are up to *c.* 15 cm long, 20 mm wide, hairless, strongly tapering to the base and the tip. The inflorescence is a large open panicle, with spikelets arranged more or less alternately on either side of the primary branches. Spikelets with 2-3 florets.

Adaptation - occurs mainly along roadsides and forest margins. Rarely found in pek savannas, where it occurs away from competition from more robust grasses. The backwards-pointing bristles on the lemma are an effective adaptation for seed dispersal by animals.

Grazing - regarded as a useful fodder grass.

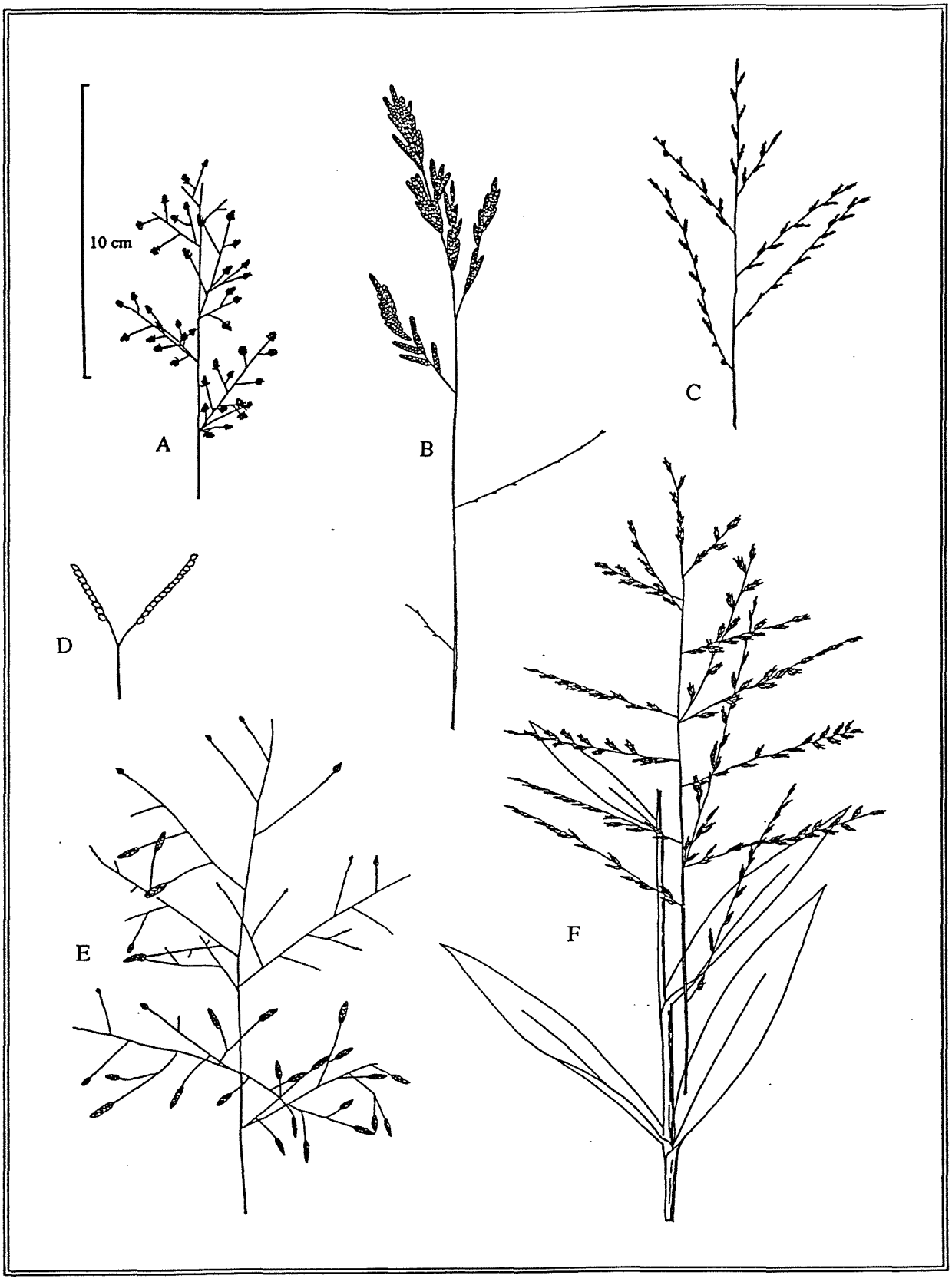

Figure 6. A - *Eragrostis unioloides*; B - *Eragrostis brownii*; C - *Diplachne malayana*; D - *Paspalum scrobiculatum*; E - *Eragrostis tremula*; F - *Centotheca lappacea*

Uses other than for grazing - none.

