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A guide to the grasses of Xieng Khouang Province, Lao PDR and some notes on ecology of grazing lands in the province

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ບົດແນະນຳກ່ຽວກັບຫຍ້າທຳມະຊາດ ແລະ ບາງຂໍ້ສັງເກດກ່ຽວກັບລະບົບນິເວດ ຂອງທົ່ງຫຍ້າລ້ຽງ ສັດ ຢູ່ ແຂວງຊຽງຂວາງ ສ. ປ. ປ. ລາວ

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Abstract

From an agro-ecological perspective, four zones are recognised in Xieng Khouang Province, these being the Plain of Jars, the Pine Tree Zone, the Upland Zone and the Valley Zone. The first three present opportunities for livestock development. Representative soils from these three zones were analysed and a collection made of grasses occurring naturally in the three zones. A total of 68 species were collected and identified. Illustrations and desciptions of these species are provided, together with a simple key for their identification and notes on their ecology and use as forage. Opportunities for the future development of grazing lands in the Province are briefly discussed.

ຈາກສະພາບທາງດ້ານນິເວດກະສິກຳ, ແຂວງຊຽງຂວາງ ໄດ້ແບ່ງອອກເປັນ ສີ່ ເຂດຄື: ເຂດທົ່ງໄຫຫີນ, ເຂດປ່າແປກ, ເຂດພູດອຍ ແລະ ເຂດຮ່ອມພູ, ຊຶ່ງທັງສາມເຂດທຳອິດນັ້ນ ແມ່ນມີຄວາມເໝາະສົມ ສຳລັບການພັດທະນາການລ້ຽງສັດ. ຄືນຈາກທັງສາມເຂດນີ້ ແມ່ນໄດ້ນຳໄປວິໄຈ, ພ້ອມນັ້ນຍັງໄດ້ເກັບກຳເອົາຕົວຢ່າງ ຂອງຫຍ້າທີ່ເກີດຢູ່ຕາມທຳມະຊາດ ເຖິງ 68 ສາຍພັນ ໃນແຂວງດັ່ງກ່າວນີ້ ເພື່ອນຳໄປໃຈ້ແຍກ. ຮູບປະກອບ ແລະ ຄຳອະທິບາຍ ກ່ຽວກັບຫຍ້າຊະນິດຕ່າງໆເຫລົ່ານີ້ ໄດ້ມີໃນບົດແນະນຳນີ້, ພ້ອມກັບວິທີການທີ່ງ່າຍດາຍ ສຳລັບການໃຈ້ແຍກຫຍ້າຊະນິດຕ່າງໆ, ບາງຂໍ້ສັງເກດກ່ຽວກັບ ສະພາບແວດລ້ອມ/ນິເວດ , ການນຳໃຊ້ເພື່ອເປັນອາຫານສັດ ຂອງຫຍ້າ ເຫຼົ່ານີ້ ແລະ ຍັງໄດ້ມີການອະທິບາຍໂດຍຫຍໍ້ ກ່ຽວກັບທ່າແຮງ ໃນການພັດທະນາ ຫລື ປັບປຸງທົ່ງຫຍ້າລ້ຽງສັດ ໃນອານາຄົດ ຢູ່ ແຂວງດັ່ງກ່າວ.

Keywords

tropical grasses, herbaceous legumes, savannas, grasslands

Introduction

The province of Xieng Khouang, in the Lao PDR, is considered by the national government to offer opportunities for further development of a livestock industry. Currently, cattle provide a significant component of smallholders' income, and in the vicinity of the provincial capital, Phonsavanh, there are extensive areas of natural grasslands and savannas, although these areas have been shown to be seriously deficient in phosphorus (Gibson 1995, 1997). The present study arose from a request from the Lao Ministry of Agriculture for information on the grasses which occur naturally in the province, and on their significance as forage for livestock.

Methods

The study involved a visit to the province over the period 19-27 November 1996. Grassland and savanna sites were visited in the south-west of the province and sites where a livestock industry was being developed or was proposed in eastern Xieng Khouang were also visited (Figure 1). Herbarium collections were made of grass species present, and of any legumes found, for identification in Australia and verification in the Netherlands. Soil to a depth of 10 cm was sampled from most sites; twenty samples were taken from each site and bulked. Soil analyses were carried out by Incitec Ltd, Brisbane, Australia, using standard laboratory methods.

A representative specimen of each species was illustrated; descriptions and a simple key were prepared based on available taxonomic literature. As there is no national herbarium in Lao PDR, and, to our knowledge, no collections of the herbaceous flora of the province have been made in the past 50 years, it was frequently necessary to base descriptions on the few specimens collected, from available taxonomic literature, and from a world grass database (Clayton 1998).

Habitat of the described and illustrated species was based on information obtained from available literature and from local sources. The extensive local knowledge of Soulivanh Novaha was particularly valuable.

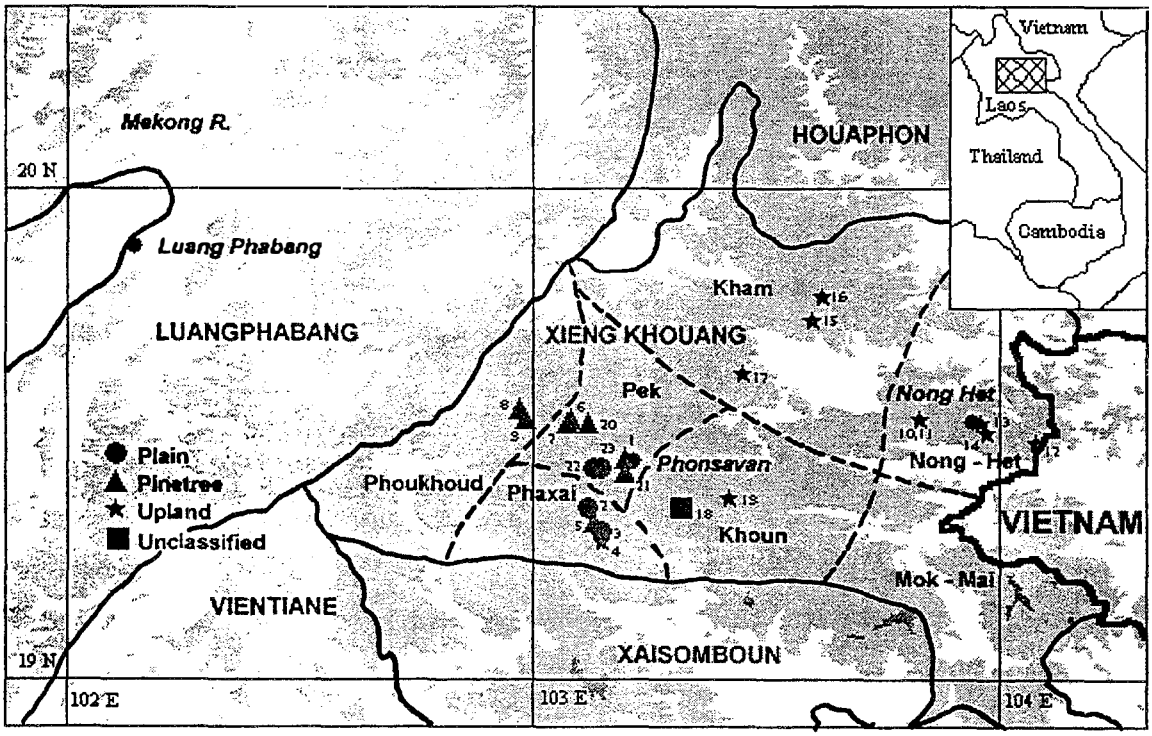

Figure 1. Sites surveyed in Xieng Khouang Province (District boundaries approximate)

Ecology

The Province of Xieng Khouang, from an agro-ecological perspective, includes four zones - the Upland Zone (Plate 1), the Pine Tree Zone (Plate 2), the Plain of Jars (Plate 3) and the Valley Zone (Plate 4). The major part of the Valley Zone is at a comparatively low altitude (about 500-800m), although similar valley areas occur in the other zones. The Valley Zone is more of interest for cropping than as a grazing resource, and will not be considered further. The Pine Tree Zone occurs in the vicinity of the Plain of Jars plateau in the central west of the province. The Plain of Jars plateau is a level grassy plain and is almost entirely devoid of trees. The Upland Zone accounts for the remainder of the Province.

The Plain of Jars

The Plain of Jars in the vicinity of Phonsavanh is an elevated and level plateau 1100m above sea level, dissected by several small rivers and streams and surrounded by hills to 2000m altitude. The landscape is apparently rejuvenated, as indicated by the steep-sided valleys and fast-flowing streams through the otherwise flat landscape. Mean annual rainfall is about 1300-1500mm. The three sites surveyed during the present study differed by no more than 10 m in altitude. The extreme flatness of the Plain, and its uniform altitude, suggest that the Plain of Jars comprises an old lake bed.

Profiles were observed in a few cuttings associated with river crossings. The surficial sediment layer was usually about 2 m thick and composed of unstructured yellow-orange-grey alluvium. In some instances, this alluvium graded down into a layer of water-worn cobbles and pebbles, largely quartzose, occasionally up to 30 cm in diameter. The underlying country rock was generally schistose. The existence of the cobble layer suggests the presence of rapidly-flowing, possibly braided, rivers at an early stage in the rejuvenation of the landscape.

Surface soils are acidic, with a pH (1:5 H_20) about 5.0, and are very deficient in nitrate nitrogen, phosphorus and potassium (Table 1). Calcium and magnesium levels are also low and could limit growth of some pasture species. Cation exchange capacities are also low and the high levels of aluminium saturation are likely to cause problems for growth of many pasture species.

Vegetation in the plain is generally grassland dominated by *Themeda triandra*, with a range of other grasses also present, including the robust and unpalatable *Cymbopogon nardus*. In the vicinity of Phonsavanh the grassland is heavily overgrazed and there was no opportunity to survey the species composition of the pastures. In favoured situations (often close to watercourses) a range of robust grasses occur, including *Microstegium vagans, Hyparrhenia newtonii, Arundinella nepalensis* and *Sorghum nitidum.*

Legumes are rare on the Plain. The only species seen were *Chamaecrista lechenaultiana* and *Flemingia ferruginea.* The latter species, as with most other species of the genus, is likely to be very unpalatable to livestock, although *F. macrophylla* is well eaten by goats.

The Pine Tree Zone

To the west, south and east of the Plain of Jars there are extensive areas of low, rolling hills, some of which are covered in woodland dominated by the 2-needle pine *Pinus merkusii* and the 3-needle pine *Pinus kesiya,* with the tree *Keetaleeria davidii,* another conifer, a common component. The understorey is dominated by *Themeda triandra* or *Eulalia phaeothrix*. Open areas in these woodlands and similar rolling grasslands around the Plain (presumably cleared) are dominated by *Themeda triandra*, with *Eulalia phaeothrix, E. ?bicornuta, Andropogon sinensis* and other grasses as minor components.

The main underlying rock types in the Pine Tree Zone are schists, sandstones and unidentified igneous rocks. Profiles are deeply weathered, with schists weathering to mudstones and clays. Soils are shallow, with the A horizon 2-10 cm, the B horizon frequently red or yellow-red clays grading into darker-coloured lower layers.

Topsoils are generally similar to those of the Plain of Jars, although soils at some sites were higher in nitrate nitrogen, calcium and magnesium and had lower aluminium saturation (Table 1).

Legumes in uncleared pine forest include *Desmodium* spp. and *Crotalaria albida.* In cleared areas of the Pine Tree Zone *Chamaecrista nomame, Crotalaria albida, Desmodium triflorum, Flemingia strobolifera, Flemingia* sp., *Phyllodium pulchellum,* and *P. vestitum* occur, and near creeks *Crotalaria ferruginea, Desmodium microphyllum* and *Lespedeza juncea.* None of these species is likely to be very palatable to livestock, although all would be of some benefit in that they fix atmospheric nitrogen, and improve soil fertility. *Phyllodium* spp. and *Flemingia* spp. are generally very unpalatable to livestock.

The Upland Zone

The Upland Zone is a complex of mountains to c. 2,800m in altitude. Areas of the Upland Zone visited are to

Table 1. Characteristics of, and concentrations of major nutrients in soils of three agro-ecological zones in Xieng Khouang.

	Upland Zone (8 sites)	Plain of Jars (3 sites)	Pine Tree Zone (5 sites)
pH (1:5 water)	5.4 (4.7-7.7)	4.9 (4.8-5.0)	4.9 (4.7-5.2)
NO_3 (mg/kg)	14.9 (0.4-58.5)	0.6 (0.2-1.3)	3.0 (0.4-10.8)
S (mg/kg)	9 (2-13)	7 (5-9)	6 (4-9)
P(BSES) (mg/kg)	15(7-54)	6 (5-7)	6 (4-8)
P(Colwell) (mg/kg)	7(3-15)	2 (2-3)	2 (1-2)
K (meq/100g)	0.4 (0.2-0.7)	0.1 (0.1-0.2)	0.2(0.1-0.4)
Ca (meq/100g)	6.2(0.5-22.4)	0.4 (0.3-0.5)	0.8 (0.3-1.8)
Mg (meq/100g)	1.0 (0.2-2.4)	0.1 (0.1-0.2)	0.4 (0.2-0.9)
Al (meq/100g)	1.7 (0-3.8)	2.4 (1.9-3.2)	2.3 (1.7-2.8)
Na (meq/100g)	0.02 (0.01-0.03)	0.02 (0.01-0.04)	0.03 (0.03-0.04)
Cl (mg/kg)	13 (10-25)	8 (5-10)	0.13 (10-15)
CEC (meq/100g)	9.35(4.12-23.43)	3.10 (2.35-4.20)	3.86 (2.73-5.51)
Al satn (%)	34 (0-79)	77 (74-79)	62 (43-81)

the southeast of the Plain of Jars (Site 19) and in the Nong Het and Kham Districts, to the east of the Nam Mat Valley. Much of the eastern Upland Zone, in the Nong Het District, is karstic, with the mountainous topography irregularly dissected by steeply sloping valleys. The rocks are predominantly limestone, interbedded with schists. Strata are frequently steeply dipping and/or contorted. Soils are generally moderately acid (pH 5-6.5) and loams to clay-loams. To the north of Chom Thong there is an area of grano-diorite, with sandy-loam soils, pH 6.0. A single site (site 17) had alkaline soils with pH 7.7. No accurate rainfall records are believed to be available; it is probable that mean annual rainfall exceeds that of Phonsavanh (1300-1500mm) and is likely to be locally variable.

Communities in the Nong Het District are predominantly Hmong, who cultivate valley areas for wetland rice and practise shifting cultivation on slopes, growing upland rice and maize. The district is well known for pig production, and buffalo are used for various purposes. Some communities own small to moderate-sized herds of cattle, which graze on abandoned upland rice fields, roadsides and pastures. The cleared areas used for grazing on the upper hill slopes are often dominated by *Imperata cylindrica*, which may comprise 99% or more of the available herbage. These areas are burnt at intervals, and grazed throughout the year .

The initial vegetation of the entire Upland Zone is likely to have been tall tropical rainforest. In most areas, this has now been extensively modified by shifting cultivation and grazing. Pastures are frequently based on *Imperata cylindrica*, which initially dominates after periods of shifting cultivation. With grazing, this gives way to weedy shrubs, the most important of which are *Tithonia diversifolia* on more fertile soils and *Chromolaena odorata* (nya phangh) and *Artemisia* sp. on less fertile soils.

Soils in the Upland Zone are extremely variable, depending on whether they have been derived from limestone, schist or other rock types (Table 1). However, the average pH of the eight sites sampled was below 5.5. Some soils in the Upland Zone had nutrient levels as low as soils on the Plain of Jars, whereas other soils had adequate levels for growth of forage species. Similarly, aluminium saturation ranged from zero to 79%.

Most cleared areas are dominated by the weedy shrubs mentioned above. Abundance and composition of the grass flora depends on the dominance of *Imperata cylindrica* and weedy shrubs. Where *I. cylindrica* is the dominant species, tall growing grasses including *Thysanolaena latifolia* (kor khaem), *Miscanthus floridulus*

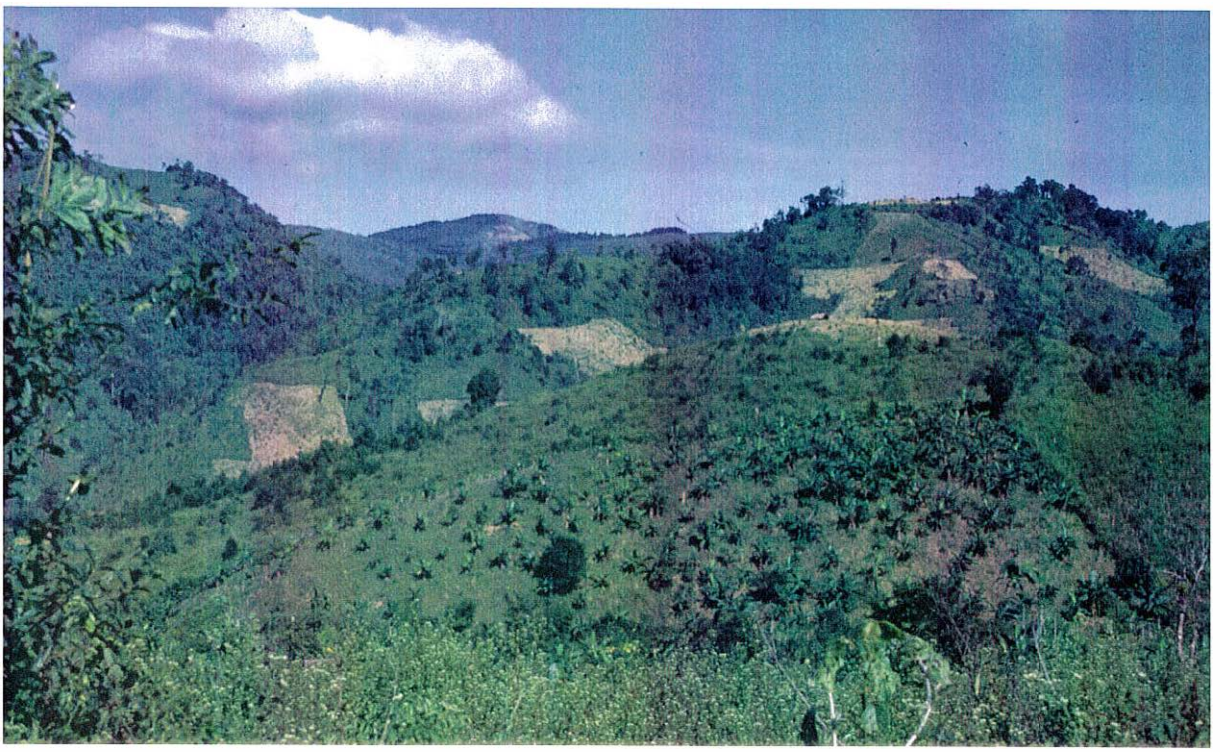

Plate 1. Upland Zone, Xieng Khouang Province, Lao PDR.

Plate 2. Pine Trec Zone, Xieng Khouang Province, Lao PDR.

Plate 3. The Plain of Jars, Xieng Khouang Province, Lao PDR.

Plate 4. The Valley Zone, Xieng Khouang Province, Lao PDR.

(kor kou) and *Neyraudia arundinacea* (kor ka nyouan) were also present. The few areas seen which were relatively free of *I. cylindrica* and not heavily grazed were dominated by *Themeda arundinacea* and *Cymbopogon nardus*, with *Ischaemum* sp. in moist areas. Where grazing is heavy *Sporobolus indicus* var. *major* (nya na phak kwai), *Paspalum conjugatum* and *Axonopus compressus* (both with the same Lao name of nya phaed) are commonly dominant grasses. On the one alkaline site *Pseudosorghum zollingeri* was the dominant grass in a community otherwise dominated by the shrub *Chromolaena odorata*. This was the only site where legumes were numerous. In other areas the most frequent legumes were the small unpalatable shrubs *Desmodium sequax* and *Flemingia sootepensis*. *T. triandra* was rarely seen in the Upland Zone.

Opportunities for sustainable development

The extensive grasslands on the Plain of Jars and the Pine Tree Zone might initially suggest that there are good opportunities for the establishment of a commercial cattle industry. However, the extreme infertility of the soils imposes a serious limitation (Gibson 1995, 1997). In order to obtain higher outputs from the system, some inputs are essential. These would include legumes tolerant of the low P status of the soils and a source of P for the cattle, either directly supplemented, or as a fertiliser to legume-based pastures.

It is unlikely to be economically feasible to fertilise large areas of grassland. The best option may be to improve small areas with adapted species such as *Brachiaria decumbens*, *B. brizantha*, *Andropogon gayanus* and *Stylosanthes guianensis* CIAT 184 and a low input of P fertiliser, to be used as a dry season feed resource. It will also be necessary to maintain low stocking rates generally, in order to ensure long-term sustainability of the natural grasslands and prevent unpalatable species such as *Sporobolus indicus* var. *major* and *Cymbopogon nardus* from invading and dominating the pastures.

Some areas in the Upland Zone are more fertile and offer greater potential. Here introduced species that appear to be well adapted are *Setaria sphacelata*, *Panicum maximum* (Thai Purple Guinea), *Desmodium intortum* and African *Trifolium* species. *Brachiaria ruziziensis* is also popular, largely because of the availability of good-quality seed.

Overgrazing in many areas has resulted in unproductive grasslands with insufficient feed to support livestock over the dry season. Controlled stocking is essential to any future livestock development in Xieng Khouang Province. Higher economic returns can be expected from land that is moderately stocked and with cattle which are ready to market in two years than land that is heavily stocked and with cattle which take four years to reach market weight.

Acknowledgments

We are grateful to the Xieng Khouang Provincial Agriculture and Forestry Office for permission to travel within the Province and for the provision of a vehicle. We are also grateful to the staff of the Queensland Herbarium for identifying legumes and to AusAID for funding the study through the Forages for Smallholders Project.

We would also like to acknowledge the assistance of Mrs JLF Hacker, who provided geomorphological interpretation of the landscapes in the Province.

A simple key to the grasses of Xieng Khouang

In order to identify a grass growing in Xieng Khouang, it is desirable to have a specimen that includes the inflorescence (seed head), leaves, stems (culms) and the base of the plant. The key first identifies to which of seven groups the species belongs. The key consists of pairs of statements; first consider the first pair of statements and decide which alternative is true for your specimen. This will then tell you which group your specimen belongs to, or tell you to go to another pair of statements. In this way, the Group your specimen belongs to can be identified, and a similar procedure can be used to identify the species within the group. It is then necessary to refer to the description and illustration of the species and check whether it agrees with your specimen.

Figure 2 shows the various parts of the grass plant and Figure 3, the different types of inflorescence; the Figures also provide illustrations of many of the terms used in the key.

It is possible that your specimen is of a species that is not included in this publication. There is little information available on the grasses of Lao PDR and the authors only had a limited opportunity to make collections in Xieng Khouang.

The key to the groups is as follows:

1. Inflorescence a leafy (spatheate) panicle, or short and almost concealed within a leaf sheath **Group 1 (Figures 4-7)**
1a. Inflorescence not leafy 2

2. Culms robust, >2 m tall, with plumose (like a bunch of feathers) panicles **Group 2 (Figures 8-13)**
2a. Culms < 2 m tall, or, if taller, panicles not plumose 3

3. Grasses with spike-like inflorescences **Group 3 (Figure 14)**
3a. Grasses with open or racemose panicles 4

4. Inflorescences open panicles, spikelets not densely crowded along panicle branches 5
4a. Inflorescences with spikelets densely crowded along panicle branches, the panicles digitate or with racemes borne on a long axis 6

5. Spikelets not awned **Group 4 (Figures 15-20)**
5a. Spikelets awned **Group 5 (Figures 21,22)**

6. Spikelets not awned **Group 6 (Figure 23)**
6a. Spikelets awned **Group 7 (Figures 24-26)**

Group 1 - Grasses with leafy (spatheate) panicles

1. Plants delicate, less than 50 cm tall 2
1a. Plants mostly >1 m tall 3

2. Inflorescence a single raceme almost completely concealed within a modified leaf sheath at the top of the culm *Kerriochloa siamensis* (Page 23)
2a. Flowering culms with many racemes, exserted from the leaf sheaths *Schizachyrium brevifolium* (Page 25)

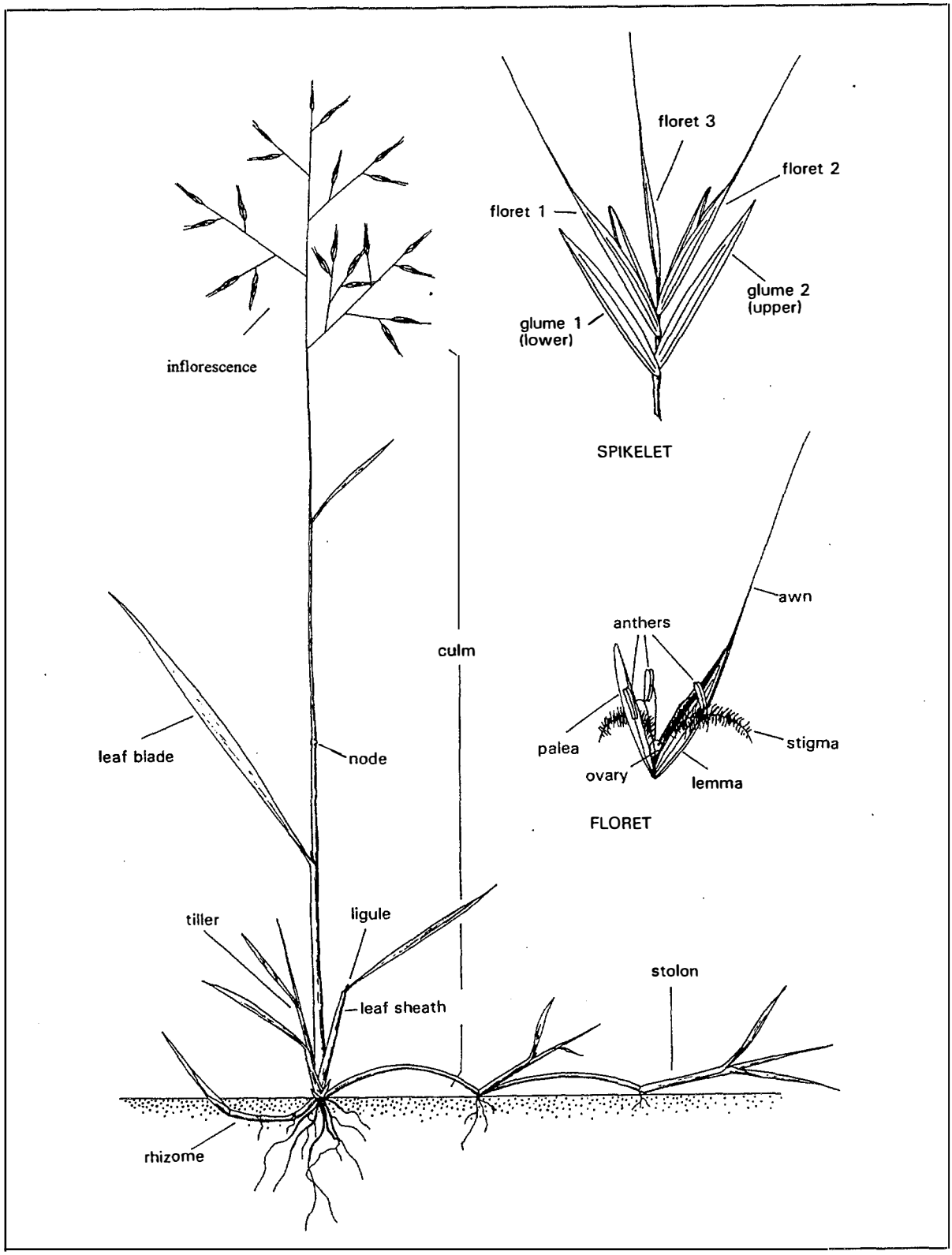

Figure 2. The parts of a grass plant (Tothill and Hacker 1983).