Deleterious properties - can be a minor weed in plantations.

Distribution - south and South-east Asia, West and tropical Africa, Polynesia and northeast Australia.

References - Schmid 1958 (p. 507); Bor 1960 (p. 457); Ho and Du'o'ng 1960 (p. 680); Lazarides 1980 (p.153).

Diplachne malayana
Description - plants are up to 50 cm tall. Leaf blades to 15 cm long, 4 mm wide, hairless. Nodes hairless. The inflorescence is a panicle with moderately spreading branches, the spikelets borne alternately on either side of the primary branches, on minute stalks. Spikelets shatter from the tip downwards, leaving one or both glumes, after florets have fallen.

Adaptation - rarely found in pek savannas (open forest). The related *D. fusca* is well known as a salt-tolerant species.

Grazing - unlikely to be of any significance for grazing.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - South-east Asia and Indonesia.

References - Lazarides 1980 (p. 170).

Eragrostis brownii
Vernacular names - Cỏ bông dài (Vietnam); Brown's lovegrass (Australia)

Description - plant to 60 cm tall, moderately leafy at the base. Leaf blades are up to 15 cm long, 3 mm wide, hairless except for a few long hairs towards the base. Nodes hairless. The inflorescence is a panicle *c.* 20 cm long, with spikelets *c.* 10 mm long densely clustered along the primary branches, each shortly stalked. Spikelets with *c.* 15 florets.

Adaptation - a species which is widely adapted to grasslands and savannas, generally on lighter soils. Occasionally found in pek savannas where there is little competition.

Grazing - of no grazing significance. The genus *Eragrostis* includes a large number of rather similar species, which are difficult to distinguish; in South-east Asia none of them have any significance as fodder plants.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - South-east Asia, Indonesia, Papua-New Guinea, northern Australia.

References - Lazarides 1980 (p. 173); Tothill and Hacker 1983 (p. 232).

Eragrostis tremula
Description - Erect plant 80 cm tall, leafy at the base, the leaves to 25 cm long, 4 mm wide, finely pointed, hairless except for a few long hairs towards the base. Nodes hairless. The inflorescence is an open panicle with secondary branching, *c.* 16 cm long, 12 cm wide, the primary branches borne singly on the axis. Spikelets *c.* 9 mm long, with *c.* 15 florets, the florets disarticulating from the base upwards, leaving a bare zig-zag rachilla.

Adaptation - generally a species occurring on disturbed ground. Found occasionally in pek savannas, where there is little competition.

Grazing - Of no grazing significance.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia, tropical Africa.

References - Schmid 1958 (p. 502); Bor 1960 (p. 514); Hộ and Du'o'ng 1960 (p. 676); Lazarides 1980 (p. 176).

Eragrostis unioloides
Vernacular names - Cỏ bông dò (Vietnam)

Description - an annual grass to *c.* 40 cm tall, the leaf blades rather short and *c.* 5 mm wide, hairless. Nodes hairless. The inflorescence is an open panicle, the spikelets about 1.5 times as long as broad, each spikelet on a quite long pedicel. *Eragrostis* is a large genus and the species are difficult to identify with certainty. Few have any significance as pasture grasses.

Adaptation - a widespread species, adapted to a range of soil types, but often an indication of advanced soil degradation. Occasionally found in pek savanna where there is less competition from more robust grasses.

Grazing - an unproductive species, of no significance as a forage.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia; subtropical and tropical Australia, introduced to USA.

References - Schmid 1958 (p. 502); Bor 1960 (p. 515); Hộ and Du'o'ng 1960 (p. 676); Lazarides 1980 (p. 176); Tothill and Hacker 1983 (p. 231).

Isachne globosa
Vernacular names - Cỏ gao (Vietnam); Swampy millet (Australia)

Description - a perennial species, with culm leaf blades up to 10 cm long, 15 mm wide, very broad at the base, hairless except for a few hairs towards the base. The inflorescence is a large and very open panicle, the branches mostly in groups of 2 - 3, stiffly spreading and themselves branched, the spikelets *c.* 2 mm long, bluntly pointed, borne towards the outside of the inflorescence. Readily distinguished from *Panicum curviflorum* by its broad leaf blades, smaller, blunt spikelets and clustered primary branches of the inflorescence.

Adaptation - more commonly occurs in flood-prone areas, but occasionally found in pek savannas.