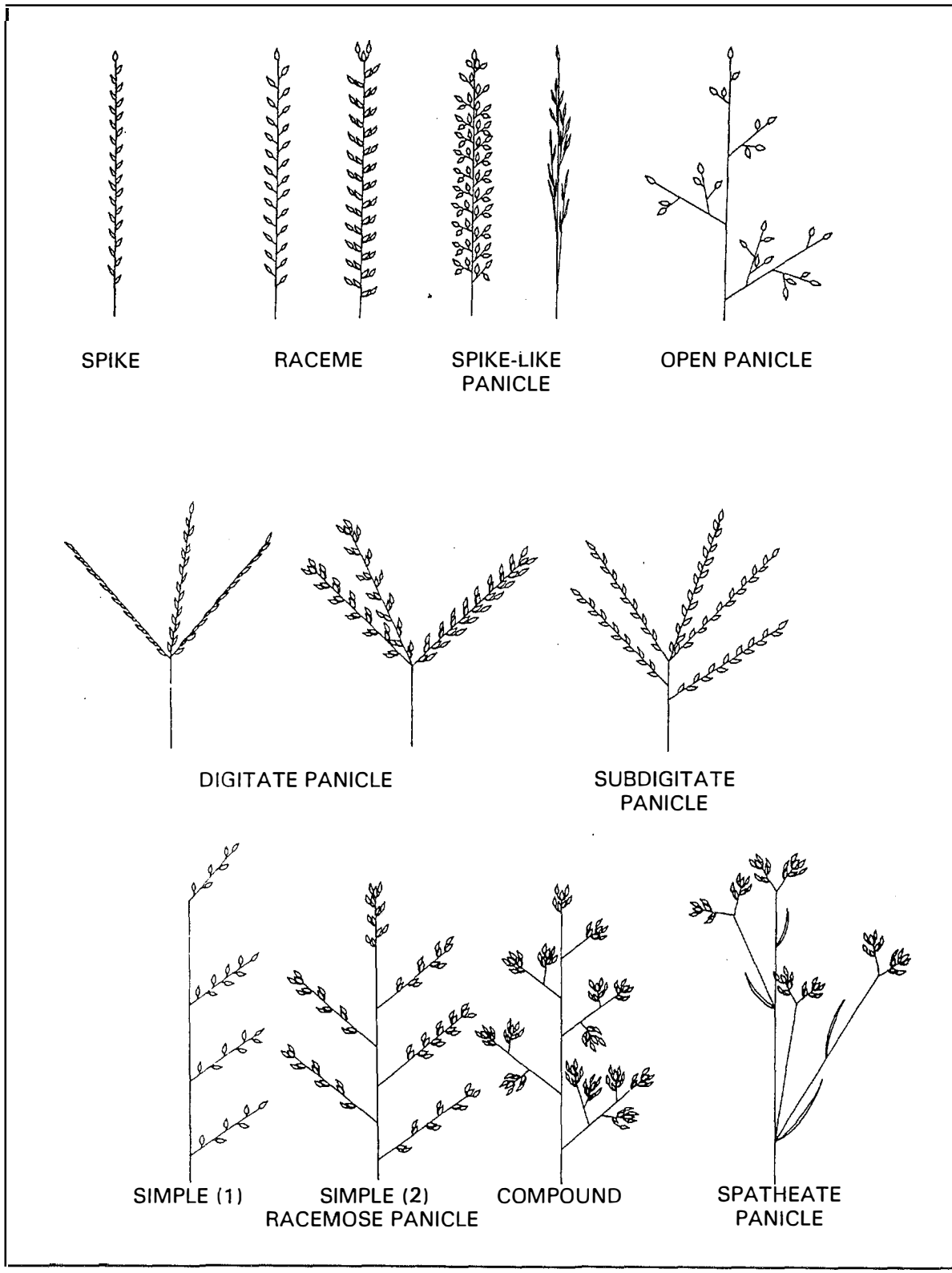

Figure 3. Stylised inflorescence forms of grasses (Tothill and Hacker 1983)

3. Spikelets with awns >15 mm long 4
3a. Spikelets not awned, or with very short awns <15 mm long 9

4. Inflorescence of paired racemes 5
4a. Terminal parts of inflorescence with fertile spikelets surrounded by clusters of 4 sterile spikelets (Figure 6, E and F) 8

5. Leaves densely hairy; racemes with dense, long yellow hairs at the base *Hyparrhenia newtonii* (Page 23)
5a. Leaves hairless; racemes without dense, long hairs at base 6

6. Inflorescence narrow, contracted *Hyparrhenia diplandra* (Page 22)
6a. Inflorescence open 7

7. Racemes each with 1-2 awns *Hyparrhenia filipendula* (Page 22)
7a. Racemes each with many awns *Andropogon chinensis* (Page 19)

8. Plants to c. 1 m tall *Themeda triandra* (Page 28)
8a. Plants 1-3 m tall *Themeda arundinacea* (Page 27)

9. Racemes or spikes >50 mm long 10
9a. Racemes or spikes < 20 mm long 12

10. Spikelets 5-10 mm long *Chionachne semiteres* (Page 21)
10a. Spikelets up to 3.5 mm long 11

11. Spikelets paired *Mnesithea cancellata* (Page 23)
11a. Spikelets solitary *Ophiuros exaltatus* (Page 25)

12. Bracts enclosing spikelets almost as broad as long *Apluda mutica* (Page 19)
12a. Bracts enclosing spikelets much longer than broad 13

13. Inflorescence 1-2 m long, with long, pendulous branches; tillers broad and flattened; leaf blades without taste; each fertile spikelets surrounded by a cluster of 4 sterile spikelets *Themeda intermedia* (Page 29)
13a. Inflorescence mostly <0.6 m long, branches short and erect; tiller bases narrow; leaf blades with a spicy taste; fertile spikelets not surrounded by sterile spikelets *Cymbopogon nardus* var. *confertiflorus* (Page 21)

Group 2 - Robust grasses >2 m tall, with plumose panicles

1. Inflorescence with many long, unbranched racemes, from a short axis *Miscanthus floridulus* (Page 31)
1a. Inflorescence with a long axis bearing branches that are unbranched or produce secondary branches 2

2. Spikelets 6-20 mm long, with 3-10 florets 3
2a. Spikelets 3-7 mm long, with 2 florets (appearing to be a single floret) 4

3. Leaf blades 1-1.5 m long; culm internodes solid; lemmas hairy; robust tussock grass to 5 m tall;hillsides *Neyraudia arundinacea* (Page 31)
3a. Leaf blades <0.6 m long; culm internodes hollow; lemmas hairless, but joints between them with long

hairs; rhizomatous grass 2-4 m tall forming thickets along stream banks and moist places
Phragmites karka (Page 34)

4. Spikelets awned — *Saccharum* sp. JBH 1420 (Page 38)
4a. Spikelets awnless — 5

5. Inflorescences open and sparse, on slender culms; flat areas and valleys in moist situations
Saccharum sp. JBH 1476 (Page 38)
5a. Inflorescences dense, borne on thick culms; mountainous areas — 6

6. Leaf blades hairless — *Saccharum spontaneum* (Page 34)
6a Leaf blades close to ligule densely covered with long hair — *Saccharum* sp. JBH 1516 (Page 38)

Group 3 - Grasses with spike-like inflorescences

1. Mat-forming grass, with an extensive root system; spikelets covered with long, silky hairs
Imperata cylindrica (Page 41)
1a. Tufted grasses; inflorescences not as above — 2

2. Spikelets 2.2-2.8 mm long, surrounded by bristles up to 10 mm long — *Setaria parviflora* (Page 42)
2a. Spikelets not surrounded by bristles — 3

3. Inflorescence up to 35 cm long, with slightly spreading lower branches; inflorescence often covered by a black smut; fruits expelled from the spikelets — *Sporobolus indicus* var. *major* (Page 43)
3a. Inflorescence 1-15 cm long, without obvious branches; inflorescence not covered with smut; fruit not expelled from spikelets — *Sacciolepis indica* (Page 41)

Group 4 - Grasses with open panicles; spikelets awnless, not crowded along panicle branches

1. Leaf blades folded (plicate) like those on a young palm — *Setaria palmifolia* (Page 55)
1a. Leaf blades flat or inrolled — 2

2. Spikelets with 6-60 florets — 3
2a. Spikelets with 1-4 florets — 6

3. Spikelets pink — *Eragrostis unioloides* (Page 49)
3a. Spikelets grey or green — 4

4. Pedicels < 1 mm longs — *Eragrostis brownii* (Page 47)
4a. Pedicels generally > 1 mm long — 5

5. Stalks of the spikelets with a small gland — *Eragrostis ferruginea* (Page 49)
5a. Stalks of the spikelets glandless — *Eragrostis atrovirens* (Page 47)

6. Robust grass 1-4 m tall; leaf blades to 8 cm wide; inflorescence up to 125 cm long; spikelets 1.2-2 mm long — *Thysanolaena latifolia* (Page 57)
6a. Grasses < 2 m tall (sometimes more in *Panicum sarmentosum*); leaf blades much narrower; inflorescence 5-50 cm long; spikelets 1-8 mm long — 7

7. Spikelets with 1 floret, resembling those of rice; occurs in swamps and standing water

Leersia hexandra (Page 51)

7a. Spikelets with 2-4 florets, not resembling those of rice; not in swamps or standing water 8

8. Spikelets with 2-4 florets; spikelets 4-8 mm long, with rough downwardly-pointing hairs *Centotheca lappacea* (Page 45)

8a. Spikelets with 2 florets (often appearing to be a single floret), spikelets 1-2.7 mm long, with no rough downwardly-pointing hairs 9

9. Plants stoloniferous or with scrambling culms 10

9a Plants erect, not stoloniferous or scrambling 12

10. Leaf blades up to 9 cm long, 27 mm wide *Panicum brevifolium* (Page 53)

10a. Leaf blades up to 40 cm long, 20 mm wide 11

11. Spikelets laterally flattened; plants stoloniferous *Cyrtococcum accrescens* (Page 45)

11a. Spikelets not laterally flattened (dorsi-ventrally flattened); plants scrambling *Panicum sarmentosum* (Page 54)

12. Leaf blades up to 30 cm long 13

12a. Leaf blades <12 cm long 14

13. Ligule a fringe of long hairs; spikelets 1-1.5 mm long, mostly whitish, with 2 fertile florets *Isachne albens* (Page 50)

13a. Ligule a membrane 0.2-0.4 mm long; spikelets 2.2-2.7 mm long, green, with 1 fertile floret *Panicum notatum* (Page 54)

14. Culms up to 60 cm tall; leaf blades 2-4 mm wide *Panicum humile* (Page 53)

14a. Culms up to 1 m tall; leaf blades 5-10 mm wide *Isachne truncata* (Page 51)

Group 5 - Grasses with open panicles; spikelets awned, not crowded along panicle branches

1. Delicate annual to 25 cm tall; lemma 3-awned *Aristida cumingiana* (Page 59)

1a. Plants > 80 cm tall; lemma 1-awned (sometimes with 2 white bristles at base) 2

2. Spikelets more or less in pairs 3

2a. Spikelets in groups of 3 or more, the terminal ones forming a triplet of one sessile and 2 pedicellate spikelets 4

3. Awn with 2 white bristles at base *Arundinella setosa* (Page 60)

3a. Awn without bristles at base *Arundinella nepalensis* (Page 59)

4. Plants strongly rhizomatous and mat-forming, the culms up to 50 cm tall *Chrysopogon aciculatus* (Page 62)

4a. Plants not strongly rhizomatous and mat-forming; culms mostly >50 cm tall 5

5. Panicle open, with clusters of spikelets at the ends of primary branches; fertile spikelets black when ripe *Sorghum nitidum* (Page 63)

5a. Panicle with secondary branches; fertile spikelets not black when ripe 6

6. Plants scrambling; stems cane-like *Capillipedium assimile* (Page 60)

6a. Plants erect; stems not cane-like. *Capillipedium parviflorum* (Page 62)

Group 6 - Grasses with racemose panicles: spikelets crowded along panicle branches; spikelets awnless

1. Inflorescence digitate, sometimes with 1 or 2 racemes below the main group 2
1a. Inflorescence with racemes borne along a long primary axis 8

2. Spikelets with 3-5 florets *Eleusine indica* (Page 69)
2a. Spikelets with 1 floret, or 2 florets, appearing to be a single floret 3

3. Plants strongly stoloniferous 4
3a. Plants not stoloniferous, or weakly stoloniferous, rooting only from lower culm nodes 7

4. Leaf blades 2-3 mm wide mm wide; stolon leaves in groups of 3 *Cynodon dactylon* (Page 65)
4a. Leaf blades 3-15 mm wide; stolon leaves single 5

5. Inflorescences 2-5 from a leaf axil, hardly exserted from the leaf sheath *Axonopus compressus* (Page 65)
5a. Inflorescence solitary, terminal, well-exserted from the upper leaf sheath 6

6. Spikelets solitary; inflorescences almost always with 2 racemes *Paspalum conjugatum* (Page 69)
6a. Spikelets in groups of 3; inflorescences with 2-3 racemes *Digitaria fuscescens* (Page 66)

7. Spikelets in pairs; fruiting spikelet yellowish *Digitaria setigera* (Page 66)
7a. Spikelets in groups of 3; fruiting spikelet dark brown *Digitaria violascens* (Page 68)

8. Spikelets in 4 neat rows; racemes 2-3 cm long *Echinochloa colona* (Page 68)
8a. Spikelets in 2 rows; racemes mostly >4 cm long 9

9. Culms > 0.9 m tall; inflorescences with 10-20 racemes *Paspalum urvillei* (Page 70)
9a. Culms < 0.7 m tall; inflorescence with 2-6 racemes *Paspalum scrobiculatum* var. *bispicatum* (Page 70)

Group 7 - Grasses with racemose panicles; spikelets crowded along panicle branches; spikelets awned

1. Panicle with several racemes from a long axis 2
1a. Panicle digitate, or nearly digitate 5

2. Grass stoloniferous; leaf blades short and broad; lower glume with a 2.5-3.5 mm long awn *Oplismenus compositus* (Page 79)
2a. Erect grasses, leaf blades long and narrow; lower glume not awned 3

3. Plants perennial *Bothriochloa bladhii* (Page 74)
3a. Plants annual 4

4. Spikelets in 3s, dissimilar; awn geniculate *Pseudosorghum zollingeri* (Page 80)
4a. Spikelets in pairs, similar, all awned; awn straight *Echinochloa crus-galli* (Page 74)

5. Spikelets solitary; leaf blades to 7.5 cm long, 15 mm wide, with bristles along margins

Arthraxon hispidus (Page 73)

5a. Spikelets in pairs or 3s; leaf blades not as above 6

6. Stems scrambling and cane-like; leaf blades characteristically narrowing towards the base 7

6a. Stems not scrambling; leaf blades not markedly narrowed towards the base 8

7. Inflorescences pale green or pale yellow, usually with few racemes *Microstegium ciliatum* (Page 78)

7a. Inflorescences reddish purple, with many racemes *Microstegium vagans* (Page 79)

8. Plants stoloniferous; inflorescence usually with 2 racemes; racemes stout *Ischaemum indicum* (Page 77)

8a. Plants tufted; inflorescence with 1-8 racemes; racemes slender 9

9. Rachis of racemes covered with purple or purplish-brown hairs *Eulalia siamensis* (Page 77)

9a. Hairs on racemes not purple or purplish-brown 10

10. Sheaths on butt (base of plant) covered with dark brown hairs; inflorescences with 1-8 racemes *Eulalia phaeothrix* (Page 75)

10a. Sheaths on butt not covered with dark brown hairs; inflorescences with 2-4 racemes 11

11. Culms mostly <50 cm tall; leaf blades hairless *Eulalia leschenaultiana* (Page 75)

11a. Culms 50-100 cm tall; leaf blades hairy *Eulalia? bicornuta* (Page 75)

Group 1 - Grasses with leafy (spatheate) panicle

Andropogon chinensis (Figure 4A)
Vernacular names - nya kan khaeng [ຫຍ້າກ້ານແຂ້ງ] (Lao)

Description – culms to 2 m tall, the leaf blades up to c. 50 cm long, 1-4 mm wide, hairless. Nodes hairless. Inflorescence a leafy panicle up to 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 4-8 mm long, most of which bear geniculate awns c. 25 mm long. The lower glume has a distinct channel.

Habitat - grows on sandy and skeletal soils in open forest and also on the edges of seasonal marshes.

Uses for livestock – in Xieng Khouang and elsewhere this species is considered to be palatable to livestock when young. Reported as having been introduced to Thailand as a fodder.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, Thailand, India, Burma, Africa. In Xieng Khouang occurs commonly in cleared areas of the Pine Tree Zone.

References - Schmid 1958, as *A. ascinodis* (p. 202, 204); Bor 1960, as *A. ascinodis* (p. 90); Lazarides 1980, as *A. ascinodis* (p. 18); Clayton and Renvoize 1982 (p. 779); Hacker *et al.*, as *A. ascinodis* 1996 (p. 11).

Apluda mutica (Figure 4B)
Vernacular names – co' rêp, co' lá-tre (Vietnam)

Description - a fine-stemmed, weak perennial, scrambling through surrounding vegetation to a height of 2 m. Leaf blades are up to 50 cm long, and are 5-15 mm wide. Ligule a membrane, minutely hairy along the upper margin. Inflorescence a leafy panicle 3-40 cm long, composed of terminal and axillary racemes. Spikelets in groups of 3, 2 of which are pedicellate and sterile. The sessile, fertile spikelet is 2-6 mm long and has 2 florets, only the upper one fertile, the lemma pointed or with a delicate awn, and falls entire.

Habitat - occurs in a wide range of habitats including disturbed sites, clearings, roadsides, plantations, also in grasslands and savannas. Commonly found in lightly shaded, moist situations.

Uses for livestock - when young, grazed by cattle and buffalo, but generally not considered to be very palatable, although locally it is considered to be a good forage.

Other uses - none.

Deleterious properties - none.

Distribution - throughout South-east and tropical Asia, Madagascar, Indonesia, northern Australia and New Caledonia. In Xieng Khouang found in valley situations on the Plain of Jars and in uplands, as a minor component of the vegetation.

References - Schmid 1958, as *A. varia* (p. 195); Bor 1960 (p. 93); Hô and Du'o'ong, 1960 (p. 680); Gilliland 1971 (p. 273); Lazarides 1980 (p. 19); Mannetje and Jones 1992 (p. 236).

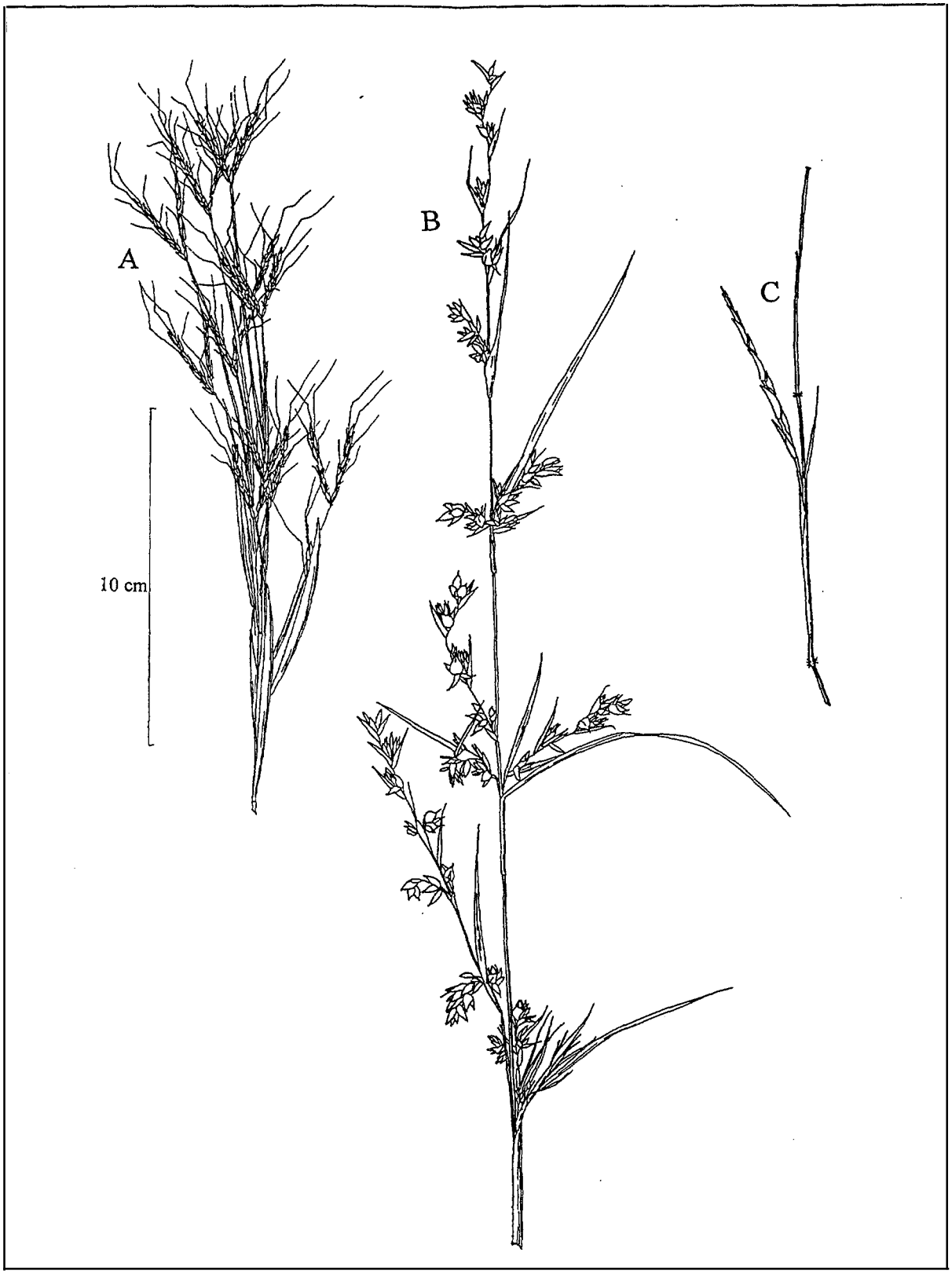

Figure 4. A - *Andropogon chinensis*; B - *Apluda mutica*; C - *Chionachne semiteres*

Chionachne semiteres (Figure 4C)
Description - culms 1-1.5 m tall. Leaf blades 30-40 cm long, 6 mm wide; leaf blades and sheaths hairless; nodes minutely hairy. Ligule a membrane 3 mm long, lacking hairs along the upper margin. Inflorescence consists of terminal and axillary spikes c. 6 cm or more long, subtended by small spathes, in a lax, leafy panicle. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet has 2 florets, only the upper one fertile, falling entire. These are described as c. 5 mm long; a specimen collected in Xieng Khouang had spikelets c. 10 mm long at the base of the raceme, shorter further up the raceme.

Uses for livestock - of no significance as a forage.

Other uses - none.

Deleterious properties - none.

Distribution - India, Burma; in Xieng Khouang found uncommonly in the Pine Tree Zone.

References - Bor 1960 (p. 263).

Cymbopogon nardus var. *confertiflorus* (Figure 5A)
Vernacular names – nya singkhai pa [ຫຍ້າສິງໄຄ່ປ່າ], nya faek [ຫຍ້າແຝກ] (Lao); co' sa dai bong to (Vietnam); citronella grass (English)

Description - perennial to 3 m tall, forming robust tussocks. Leaves are basal, blue-green in colour, the blades to 1 m long, 10 mm wide, hairless, and with a narrow white mid-vein. Leaves have a distinctly pungent smell when crushed. Ligule a membrane 3-9 mm long, lacking hairs along the upper margin. Inflorescence a narrow leafy panicle 15-60 cm long, with paired racemes 10-20 mm long. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet has 2 florets, only the upper one fertile. It is 3-7 mm long, has a short awn 5-15 mm long, and falls entire.

Habitat - a species that occurs commonly on open grasslands at medium altitudes in Indo-China. Grows on infertile soils and on red soils derived from basalt.

Uses for livestock - unpalatable to livestock.

Other uses - in Xieng Khouang the swollen shoot bases are boiled to prepare a shampoo which is believed to cure dandruff, and a preparation from this grass is used to relieve dizziness. Culms are woven into a mat which is used for fencing gardens May also be used for manufacture of paper pulp.

Deleterious properties - an unpalatable species which can become a sub-dominant species in grazing lands.

Distribution - South-east Asia, India, Sri Lanka, East Africa. In Xieng Khouang, common in the Pine Tree Zone and on the Plain of Jars, and also occurs in valleys in the Upland Zone. An awnless form is cultivated for production of citronella oil in many parts of South-east Asia.

References - Schmid 1958, as *C. confertiflorus* (p. 224, 227); Bor 1960 (p. 130); Hô and Du'o'ong, 1960 (p. 669); Gilliland 1971 (p. 296); Lazarides 1980 (p. 29,31); Clayton and Renvoize 1982 (p. 764).

Hyparrhenia diplandra (Figure 5B)
Vernacular names – nya faek kan khaeng [ຫຍ້າແຝກກ້ານແຂງ] (Lao).

Description - robust perennial to 3.5 m tall, with leaf blades to 60 cm long, 3-10 mm wide. Leaf blades and sheaths hairless, except for long hairs close to the junction of the blade and sheath. Nodes hairless. Ligule a membrane 1-2 mm long, lacking hairs along the upper margin. Inflorescence narrow and leafy, 20-45 cm long, composed of paired terminal and axillary racemes. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile, hairless. The sessile spikelet has 2 florets, only the upper one fertile. It is 6-8 mm long, with an awn 2-5.5 cm long, and falls entire.

Habitat - a common grass in open savannas, often growing with *Cymbopogon nardus*. Often found on clay soils derived from basalts or schists.

Uses for livestock - locally considered to be palatable to livestock before flowering.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, Thailand, Indonesia (Sulawesi), China (Hainan), Africa. In Xieng Khouang occurs in the Pine Tree Zone, and in valleys in the Upland Zone.

References - Schmid 1958, as *Cymbopogon eberhardtii* (p. 227,229); Hô and Du'o'ong, as *Cymbopogon eberhardtii* 1960 (p. 670); Lazarides 1980 (p. 47,48).

Hyparrhenia filipendula (Figure 5C)
Vernacular names - tambookie grass (Australia).

Description - a tufted perennial with culms to 2 m tall. Leaf blades up to 40 cm long and 6 mm wide, the blades, sheaths and nodes hairless except for a few long hairs towards the base of the leaf blade. Ligule a membrane 0.5-1 mm long, lacking hairs along the upper margin. Inflorescence a narrow leafy panicle 30-80 cm long, with slender paired racemes, each raceme with 1-2 awned spikelets. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet has 2 florets, only the upper one fertile, and is covered with white hairs. It is 4.5-8 mm long, bears a long awn, and falls entire.

Habitat - occurs in grasslands and savannas, on soils derived from schists and granites.

Uses for livestock – moderately palatable to livestock. Cultivated to a limited extent as a pasture species in tropical America.

Other uses - none.

Deleterious properties - none.

Distribution - South-east Asia, Philippines, Indonesia, Papua-New Guinea, Sri Lanka, Africa and eastern Australia. In Xieng Khouang, occurs on the Plain of Jars.

References - Schmid 1958, as *Cymbopogon filipendulus* (p. 229); Bor 1960 (p. 167); Hô and Du'o'ong, as *Cymbopogon filipendulus* 1960 (p. 670); Lazarides 1980 (p. 47,48); Tothill and Hacker 1983 (p. 275); Mannetje and Jones 1992 (p. 239).

Hyparrhenia newtonii (Figure 5D)
Vernacular names - nya kan khaeng [ຫຍ້າກ້ານແຂ້ງ] (Lao).

Description - perennial tussock to 2 m tall. the leaf blades to c. 50 cm long and 7 mm wide. Leaf blades and sheaths hairy; densely hairy near the ligule. Nodes hairless. Ligule a membrane 1 mm long, lacking hairs along the upper margin. Inflorescence narrow and leafy, 15-30 cm long, with terminal and axillary paired racemes which are angled backwards, with prominent long hairs at the base. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet has 2 florets, only the upper one fertile. They are 5-10 mm long, excluding the 2.2-2.5 cm long, bent awn, and fall entire.

Habitat - occurs on light textured to loam soils in sunny situations.

Uses for livestock - locally considered to be a useful forage before flowering.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, Thailand, Indonesia (Flores, Sumba), Philippines and Papua-New Guinea, and also Africa. In Xieng Khouang, locally abundant in small valleys in the Plain of Jars and in cleared areas of the Pine Tree Zone.

References - Lazarides 1980 (p. 48). Clayton and Renvoize 1982 (p. 816).

Kerriochloa siamensis (Figure 6A)
Description - a slender perennial to c. 50 cm tall, branching extensively in the lower part of the plant. Leaves are crowded on the culms, the blades to 4 cm long, 4 mm wide, hairy, the sheaths also hairy. Nodes hairless. Ligule a membrane 1 mm long, lacking hairs along the upper margin. Inflorescence almost totally enclosed within a slightly curved modified leaf sheath, only 1-2 awns and ends of spikelets emerging. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet has 2 florets, only the upper one fertile, and is 5-6 mm long, with a long awn, and falls entire.

Habitat - occurs as a minor component of open grasslands, on degraded sandy granitic soils and lateritised red earths. Also reported as occurring on open rocky ground and along roadsides. A lowland form occurs in a wide range of situations in Cambodia.

Uses for livestock - tolerant of heavy grazing, but not a productive species.

Other uses - none.

Deleterious properties - none.

Distribution - Thailand, Vietnam, Cambodia. In Xieng Khouang occurs on the Plain of Jars and in grasslands in the Pine Tree Zone.

References - Schmid 1958 (p. 180-183); Lazarides 1980 (p. 55).

Mnesithea cancellata (Figure 6B)
Vernacular names – nya laow khang [ຫຍ້າເຝົ້າຄ້ຽ] (Lao)

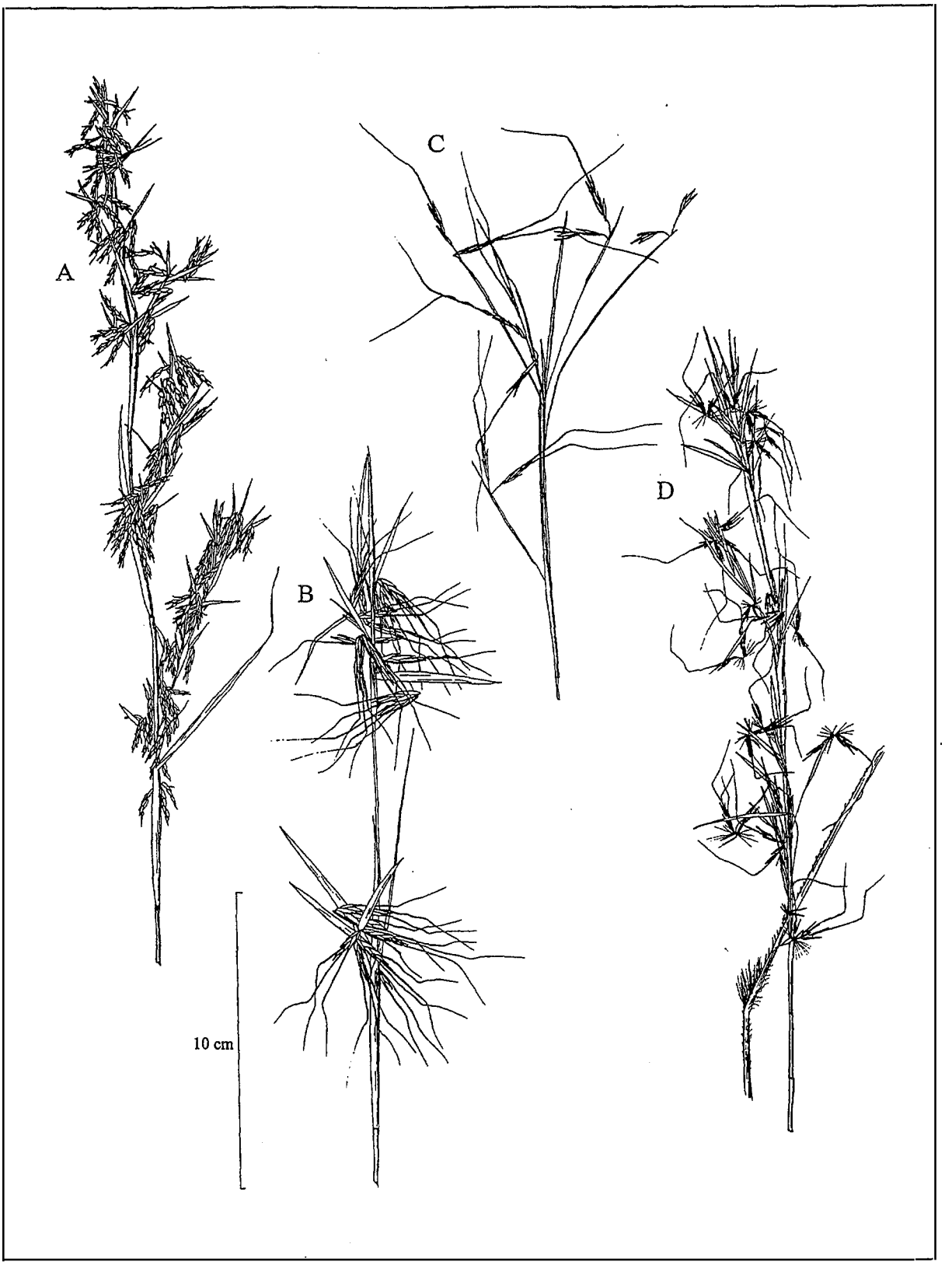

Figure 5. A - *Cymbopogon nardus* var. *confertiflorus*; B - *Hyparrhenia diplandra*; C - *H. filipendula;* D - *H. newtonii*

Description - perennial to 1.5 m tall, with leaf blades to c. 30 cm long, 4-6 (rarely –12) mm wide, hairless to shortly hairy. Leaf sheaths and nodes also hairless to hairy. Ligule a membrane, lacking hairs along the upper margin. Hairless racemes c. 7-10 cm long are produced terminally and in upper leaf axils. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 2.5-3.5 mm long and has 2 florets, only the upper one fertile, and falls entire.

Habitat - grows in open, grassy pine forests.

Uses for livestock - species of *Mnesithea* are generally considered to be of minor forage value.

Other uses - none.

Deleterious properties - none.

Distribution - Thailand, Malay peninsular, Indonesia (Bangka). In Xieng Khouang, occurs in the Pine Tree Zone.

References - Gilliland 1971, as *Coelorhachis cancellata* (p. 269); Lazarides 1980, as *Coelorhachis cancellata* (p. 29); Mannetje and Jones 1992 (p. 240).

Ophiuros exaltatus (Figure 6C)

Vernacular names - nya dii han [ຫຍ້າດີຮ້າງ] (Lao); canegrass (Australia)

Description - perennial with culms to 2.5 m tall, the leaf blades inrolled, becoming flat, up to 60 cm long and 10-15 mm wide. Leaf blades and sheaths hairy along the margins in the specimen collected, although the species typically has hairless leaves. Nodes hairless. Ligule a membrane 0.5-1 mm long, lacking hairs along the upper margin. Inflorescence is a leafy panicle, 10-40 cm long, with terminal and axillary clusters of racemes c. 10 cm long. Spikelets solitary, in two rows, more or less immersed in the rachis, 2.5-5 mm long, each with 2 florets, only the upper one fertile, falling entire.

Habitat Occurs in seasonally wet grasslands on heavier soils and open savanna. Adapted to soils with a high pH.

Uses for livestock - locally considered to be unpalatable to livestock. Elsewhere considered to be moderately palatable when young, although not important as a fodder.

Other uses – in Xieng Khouang, used for the treatment of jaundice.

Deleterious properties - none.

Distribution - occurs from India to northern Australia. In Xieng Khouang, occurs in the Pine Tree Zone, where it can be locally common near to streams.

References - Schmid 1958, as *Rottboellia corymbosa* (p. 193,194); Bor 1960 (p. 199); Lazarides 1980 (p. 61); Tothill and Hacker 1983, as *Ophiuros megaphyllus* (p. 315).

Schizachyrium brevifolium (Figure 6D)

Vernacular names - nya nyung tia [ຫຍ້າຍຸ້ງເຕ້ຍ] (Lao).

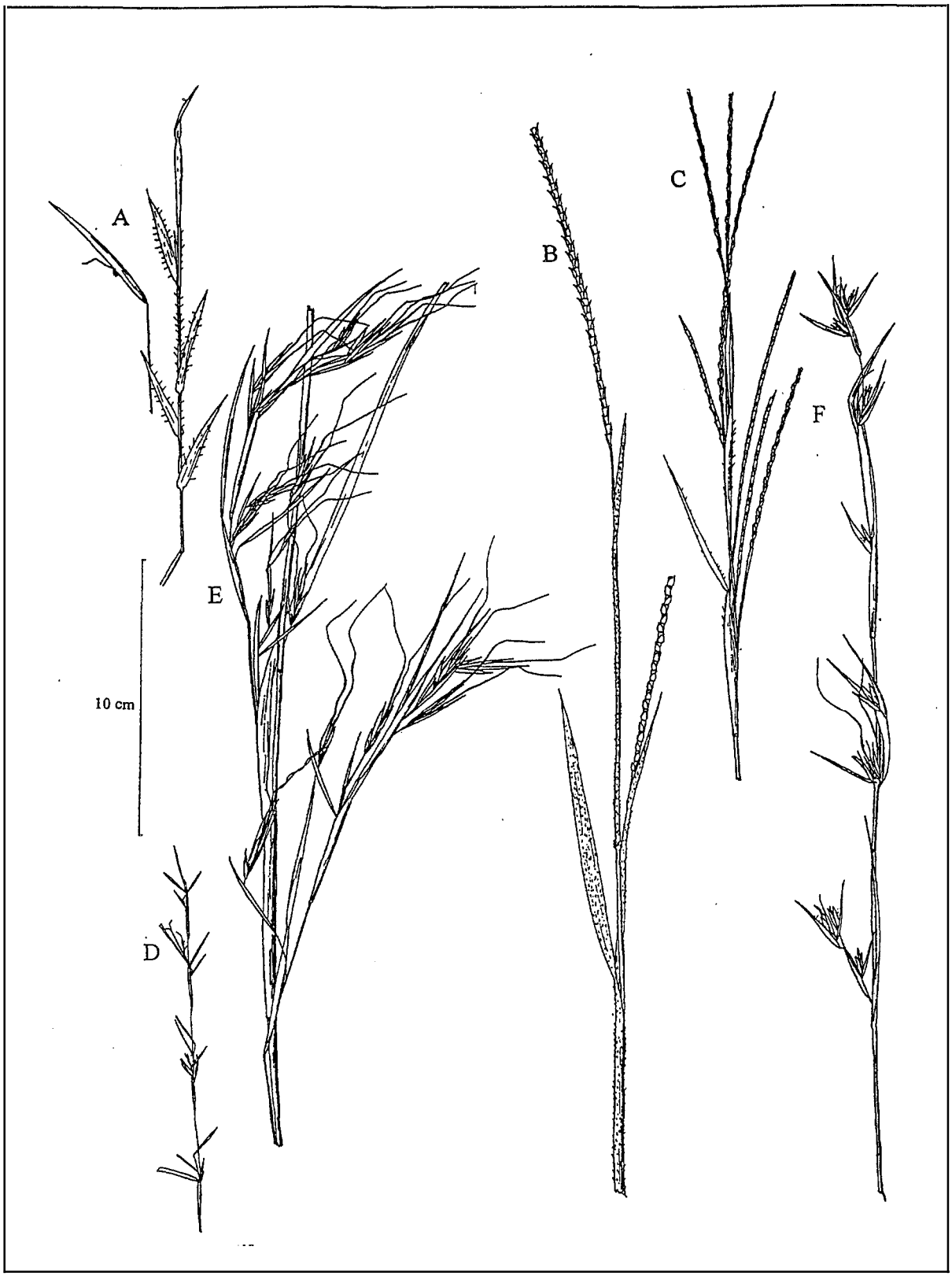

Figure 6. A - *Kerriochloa siamensis*; B - *Mnesithea cancellata*; C - *Ophiuros exaltatus*; D - *Schizachyrium brevifolium*; E - *Themeda arundinacea*; F - *T. triandra*

Description - a very delicate erect, ascending or trailing annual to c. 25 cm tall. Leaf blades up to c. 3 cm long, 4 mm wide, blunt-ended, the blades and sheaths hairless. Ligule a membrane, lacking hairs along the upper margin. Inflorescence is a narrow, leafy panicle, with very delicate terminal and axillary racemes 10-15 mm long. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 2-4 mm long, with 2 florets, only the upper one fertile, usually awned, falling entire.

Habitat - a widespread and common species, indicative of low soil fertility. Occurs in degraded savannas, along tracks and roadsides, and in open sandy or rocky sites in dry forests or grasslands.

Uses for livestock - an unproductive species of little significance as a forage.

Other uses - none.

Deleterious properties - none.

Distribution - South-east Asia, tropical Asia, Africa and America. In Xieng Khouang, occurs as a minor component of *Themeda triandra*-dominant open grasslands in the Pine Tree Zone and on the Plain of Jars.

References - Schmid 1958 (p. 200); Bor 1960 (p. 215); Hô and Du'o'ong, 1960 (p. 662); Gilliland 1971 (p. 291); Lazarides 1980 (p. 69,70); Hacker *et al.* 1996 (p. 14); Mannetje and Jones 1992 (p. 242).

Themeda arundinacea (Figure 6E)

Vernacular names – nya jik jork nyai [ຫຍ້າຈີກຈອກນ້ອຍ] (Lao); co' lô duôi (Vietnam)

Description - robust perennial with culms to 3 m or more tall, the tillers with strongly flattened bases with overlapping sheaths. Leaf blades hairless, up to 50 cm or more long, 6 mm wide. Nodes hairless. Ligule a membrane with minute hairs along the upper margin. Inflorescence is a leafy panicle, 30-60 cm long, with many clusters of bracts and spikelets, with 2-4 geniculate, black-based awns from each cluster, the awns c. 8 cm long. Spikelets in groups, with a sessile fertile spikelet surrounded by sessile and pedicellate sterile spikelets. The sessile spikelet is c. 10 mm long and has 2 florets, only the upper one fertile, and falls entire.

Habitat - a common and widespread species in grasslands and savannas of Indo-China, occurring on a variety of soil types, including infertile soils.

Uses for livestock - young growth is grazed, but plants soon become woody and unattractive to livestock.

Other uses - culms are used for building walls of houses and the leaves are used for pulp for paper-making.

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. Locally abundant to subdominant in some deforested valleys in Xieng Khouang uplands.

References - Schmid 1958 (p. 233); Bor 1960 (p. 250); Hô and Du'o'ng 1960 (p. 669); Gilliland 1971 (p. 301); Lazarides 1980 (p. 76); Hacker *et al.* 1996 (p. 15).

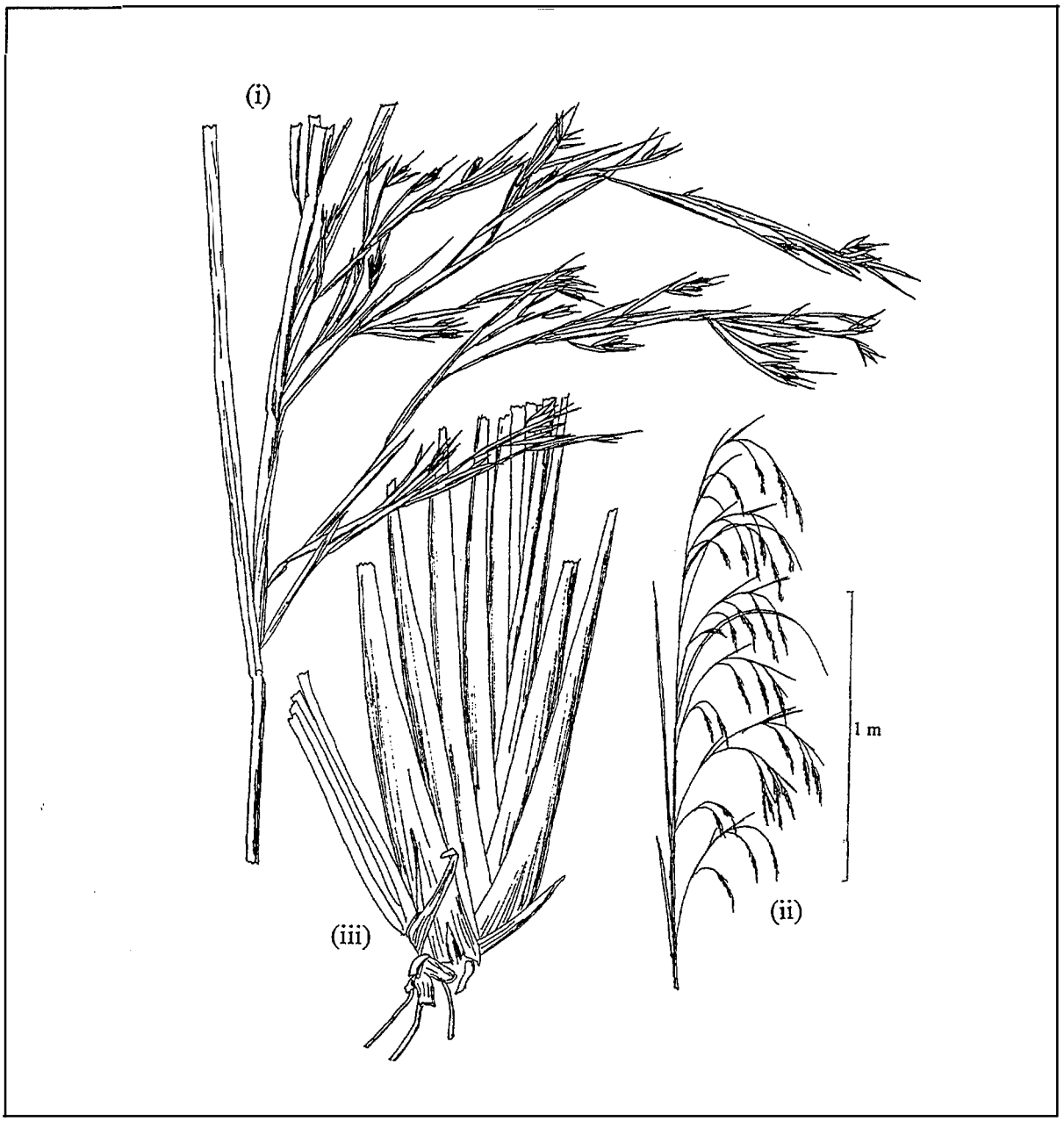

Figure 7. *Themeda intermedia* (i) portion of inflorescence (ii) entire inflorescence (iii) base of culm

Themeda triandra (Figure 6F)

Vernacular names – nya jik jork noi [ຫຍ້າຈິກຈອກນ້ອຍ] (Lao); co' bông cao ru'ng khôp, co' tam hung (Vietnam); kangaroo grass (Australia)

Description – perennial, forming tussocks and in Xieng Khouang with culms mostly to c. 1 m tall. Leaf blades are narrow, c. 5 mm wide, hairless. Ligule a membrane with minute hairs along the upper margin. Inflorescence a leafy panicle 10-30 cm long, with 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. Spikelets in groups, with a sessile fertile spikelet surrounded by 2 pairs of sessile and 1 pair of pedicellate male or sterile spikelets. The sessile spikelet is 6-11 mm long and has 2 florets, only the upper one fertile, and falls entire

Habitat - occurs in savannas and grasslands, generally on lighter soils. Tolerant of some shade, but generally

not adapted to the most degraded or very dry soils. However, in Xieng Khouang, the species is largely restricted to shallow, acid, infertile soils, where it is frequently the dominant species over large areas.

Uses for livestock - a palatable and nutritious grass, especially when young, but may die out if grazed or burnt too frequently. Livestock grazing *T. triandra*-dominant pastures in Xieng Khouang require supplementary phosphorus if they are not to become severely P-deficient (Gibson 1995, 1997).

Other uses - none.

Deleterious properties - none.

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. In Xieng Khouang, it is the dominant grass species over the Plain of Jars and Pine Tree Zone.

References - Schmid 1958 (p. 230-232); Bor 1960 (p. 254); Hô and Du'o'ng 1960, (p. 669); Lazarides 1980 (p. 76); Tothill and Hacker, as *T. australis* 1983 (p. 403); Hacker *et al.* 1996 (p. 15).

Themeda intermedia (Figure 7)

Vernacular names – nya faek fap [ຫຍ້າແຝກຟາບ] (Lao); tao daa [ເຕົ່າດ້າ] (Hmong)

Description - robust perennial with culms to 4 m tall, the tillers strongly flattened at the base (c. 10 cm wide) and with upper leaves to 40 cm long, 6 mm wide. Leaf blades and nodes hairless. Ligule a membrane without hairs along the upper margin. Inflorescence leafy, up to 2 m long, composed of terminal and axillary racemes. Spikelets in groups, with a sessile fertile spikelet surrounded by sessile and pedicellate sterile spikelets. The sessile spikelet has 2 florets, only the upper one fertile, and falls entire. They are 7-9 mm long, dark brown and densely hairy, with straight awns c. 10 mm long.

Habitat - occurs in open situations on acid to neutral soils.

Uses for livestock - locally considered to be palatable to livestock only when young.

Other uses - none.

Deleterious properties - none.

Distribution – Occurs from India to Indonesia, Borneo, Philippines, Moluccas, Papua New Guinea. In Xieng Khouang, it is commonly found in valley areas and other sites protected from grazing in the Plain of Jars and Pine Tree Zone, and cleared hillsides in the Upland Zone.

References - Bor 1960 (p. 251).

Group 2 - Robust grasses >2 m tall, with plumose panicles

Miscanthus floridulus (Figure 8)

Vernacular names - kor kou [ກໍ່ກູ], kor khom bao, [ກໍ່ຄົ້ມບາວ] lao kai noi [ເຄົ້າໄກ່ນ້ອຍ] (Lao); tao tuu suu [ເຕົ່າຕູ້ຊູ] (Hmong)

Description - robust perennial to 2 m or more tall, with solid culms, forming large tussocks. Leaf blades to 1 m long, 14 mm wide, with a prominent white mid-vein. Leaf sheaths hairy along the margins. Ligule a membrane 1-3 mm long, minutely hairy along the upper margin. Inflorescence with unbranched racemes from a short axis. Spikelets paired, similar, 2.5-3.5 mm long, awned, with 2 florets, only the upper one fertile, falling entire from the persistent branches.

Habitat - open situations, forest margins and cleared land once under forest.

Uses for livestock – although elsewhere considered to be of no significance as fodder, in Xieng Khouang reputed to be relished by cattle and buffalo.

Other uses - culms are used for arrow-shafts in Papua New Guinea and for racks for vegetables and tobacco in the Philippines. The Hmong people use it symbolically in clan gatherings to exorcise bad luck.

Deleterious properties - none.

Distribution – widespread in the Malay Peninsular and South-East Asia, Indonesia, Taiwan, Japan, Papua-New Guinea and the Philippines. In Xieng Khouang, common and widespread on cleared hillsides in the Upland Zone and disturbed ground.

References - Gilliland 1971 (p. 217); Lazarides 1980 (p. 58).

Neyraudia arundinacea (Figure 9)

Vernacular names – kor ka nyouan [ກໍ່ກະຍວນ] (Lao); tao lhao [ເຕົ່າເລົ້າ] (Hmong); co' lau, sây-khô (Vietnam).

Description - robust perennial to 5 m tall, with solid culms. Leaf blades 1-1.5 m long, up to 4 cm wide, with sparse hairs on the upper surface, without a distinct white midvein; leaf sheaths hairless. Ligule a fringe of hairs. Inflorescences are large, open panicles to c. 80 cm long, dense and bushy, purplish, the branches in whorls and much branched. Spikelets solitary, similar, 6-9 mm long, with 3-7 fertile florets and upper sterile florets, breaking up at maturity, the tip of each lemma with a short awn.

Habitat - occurs in both dry and humid climates, often on moderately acid soils. Frequently found in areas of shifting cultivation which were previously under forest in the Upland Zone.

Uses for livestock – in Xieng Khouang and elsewhere considered to be palatable when young to cattle, buffalo and horses, but becomes very stemmy with maturity.

Other uses - in Xieng Khouang, the inflorescences are used for making mattresses and the culms are used as supports for thatch for houses. Young shoots are locally cooked as a vegetable.

Deleterious properties - none.

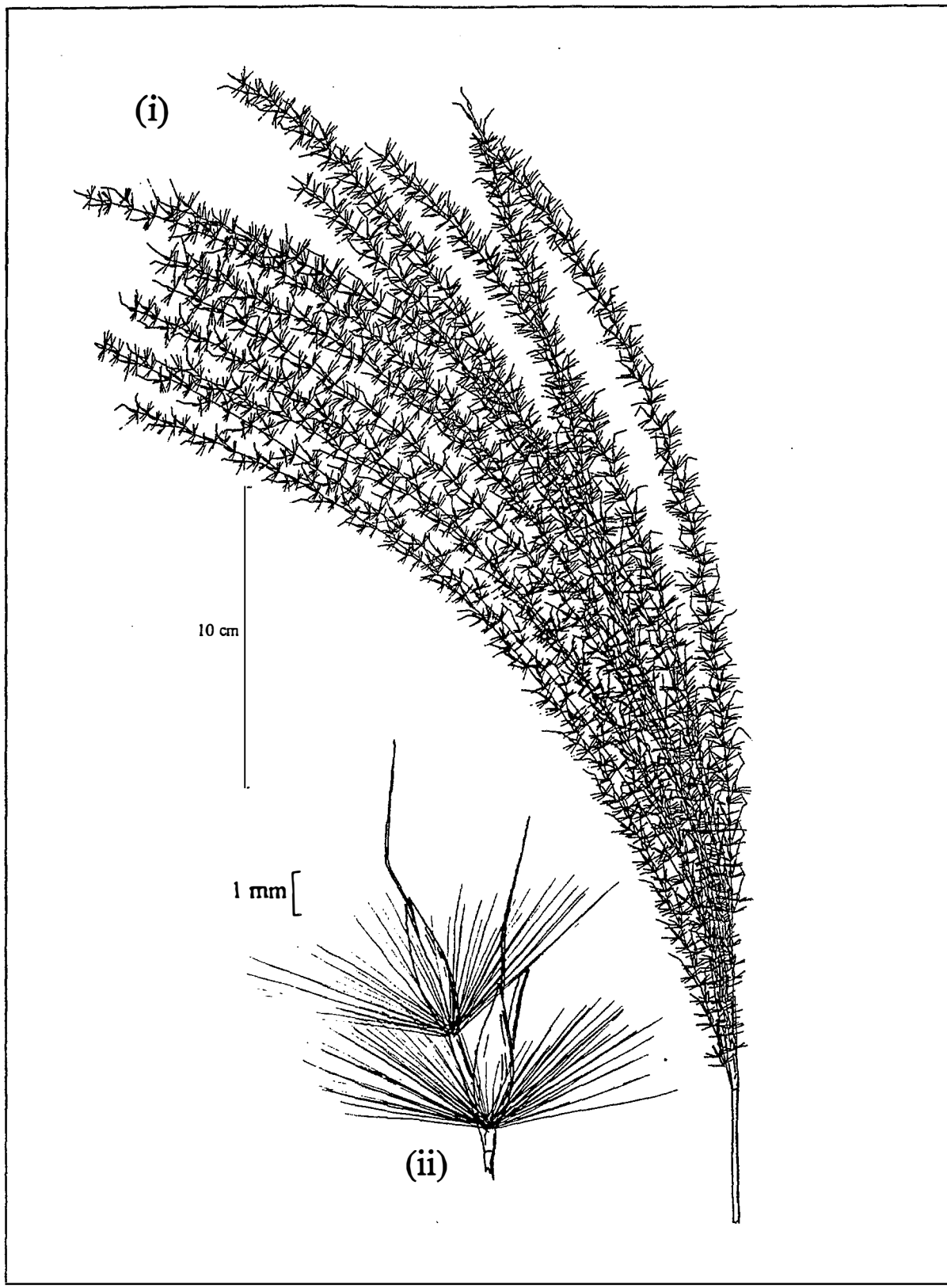

Figure 8. *Miscanthus floridulus* (i) inflorescence; (ii) pair of spikelets

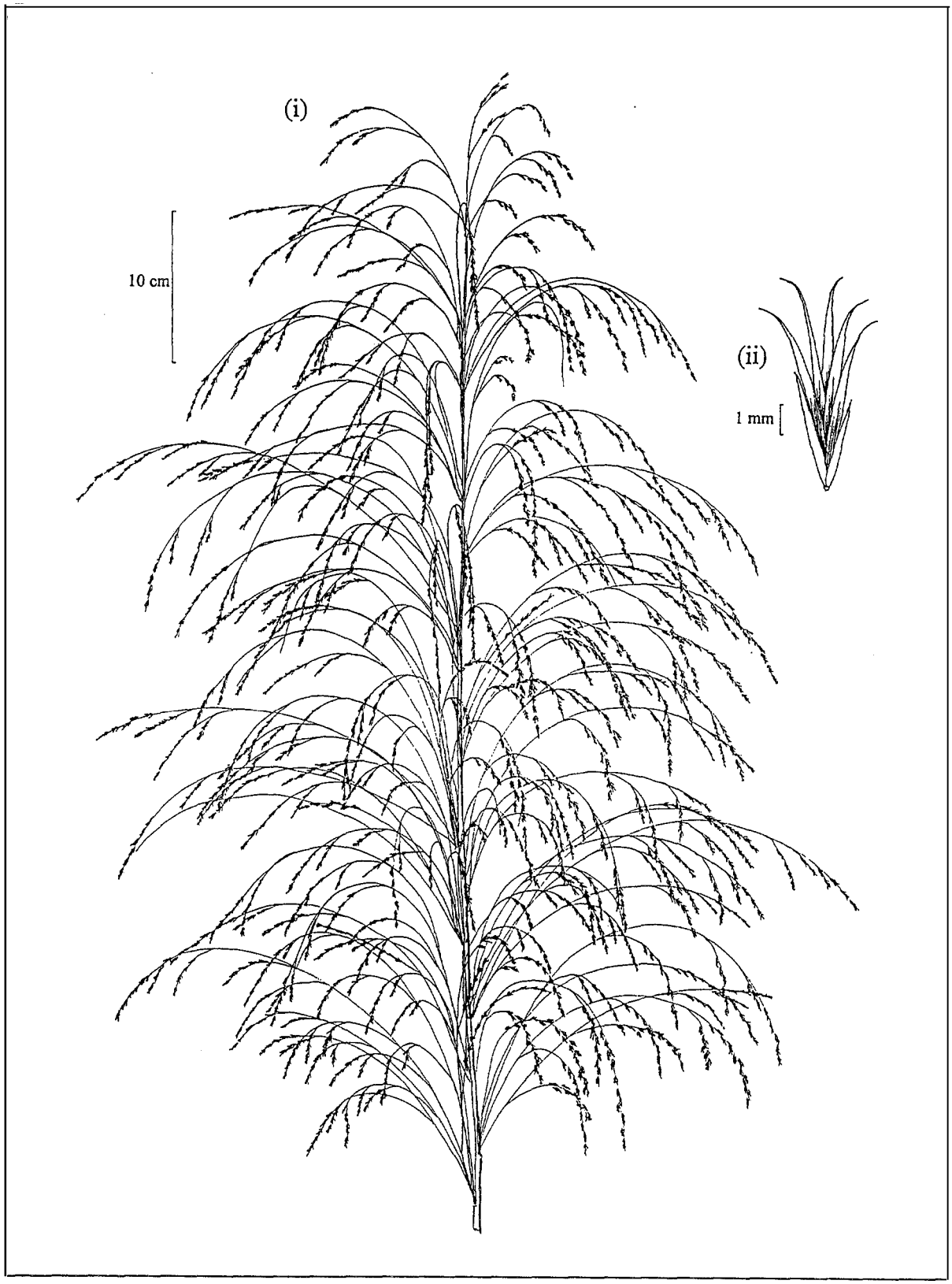

Figure 9. *Neyraudia arundinacea* (i) inflorescence; (ii) spikelet

Distribution – India to China, Malay Peninsular, Indonesia. Another variety of the same species occurs in tropical Africa. In Xieng Khouang frequently found on steep, previously forested hillsides in association with *Imperata cylindrica* and *Miscanthus floridulus*.