Grazing - well grazed by cattle and buffalo.

Uses other than for grazing - none.

Deleterious properties - can be a troublesome weed of rice fields.

Distribution - South-east Asia, Philippines and occasionally in northern Australia.

References - Schmid 1958, as *I. miliacea* (p. 327); Bor 1960 (p. 580); Lazarides 1980 (p. 89); Tothill and Hacker 1983 (p. 281).

Panicum curviflorum var. *suishaense*

Description - leaf blades are *c.* 25 cm long, 5 mm wide, hairless. Culms erect, to 1 m tall, the nodes hairless. The inflorescence is a large, open panicle *c.* 30 cm long, 25 cm wide, the branches occurring singly on the main axis, but with secondary branching, the spikelets *c.* 4 mm long, pointed. (readily distinguished from *Isachne globosa* by its narrower leaf blades, pointed spikelets and inflorescence branches borne singly)

Adaptation - occasionally found in pek savannas.

Grazing - likely to be grazed when young.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - unknown

References - this species is not recorded in available literature.

Paspalum scrobiculatum

Vernacular names - Cỏ dáng (Vietnam); kodo millet, kodra millet (India); scrobic, ditch millet (Australia).

Description - a creeping annual or perennial to 30 cm or more tall, leafy at the base from a short rhizome. Leaf blades *c.* 12 cm long, 5 mm wide, hairless except for a few long hairs along the margins and towards the base of the leaf blade. Nodes hairless. The inflorescence consists of 2 racemes. The spikelets are rounded, *c.* 2.5 mm long, hairless.

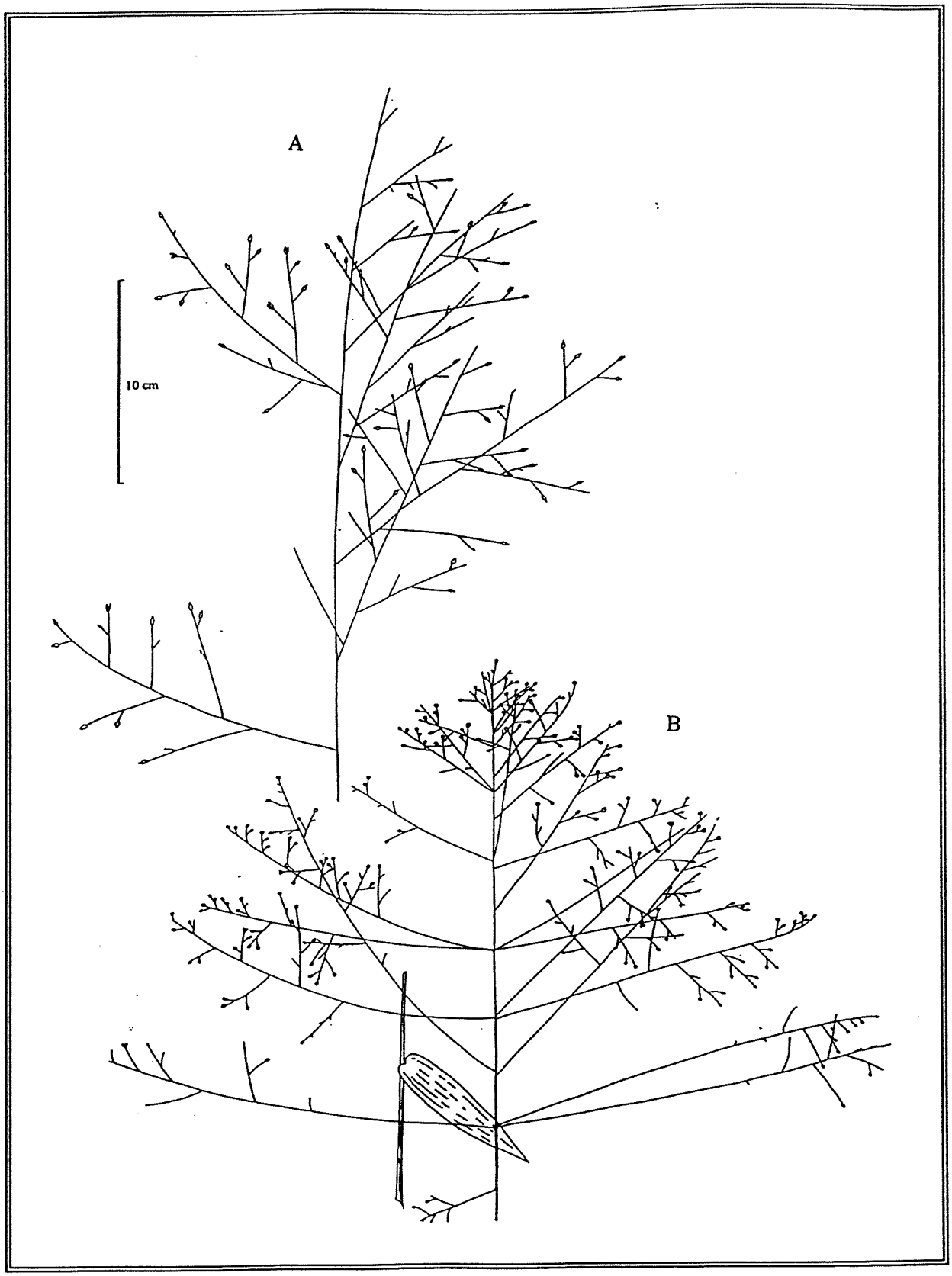

Figure 7. A - *Panicum curviflorum* var. *suishaense*; B - *Isachne globosa*

Adaptation - generally a species of moist places. Very occasionally found in pek savannas, away from competition from more robust grasses.

Grazing - grazed by cattle and buffalo.

Uses other than for grazing - cultivated in India as a cereal.

Deleterious properties - the forage is reputed occasionally to be toxic to livestock; also, eating the grain has caused toxicity both in livestock and humans.

Distribution - India, South-east Asia, Australia.

References -Bor 1960, as *P. commersonii* (p. 335); Lazarides 1980 (p. 132, 133); Tothill and Hacker 1983 (p. 334).

Grasses with open panicles; spikelets awned (Figure 8)

Aristida cumingiana

Description - an attractive, delicate grass, apparently annual, to about 25 cm tall, with leaf blades hairless, *c.* 8 cm long and 1 mm wide. The inflorescence is purple-coloured, with narrow spikelets *c.* 2 mm long, each with a single floret with an awn with 3 fine branches.

Adaptation - quite commonly found along paths in pek savannas. Generally occurs on degraded soils.

Grazing - of no grazing significance.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - tropical Africa, India, South-east Asia, China, Papua-New Guinea, Philippines.

References - Schmid 1958 (p. 474); Bor 1960 (p. 409); Lazarides 1980 (p. 150).

Capillipedium cinctum

Description - a grass with culms to *c.* 1 m tall, the leaf blades to *c.* 40 cm long, 8 mm wide, with a distinct, white mid-vein. Upper nodes prominently hairy. The inflorescence has 1-2 branches at each inflorescence node, with secondary branching, each branch terminating in a group of 3-5 spikelet pairs, each pair with a single geniculate awn.

Adaptation - occasionally found in pek savannas.

Grazing - of little grazing significance, but likely to be palatable to livestock.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - Indo-China, China, Philippines.