References - Schmid 1958, as *Arundo madagascariensis* (p. 490); Bor 1960 (p. 518); Lazarides 1980 (p. 178).

Phragmites karka (Figure 10)

Vernacular names - nya or [ຫຍ້າອີ້] (Lao); loh kor [ฉ่ำก่ำ] (Hmong); sây (Vietnam).

Description - perennial to 4 m tall, with hollow culms and long rhizomes. Leaf blades and sheaths hairless. Blades to 60 cm long, 10-30 mm wide. Ligule a very short membrane with long hairs along the upper margin. Inflorescence a bushy, open panicle up to 75 cm long, the spikelets solitary, similar, 10-12 mm long excluding the short awns, with 4-6 florets, all except the uppermost ones fertile,. Lemmas are hairless, the joints between the florets hairy.

Habitat - grows close to rivers and streams.

Uses for livestock – generally this species is considered not to be very palatable to livestock, but in Xieng Khouang it is considered to be very palatable when young, especially to buffalos..

Other uses - Elsewhere it is used for paper-pulp and the split culms are woven into matting for lining huts. It is also used for making baskets, chairs, fences, fishtraps, brooms, arrow shafts, musical instruments and thatch.

Deleterious properties - none

Distribution - South-east and tropical Asia, Polynesia, tropical Australia and Africa. Widespread up to 1800 m altitude throughout Indo-China.

References - Schmid 1958 (p. 492); Bor 1960 (p.416); Gilliland 1971 (p. 49); Lazarides 1980 (p. 152); Mannetje and Jones 1992 (p. 251).

Saccharum spontaneum (Figure 11)

Vernacular names – kor lao xang [ກໍເຜິ້ງຊ້າງ], kor lao phong [ກໍເຜິ້ງພົ້ງ] (Lao); tao suer [ເຕົ່າຊື] (Hmong); co' lách, lau (Vietnam).

Description - robust rhizomatous perennial with solid culms to 6 m tall, 1.5 cm thick, forming strong tussocks, and with erect leaf blades to 2 m long, 5 cm wide, with a distinct white mid-vein. Leaf blades are hairless, but rough along the margins. Ligule a membrane with minute hairs along the upper margin. Inflorescences are bushy panicles up to 80 cm long, with extensive secondary branching, the main axis densely hairy. Spikelets in pairs, similar, 3-7 mm long, each with 2 florets, only the upper one fertile, falling entire.

Habitat - Tolerant of a wide range of soils, but prefers a high rainfall. Not tolerant of flooding for long periods.

Uses for livestock – in Xieng Khouang and elsewhere this species is considered to be very palatable to livestock when young. Needs to be cut at frequent intervals to provide leafy forage.

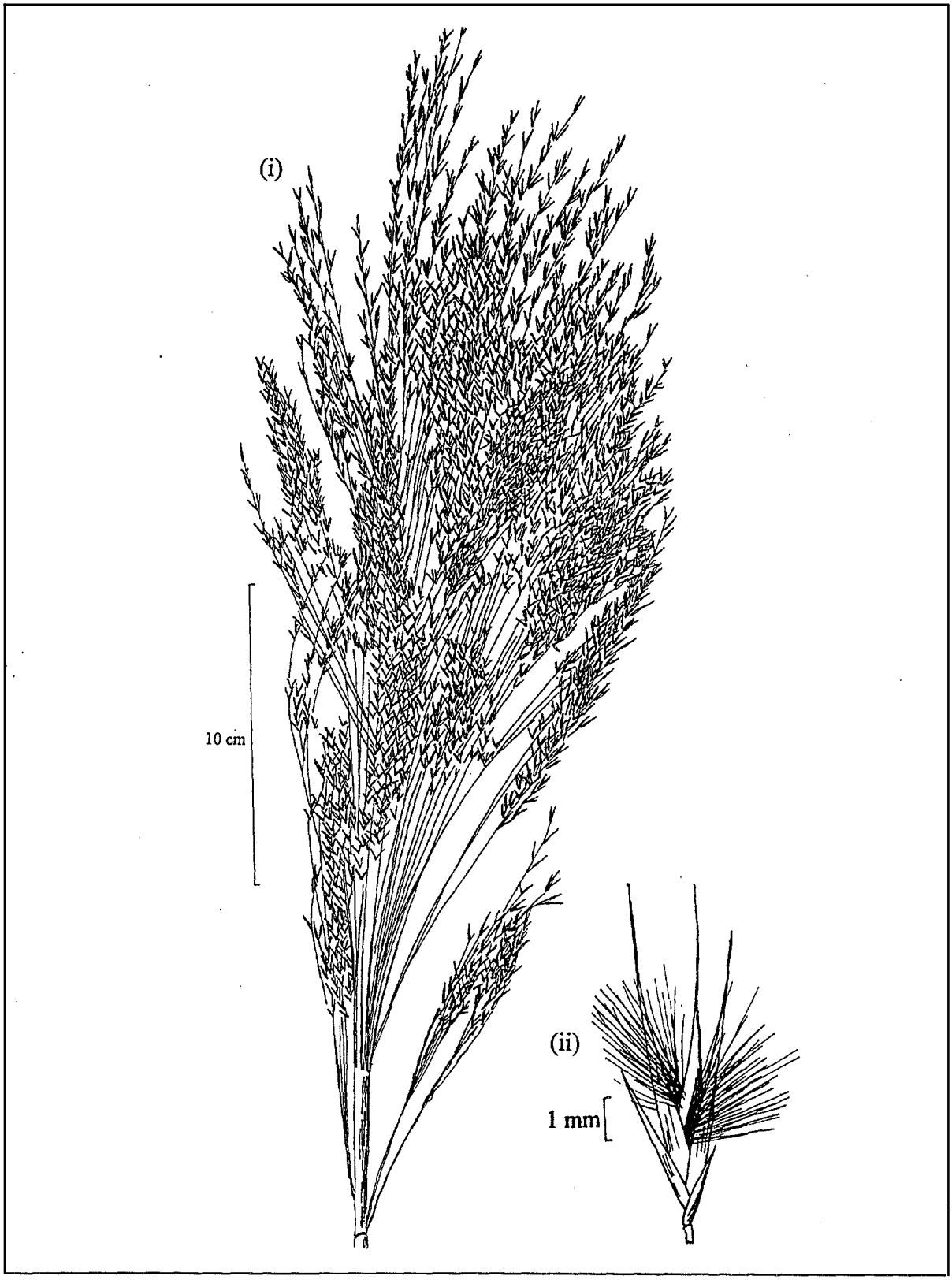

Figure 10. *Phragmites karka* (i) inflorescence: (ii) spikelet

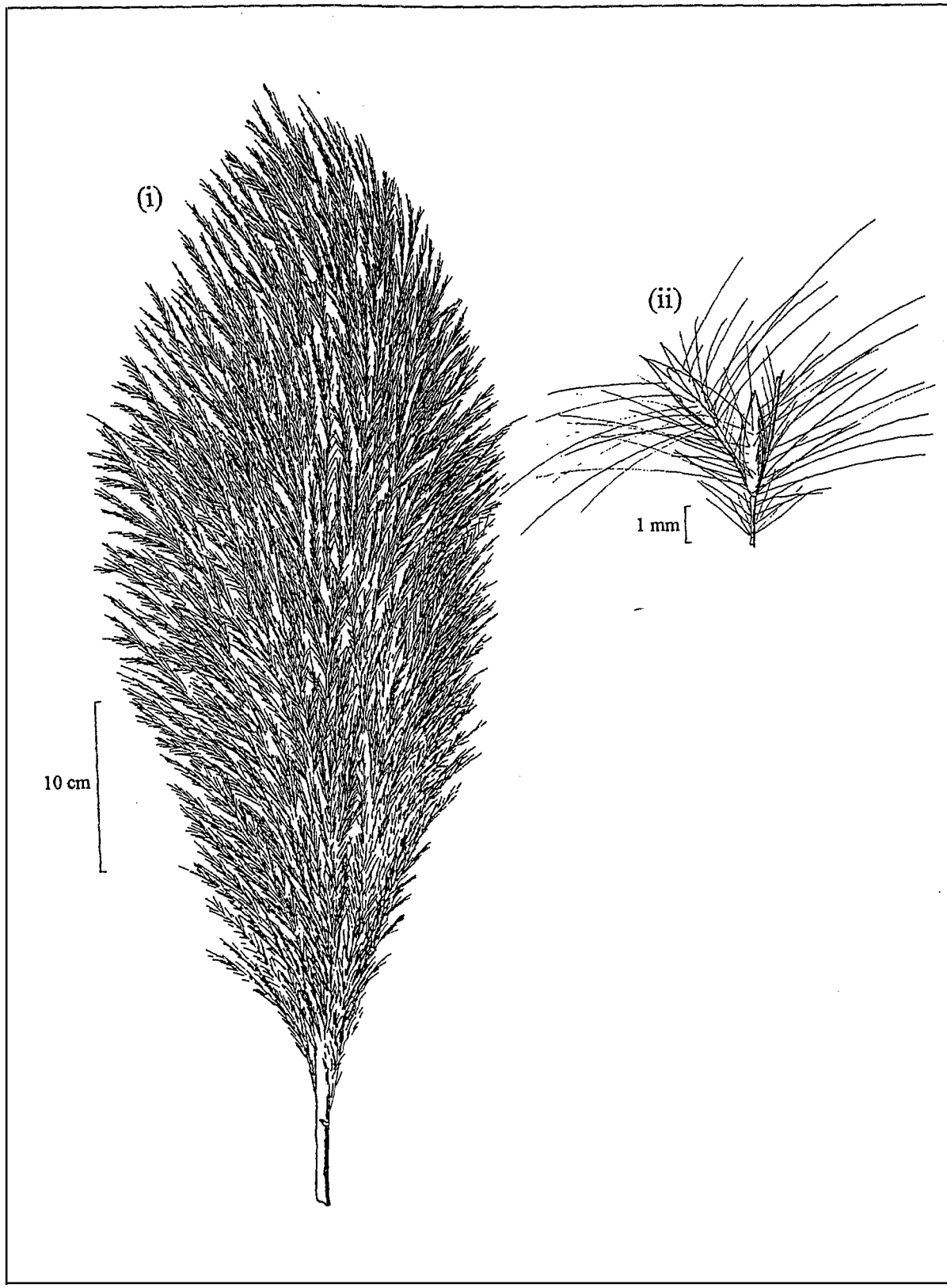

Figure 11. *Saccharum spontaneum* (i) inflorescence; (ii) pair of spikelets

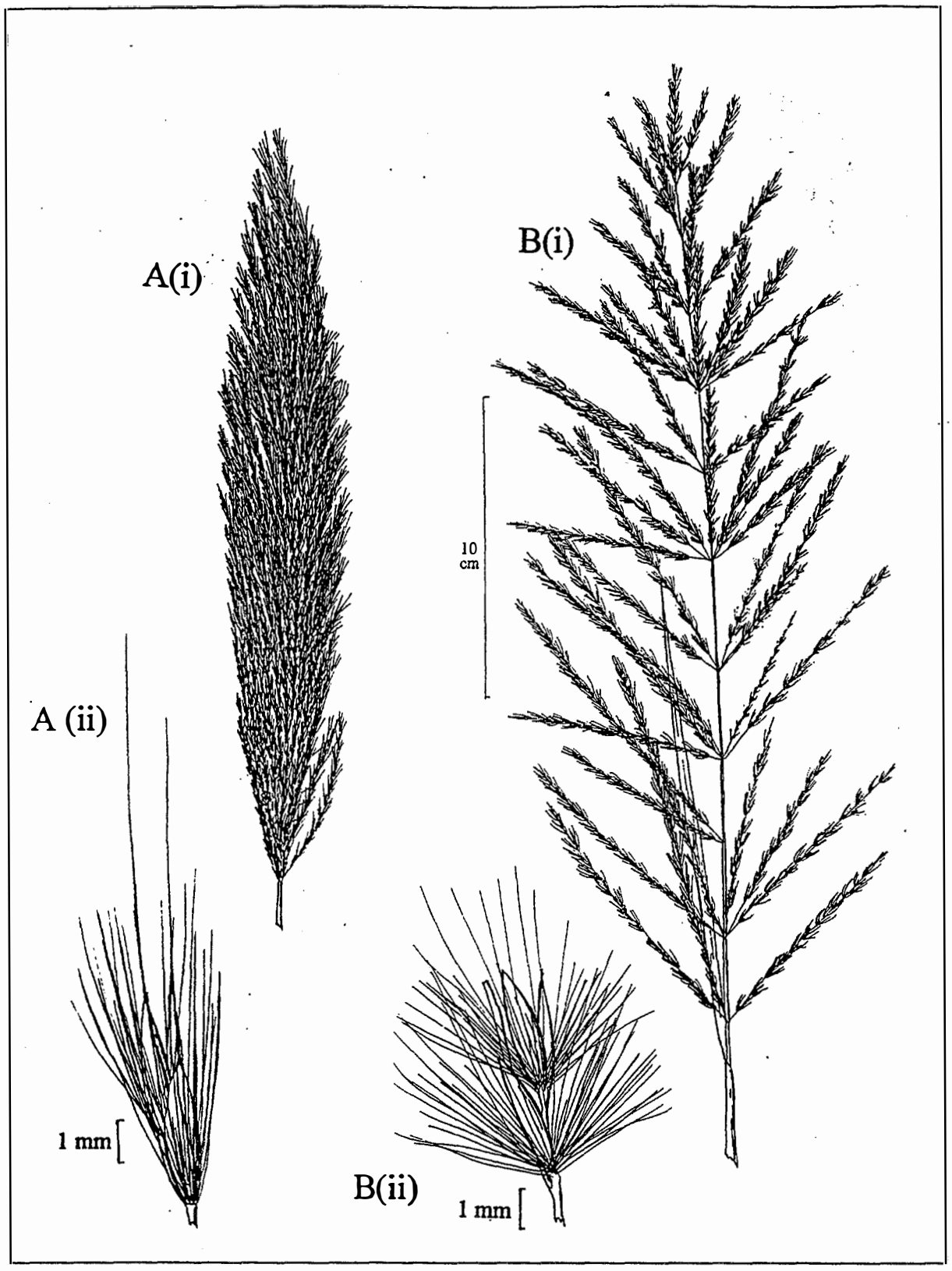

Figure 12. A - *Saccharum* sp. JBH1420; A(i) young inflorescence; A(ii) pair of spikelets; B - *Saccharum* sp. JBH 1476 B(i) inflorescence; B(ii) pair of spikelets

Other uses - the inflorescences are locally used for making mattresses. Plants can be used for making paper pulp and the leaves are used as a thatching material. *S. spontaneum* is also grown for erosion control and as an ornamental.

Deleterious properties - occurs as a serious weed in settled areas and in plantations.

Distribution - throughout South-east Asia and the Old World tropics. Frequently found on cleared hillsides in the Upland Zone of Xieng Khouang, together with *Miscanthus floridulus* and *Neyraudia arundinacea*.

References - Schmid 1958 (p. 156-158); Bor 1960 (p. 214); Gilliland 1971 (p. 224); Lazarides 1980 (p. 68,69), Mannetje and Jones 1992 (p. 195).

***Saccharum* sp.** JBH1420 (Figure 12A)

Vernacular names – kor khaem van [ກ໋ແຂມຫວານ] (Lao); tao kaar yi [ເຕົ່າກ້າຍີ] (Hmong)

Description - leafy perennial to c. 3 m tall. Upper leaf blades to c. 40 cm long, 25 mm wide, the blades and sheaths hairless. Inflorescence dense, with secondary branching. Spikelets similar, in pairs, c. 4 mm long, awned.

Habitat - occurs in the Upland Zone in Xieng Khouang, in grasslands dominated by *Imperata cylindrica*.

Uses for livestock - locally considered to be very palatable at all times before flowering

Other uses - none.

Deleterious properties - none.

***Saccharum* sp.** JBH1476 (Figure 12B)

Vernacular names - nya oi nou [ຫຍ້າອ້ອຍໜູ] (Lao)

Description - leafy perennial to c. 3.5 m tall, the stem bases sweet to taste. Leaf blades up to 1 m long, 15 mm wide, very rough, and with a prominent white midrib, both blades and sheaths hairless. Nodes indistinctly hairy. Inflorescence rather open, c. 30 cm long, with unbranched racemes from a long axis. Spikelets similar, in pairs, c. 3.5 mm long.

Habitat - widespread in moist situations in the Pine Tree Zone of Xieng Khouang.

Uses for livestock – locally used as a cut-and-carry forage for buffaloes, at the pre-flowering stage of growth. Children like to chew the sweet stems.

Other uses - none.

Deleterious properties - none.

Distribution - widespread in Xieng Khouang in moist situations in the Pine Tree Zone and Upland Zone.

***Saccharum* sp.** JBH1516 (Figure 13)

Vernacular names – lao khao [ເລົ້າຂາວ] (Lao); tao der [ເຕົ່າເດ] (Hmong)

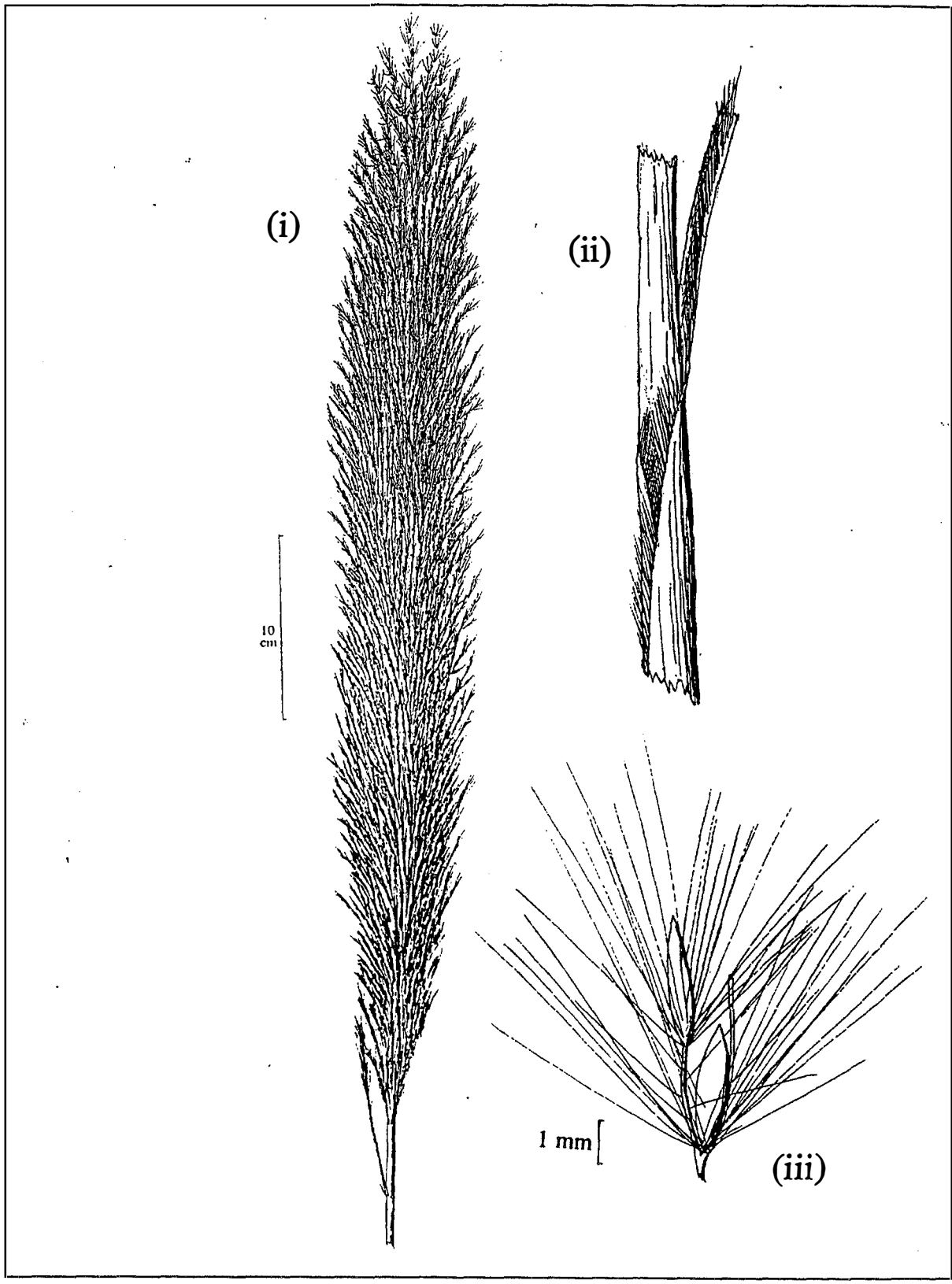

Figure 13. *Saccharum* sp. JBH1516; (i) inflorescence; (ii) junction of leaf sheath and blade; (iii) pair of spikelets

Description - leafy perennial to c. 2 m tall, the leaf blades c. 30 mm wide, narrower than those of *Saccharum spontaneum*, up to c. 1 m long, with a prominent white midrib, which is densely covered with long silky hairs close to the junction with the leaf sheath. Inflorescence up to c. 60 cm long, dense, with secondary branching. Spikelets similar, in pairs, c. 3 mm long, densely covered with long silky hairs.

Habitat – grows on hillsides in the Upland Zone of Xieng Khouang.

Uses for livestock – locally considered to be palatable to cows and buffalo, a cut-and-carry forage

Other uses – inflorescences are used for making mattresses.

Deleterious properties - none.

Group 3 - Grasses with spike-like inflorescences

Imperata cylindrica (not illustrated)

Vernacular names – nya kha [ຫຍ້າຄາ] (Lao); keng [ເກ້ງ] (Hmong); sbeou (Cambodia); co' tranh (Vietnam); blady grass (Australia).

Description - strongly rhizomatous perennial to 1.8 m tall, with long, erect leaves. Ligule a membrane with minute hairs along the upper margin. Inflorescence a narrow spike-like panicle, the spikelets in pairs, small and covered with long, silky, white hairs, enabling them to be carried long distances in the wind. Spikelets 2.2-6 mm long , with 2 florets, only the upper one fertile. 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.

Habitat - adapted to a wide range of soil types, but generally favours lighter soils. In Indo-China occurs up to an altitude of 2,000 m, in moderately to very humid districts. Characteristically a species of full sunlight, frequently dominating hillsides that have been cleared from primary or secondary forest. Tolerant of fire and cultivation.

Uses for livestock - grazed when young, but becomes unpalatable as it matures. In many parts of South-east Asia, burning is practised to maintain palatable herbage. In the Xieng Khouang Upland Zone, overgrazing may result in disappearence of *I. cylindrica* and replacement with unpalatable shrubs.

Other uses - a good species for thatching and can be made into paper. Reputed in the Philippines to have medicinal properties. In Xieng Khouang roots (rhizomes?) are used in the treatment of kidney pains.

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 results in dominant stands of this species.

Distribution - south and South-east Asia, east and southern Africa, tropical and subtropical Australia. In Xieng Khouang, a characteristic species of the Upland Zone.

References - Schmid 1958 (p. 153,154); Bor 1960 (p. 169); Gilliland 1971 (p. 220); Lazarides 1980 (p. 49,50); Tothill and Hacker 1983 (p. 279); Mannetje and Jones 1992 (p. 140); Hacker *et al.* 1996 (p. 20).

Sacciolepis indica (Figure 14A)

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, hairless. Nodes hairless. Ligule a membrane 0.5 mm long. Inflorescence is a dense spike-like panicle 1-15 cm long. Spikelets solitary, all similar, 2.5-3 mm long, with 2 florets, only the upper one fertile, falling entire. The species is quite similar to *Setaria parviflora*, but the inflorescence does not have the prominent bristles that are characteristic of *Setaria* spp.

Habitat - adapted to a wide range of habitats, from rice fields and garden cultivation to grassland, savanna and marshes, but more commonly found on moderately infertile soils.

Uses for livestock - considered to be a good forage plant, but generally not a very productive species. In some regions of Indo-China, reported to grow as a low and dense grassland.

Other uses - none.

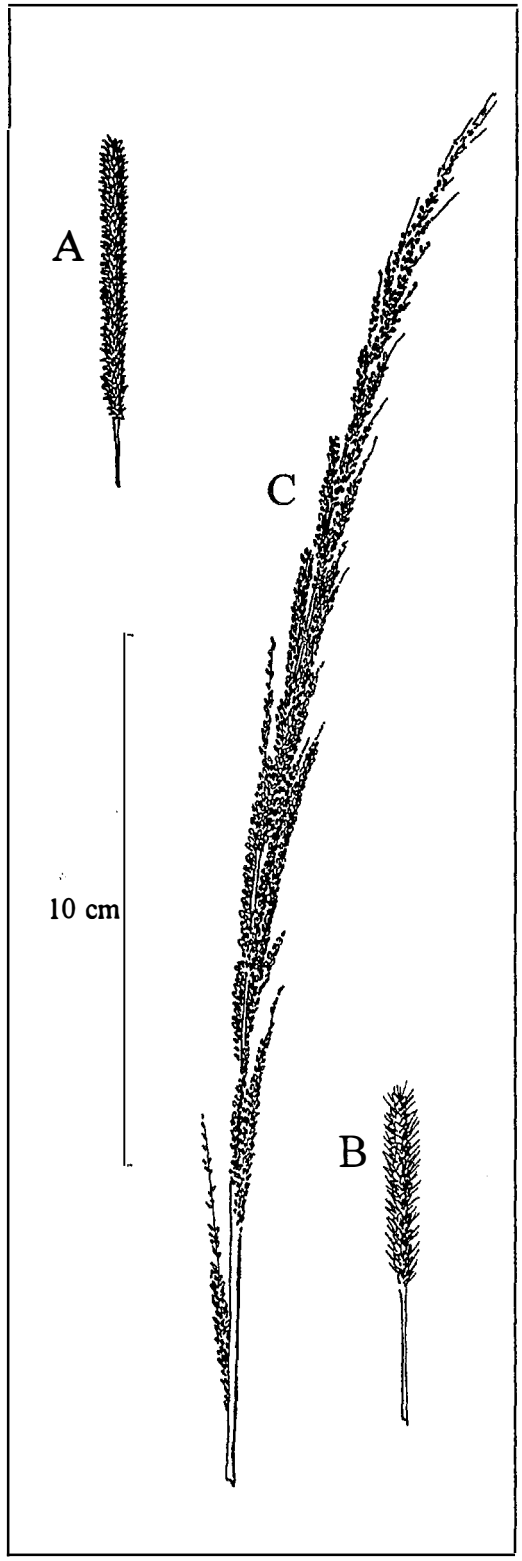

Figure 14. A - *Sacciolepis indica*; B - *Setaria parviflora*; C - *Sporobolus indicus* var *major*

Deleterious properties - none.

Distribution - south and South-east Asia, Polynesia, northern Australia; introduced to Africa and America. Commonly found as a minor component of grasslands on the Plain of Jars, cleared areas of the Pine Tree Zone and the Upland Zone.

References - Schmid 1958 (p. 348-350); Bor 1960 (p. 357); Hô and Du'o'ng 1960 (p. 674); Gilliland 1971 (p. 152); Lazarides 1980 (p. 139,140); Tothill and Hacker 1983 (p. 367); Mannetje and Jones 1992 (p. 242); Hacker *et al.* 1996 (p. 21).

Setaria parviflora (Figure 14B)

Vernacular names - Queensland pigeon grass (Australia); knotroot bristlegrass; foxtail.

Description - annual to 60 cm tall, with tillers flattened at the base. Leaf blades are up to 30 cm long, 8 mm wide, hairless. Ligule a fringe of hairs 0.4-1.2 mm long. Inflorescence a spike-like panicle up to 12 cm long, the spikelets are solitary, all similar, and are almost obscured by spreading brownish or purplish bristles up to 10 mm long, which remain attached to the inflorescence after the spikelets have fallen. Spikelets 2.2-2.8 mm long, with 2 florets, only the upper one fertile, falling entire The species was previously known as *S. pallide-fusca.*

Habitat - widespread as a constituent of grasslands and savannas, generally in well lit situations. Frequently found where the soil has been disturbed (*e.g.* roadsides).

Uses for livestock - generally not a productive species, although where it occurs as a significant component of the pasture, reported to be a good pasture species when young.

Other uses - none.

Deleterious properties - a significant weed in cultivation.

Distribution – pan-tropical. In Xieng Khouang commonly found as a minor component of grasslands on the Plain of Jars, cleared areas of the Pine Tree Zone and grazing lands in the Upland Zone.

References - Bor 1960, as *S. pallide-fusca* (p. 363); Gilliland 1971, as *S. pallide-fusca* (p. 159); Lazarides 1980 as *S. pallide-fusca* (p. 141,142); Tothill and Hacker, as *S. pallidefusca* 1983 (p. 376); Hacker *et al.* 1996 (p. 23).