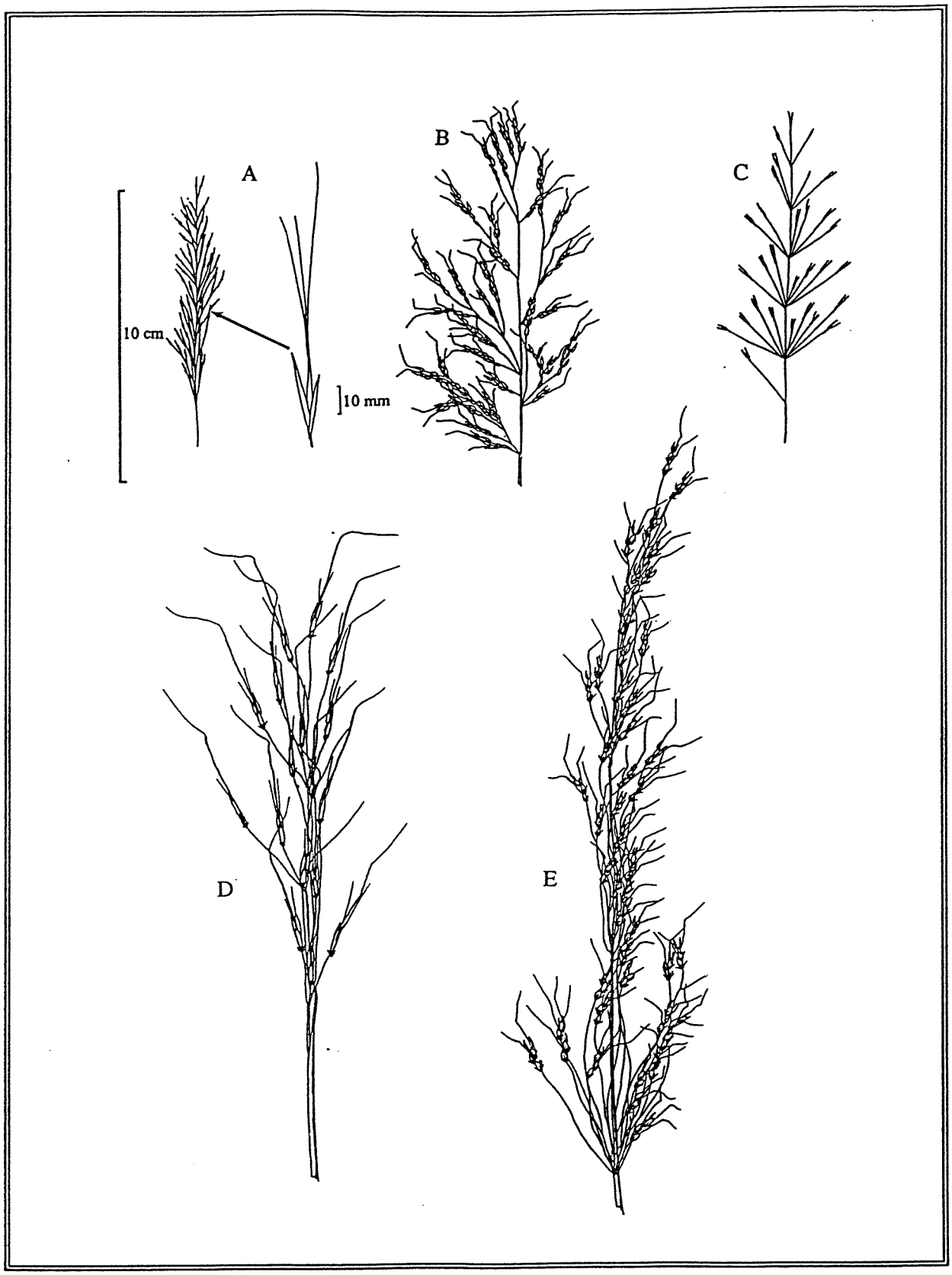

Figure 8. A - *Aristida cumingiana*; B - *Capillipedium cinctum*; C - *Chrysopogon aciculatus*; D - *Chrysopogon schmidianus*; E - *Sorghum nitidum*

References - Schmid 1958 (p. 208); Lazarides 1980 (p. 25).

Chrysopogon aciculatus
Vernacular names - couk (Lao); cỏ-may (Vietnam); Mackies pest (Australia)

Description - a strongly rhizomatous perennial , the culms creeping or decumbent at the base, branching and rooting and forming a dense mat. The leaf blades are blunt-tipped, hairless, 3-10 cm long, 4-8 mm wide. Culms are up to *c.* 50 cm tall, but usually shorter, the inflorescence with several whorls of branches, each ending in a single cluster of 3 spikelets, with a single *c.* 6 mm long awn.

Adaptation - a species of more-or-less impoverished, disturbed, sandy soils. In pek grasslands it is only found in clearings, exposed to full sunlight and grazing.

Grazing - Considered to be of average quality for grazing, but not a productive species. Owing to its rhizomatous habit, it is tolerant of heavy grazing and is frequently a major component of overgrazed land.

Uses other than for grazing - the stolons are used for making brushes and the seeds have vermifugal properties.

Deleterious properties - a difficult weed to eradicate in cultivation. The stiffly hairy "seeds" can penetrate mouths and feet of grazing cattle, causing injury.

Distribution - south and South-east Asia, Vanuatu, Polynesia, Australia; introduced to West Africa.

References - Schmid 1958 (p. 210); Bor 1960 (p. 115); Lazarides 1980 (p. 26); Tothill and Hacker 1983 (p. 162).

Chrysopogon schmidianus
Description - culms to *c.* 0.5 m tall. The inflorescence is an open panicle *c.* 17 cm long, the branches simple, each bearing a triplet of spikelets. The triplet of spikelets is *c.* 12 mm long (excluding the awn) includes a fertile central spikelet which bears a geniculate awn *c.* 5 cm long, and a pedicellate awnless spikelet on each side. Towards the base of the triplet are dense, upwardly pointing, ginger-coloured hairs.

Adaptation - tends to occur on degraded soils. Quite commonly found in pek savannas.

Grazing - probably of no grazing significance.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - Indo-China.

References - Schmid 1958 (p. 210); Lazarides 1980 (p. 28).

Sorghum nitidum
Vernacular names - Kè dại (Vietnam); brown sorghum (Australia)

Description - a slender perennial with culms to 1.5 m tall and leaf blades to 30 cm long, 11 mm wide. The inflorescence is a moderately open panicle, the branches rather short (to *c.* 5 cm long), in whorls, each bearing a single raceme of several spikelets *c.* 10 mm long. Spikelet groups are dark purplish brown as they approach maturity, becoming shiny black, densely covered with dark brown ascending hairs, bearing 2 geniculate awns *c.* 2 cm long.

Adaptation - tends to prefer well-drained sites. Occasionally occurs in pek savannas, its tall growth enabling it to survive where pek is growing well.

Grazing - palatable to stock, and useful for grazing where it is abundant.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia. Philippines, northern Australia.

References - Bor 1960 (p. 245); Lazarides 1980 (p. 72, 73); Tothill and Hacker 1983 (p. 380); Lazarides *et al.* 1992 (p. 625).

Grasses with digitate panicles; spikelets awned (Figure 9)

Apocopis courtallumensis
Description - a perennial species to *c.* 1 m tall, leafy along the culms. Nodes hairless. Leaf blades up to 12 cm long, 5 mm wide, hairless. The inflorescence consists of a pair of racemes *c.* 4 cm long, 4 mm wide, closely appressed and appearing to be a single spike, dark purple-brown in colour, flattened. The spikelets are neatly arranged and overlapping, very broad towards the tip, indistinctly hairy, and with geniculate awns *c.* 20 mm long.

Adaptation - not common in pek savannas.

Grazing - grazed in association with other grasses, but of little economic importance.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia, Sri Lanka, China.

References - Schmid 1958, as *A. wightii* (p. 180); Bor 1960 (p. 95); Lazarides 1980 (p. 20).

Eulalia* sp. aff. *E. milsumi
Description - nodes are hairless. Racemes about 4, *c.* 6 cm long, white and silky, arranged along a short inflorescence axis, the spikelets *c.* 1.5 mm long, untidily arranged, bearing