Sporobolus indicus* var. *major (Figure 14C)

Vernacular names - nya na phak kwai [ຫຍ້າຫນ້າຜາກຄວາຍ] (Lao); nyor sa pau [ຫຍໍ້ຊ້າເປົາ](Hmong)

Description - perennial to 70 cm tall, forming dense tussocks. Leaf blades, sheaths and nodes hairless, the blades to 45 cm long, 5 mm wide. Ligule a fringe of hairs. Inflorescence a narrow panicle to 35 cm long, often infected by a black smut. Spikelets solitary, all similar, 1.8-1.9 mm long, with a single fertile floret. Fruits are expelled when ripe.

Habitat - Adapted to fertile, and stony, infertile soils. Frequently found in over-grazed short grassland.

Uses for livestock -not palatable to livestock.

Other uses - reported to have some use for fibre.

Deleterious properties - unpalatable and tends to become a major component of overgrazed pastures.

Distribution - South-east Asia, Malay Peninsular, Indonesia, India, Burma, Sri Lanka, China, Japan, Australia. In Xieng Khouang frequently found in areas of short, heavily grazed grassland.

References - Schmid 1958 (p.486,488); Bor 1960 (p. 630); Hô and Du'o'ng 1960 (p. 686); Gilliland 1971, as *S. fertilis* (p. 106); Lazarides 1980, as *S. fertilis* (p. 190,191); Tothill and Hacker 1983 (p. 389); Baaijens and Veldkamp 1991 (p. 437); Mannetje and Jones 1992 (p. 253);.

Group 4 - Grasses with open panicles; spikelets without awns, not crowded along panicle branches

Centotheca lappacea (Figure 15A)
Vernacular names - co' móc (Vietnam)

Description - perennial to 60 cm or more tall, with leaf blades to 20 cm long, 30 mm wide. Blades, sheaths and nodes hairless. Ligule a membrane 2-3 mm long, lacking hairs along the upper margin. Inflorescence an open panicle up to 25 cm long, 10 cm wide, with spikelets arranged more or less alternately on either side of the branches. Spikelets solitary, all similar, 4-8 mm long, with 2-4 florets, all fertile or with the uppermost sterile, the spikelets falling entire. The florets have distinctive backwards-pointing bristles.

Habitat - prefers moist and shady places.

Uses for livestock - a moderately palatable forage, which may be grazed or used for cut-and-carry.

Other uses - none.

Deleterious properties - the backwards-pointing bristles enable the spikelets to attach to fur of passing animals which distribute the seed to other sites. *C. lappacea* is considered to be a minor weed of cultivation, including coconut plantations.

Distribution - south and South-east Asia, West and tropical Africa, Polynesia, and northern Australia. Not common in Xieng Khouang, where it occurs in moist situation (roadside ditches) in the Pine Tree Zone.

References - Schmid 1958 (p. 507); Hô and Du'o'ng 1960 (p. 680); Bor 1960 (p. 457); Gilliland 1971 (p. 53); Lazarides 1980 (p. 153,154); Mannetje and Jones 1992, as *C. latifolia* (p. 79), Hacker *et al.* 1996 (p. 23).

Cyrtococcum accrescens (Figure 15B)
Description - stoloniferous grass to 1 m tall, with crowded leaves to 25 cm long, 20 mm wide, the leaf blades with long hairs on both surfaces and sheaths also hairy. Nodes hairless. Ligule a membrane, lacking hairs along the upper margin. Inflorescence a large, open panicle to 50 cm long,, 30 cm wide. Spikelets solitary, similar, laterally flattened, 1.3-1.5 mm long, with 2 florets, only the upper one fertile, falling entire. The genus is distinguished from *Panicum* in having laterally flattened spikelets rather than dorsi-ventrally flattened spikelets

Habitat - occurs in shady, moist places in primary and secondary forests, especially along roadsides, and in areas of disturbance.

Uses for livestock - considered to be of some value as a forage, in shady sites.

Other uses - recorded as being an "auxilliary plant in agriculture and forestry".

Deleterious properties - a minor weed on the edges of rice fields and in plantations.

Distribution - South-east Asia, China, Japan, India, Sri Lanka. In Xieng Khouang, occurs in the Upland Zone.

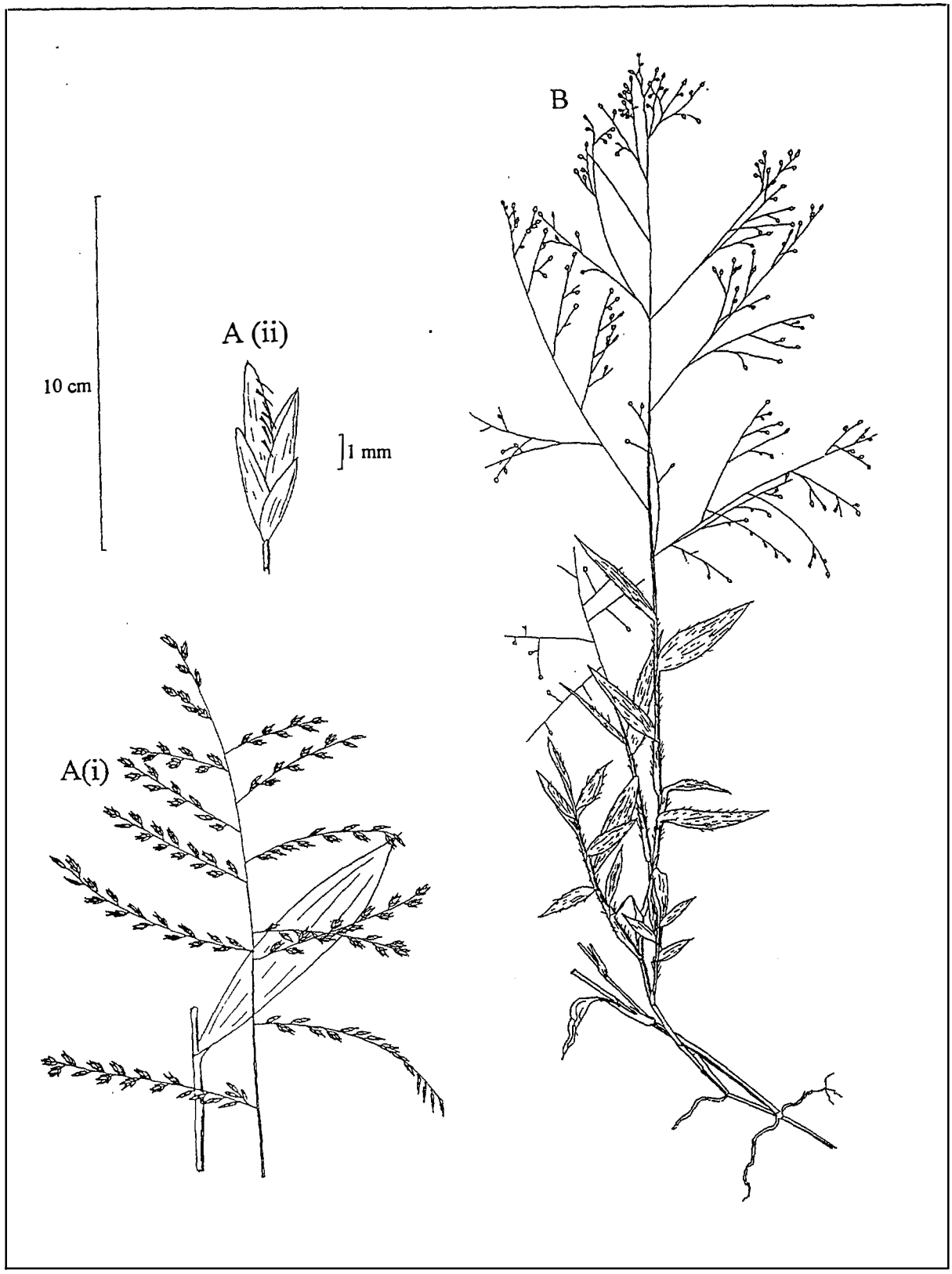

Figure 15. A(i) - *Centotheca lappacea* inflorescence, A(ii) spikelet; B - *Cyrtococcum accrescens*

References - Bor 1960 (p. 291); Lazarides 1980 (p.111,112); Gilliland 1971 (p. 149); Mannetje and Jones 1992 (p. 248).

Eragrostis atrovirens (Figure 16A)
Description - perennial with culms to 1.2 m tall, usually shorter in Xieng Khouang. Leaf blades 10-20 cm long, inrolled when dry. Ligule a fringe of hairs. Inflorescence a more or less open panicle up to 20 cm long and 9 cm wide. Spikelets solitary, all similar, 3-20 mm long and up to 2.5 mm wide, with 6-12 florets (recorded with up to 50 florets elsewhere). All florets except the terminal ones are fertile; the spikelets, break up from below upwards and the paleas fall early.

Habitat - grasslands and waste places.

Uses for livestock - a significant part of available fodder in waste places in the Indian plains. In Xieng Khouang grasslands, only a minor and insignificant component of herbage on offer. This species is unlikely to be of high forage value, although it has been described as "an important fodder grass" (Lazarides 1980). The genus *Eragrostis* includes a large number of rather similar species, which are difficult to distinguish; in South-east Asia they generally have little significance as fodder plants.

Other uses - none.

Deleterious properties - none

Distribution - South-east Asia, Taiwan, Japan, India, Peninsular Malaysia, Indonesia and Africa; introduced in northern Australia. In Xieng Khouang *E. atrovirens* is the most frequently encountered species of the genus and is commonly found as a minor component of herbage in the Upland Zone, the Pine Tree Zone and the Plain of Jars.

References - Bor 1960 (p. 503); Gilliland 1971 (p. 68); Lazarides 1980 (p. 173), Mannetje and Jones 1992 (p. 238).

Eragrostis brownii (Figure 16B)
Vernacular names - cò bong dài (Vietnam); Brown's lovegrass (Australia)

Description – a grass to 1.1 m tall, moderately leafy at the base. Leaf blades are up to 25 cm long, 2-3 mm wide, and are hairless. Nodes hairless. Ligule a fringe of hairs. Inflorescence a panicle c. 20 cm long, with spikelets to 12 mm long clustered along the primary branches, each shortly stalked. Spikelets solitary, all similar, with up to c. 25 florets; all florets except the terminal ones are fertile. They break up from below upwards, the paleas persisting for a long time.

Habitat - a widely adapted species, but only a minor component of herbaceous vegetation in grasslands and savannas.

Uses for livestock - of no grazing significance.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, Thailand, Indonesia, Papua-New Guinea, Australia. In Xieng Khouang, found on the Plain of Jars and also in the Pine Tree Zone.

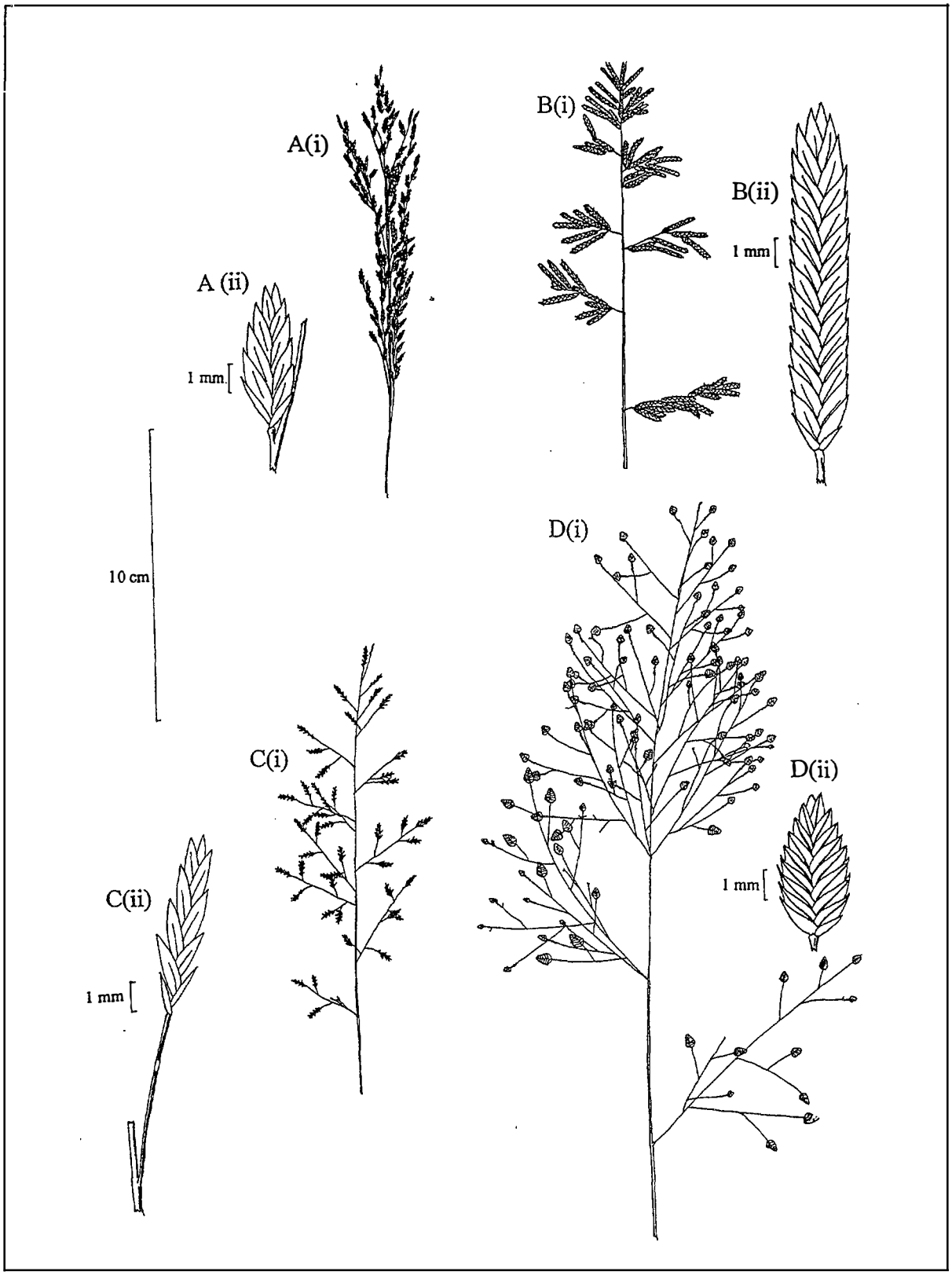

Figure 16 A(i), A(ii) - *Eragrostis atrovirens;* B(i), B(ii) - *E. brownii;* C(i), C(ii) - *E. ferruginea;* D(i), D(ii) - *E. unioloides.* For all species, (i) is inflorescence, (ii) spikelet

References - Lazarides 1980 (p. 173); Tothill and Hacker 1982 (p.232); Hacker *et al.* (p. 25); Mannetje and Jones 1992 (p. 238).

Eragrostis ferruginea (Figure 16C)
Description - perennial 40-80 cm tall. Ligule a fringe of hairs. Inflorescence a panicle up to 25 cm long, 8 cm wide. Spikelets solitary and similar, and borne on stalks which have a minute glandular band. They are purplish olive-green in colour, 6-10 mm long, 1.5 mm wide, and all florets except the terminal ones are fertile. Spikelets break up at maturity.

Habitat - in tropical regions more commonly found at higher altitudes

Uses for livestock - of no significance for livestock.

Other uses - none.

Deleterious properties - none.

Distribution - South-east Asia, China, India, Japan. In Xieng Khouang, occurs in the Upland Zone, close to streams.

References - Schmid 1958 (p. 500, 503); Bor 1960 (p. 508); Hô and Du'o'ng 1960 (p. 676); Lazarides 1980 (p. 174).

Eragrostis unioloides (Figure 16D)
Vernacular names - nya khouak phou [ຫຍ້າຂວກພູ] (Lao); co' bóng do', xuân tha'o do' (Vietnam)

Description - annual or perennial, sometimes with stolons, and with numerous culms to 80 cm tall. Leaf blades 2-20 cm long, 2-8 mm wide, hairless. Leaf sheaths and nodes hairless. Ligule a fringe of hairs. Inflorescence an open panicle up to 20 cm long. Spikelets solitary, pink, oval, 4-12 mm long, with 8-60 florets which shed progressively from the base of the spikelet as they mature. All florets except the terminal ones are fertile.

Habitat - occurs in a wide range of situations, from roadsides and old cultivation to marshy areas and over-grazed savanna, and from low to high altitudes. Often an indicator of impoverished or degraded soils.

Uses for livestock – in Thailand, whole plants are pulled up and fed to cattle. Where it occurs in abundance in paddy fields, it is grazed, although it does not withstand repeated grazing. Of little significance as a forage for livestock.

Other uses - in Malaysia, considered to be useful as a natural green manure in paddy fields.

Deleterious properties - none.

Distribution – probably originally from South-East Asia, now pan-tropical. In Xieng Khouang, occurs on the Plain of Jars and Pine Tree Zone.

References - Schmid 1958 (p.497, 502); Bor 1960 (p. 515); Hô and Du'o'ng 1960 (p. 676); Gilliland 1971 (p. 66); Lazarides 1980 (p. 176); Tothill and Hacker 1983 (p. 231); Mannetje and Jones 1992 (p. 128).

Isachne ?albens (not illustrated)
Description - erect tufted perennial 0.5-1 m tall, sometimes with ascending or scrambling culms. Leaf blades 5-30 cm long, c. 15 mm wide. Sheaths hairless, blades hairless or hairy. Ligule a fringe of hairs. Inflorescence a very open panicle 10-40 cm long. Spikelets solitary, similar, 1-1.5 mm long, with 2 fertile, white florets, breaking up at maturity.

Habitat – most commonly occurs in open, moist sites in medium to high altitudes, often near streams and in association with primary or secondary forest.

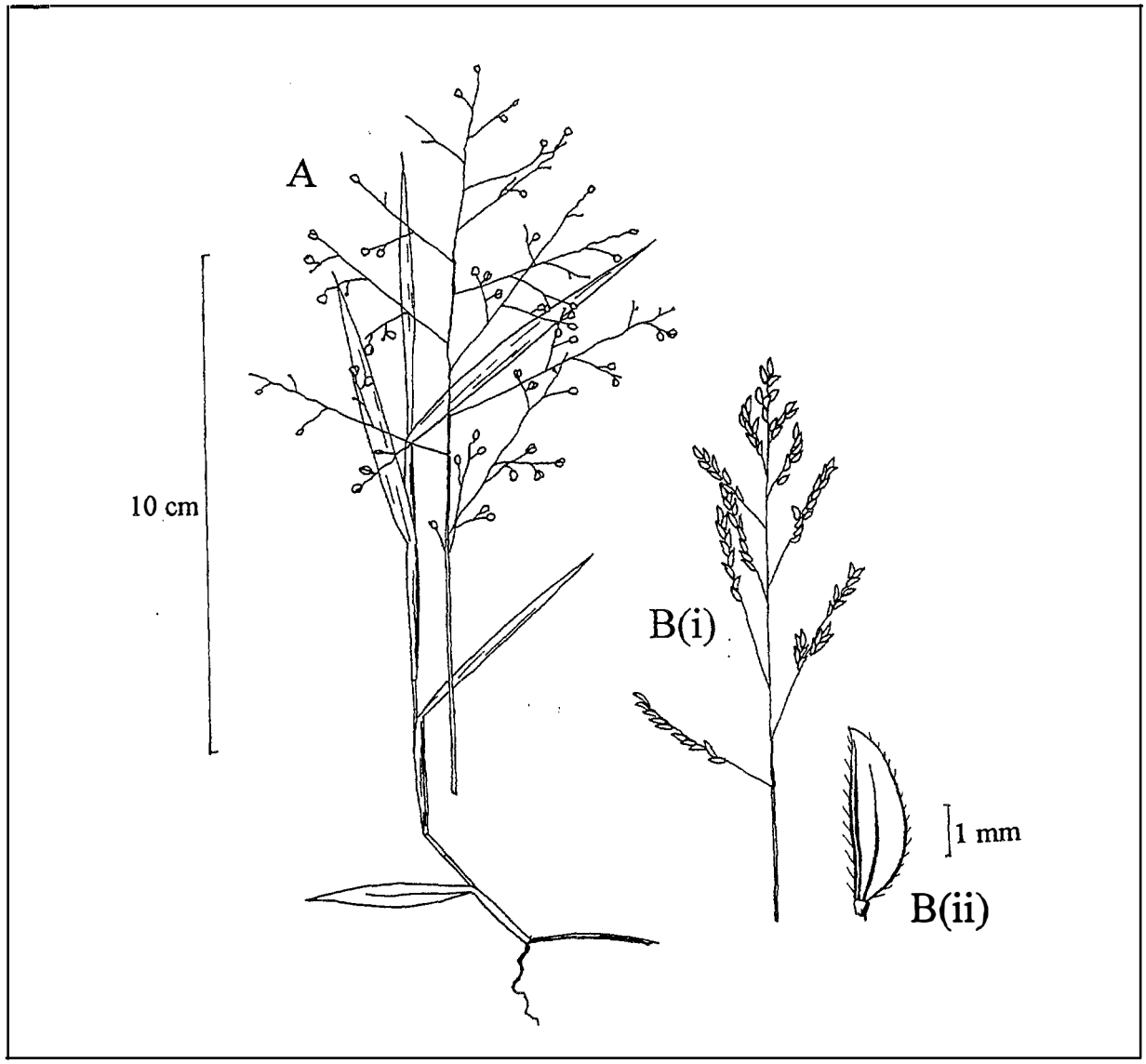

Figure 17. A - *Isachne truncata*; B - *Leersia hexandra*

Uses for livestock – in Xieng Khouang and elsewhere considered to be a valuable fodder species for cattle.

Other uses - none.

Deleterious properties - none.

Distribution - South-east Asia, India. In Xieng Khouang, sometimes found near streams in the Pine Tree Zone.

References - Schmid 1958 (p. 328,330); Bor 1960 (p. 578,579); Gilliland 1971 (p. 121); Lazarides 1980 (p. 88,89); Mannetje and Jones 1992 (p. 240).

Isachne truncata (Figure 17A)

Vernacular names - nya xai phou [ຫຍ້ຳໄຂ່ພູ້](Lao).

Description – erect grass with culms to 1 m tall, sometimes rooting from lower nodes in moist situations. Leaf blades to 8 cm long, 5-10 mm wide, the blades and sheaths hairless except for bristles along the margins of the upper sheaths. Nodes hairless. Ligule a fringe of hairs. Inflorescence an open panicle. Spikelets similar, solitary, 2 mm long, with 2 fertile florets, breaking up at maturity.

Habitat - grows in the Pine Tree Zone, and may also be found in shallow standing water.

Uses for livestock - of no significance as a forage.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, China. In Xieng Khouang occurs in cultivation areas in valleys in the Upland Zone.

References - Schmid 1958 (p. 327,330); Lazarides 1980 (p. 92).

Leersia hexandra (Figure 17B)

Vernacular names - nya xai [ຫຍ້ຳໄຂ](Lao); co' bac (Vietnam); cut grass, rice grass (English).

Description - aquatic grass to 1.5 m tall, nodes on lower stems freely rooting in mud. Leaf blades to 25 cm long, 15 mm wide, hairless; nodes minutely hairy. Ligule a blunt membrane 1-2 mm long, hairless along the upper margin. Inflorescence a narrow panicle 5-15 cm long, c. 2.5 cm wide. Spikelets solitary, similar, 3.5-4.5 mm long, with a single floret, which is fertile, falling entire.

Habitat - grows in standing water and swampy areas at all altitudes in Indo-China. Often grows in single-species stands.

Uses for livestock – in Xieng Khouang and elsewhere this species is considered to be very palatable to livestock, especially horses. Harvested for cut-and-carry forage during the dry season. In some countries, *L. hexandra* is cultivated in ricefields for hay, but may escape to become a troublesome weed. Sometimes toxic to livestock when fed fresh.

Other uses - none.

Deleterious properties - can be a weed of fallow or abandoned ricefields.

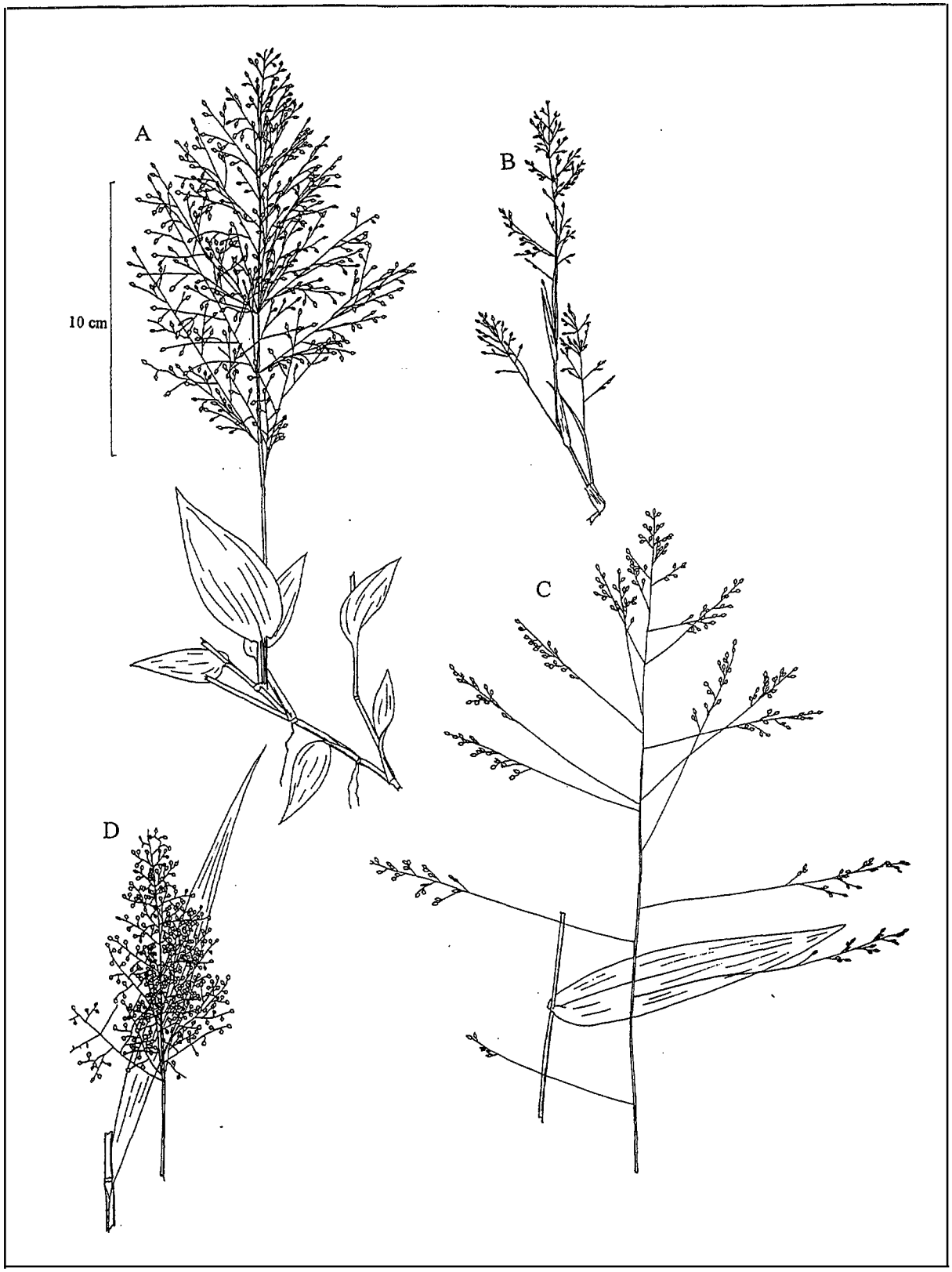

Figure 18. A - *Panicum brevifolium*; B - *P. humile*; C - *P. notatum*; D - *P. sarmentosum*

Distribution - throughout South-east Asia; native to the tropics of the New and Old Worlds. In Xieng Khouang, occurs in moist and swampy areas in the Pine Tree Zone and the Upland Zone.

References - Schmid 1958 (p. 472); Bor 1960 (p. 599); Gilliland 1971 (p. 97); Lazarides 1980 (p. 182,183); Tothill and Hacker 1983 (p.295); Mannetje and Jones 1992 (p. 240).

Panicum brevifolium (Figure 18A)

Description - short-lived perennial, stoloniferous grass, the culms branching and rooting at the nodes. Culms are up to 1.2 m tall, with leaf blades to 9 cm long, 27 mm wide, hairless or covered with long hairs. Sheaths with hairs along the margins. Nodes hairless. Ligule a membrane which is hairy along the upper margin. Inflorescence an open panicle, barely exserted from the leaf sheath, purplish in colour, the spikelets solitary, similar, 1.5-2 mm long. Spikelets with 2 florets, only the upper one fertile, falling entire. This species is unusual in the genus in that there are minute glandular patches on the panicle branches.

P. brevifolium is readily identified by its short, broad leaf blades.

Habitat - in Indo-China grows at lower to medium altitudes, in moist and shady places, along forest margins and clearings, and stream banks. In more humid climates may be found in open situations. Found on alluvial soils and permeable basaltic red earths.

Uses for livestock - of minor significance as a forage.

Other uses - none.

Deleterious properties - none.

Distribution - widespread in tropical Asia and Africa. In Xieng Khouang, occasionally found in moist, shaded situations in the Upland Zone.