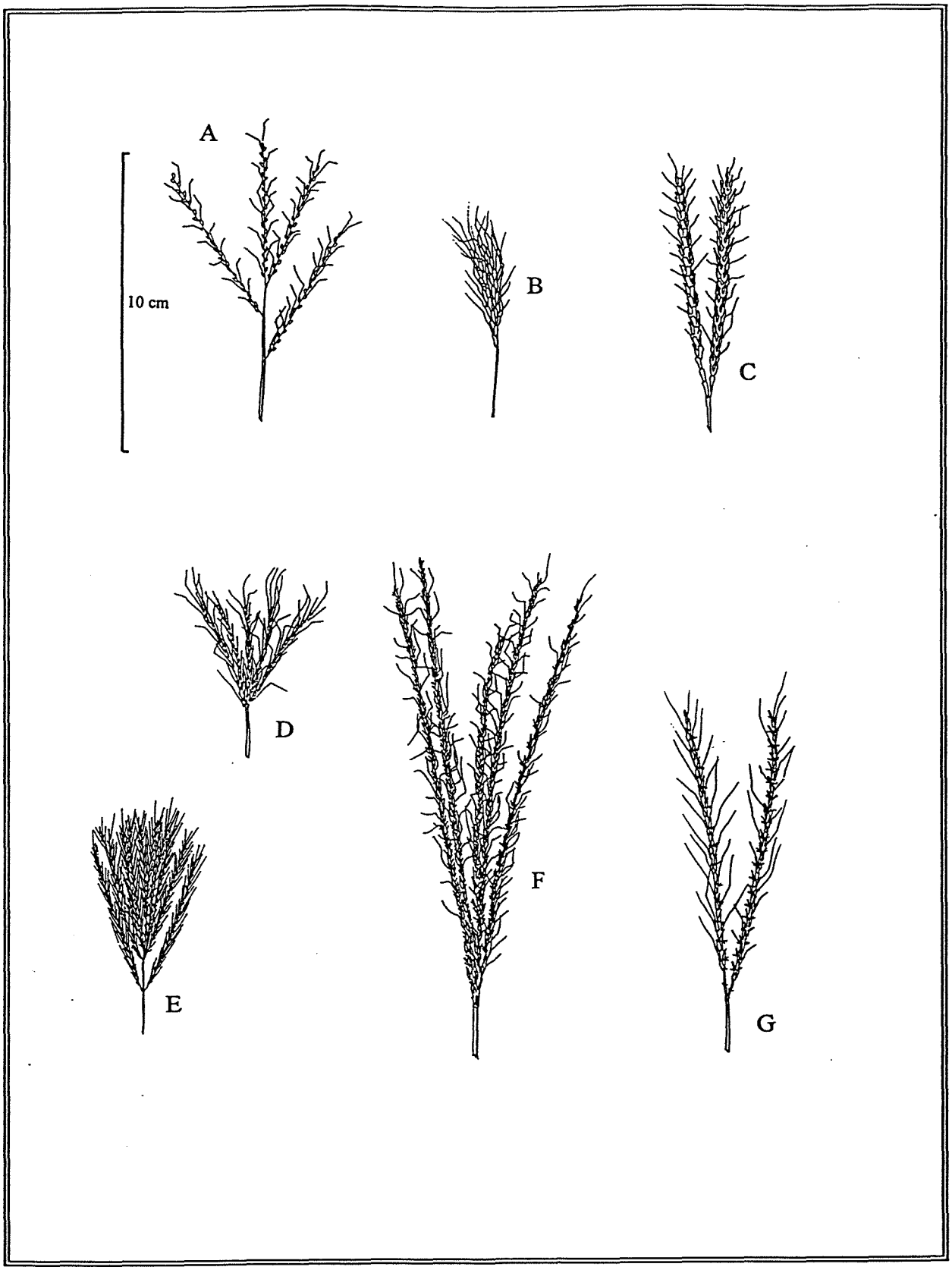

Figure 9. A - *Eulalia* sp. aff. *E. milsumi*; B - *Apocopis courtallumensis*; C - *Ischaemum barbatum*; D - *Pseudopogonatherum contortum*; E - *Gymnopogon delicatulus*; F - *Eulalia trispicata*; G - *Microstegium* sp.

geniculate awns *c.* 12 mm long and covered with silky hairs. Anthers black. *E. milsumi* is distinguished from other members of the genus by its 2-awned lower glume.

Adaptation - rarely found in pek savannas.

Grazing - of no grazing significance.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - *E. milsumi* is only known from the Malay Peninsular.

References - Lazarides 1980 (p. 40).

Eulalia trispicata
Description - a perennial, with culms to *c.* 1.2 m tall. The inflorescence is a digitate panicle, mostly with 5-12 brownish racemes, *c.* 16 cm long. Spikelets bear geniculate awns *c.* 15 mm long.

Adaptation - grows in woodlands, waste places and grazing lands. One of the more common grasses in pek savannas, where its tall growth enables it to compete with the pek.

Grazing - acceptable to cattle.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - occurs in South and South-east Asia and northern Australia.

References - Bor 1960 (p. 157); Lazarides 1980 (p. 38); Tothill and Hacker 1983 (p. 245).

Gymnopogon delicatulus
Vernacular names - Khonkatai (Lao)

Description - a delicate annual with culms to 25 cm tall, leafy and well-tillered at the base. Leaf blades are up to 30 mm long, 3 mm wide, hairless except for a few hairs towards the base. Nodes hairless. The inflorescence is a panicle with 5 - 10 racemes, borne quite close together. Racemes are up to 5 cm long, held loosely erect, the spikelets with 3 florets, each with a very fine straight awn 6-20 mm long. (the straight awn readily distinguishes this species from *Eulalia.* This species was formerly included in the genus *Chloris*, which it resembles; it differs in its long glumes and several other characters).

Adaptation - a grass of sandy, infertile or skeletal soils. In pek savannas quite common along tracks where there is little shade and where there is little competition from more robust grasses.

Grazing - of no grazing significance

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia.

References - Schmid 1958, as *Chloris delicatula* (p. 513); Bor 1960 (p. 472); Lazarides 1980 (p. 161).

Ischaemum barbatum
Description - a moderately robust perennial, mostly erect, with leaf blades to 22 cm long, 9 mm wide, tapering towards the base and tip, hairless, with the mid vein on the under surface distinctly pale. Nodes slightly hairy. The inflorescence consists of two racemes *c.* 7-10 cm long, slightly spreading; spikelets with fine awns to 10 mm long on either side of the raceme.

Adaptation - usually found in grassland and open sites in savanna and forest. Sometimes found in pek savannas.

Grazing - considered to be a moderately useful grass for grazing, where it is abundant.

Uses other than for grazing - none.

Deleterious properties - can occur as a weed in disturbed ground.

Distribution - one of the most widespread species of this genus in South-east Asia.