References - Schmid 1958 (p. 333,336); Bor 1960 (p. 324); Hô and Du'o'ng 1960 (p. 666,668); Gilliland 1971 (p. 139); Lazarides 1980 (p. 126,129); Mannetje and Jones 1992 (p. 241); Veldkamp 1996.

Panicum humile (Figure 18B)

Description - tussocky and densely-tillered annual to 60 cm tall, flowering prolifically. Leaf blades up to 12 cm long, 2-4 mm wide, the blades, sheaths and nodes hairless. Inflorescence a panicle up to 11 cm long, 6 cm wide. Spikelets solitary, similar, 1.65-1.9 mm long, often purplish-coloured, with 2 florets, only the upper one fertile, falling entire.

Habitat - grows in open waste land, moist grazing land and areas disturbed by cultivation or habitation, mostly on light soils and with some shade.

Uses for livestock - provides useful grazing in some lowland areas, but not a high-yielding species.

Other uses - none

Deleterious properties - none.

Distribution - South-east Asia, Malaysia, Indonesia, Philippines, Borneo, China, India and north tropical Africa. In Xieng Khouang, found as a minor component of open grasslands in the Pine Tree Zone.

References - Schmid 1958 (p. 334,336); Bor 1960, as *P. austroasiaticum* (p. 324); Hô and Du'o'ng 1960 (p. 666); Gilliland 1971, as *P. walense* (p. 68); Lazarides 1980, as *P. walense* (p.128,130); Mannetje and Jones 1992, as *P. walense* (p.241); Veldkamp 1996 (p. 194).

Panicum notatum (Figure 18C)
Description - grass with erect culms to 2 m tall. Leaf blades up to 18 cm long, 10-30 mm wide, the blades and sheaths hairless or almost hairless, the nodes hairless. Ligule is a membrane 0.2-0.4 mm long, minutely hairy along the upper margin. Inflorescence an open panicle, up to 40 cm long, 25 cm wide, the branches bare in the lower half. Spikelets solitary, similar, shiny, 2.2-2.7 mm long, with 2 florets, only the upper one fertile, falling entire.

Habitat - grows in shady and moist places at all altitudes in Indo-China. Typically a forest grass, adapted to a range of different soil types, and occurring in clearings and edge of cultivation. Also sometimes found in grasslands.

Uses for livestock - considered to be too coarse to be a good fodder, although utilised as a minor forage and locally considered to be palatable to livestock.

Other uses - none.

Deleterious properties - none.

Distribution - South-east Asia, S. China, Malaysia, Indonesia, Philippines, India, Burma. A common and widespread species throughout Indo-China. In Xieng Khouang, found as scattered plants in valley situations in the Upland Zone, the Plain of Jars and Pine Tree Zone.

References - Schmid 1958, as *P. montanum* (p. 333,336); Bor 1960 (p. 701); Gilliland 1971 (p. 142); Lazarides 1980 (p. 127, 130); Mannetje and Jones 1992 (p. 241); Veldkamp 1996 (p. 199.

Panicum sarmentosum (Figure 18D)
Vernacular name – co' voi (Vietnam)

Description - perennial to 8 m tall with well-branched culms, which often scramble through and over other plants, rooting at the nodes. Leaf blades to 40 cm long, 15-20 mm wide, the blades more or less hairy on both surfaces, the sheaths on the creeping stems densely hairy. Nodes hairless. Ligule a fringe of hairs. Inflorescence a moderately dense, open panicle to c. 11 cm long. Spikelets solitary, similar, 2-2.5 mm long and distinctively shiny, with 2 florets, only the upper fertile, falling entire.

Habitat - occurs in clearings and along margins of primary or secondary forest, often in dense, tangled masses, but reported not to occur in open forest or savanna.

Uses for livestock - of minor value as a forage; the young growth is moderately palatable.

Other uses - none.

Deleterious properties - may occur as a serious weed in gardens, old cultivation and rice fields.

Distribution - South-east Asia, India, Burma, southern China, Malaysia, Indonesia, Philippines, Papua-New Guinea, northern Australia, In Xieng Khouang, occasionally found along roadsides through forested valleys in the Pine Tree Zone.

References - Schmid 1958 (p. 333,336); Bor 1960 (p. 330); Hô and Du'o'ng 1960 (p. 666,668); Gilliland 1971 (p. 139); Lazarides 1980 (p.128,130); Mannetje and Jones 1992 (p. 241); Veldkamp 1996 (p. 203).

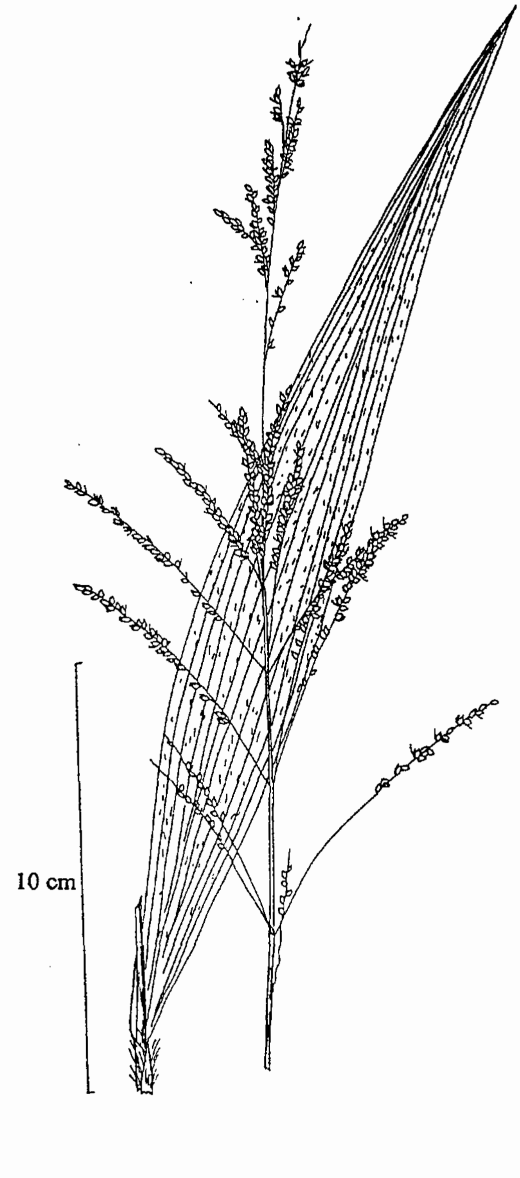

Figure 19. *Setaria palmifolia*

Setaria palmifolia (Figure 19)

Vernacular names - nya sai hia [ຫຍ້າໄສ້ເຮັ້ຽ], nya mang [ຫຍ້າມ່າງ] (Lao); ti daa [ຕິດ້າ] (Hmong); palm grass (Australia).

Description - robust perennial up to 2 m tall. Leaf blades to 70 cm long, 100 mm wide, when young longitudinally folded`like a young palm leaf, shortly hairy on both surfaces. Ligule a fringe of hairs 0.4-1.2 mm long. Inflorescence an open panicle 30-70 cm long, with a single bristle beneath some spikelets. Spikelets solitary, similar, 3-4 mm long, with 2 florets, only the upper one fertile, falling entire.

Habitat - in Indo-China occurs from the plains to medium altitudes, in shaded situations on the plains, but at higher altitudes may occur in full sunlight. Indicative of fertile soils.

Uses for livestock – in Xieng Khouang, considered to be a useful forage for cattle, horses and buffaloes, but elsewhere, regarded only as a minor forage. Stays green in frosty situations.

Other Uses - the grain is sometimes eaten as a subsitute for rice, and the thickened shoots are eaten as a vegetable. Also grown as an ornamental.

Distribution - Southeast Asia, India, China, Japan, Malaysia, Indonesia; introduced to tropical Africa, Central America; naturalised in northeast Australia. In Xieng Khouang, occurs in valleys in the Pine Tree Zone and in the Upland Zone in areas associated with shifting cultivation

References -Schmid 1958 (p.351,353); Bor 1960 (p.363); Hô and Du'o'ng 1960 (p. 654); Gilliland 1971 (p. 157); Lazarides 1980 (p.141,142); Tothill and Hacker 1983 (p.376); Mannetje and Jones 1992 (p. 243); Veldkamp 1994.

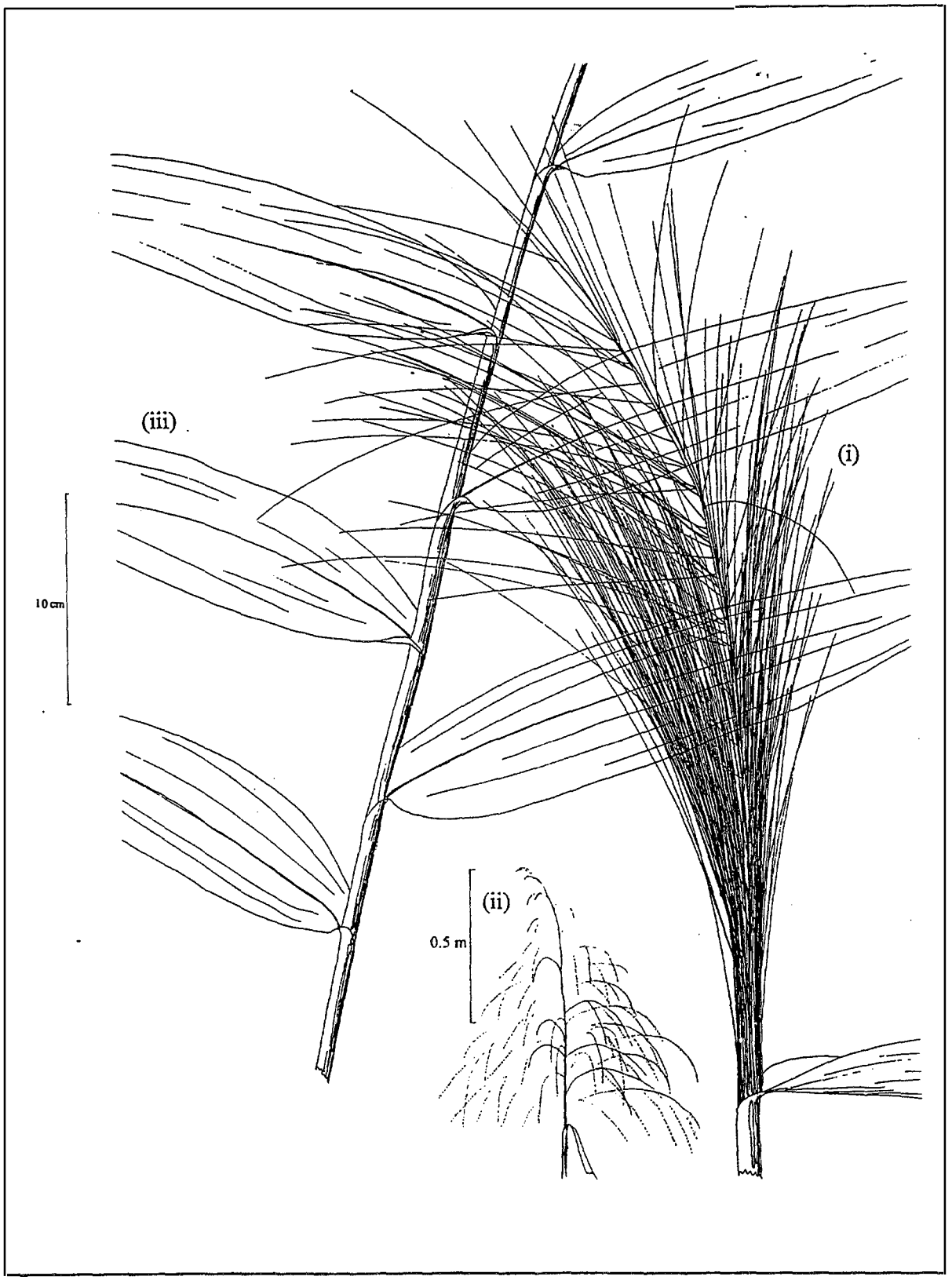

Figure 20. *Thysanolaena latifolia* (i) juvenile inflorescence, (ii) mature inflorescence, (iii) part of flowering culm

Thysanolaena latifolia (Figure 20)

Vernacular names - kor khaem, [ກໍແຂມ] (Lao); tao khao sua [ເຕົ່າເຄົ້າຊົ້ວ] (Hmong); dót, dông trùng hòa tha'o (Vietnam); tiger grass (English).

Description - robust perennial with culms to 4 m or more tall, the leaves characteristically crowded on the culm, the blades to 60 cm long, 40-80 mm wide, the blades hairless, the sheaths hairy along the margins. Ligule a membrane 1-2 mm long. Inflorescence is a very large open panicle 15-125 cm long. Spikelets similar, 1.2-2 mm long, with 2 florets, only the upper one fertile, falling entire with pedicel attached.

Habitat - grows in full sun or light shade, mostly as isolated plants in valleys or on slopes. Often found on soils derived from schists.

Uses for livestock - in Xieng Khouang and elsewhere *T. latifolia* is considered to be an excellent and nutritious forage either for grazing or cut-and-carry. Later flowering than most forages in the region, it retains its quality into the dry season.

Other uses - the inflorescences are used for making brooms.

Deleterious properties - none.

Distribution - Throughout South-east Asia; also India, Burma and China, and cultivated in America as an ornamental. In Xieng Khouang, common in the highlands, forest margins and *Imperata cylindrica* dominant grasslands, and in valleys in the Pine Tree Zone.

References - Schmid 1958, as *T. maxima* (p. 343); Bor 1960, as *T. maxima* (p. 650); Hô and Du'o'ng 1960, as *T. maxima* (p. 672); Gilliland 1971, as *T. maxima* (p. 45); Lazarides 1980, as *T. maxima* (p. 193), Mannetje and Jones 1992 (p. 224).

Group 5 - Grasses with open panicles; spikelets awned, not crowded along panicle branches

Aristida cumingiana (Figure 21A)
Vernacular names – nya som [ຫຍ້າສົ້ມ] Lao.

Description - attractive, delicate, densely tillered annual, to 25 cm tall. Leaf blades to 10 cm long, 1.5 mm wide, hairless. Ligule a fringe of hairs. Inflorescences are delicate panicles, produced in large numbers from the small plants. Spikelets solitary and similar, c. 3 mm long, excluding the 3 awns, with a single floret which is fertile, breaking up at maturity.

Habitat - occurs from the plains to medium altitudes in Indo-China, generally on degraded soils. Quite common in open forest.

Uses for livestock - of no grazing significance.

Other uses - none.

Deleterious properties - none.

Distribution - South-east Asia, India, China, Papua-New Guinea, Philippines, tropical Africa. In Xieng Khouang occurs on the Plain of Jars.

References - Schmid 1958 (p. 474); Bor 1960 (p. 409); Lazarides 1980 (p. 150); Hacker *et al.* 1996 (p. 29).

Arundinella nepalensis (Figure 21B)
Vernacular names - nya kan khaeng nam [ຫຍ້າກ້ານແຂ້ງນ້ຳ] (Lao); reed grass (Australia).

Description - perennial with cane-like culms to 2 m tall. Leaf blades to 20 cm or more long, 8 mm wide, the blades, sheaths and nodes hairless. Ligule a membrane 1 mm long, without hairs along the upper margin. Inflorescence a panicle to 60 cm long, with spikelets in pairs, similar, evenly spaced along the branches. Spikelets 4-6 mm long, excluding the short awn, with 2 florets, only the upper one fertile. They break up at maturity.

Habitat - mostly grows in moist situations, near rivers.

Uses for livestock - of little value as a fodder. A minor forage species, locally considered to be unpalatable to livestock except when young.

Other uses - none.

Deleterious properties - none.

Distribution - occurs throughout South-east Asia, and in China, Japan and northern Australia. In Xieng Khouang commonly found in valley situations in the Plain of Jars and Pine Tree Zone.

References - Bor 1960 (p. 420,423); Lazarides 1980 (p. 82); Tothill and Hacker 1983 (p. 115); Mannetje and Jones 1992 (p. 236).

Arundinella setosa (Figure 21C)

Vernacular names - nya kan khaeng nam [ຫຍ້າກ້ານແຂງນ້ຳ] (Lao).

Description - perennial up to 1.5 m tall, similar to *A. nepalensis* but differs in spikelet details (see Figure 21). Leaf blades up to 40 cm long, 9 mm wide, the sheaths and leaf blades almost hairless. Ligule a membrane 1 mm long, with minute hairs along the upper margin. Inflorescence a panicle to 45 cm long, with spikelets solitary or in pairs, similar, evenly spaced along the branches. Spikelets 5-7 mm long, excluding the short awn, with 2 florets, only the upper one fertile. The upper floret is awned, with 2 white bristles at the base. The spikelets break up at maturity.

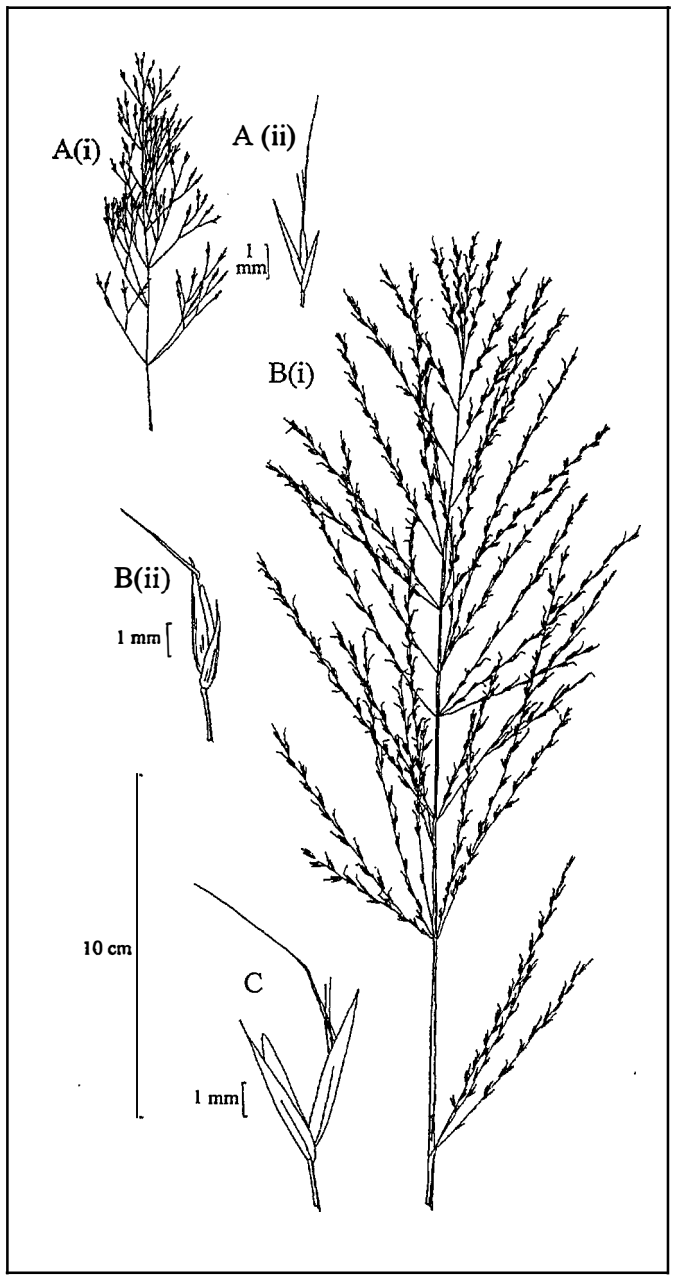

Figure 21. A(i) - *Aristida cumingiana* inflorescence, A(ii), spikelet;– B(i) *Arundinella nepalensis* inflorescence, B(ii) - spikelet; C -*Arundinella setosa* spikelet

Habitat - generally a species of medium altitudes in Indo-China, growing in full sunlight in open grassland or moderate shade on soils which are to some extent degraded. Also grows in open forests or clearings on seasonally swampy, lateritised soils.

Uses for livestock - has been classed as a minor forage, but also said to be avoided by cattle.

Other uses - none.

Deleterious properties - none.

Distribution - throughout South-east Asia, India, Burma, Malaysia, Indonesia; also in northern Australia. In Xieng Khouang occurs in lightly-grazed situations on the Plain of Jars and Pine Tree Zones, in valley situations and in open grassland away from valleys.

References - Schmid 1958 (p. 460,462); Bor 1960 (p. 424); Gilliland 1971 (p. 95); Lazarides 1980 (p. 83); Mannetje and Jones 1992 (p. 237).

Capillipedium assimile (Figure 22A)

Description - grass with heavy, cane-like stems, scrambling to a height of 2.2 m, and with numerous flowering branches from upper nodes, rooting from lower nodes on the soil surface. Leaf blades to 15 cm long, 6 mm wide, blades and sheaths hairless. Nodes with a ring of white hairs (there are also forms of this species with hairless nodes). Ligule a membrane with minute hairs along the upper margin. Inflorescence a small panicle c. 7-10 cm long, each branch tipped by a raceme with 3-5 spikelets 2.5-3.5 mm long,

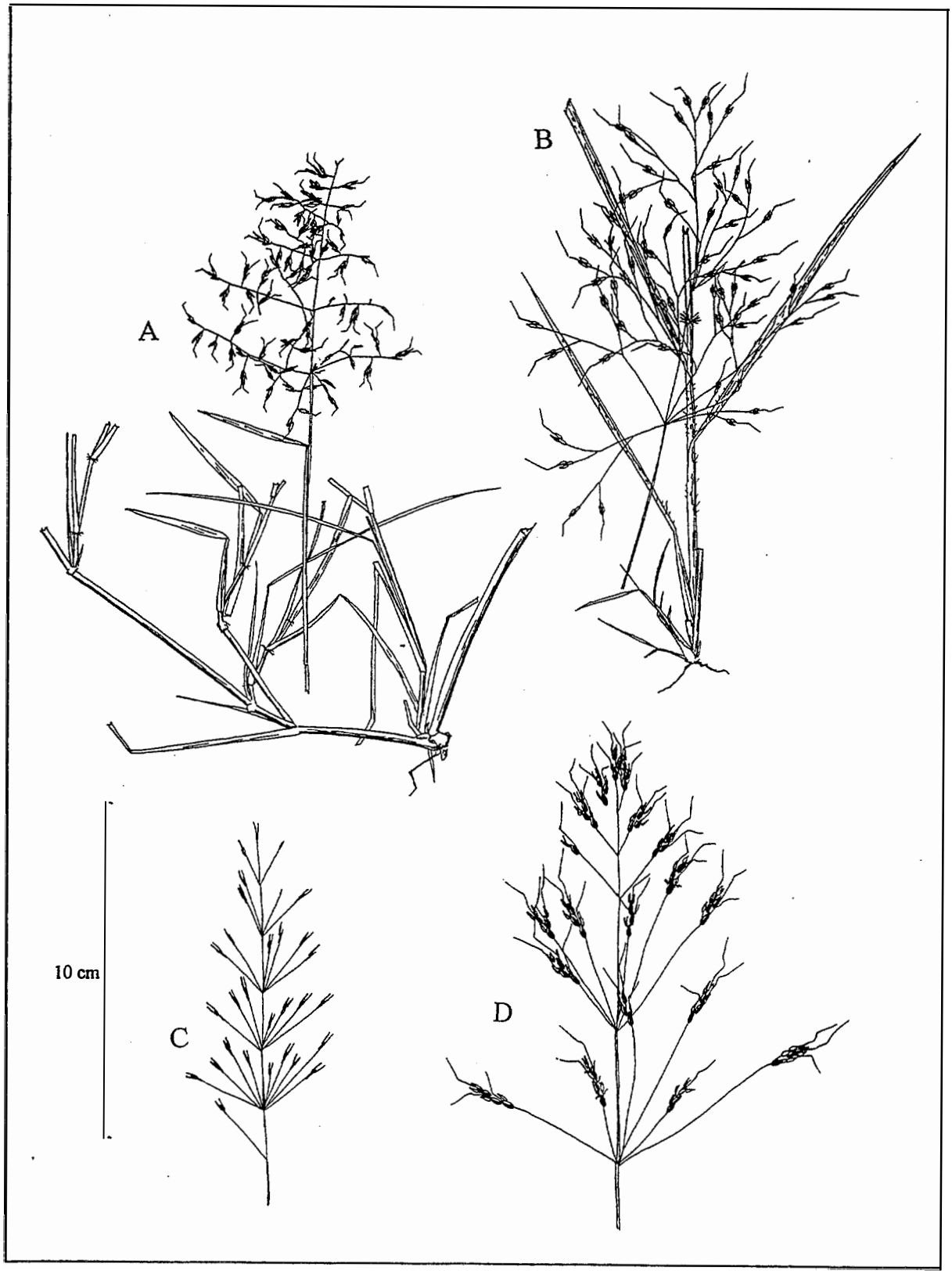

Figure 22. A - *Capillipedium assimile*; B - *C. parviflorum*; C - *Chrysopogon aciculatus*; D - *Sorghum nitidum*

excluding the awn. Spikelets in pairs, the sessile spikelet fertile and awned, the pedicellate spikelet sterile (the terminal group of spikelets includes 1 sessile and 2 pedicellate spikelets). The sessile spikelet has 2 florets, the upper fertile and awned. Spikelets fall entire.

Habitat - grows in savannas, grasslands and woodlands, often in open or disturbed sites along river banks or forest margins. In Xieng Khouang, tends to occur along roadsides and forest margins rather than in open grassland.

Uses for livestock - eaten by cattle and buffaloes before the stems become woody. In Xieng Khouang, not considered to be a useful grass for livestock.

Other uses - woody stems are used as cleaners for tobacco pipes.

Deleterious properties – none

Distribution – Indo-China, Philippines, Thailand, Indonesia, China, Japan, Burma, India. In Xieng Khouang occurs in valleys in the Pine Tree Zone and Plain of Jars, and also in the Upland Zone.

References – Schmid 1958 (p. 206,208); Bor 1960 (p. 110); Lazarides 1980 (p. 25); Mannetje and Jones 1992 (p. 237).

Capillipedium parviflorum (Figure 22B)

Description – grass with erect culms to 1 m tall. Leaf blades to 20 cm long, 5 mm wide, the sheaths and upper and lower surfaces of the blades sparsely to densely hairy. Nodes with a ring of white hairs. Inflorescence an open panicle 8-12 cm long, with branches in whorls, the branches tipped by racemes. Spikelets in pairs, the sessile spikelet fertile and awned, the pedicellate spikelet sterile (the terminal group of spikelets includes 1 sessile and 2 pedicellate spikelets). The sessile spikelet is 4-6 mm long excluding the awn and has 2 florets, the upper fertile and awned. Spikelets fall entire.

Habitat - a common constituent of grasslands on heavy-textured soils. In Indo-China occurs in open forest at medium altitudes. Apparently not abundant in Xieng Khouang.

Uses for livestock - in India, eaten by sheep, cattle and goats.

Other uses - none.

Deleterious properties - in some countries occurs as a weed of settled areas.

Distribution - throughout Southeast Asia and the tropics of the Old World. In Xieng Khouang, occasionally found near creeks in the Pine Tree Zone.

References - Schmid 1958 (p. 206,208); Bor 1960 (p. 112); Gilliland 1971 (p. 279); Lazarides 1980 (p.24,25); Tothill and Hacker 1983 (p. 147).

Chrysopogon aciculatus (Figure 22C)

Vernacular names – nya khouak [ຫຍ້າຂວກ] (Lao); co'may, co'bông (Vietnam); Mackies pest (Australia).

Description - strongly rhizomatous perennial, the culms up to 50 cm tall but usually shorter, creeping or decumbent at the base, branching and rooting and forming a dense mat. Leaf blades are blunt-tipped, hairless, 3-10 cm long, 4-8 mm wide. Ligule a very short membrane. Inflorescence a panicle 5-12 cm long, c. 2.5 cm

wide, with several whorls of branches, each ending in a single cluster of 3 spikelets. Spikelets dissimilar, the sessile spikelet fertile and with a 5.2-8 mm awn, the 2 pedicellate spikelets sterile. Sessile spikelets have 2 florets, only the upper one fertile. Spikelets fall entire.

Habitat - a species of more-or-less impoverished, disturbed, sandy soils, generally in areas which have been heavily grazed.

Uses for livestock - considered to be of average quality for grazing, but not a productive species.

Other uses - 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, northern Australia; introduced to West Africa. In Xieng Khouang, a significant component of the vegetation in heavily grazed pastures on the Plain of Jars, cleared areas of the Pine Tree Zone and valleys in the Upland Zone.

References - Schmid 1958 (p. 210); Bor 1960 (p. 115); Hô and Du'o'ng 1960 (p. 672); Gilliland 1971 (p. 236); Lazarides 1980 (p. 26); Tothill and Hacker 1983 (p. 162); Hacker *et al.* 1996 (p. 31).

Sorghum nitidum (Figure 22D)
Vernacular names - kè dai (Vietnam); brown sorghum (Australia).

Description - slender perennial with culms to 2 m tall. Leaf blades to 110 cm long, 11 mm wide, the blades and sheaths hairless. Nodes with a ring of white hairs. Ligule a membrane 1.5-2 mm long, with or without minute hairs along the upper margin. Inflorescence a moderately open panicle with branches in whorls, bearing clusters of spikelets c. 10 mm long at the ends. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile (the terminal group has 2 pedicellate sterile spikelets). Sessile spikelets 3.5-7 mm long with 2 florets, only the upper one fertile, with or without a geniculate awn up to 2.5 cm long, black when ripe, densely covered with dark brown hairs, falling entire.

Habitat - occurs in grasslands and savannas; tends to prefer well-drained sites.

Uses for livestock - a forage of minor importance, palatable to stock, and useful for grazing where it is abundant.

Other uses - none.

Deleterious properties - none.

Distribution - south and South-east Asia, S. China, Indonesia, Philippines, northern Australia. In Xieng Khouang occurs as a minor component of grasslands and valleys on the Plain of Jars, the Pine Tree Zone and cleared areas in the Upland Zone.

References - Bor 1960 (p. 245); Lazarides 1980 (p. 72,73); Tothill and Hacker 1983 (p. 380); Mannetje and Jones 1992 (p. 243); Hacker *et al.* 1996 (p. 32).

Group 6 - Grasses with racemose panicles; spikelets crowded along panicle branches; spikelets awnless

Axonopus compressus (Figure 23A)

Vernacular names - nya phaed [ຫຍ້າແພດ](Lao); nyor[ໜ້ຍ] (Hmong); broad-leaved carpet grass, mat grass (Australia)

Description - prostrate and stoloniferous perennial with culms to 50 cm tall. Leaf blades 3-25 cm long, mostly short in grazed pastures, 3-10 mm wide, blunt-tipped, hairless on lower surface but with sparse, long hairs on upper surface and along margins. Leaf sheaths strongly compressed. Nodes often densely hairy. Ligule a short membrane with minute hairs along the upper margin. Inflorescence a subdigitate panicle, barely extruded from the upper leaf sheath, with 2-4 slender spikes 3-11 cm long. More than one inflorescence can arise from a single leaf sheath. Spikelets solitary, all similar, 2-3.5 mm long, arranged in 2 overlapping rows on the underside of the axis, falling entire at maturity. They have 2 florets, only the upper one being fertile.

Habitat - adapted to short, open grasslands and also moderately shade tolerant. Grows on a range of soil types but prefers lighter soils, generally moderately fertile but well-drained.

Uses for livestock - considered to be a useful grass for grazing, although not as productive as some other grasses and becomes unpalatable late in the wet season.

Deleterious properties - can be a troublesome weed in gardens and plantations.

Other Uses - in some countries, used as a lawn grass.

Distribution - native to tropical America, now widespread through the tropics and subtropics of the world. Together with *Paspalum conjugatum*, locally abundant or dominant in heavily grazed pastures in the Pine Tree Zone of Xieng Khouang, and in the eastern Upland Zone (Nong Het District).

References - Schmid 1958 (p. 309); Bor 1960 (p. 278); Hô and Du'o'ng 1960 (p. 660); Lazarides 1980 (p. 106); Tothill and Hacker 1983 (p. 125); Mannetje and Jones 1992 (p. 53).

Cynodon dactylon (Figure 23B)

Vernacular names – nya phaed khem [ຫຍ້າແພດເຂັ້ມ](Lao) - co' chí', co'ông, co'gà (Vietnam); green couch, common couch (Australia); Bermuda grass (USA).

Description - stoloniferous and/or rhizomatous perennial, the culms up to 40 cm tall, often much shorter. Leaf blades 3-6 cm long, 2-3 mm wide, hairy or hairless, on stolons mostly in groups of 3. Leaf sheaths and nodes hairless. Ligule a dense row of short hairs with a tuft of longer hairs at either end. Inflorescence consists of 1-6 digitately arranged spikes, each 2-5 cm long, with sessile spikelets borne in 2 overlapping rows on the underside of the axis. Spikelets solitary and similar, 2-2.5 mm long, laterally flattened, with a single floret, which is fertile.

Cultivars and forms of the species found in other regions may be more robust, with larger leaves and inflorescences.

Habitat - occurs at all altitudes in Indo-China, on cleared land and in sunny to lightly shaded situations.. Adapted to well-drained soils but will tolerate flooding. Grows on alkaline to rather acid soils, but does not tolerate extreme acidity. Adapted to grazing, but in Xieng Khouang, where grazing is heavy, other grasses such as *Axonopus compressus* and *Paspalum conjugatum* tend to become dominant.

Uses for livestock this species is considered to be a good grazing grass and is particularly relished by horses. A number of very productive cultivars have been bred in the USA.

Other Uses – a good soil binder (erosion control), especially under dry conditions, Also used as a lawn grass, for tennis courts and golf courses in Australia, USA and elsewhere.

Deleterious properties - can be a troublesome weed of cultivation. When wilted, can become toxic to livestock, although this is unusual. Pollen is said to be allergenic.

Distribution - occurs throughout the world's tropics and subtropics, also extending into temperate latitudes. Sometimes found as a minor component in grazed pastures on more fertile soils in the Upland Zone of Xieng Khouang.

References - Schmid 1958 (p.510,513); Bor 1960 (p.469); Hô and Du'o'ng 1960 (p. 656); Lazarides 1980 (p.159); Tothill and Hacker 1983 (p.175); Mannetje and Jones 1992 (p.100).

Digitaria fuscescens (Figure 23C)
Description – stoloniferous, mat-forming annual or weak perennial with culms to 45 cm tall. Leaf blades to 28 cm long, 12 mm wide; leaf blades, sheaths and nodes on the culms hairless; stolon nodes hairy. Ligule a membrane, lacking hairs on the upper margin. Inflorescence a digitate panicle with 2-3 racemes c. 8 cm long. Spikelets similar, hairless, 1.3-1.6 mm long, in groups of 3. Each spikelet has 2 florets, only the upper one fertile. When ripe the fruit becomes yellowish brown, with a blue tip, falling entire.

Habitat - occurs in disturbed sites and along roadsides.

Uses for livestock - likely to be palatable to livestock, but not a productive species.

Other Uses – a useful soil binder (erosion control).

Deleterious properties - can be a troublesome weed.

Distribution - South-east Asia, India, Burma, Malaysia, Indonesia, S. China, Madagascar.

References - Bor 1960 (p.301); Veldkamp 1973 (p. 61); Gilliland 1970 (p. 191); Lazarides 1980 (p.115).

Digitaria setigera (Figure 23D)
Vernacular names - nya nyung kheua [ຫຍ້ານ້ຽງເຄືອ] (Lao).

Description - a stoloniferous annual with culms to 120 cms tall and leaf blades to 28 cm long, 12 mm wide, sparsely hairy on both surfaces. Nodes and sheaths are covered with long, spreading hairs. Ligule a membrane, lacking hairs on the upper margin. Inflorescence a racemose panicle, usually with 3-10 racemes. Spikelets similar, in pairs, 2-3.5 mm long. Each spikelet has 2 florets, only the upper one fertile, and falls entire.

Habitat - occurs in areas of disturbance, roadsides and as a weed of cultivation.

Uses for livestock – in Xieng Khouang and elsewhere considered to be very palatable to livestock, but not a very productive species.

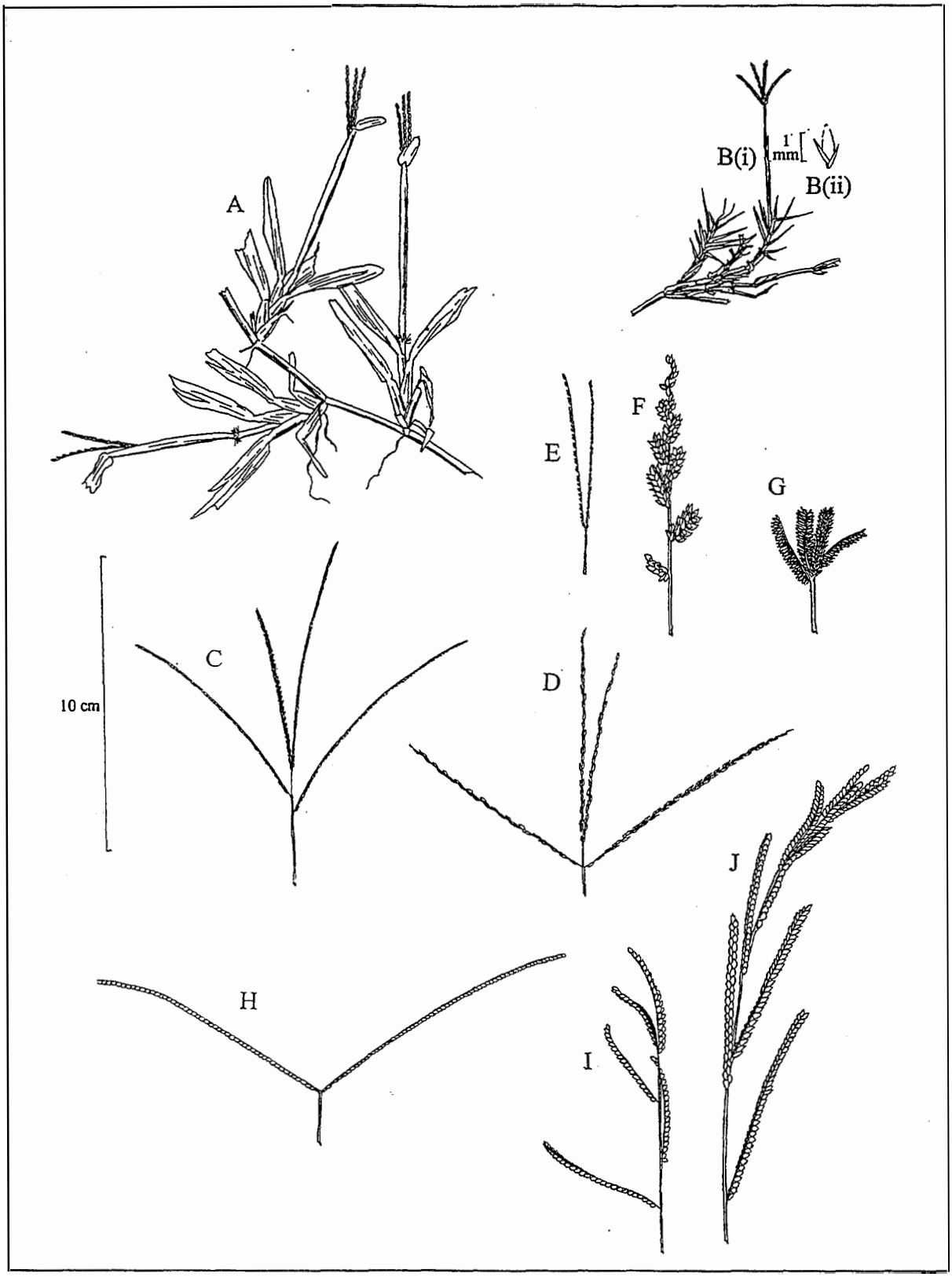

Figure 23. A - *Axonopus cimpressus*; B - *Cynodon dactylon*; C - *Digitaria fuscescens*; D - *D. setigera*; E - *D. violascens*; F - *Echinochloa colona*; G - *Eleusine indica*; H - *Paspalum conjugatum*; I - *P. scrobiculatum* var. *bispicatum*; J - *P. urvillei*

<u>Other Uses</u> - nil
<u>Deleterious properties</u> - a significant weed of cultivation.

<u>Distribution</u> - India, Burma, Thailand, Malaysia, Indonesia, Solomon Islands, Philippines, northern Australia.

<u>References</u> - Schmid 1958, as *D. pruriens* (p. 308); Bor 1960 (p.295,305); Hô and Du'o'ng 1960, as *D. marginata* (p. 658); Veldkamp 1973 (p. 37); Lazarides 1980 (p.113,117).

Digitaria violascens (Figure 23E)
<u>Vernacular names</u> - nya nyung kheua [ຫຍ້າຍຸງເຄືອ](Lao); co'chi bong tím (Vietnam)

<u>Description</u> - annual or short-lived perennial with erect culms to 70 cm tall. Leaf blades 3-25 cm long, 4-7 mm wide, hairless except for a few hairs near the base. Ligule a membrane, lacking hairs on the upper margin. Inflorescence with 2-7 digitately arranged racemes 5-15 cm long. Spikelets similar, 1-2 mm long, in groups of 3. Each spikelet has 2 florets, only the upper one fertile. The fruit is chestnut-brown, becoming purple when ripe, and falls entire.

<u>Habitat</u> - common along roadsides at medium to high altitudes in Indo-China. Widespread and common in disturbed areas, such as abandoned fields, and also a minor component of natural grasslands.

<u>Uses for livestock</u> - considered to be a minor forage species.

<u>Other Uses</u> - none.

<u>Distribution</u> - pan-tropical. In Xieng Khouang, found as a minor component of grasslands in the Pine Tree Zone.

<u>References</u> - Schmid 1958 (p. 306,309); Bor 1960 (p. 307); Gilliland 1970 (p. 191); Veldkamp 1973 (P. 63); Lazarides 1980 (p. 113,118); Tothill and Hacker 1983 (p. 196); Mannetje and Jones 1992 (p. 238).

Echinochloa colona (Figure 23F)
<u>Vernacular names</u> - sau khua [ເສົ້າຄົ້ວ](Hmong); co'lôìg vu'c (Vietnam); awnless barnyard grass (Australia)

<u>Description</u> - an erect annual or short-lived perennial to 1 m tall. Leaf blades, sheaths and nodes hairless, the blades 5-30 cm long, 2-8 mm wide. Ligule absent. Inflorescence a racemose panicle up to 15 cm long, with 3-10 short racemes up to 3 cm long. Spikelets similar, 1.5-3 mm long, in 4 neat rows. Each spikelets has 2 florets, only the upper one fertile. Spikelets fall entire.

<u>Habitat</u> - in Indo-China, frequently found at low to medium altitudes, near streams or swamps, including rice fields. Tends to prefer medium-textured to heavy, fertile soils and disturbed situations.

<u>Uses for livestock</u> - a palatable species, even as late as full flowering.

<u>Other Uses</u> - in some countries, country people collect the grain for human consumption.

<u>Deleterious properties</u> - a weed of cultivation, particularly in rice fields.

<u>Distribution</u> - common throughout Southeast Asia, subtropical and tropical Africa and Australia; introduced to America. In Xieng Khouang, occurs in moist situations such as near streams in the Upland Zone.

References - Schmid 1958 (p.320); Bor 1960 (p.308); Hô and Du'o'ng 1960 (p. 678); Lazarides 1980 (p.118, 119); Tothill and Hacker 1983 (p.205); Mannetje and Jones 1992 (p. 125).

Eleusine indica (Figure 23G)

Vernacular names - nya phak khwai [ຫຍ້າຜັກຄວ້າຍ](Lao); co' mãn trãu, ço vuon trâu (Vietnam); crowsfoot (Australia)

Description - annual to 60 cm tall, often much shorter where it is grazed or in pathways. Leaf blades 3-8 mm wide, folded towards the base, hairless except for a few hairs along the lower margins. Ligule a membrane 0.6-1 mm long, with minute hairs along the upper margin. Inflorescence a digitate panicle, with 2-7 racemes 4-15 cm long, sometimes with 1 or more racemes below the main group. Spikelets solitary, similar, hairless, flattened, with 3-9 florets, all except the upper ones fertile, breaking up at maturity.

Habitat - common on disturbed ground throughout Indo-China, at all altitudes; sometimes occurs in pastures where grazing is heavy and it can establish in spaces between other plants. Frequently found as a weed in towns and villages, and along roadsides.

Uses for livestock – in Xieng Khouang and elsewhere this species is considered to be a nutritious grass; can also be made into hay or silage.

Other Uses - eaten in Xieng Khouang as a green vegetable. Although an annual grass, a good soil-binder.

Deleterious properties - a significant weed of cultivation; when wilted, it can be toxic to stock.

Distribution - occurs throughout the tropical and subtropical regions of the world.

References - Schmid 1958 (p.518); Bor 1960 (p.493); Hô and Du'o'ng 1960 (p. 656); Lazarides 1980 (p.171); Tothill and Hacker 1983 (p.215).

Paspalum conjugatum (Figure 23H)

Vernacular names – nya phaed[ຫຍ້າແຝ້ດ] (Lao); nyor ea[ຫຍໍ້ເອ] (Hmong); co'công viên (Vietnam); sour grass (Australia)

Description - vigorous stoloniferous perennial, the culms to 80 cm or more tall. Blades 8-20 cm long 5-15 mm wide, hairless or with short hairs along the lower margins of the leaf blade. Leaf sheaths compressed. Ligule a membrane 1-1.5 mm long, lacking hairs along the upper margin. Inflorescence digitate, with 2 (rarely 3) racemes 7-16 cm long. Spikelets solitary, similar, in 2 overlapping rows, 2 mm long, with a fringe of hairs along the margin, green. Spikelets have 2 florets, only the upper one fertile, and fall entire.

Habitat - Occurs in shady and humid, but not swampy, situations at lower and middle altitudes in Indo-China. A dominant grass in many heavily grazed pastures in open and moist situations at medium altitudes.

Uses for livestock - more palatable to water buffaloes than cattle, but considered to be more palatable to cattle on poorer soils. In Xieng Khouang it is considered to be well grazed by cattle and pigs.A shade tolerant species, occurring under plantation crops. *P. conjugatum* dominance is generally considered to be indicative of overgrazing.

Other uses - none.

Deleterious properties - a common weed in waste ground, cultivation areas and plantations.

Distribution - occurs throughout the tropics and subtropics of the whole world. In Xieng Khouang, occurs in grasslands in the Pine Tree Zone and valley grasslands in the Upland Zone.

References - Schmid 1958 (p.302,304); Bor 1960 (p.336); Hô and Du'o'ng 1960 (p. 658); Gilliland 1970 (p. 180); Lazarides 1980 (p.132,133); Tothill and Hacker 1983 (p.334); Koning and Sosef 1985 (p. 290); Mannetje and Jones 1992 (p. 177).

Paspalum scrobiculatum* var. *bispicatum (Figure 23I)

Vernacular names - nya phaed khom[ຫຍ້າແຜ່ໂຄມ] (Lao); co'dáng (Vietnam); kodo, kodra millet (India); scrobic, ditch millet (Australia).

Description - tufted annual or perennial to 0.7 m tall. Leaf blades and sheaths hairless or sparsely hairy. Nodes hairless. Leaf blades to 25 cm long, 5-15 mm wide. Ligule a membrane up to 1.8 mm long. Inflorescence a racemose panicle, with 2-6 (rarely more) racemes. Spikelets solitary, similar, not always overlapping, 2-3 mm long, hairless. They have 2 florets, only the upper one fertile, and fall entire.

Habitat - along roadsides and in marshy situations and often where there has been some disturbance. Well adapted to water-logged soils. Often found where there is some shade; prefers moderate fertility. In Southeast Asia, *P. scrobiculatum* occurs in a wide range of situations, generally in more open and moist sites, or sometimes in open grasslands and savannas.

Uses for livestock - cultivated in India as a fodder crop.

Other Uses - in India, also cultivated for grain.

Deleterious properties – nil. The grain of the related var. *scrobiculatum* is reputed to be toxic, both to animals and humans, under some situations.

Distribution - throughout the Old World tropics. Not very common in Xieng Khouang province, where it is found along roadsides and near cultivation in the Upland Zone.

References - Schmid 1958 (p.300, 302); Bor 1960 (p.340); Gilliland 1970 (p. 185); Lazarides 1980 (p.132, 133); Tothill and Hacker 1983 (p.334); Koning and Sosef 1985 (p. 305); Mannetje and Jones 1992 (p. 185); Hacker *et al.* 1996 (p. 27).

Paspalum urvillei (Figure 23J)

Vernacular name - vasey grass (Australia)

Description - perennial with culms 90-150 cm or more tall. Leaf blades 50-80 cm long, 8-15 mm wide. Leaf blades, sheaths and nodes hairless, except for a few long hairs near the base of the leaf blade. Ligule triangular, up to 6 mm long. Inflorescence a racemose panicle with 10-20 racemes. Spikelets similar and in pairs, 2-3 mm long, each with a fringe of hairs round the margin. They have 2 florets, only the upper one fertile, and fall entire.

Habitat - occurs along roadsides in sunny situations or where there is some shade.

Uses for livestock - considered in Xieng Khouang and elsewhere to be a good forage for cattle, but older

growth becomes coarse and unpalatable. Has been cultivated as a forage in some countries. Although it has been introduced to a number of countries for use as a forage, it is not now considered to be a useful forage.

Other Uses - none.

Deleterious properties – in some countries, regarded as a minor weed.

Distribution - Native to South America, this species is now widespread through the tropics and subtropics of the whole world. In Xieng Khouang occurs along roadsides in the Upland Zone.

References - Schmid 1958 (p.302, 304); Bor 1960 (p.341); Hô and Du'o'ng 1960 (p. 658); Lazarides 1980 (p.134); Tothill and Hacker 1983 (p.334); Koning and Sosef 1985 (p. 308).

Group 7 - Grasses with racemose panicles; spikelets crowded along panicle branches; spikelets awned

Arthraxon hispidus (Figure 24A)

Vernacular names - nya hangh kai [ຫຍ້າຮັງໄກ່](Lao); nyor ye kai [ຫຍ້ເຍໄກ້](Hmong).

Description - delicate tufted or weakly stoloniferous grass with culms to c. 70 cm tall, the leaf blades 0.5-7.5 cm long, 2-15 mm wide, hairless except for bristles along the margins. Sheaths and nodes hairless. Ligule a membrane 0.5-1 mm long, minutely hairy along the upper margin. Inflorescence a racemose panicle with 3-15 spikes 2-5 cm long. Spikelets solitary, 2-8 mm long, with a fine, straight awn, and have 2 florets, only the upper one fertile. They shed entire.

Habitat - a widespread species in Indo-China at medium to high altitudes. Occurs in moist and shady situations on stream banks and along roadsides at medium altitudes.

Uses for livestock - likely to be palatable to cattle and buffalo, but an unproductive grass of little significance to livestock.

Other uses - none.

Deleterious properties - none.

Distribution - most parts of South-East Asia, India, China, Malaysia, Indonesia, Japan, tropical Africa, eastern Australia; introduced to North America. In Xieng Khouang an early coloniser after shifting cultivation in the Upland Zone, also occurring along roadsides.

References - Schmid 1958, as *A. ciliaris* (p. 199,200); Bor 1960 (p. 97,99); Hô and Du'o'ng 1960 , as *A. ciliaris* (p. 660); Lazarides 1980 (p. 21); Tothill and Hacker 1983 (p. 113); Mannetje and Jones 1992 (p. 236).

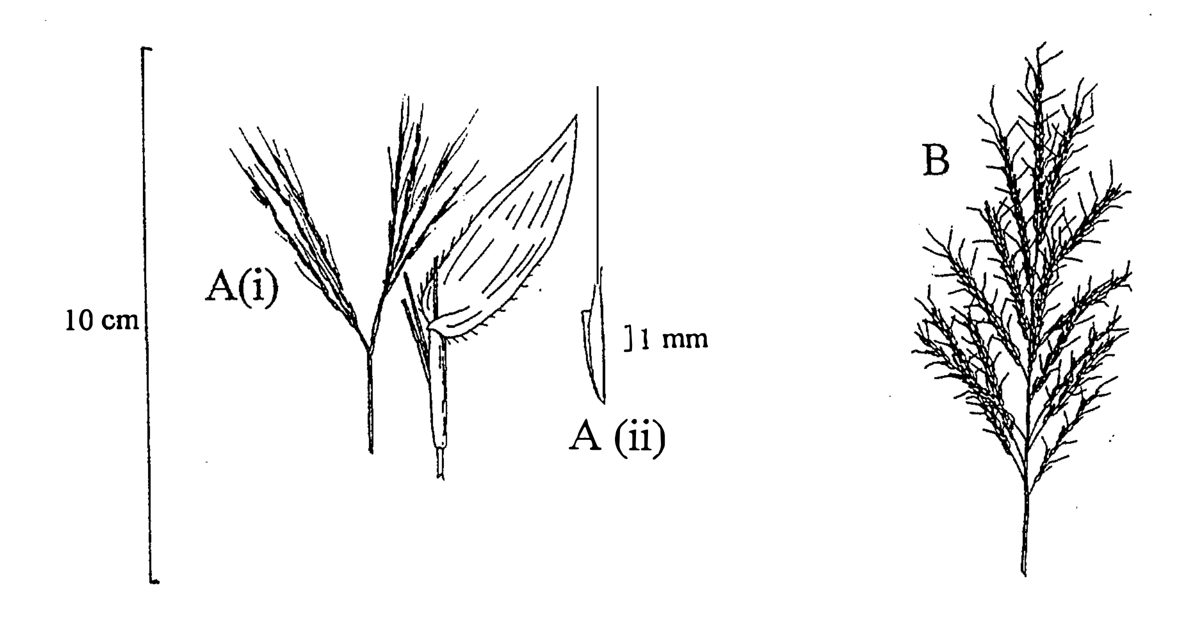

Figure 24. A(i) *Arthraxon hispidus* inflorescence, A(ii) - spikelet; B - *Bothriochloa bladhii*

Bothriochloa bladhii (Figure 24B)
Vernacular names - forest bluegrass, Burnett River bluegrass (Australia)

Description - perennial with culms to 90 cm tall. Leaf blades to 30 cm long, 7 mm wide, hairless. Nodes with a ring of white hairs c. 1 mm long. Ligule a membrane, lacking hairs along the upper margin. Inflorescence a racemose panicle, up to 20 cm long, with 5-15 branches arranged singly or several together along an axis 4-14 cm long. Spikelets in pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 3-4 mm long, awned, with 2 florets, only the upper floret fertile, shedding entire.

Habitat - at lower altitudes in South-east Asia this species is often a major constituent of grasslands and savannas. Sometimes occurs on disturbed ground. *B. bladhii* prefers dry, moderately fertile soils either in full sun or moderate shade.

Uses for livestock - considered to be a good fodder grass, but regarded as a minor forage in the region. A commercial cultivar of this species (cv. Swann) has been released as a pasture grass in Australia.

Other uses - none.

Deleterious properties - can be a minor weed of cultivation.

Distribution - India, South-east Asia, Australia, tropical Africa. In Xieng Khouang occasionally found in the Pine Tree Zone and along roadsides elsewhere.

References - Schmid 1958, as *Amphilophis intermedia* (p. 204,206); Bor 1960, as *B. intermedia* (p. 108); Gilliland 1970, as *B. intermedia* (p. 281); Lazarides 1980 (p. 23,24); Tothill and Hacker 1983 (p. 127); Mannetje and Jones 1992 (p. 237).

Echinochloa crus-galli (not illustrated)
Vernacular names - co'lôìng vûc, song chong (Vietnam); barnyard grass (Australia)

Description - robust, erect annual to 1.5 m. Leaf blades hairless, 5-50 cm long, 0.5-2 cm wide, the sheaths hairless or hairy. Nodes hairy. Ligule absent. Inflorescence is racemose panicle 6-22 cm long, the lower racemes usually branched, the upper shorter and more crowded. Spikelets crowded, untidily arranged in 2-several rows, similar, 3-7 mm long, with a distinct point or awn up to 50 mm long. Each spikelet has 2 florets, only the upper floret fertile.

Habitat - frequently found near streams or swamps, and also as a weed in rice fields and lowland dryland farms. Best adapted to fertile soils, although it also occurs on sandy soils.

Uses for livestock - locally considered to be relished by cattle.

Other Uses – an ancient cereal, and in some countries, village people still collect the grain for human consumption. Young shoots are used as a vegetable.

Deleterious properties - a weed of cultivation,. Considered to be the world's worst weed of paddy fields.fields.

Distribution – a species with numerous forms, world-wide in temperate to tropical areas. In Xieng Khouang, occurs in moist situations such as near streams in the Upland Zone.

References - Schmid 1958 (p.320); Bor 1960 (p.310); Hô and Du'o'ng 1960 (p. 648,678); Lazarides 1980 (p.118, 119); Tothill and Hacker 1983 (p.206); Mannetje and Jones 1992 (p. 126).

Eulalia ? bicornuta (Figure 25A)

Vernacular names - nya khai noi [ຫຍ້າເຄົ້າຍນ້ອຍ] (Lao)

Description – perennial, forming strong tussocks, with culms to 1 m tall and with slender tiller bases. Leaf blades 10-20 cm long, 2-3 mm wide, hairy. Ligule a membrane, lacking hairs along the upper margin. Inflorescence a racemose panicle, with 2-3 grey racemes, 3-10 cm long. Spikelets in dissimilar pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 3-4 mm long, awned, with 2 florets, only the upper one fertile, falling entire.

Habitat - grows in medium to high altitude savannas in infertile, degraded, alluvial or basaltic soils. Not tolerant of shade.

Uses for livestock - locally considered to be palatable to livestock.

Other uses - none.

Deleterious properties - none.

Distribution - Thailand, Lao, Burma. In Xieng Khouang common in grasslands in the Pine Tree Zone and on the Plain of Jars, in association with *Themeda triandra*.

References - Schmid 1958, as *Pseudopogonatherum* sp. 3 (p. 166,168); Bor 1960 (p. 154,155); Lazarides 1980 (p. 39).

Eulalia leschenaultiana (Figure 25B)

Description - culms mostly <50 cm tall, with whitish hairs at the base. Leaf blades usually <10 cm long, 5 mm wide, hairless except for a few long hairs near junction with the leaf sheath or sparsely hairy. Ligule a membrane with minute hairs along the upper margin. Inflorescence a racemose panicle, with 2-4 racemes, the racemes 3-9 cm long, covered in rich chestnut-brown hairs. Spikelets in dissimilar pairs, the sessile,spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 3-4 mm long, awned, with 2 florets, only the upper one fertile, falling entire.