References - Lazarides 1980 (p. 50).

***Microstegium* sp. (?)**
Description - a perennial, leafy at the base, and with culms to 1.1 m tall, the base thickened, with the remains of old leaf sheaths. Nodes hairless. Leaf blades narrow and rolled, up to 15 cm long, 1 mm wide, hairless. The inflorescence consists of a pair of racemes *c.* 10 cm long, pale in colour, with geniculate awns *c.* 15 mm long on either side. Spikelets with a dense ring of silky hairs at the base.

Adaptation - Species in this genus are frequent in disturbed situations, but are also found in woodlands and grasslands. Occasionally found in pek savannas.

Grazing - *Microstegium* spp. tend to be avoided by livestock.

Uses other than for grazing - none.

Deleterious properties - none

Distribution - the genus is widespread in south and South-east Asia.

References - Schmid 1958 (p. 168); Bor 1960 (p. 192); Lazarides 1980 (p. 56).

Pseudopogonatherum contortum

Description - an annual or short-lived perennial with culms to *c.* 70 cm tall, the leaf blades up to *c.* 20 cm long, 1 mm wide, hairless. Nodes hairless. The inflorescence is a dense cluster of 3-15 racemes 2-6 cm long. Spikelets are densely arranged on the racemes and bear purplish awns about 1.5 cm long.

Adaptation - occurs in open forests, mostly on sandy soils. Sometimes quite abundant in pek savannas.

Grazing - grazed by cattle, but not a very productive grasses.

Uses other than for grazing - none.

Deleterious properties - none.

Distribution - south and South-east Asia, China, northern Australia.

References - Schmid 1958 (p. 166); Bor 1960 (p. 204); Lazarides 1980 (p. 65); Tothill and Hacker 1983 (p. 359).

Glossary of Lao species names

Chawd	*Arundinaria* sp.
Chik	*Shorea obtusa*
Couk	*Chrysopogon aciculatus*
Deng	*Xylia kerrii*
Hang	*Quercus griffithii*
Kahok	*Eulalia fulva*
Khonkatai	*Gymnopogon delicatulus*
Koak kadouk ng phumg	*Desmodium heterocarpon*
Koung	*Dipterocarpus tuberculatus*
Loub euang	*Dendrolobium lanceolatum*
Makcaleng	*Crotalaria alata*
Nga chalouad	*Pennisetum polystachyon*
Nga nong	*Heteropogon contortus*
Nga kamong	*Schizachyrium sanguineum*
Paek	*Pinus merkusii*
Pek noi	*Arundinaria* sp.
Pek nyai	*Arundinaria* sp.
Pong	*Chionachne ? koenigii*
Sard	*Dipterocarpus obtusifolius*
Seuak	*Terminalia tomentosa*
Som siaow noi	*Bauhinia* sp. (shrub)
Som siaow nyai	*Bauhinia* sp. (tree)
Thoa phi	*Vigna dalzelliana*

Glossary of botanical terms

Anther	organ within the floret which contains the pollen
Awn	long bristle (stout hair) on lemmas or glumes of some grasses
Axil (leaf)	The angle formed by a culm and its branch, leaf or bract
Bract	scale-like modified leaf
Cane	the stem of a bamboo
Culm	flowering stem of a grass
Fertile	bearing anthers and an ovary; hence capable of bearing a seed
Floret	"flower" of a grass, consisting of lemma, palea and parts within
Geniculate (awn)	bent in a knee-like manner
Glume	lowermost bract of a spikelet (commonly in pairs)
Inflorescence	flower-head of a grass
Lemma	lowermost of two bract-like scales of a floret
Node	structure on the culm from which leaves and secondary branches originate. Often swollen
Palea	uppermost of two bract-like scales of a floret
Panicle	branched inflorescence
Pedicel	short stalk on which the spikelet is borne, in many grasses
Pedicellate	with a pedicel
Peduncle	the stalk of a raceme

Raceme	a single axis bearing spikelets on pedicels
Rachilla	axis of a spikelet, on which florets are borne
Rhizome	underground, creeping stem, leafless but bearing bracts
Rhizomatous	bearing rhizomes
Sheath (leaf)	the lower part of a grass leaf, mostly enveloping the culm or younger leaves
Spike	a single individual axis bearing spikelets which lack pedicels
Spikelet	unit of a grass inflorescence typically with two glumes and 1-several florets
Stigma	two feather-like branches of the style which are usually exserted to receive pollen at flowering
Whorl	a ring of branches, like the spokes on a bicycle wheel

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