Habitat - occurs from sea level to c. 1000 m altitude, often on limestone, and is often a major component of grasslands.

Uses for livestock – this species is considered to be a useful fodder for cattle and horses.

Other uses - none.

Deleterious properties - none.

Distribution - throughout South-east Asia, Peninsular Malaysia, Indonesia, Philippines, India, China. In Xieng Khouang, occurs uncommonly in the Pine Tree Zone.

References - Bor 1960 (p. 153,155); Gilliland 1971 (p. 241); Lazarides 1980 (p. 38,39).

Eulalia phaeothrix (Figure 25C)

Vernacular names - nya khai houa[ຫຍ້າເຄົ້າຍຫົວ] (Lao).

Description – culms to 1.8 m tall (reported as only to 80 cm tall in other regions) with swollen and fibrous tiller bases to 1 cm thick, covered in brown or reddish-brown hairs. Leaf blades to 50 cm long, 4 mm wide, the blades with a narrow white mid-vein. Leaf blades, sheaths and nodes hairless except for a few long hairs near the junction of the leaf blade and sheath. Ligule a membrane with minute hairs along the upper margin. Inflorescence a racemose panicle with 1-8 racemes 4-20 cm long, covered in reddish-brown hairs. Spikelets in dissimilar pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 3.5-5 mm long., awned, with 2 florets, only the upper one fertile, falling entire.

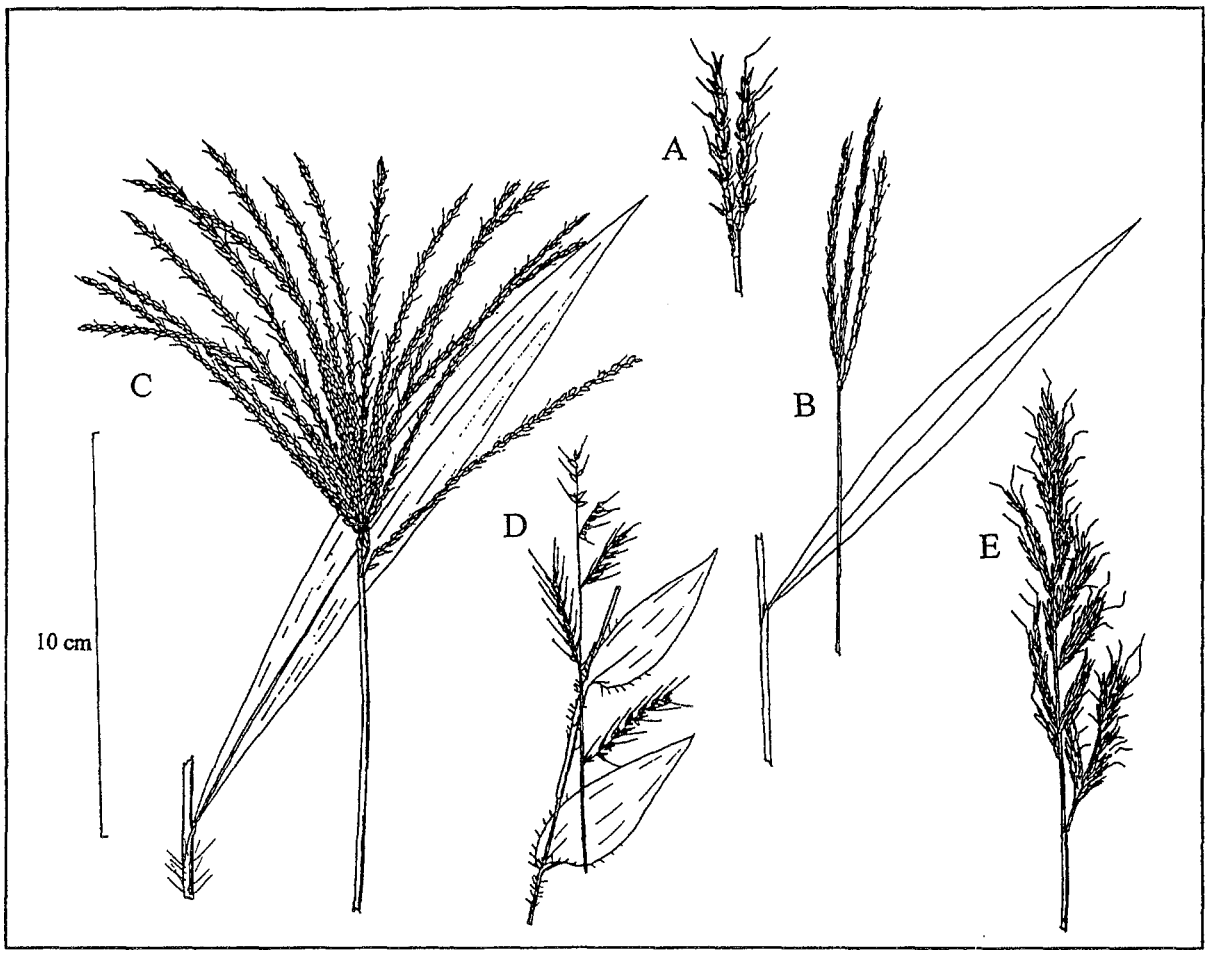

Figure 25. A - *Eulalia ?bicornuta*; B - *E. leschenaultiana*; C(i) - *E. phaeothrix* inflorescence, C(ii) stem base; D - *E. siamensis*

Habitat - occurs in shaded situations in open forest and pine tree savannas, and in full sunlight, often on soils derived from schist or basalt. A species which is indicative of degraded soils.

Uses for livestock - locally grazed by goats but not by cattle.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, Thailand, India, Sri Lanka. In Xieng Khouang, widespread and common, sometimes locally dominant in shaded sites in uncleared areas of the Pine Tree Zone; also occurs in open

Corrigendum

Figure 25 (page 76) should be as below

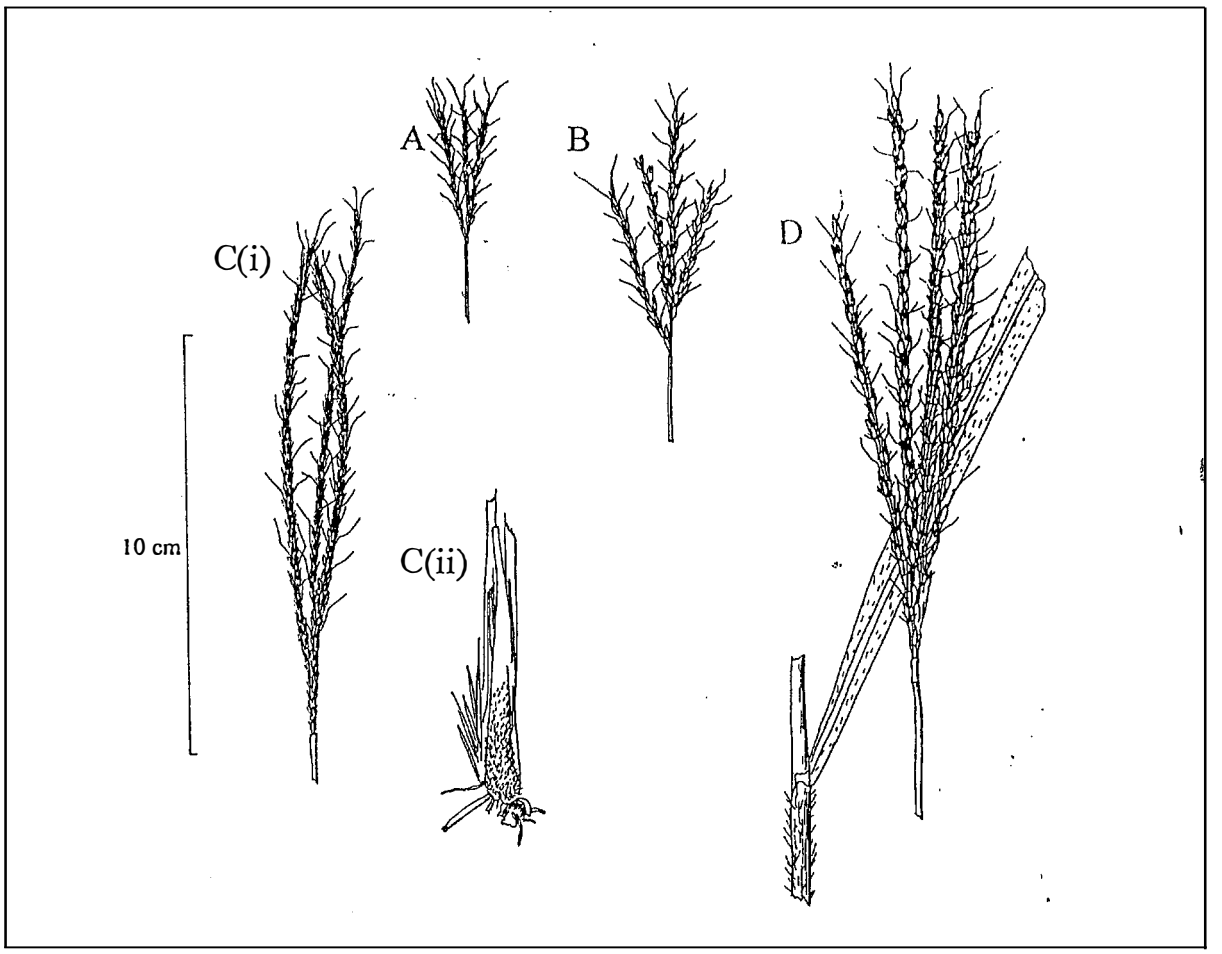

Figure 25. A - *Eulalia ?bicornuta*; B - *E. leschenaultiana*; C(i) - *E. phaeothrix* inflorescence, C(ii) stem base; D - *E. siamensis*

situations in the Pine Tree Zone and in valleys in the Plain of Jars.

References - Schmid 1958 (p.165); Bor 1960 (p. 153,156); Lazarides 1980 (p. 40).

Eulalia siamensis (Figure 25D)
Vernacular names - nya khai nyai [ຫຍ້າແຄ ໃຫຍ່] (Lao).

Description - robust perennial to 2 m tall, similar to *E. phaeothrix*, except that the base of the plant is covered with yellowish woolly hairs. Leaf blades 50-100 cm long, 5-10 mm wide, densely and minutely hairy on both surfaces and with a narrow white mid-vein. Upper leaf sheaths densely covered with long (2-4 mm) hairs; nodes hairless. Ligule a membrane lacking hairs along the upper margin. Inflorescence a racemose panicle with c. 4 racemes covered in purple to purplish-brown hairs. Spikelets c. 5 mm long. Spikelets in dissimilar pairs, the sessile spikelet fertile, the pedicellate spikelet sterile. The sessile spikelet is 5-6.5 mm long., awned, with 2 florets, only the upper one fertile, falling entire.

Habitat - occurs in open grasslands on acidic soils.

Uses for livestock - locally considered to be very palatable to livestock.

Other uses - none.

Deleterious properties - none.

Distribution - Lao, Thailand, probably Burma. In Xieng Khouang, common in open grasslands in the Pine Tree Zone; also occurs on the Plain of Jars.

References - Bor 1960 (p. 153,157); Lazarides 1980 (p. 40).

Ischaemum indicum (Figure 26A)
Vernacular names - Batiki blue grass (English).

Description - stoloniferous perennial with culms to 60 cm tall. Leaf blades up to 20 cm long, 10 mm wide, sparsely to densely hairy. Ligule a membrane 0.8-2 mm long, lacking hairs along the upper margin. The inflorescence has 2 appressed racemes 2-10 cm long. Spikelets in pairs, one sessile and one pedicellate, each with a geniculate awn up to 15 mm long, and with a lower sterile floret and upper fertile floret, falling entire.

Habitat - occurs at all altitudes in Indo-China, growing in open or disturbed situations, including swampy areas. Tolerant of infertile and acidic soils.

Uses for livestock - considered a useful forage in parts of South-east Asia, and may be grazed or used for cut-and-carry. As with most grasses, cutting should be before the flower heads emerge as quality falls rapidly with later stages of maturity.

Other uses - nil.

Deleterious properties - none.

Distribution – South-east Asia , including Peninsular Malaysia, Vietnam, Indonesia and Philippines. Introduced to West Africa, Australia and Pacific Islands. In Xieng Khouang, occurs in valleys in the Plain of Jars and seasonally waterlogged situations in Upland Zone valleys.

References - Schmid 1958, as *I. ciliare* (p. 177,179); Hô and Du'o'ng 1960, as *I. ciliare* (p. 651); Gilliland 1971 (p. 263); Mannetje and Jones 1992, as *I. ciliare* (p. 142).

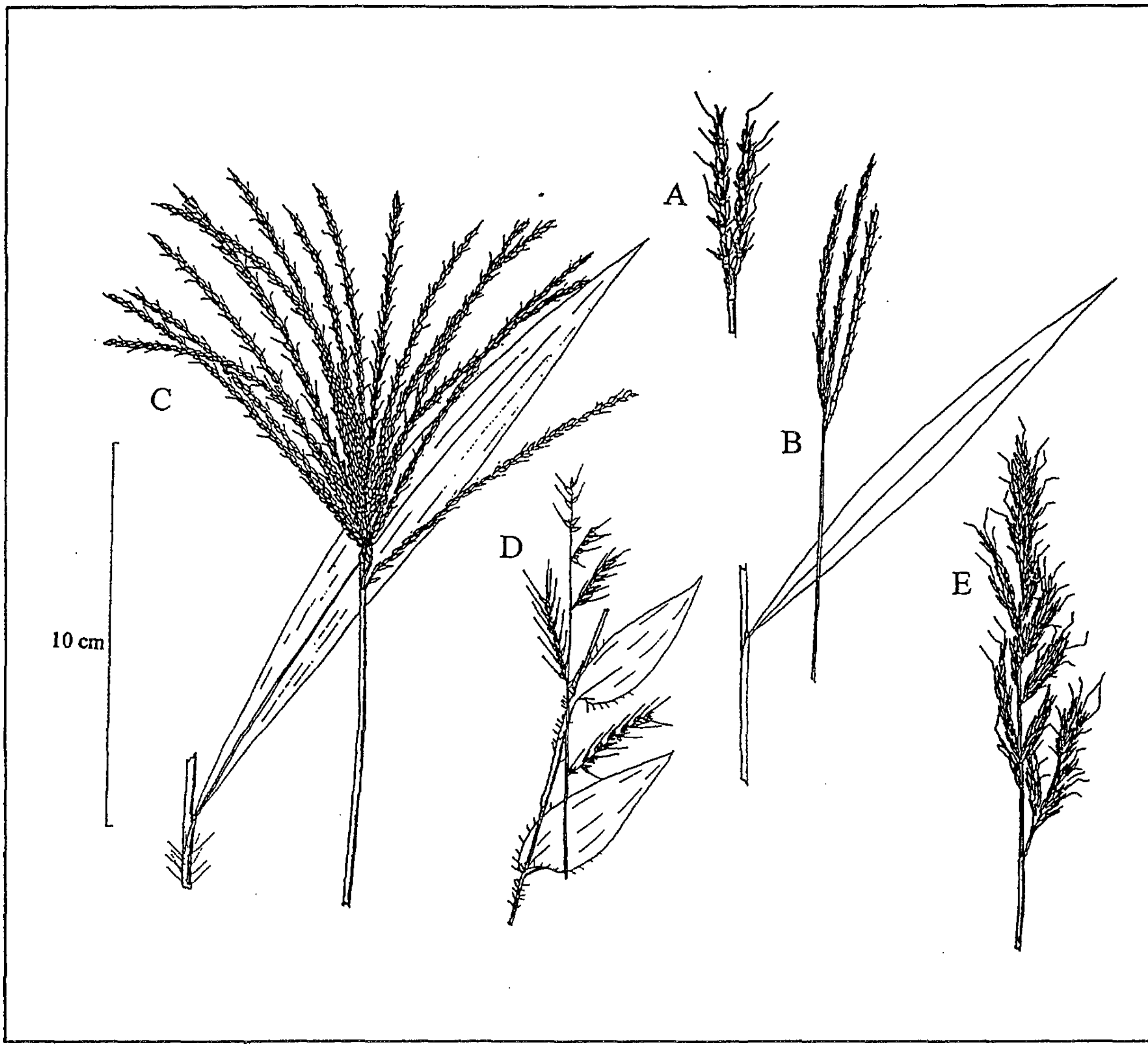

Figure 26. A - *Ischaemum indicum*; B - *Microstegium ciliatum*; C - *M. vagans*; D - *Oplismenus compositus*; E - *Pseudosorghum zollingeri*

Microstegium ciliatum (Figure 26B)

Vernacular names - nya nyung noi[ຫຍ້າຍຸງນ້ອຍ] (Lao); maw saw meh[ມໍ່ຊໍ້ເມ] (Hmong).

Description - a scrambling grass with trailing stems to 3 m or more long, culms and slender leafy stems ascending through surrounding vegetation to 3 m. Leaf blades very narrow at the base (in common with other *Microstegium* spp.), soft, up to 15 cm long, 25 mm wide, hairless or with sparse hairs on the lower surface and a prominent white mid-vein. Nodes hairless. Ligule a membrane 0.5 mm long, lacking hairs along the upper margin. Inflorescence a pale green or pale yellow digitate panicle with 2-22 racemes 3-16 cm long, the spikelets in pairs, 2.5-4 mm long, one sessile and the other pedicellate, both awned. Spikelets with 2 florets, only the upper one fertile, falling entire.

Habitat - occurs growing as dense colonies along roadsides, forest margins and scrubby vegetation protected

from grazing.

Uses for livestock – in Xieng Khouang and elsewhere this species is considered to be a very good forage, but does not tolerate frequent grazing.

Other uses - none.

Deleterious properties - none.

Distribution - throughout South-east Asia, India, Burma, Sri Lanka, southern China, Taiwan, Japan. In Xieng Khouang, occurs in the Upland Zone and in wooded valleys and protected areas in the Pine Tree Zone.

References - Schmid 1958 (p. 168,170); Bor 1960 (p. 193); Gilliland 1970 (p. 249); Hô and Du'o'ng 1960 (p. 660); Lazarides 1980 (p. 56); Mannetje and Jones 1992 (p. 165).

Microstegium vagans (Figure 26C)
Vernacular names - nya nyung nyai [ຫຍ້ານ້ຽງໃຫຍ່] (Lao); maw saw [ໝໍ້ຊໍ] (Hmong).

Description - robust perennial with trailing stems to several metres long, the culms ascending to 1.5 m or more. Leaf blades very narrow at the base (in common with other *Microstegium* spp.), up to c. 22 cm long, 20 mm wide, hairless, the sheaths with long, upward-pointing hairs, the blades with a prominent white mid-vein. Ligule a membrane, lacking hairs along the upper margin. Inflorescence a digitate panicle, reddish-purple in colour, with 6-30 spreading racemes 8-12 cm long, the spikelets in pairs, 2.5-4 mm long, one sessile and the other pedicellate, both awned. Spikelets with 2 florets, only the upper one fertile, falling entire.

Habitat - a species of shaded conditions along forest margins and roadsides through forested country. In southern regions of Indo-China, restricted to higher altitudes.

Uses for livestock – in Xieng Khouang considered to be very palatable and nutritious to livestock, with the exception that it is reputed to be unpalatable to goats.

Other uses - none.

Deleterious properties - none.

Distribution - in Xieng Khouang occurs in the Upland Zone growing in disturbed sites amongst other vegetation.

References - Schmid 1958, as *M. gratum* (p. 168); Bor 1960 (p. 193,195); Gilliland 1970 (p. 250); Lazarides 1980 (p. 56,57).

Oplismenus compositus (Figure 26D)
Description - stoloniferous, with culms ascending to 60 cm and leaf blades to c. 11 cm long, 20 mm wide, hairy along the margins, otherwise softly hairy or hairless. Sheaths with upward-pointing hairs below the junction with the blade, otherwise hairless or hairy. Nodes minutely hairy. Ligule a membrane lacking hairs along the upper margin. Inflorescence a racemose panicle with several racemes quite widely distributed along an axis of up to 10 cm or more long, the lower racemes to >4 cm long, the upper ones progressively shorter. Spikelets similar, in pairs, 2.5-4 mm long, excluding the 5 mm straight awn. Spikelets have 2 florets, only the upper one fertile, and fall entire.

Habitat - occurs at all altitudes in Indo-China but is a species restricted to moist and shaded situations. *O. compositus* is one of the few grasses that can grow in dense forest.

Uses for livestock - a minor forage of little significance, although considered to be of high quality.

Other uses - none.

Deleterious properties - none.

Distribution - throughout South-east Asia and the Old World tropics, also in the New World tropics.

References - Schmid 1958 (p. 320,322); Bor 1960 (p. 317); Hô and Du'o'ng 1960 (p. 678); Gilliland 1971 (p. 171); Lazarides 1980 (p. 125); Tothill and Hacker 1983 (p. 317); Mannetje and Jones 1992 (p. 241).

Pseudosorghum zollingeri (Figure 26E)
Description - an annual with culms 0.4-0.9 m tall (specimens attributed to this species from a site in Xieng Khouang were up to 2 m tall). Leaf blades to 50 cm long, 5-8 mm wide, the blades, sheaths and nodes hairless, except for sparse long hairs on the leaf sheaths. Ligule a membrane 1.5-2 mm long, lacking hairs along the upper margin. Inflorescence a narrow, dense, racemose panicle 10-12 cm long, purplish, with lower racemes c. 4-5 cm long. Spikelets in 3s, the sessile fertile fertile, the pedicellate spikelets sterile. Sessile spikelet 4-5 mm long, excluding the awn, with 2 florets, only the upper one fertile, falling entire.

Habitat - apparently restricted to fertile, alkaline soils. Grows in full sunlight and in some shade.

Uses for livestock – of some value as a minor forage, being still fresh when other grasses are withered by drought.

Other uses - none.

Deleterious properties - none.

Distribution - Indo-China, Indonesia, Philippines. In Xieng Khouang, locally dominant on cleared hillsides in the Upland Zone where soils are alkaline.

References - Schmid 1958 (p. 210,212); Lazarides 1980 (p. 66); Mannetje and Jones 1992 (p. 242).

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
Axillary	borne within an axil
Blade (leaf)	the upper, mostly flattened, part of a grass leaf
Bract	scale-like modified leaf
Culm	stem of a grass, which mostly develops a terminal flower head
Digitate	with spikes or racemes at tip of culm
Fertile (floret or spikelet)	bearing an ovary (and often also anthers), 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
Ligule	a small collar-like structure (membranous or a fringe of hairs) at the junction of the leaf blade and sheath
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 a spikelet is borne
Pedicellate	with a pedicel
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
Sessile	without a stalk or pedicel
Seta (setae)	a fine bristle
Sheath (leaf)	the lower part of a grass leaf, mostly enveloping the culm or younger leaves
Spathe	modified leaf enclosing part or whole of inflorescence
Spatheate (panicle)	one with branches subtended by modified leafy bracts
Spike	a single individual axis bearing spikelets which lack pedicels
Spikelet	unit of a grass inflorescence typically with two glumes and one or more florets
Sterile (floret or spikelet)	lacking an ovary (but sometimes with anthers), hence not capable of bearing a seed
Stolon	creeping above-ground stem that may produce roots and shoots at nodes
Stoloniferous	bearing stolons
Subdigitate	with spikes or racemes mostly at tip of culm, but with one or more clearly lower
Whorl	a ring of branches, arranged like the spokes of a wheel

Glossary of Lao and Hmong species names

	Lao Name Transliteration	Lao Script	Hmong Name Transliteration	Lao Script
Andropogon chinensis	nya kan khaeng	ຫຍ້າກ້ານແຂງ		
Aristida cumingiana	nya som	ຫຍ້າສົ້ມ		
Artemisia sp.			sau yi	ເຊົາຢີ
Arthraxon hispidus	nya hangh kai	ຫຍ້າຮັງໄກ່	nyor ye kai	ຫຍໍ້ເຢໄກ້
Arundinella nepalensis	nya kan khaeng nam	ຫຍ້າກ້ານແຂງນ້ຳ		
Arundinella setosa	nya kan khaeng nam	ຫຍ້າກ້ານແຂງນ້ຳ		
Axonopus compressus	nya phaed	ຫຍ້າແຜດ	nyor	ຫຍໍ້
Carex baccans	nya liam	ຫຍ້າຫລຽ່ມ		
Chromolaena odorata	nya khiw	ຫຍ້າຂີວ		
Chromolaena odorata	nya phangh	ຫຍ້າຜັ້ງ	paa der	ປ່າເດີ້
Chrysopogon aciculatus	nya khouak	ຫຍ້າຂວກ		
Crotalaria albida	kor kerp bod phii noi	ກໍເກີບປົດຜີນ້ອຍ	paw soong kau ter	ປໍຊົງເຄົາເຕີ່
Crotalaria ferruginea	kor mak kah ding ma noi	ກໍໝາກກະດິງມ້ານ້ອຍ		
Cymbopogon nardus var. *confertiflorus*	nya faek nya singkhai pa	ຫຍ້າແຝກ ຫຍ້າສິງໄຄປ່າ		
Cynodon dactylon	nya phaed khem	ຫຍ້າແຜດເຂັ້ມ		
Desmodium heterocarpon var. *heterocarpon*	nya thoua pa	ຫຍ້າຖົ່ວປ່າ		
Desmodium microphyllum	kor nya had	ກໍຫຍ້າຮັດ		
Desmodium sequax			thaa bau	ທ້າເບົາ
Digitaria setigera	nya nyung kheua	ຫຍ້າຍຸງເຄືອ		
Digitaria violascens	nya nyung kheua	ຫຍ້າຍຸງເຄືອ		
Echinochloa colona			sau khua	ເສົ້າຄົ້ວ
Eleusine indica	nya phak khwai	ຫຍ້າຜັກຄວາຍ		
Eragrostis unioloides	nya khouak phou	ຫຍ້າຂວກຜູ້		
Eriosema chinensis	kor mak mom	ກໍໝາກໝອ່ນ		
Eulalia bicornuta	nya khai noi	ຫຍ້າຄາຍນ້ອຍ		
Eulalia phaeothrix	nya khai houa	ຫຍ້າຄາຍຫົວ		
Eulalia siamensis	nya khai nyai	ຫຍ້າຄາຍໃຫຍ່		

Flemingia sp	kor leuad dang	ກໍເລືອດຄັ້ງ		
Hyparrhenia diplandra	nya faek kan khaeng	ຫຍ້າແຝກກ້ານແຂ້ງ		
Hyparrhenia newtonii	nya kan khaeng	ຫຍ້າກ້ານແຂ້ງ		
Imperata cylindrica	nya kha	ຫຍ້າຄາ	keng	ເກ້ງ
Isachne truncata	nya xai phou	ຫຍ້າໄຊຜູ້		
Keetaleeria davidii	mai hiing	ໄມ້ຫີ້ງ	tchia	ເຈ້ຍ
Leersia hexandra	nya xai	ຫຍ້າໄຊ		
Lespedeza juncea	kor nya hoi ian	ກໍຫຍ້າຫ້ອຍອ່ຽນ		
Lespedeza sp.	kor nya hoi ian	ກໍຫຍ້າຫ້ອຍອ່ຽນ		
Microstegium ciliatum	nya nyung noi	ຫຍ້າຍຸ້ງນ້ອຍ	maw saw meh	ມໍ້ຊໍ້ເມ
Microstegium vagans	nya nyung nyai	ຫຍ້າຍຸ້ງໃຫຍ່	maw saw	ມໍ້ຊໍ້
Miscanthus floridulus	kor khom bao kor kou lao kai noi	ກໍຄົ້ມບາວ ກໍ່ກູ ເລົ້າໄກ່ນ້ອຍ	tao tuu suu	ເຕົ່າຕູ້ຊູ
Mnesithea cancellata	nya lao khang	ຫຍ້າເລົ້າຄ້ັງ		
Mucuna sp.	kor tam nyae	ກໍຕໍາແຍ		
Mucuna sp.			dor caa khi	ດໍ່ກ໊ໍາຊີ
Neyraudia arundinacea	kor ka nyouan	ກໍກະຍວນ	tao lhao	ເຕົ່າເລົ້
Ophiuros exaltatus	nya dii han	ຫຍ້າດີຮານ		
Paspalum conjugatum	nya phaed	ຫຍ້າແຝດ	nyor ea	ຫຍໍ້ເອ້ຽ
Paspalum scrobiculatum var. *bispicatum*	nya phaed khom	ຫຍ້າແຝດຂົມ		
Paspalum urvillei			tao du ku	ເຕົ່າຕູ້ກູ
Phragmites karka	nya or	ຫຍ້າອໍ້	loh kor	ລໍ່ກ໊ໍ
Pinus kesiya	ton paek	ຕົ້ນແປກ	thuu	
Pinus merkusii	ton khoua	ຕົ້ນຄົວ		
Pueraria sp.			maa sawng pow	ม้าซิ่งเป้า
Saccharum spontaneum	kor lao xang kor lao phong	ກໍເລົ້າຊ້າງ ກໍເລົ້າຜົ້ງ	tao suer	ເຕົ່າຊີ
Saccharum sp.	lao khao	ເລົ້າຂາວ	tao der	ເຕົ່າເດ້
Saccharum sp.	kor khaem van	ກໍແຂມຫວານ	tao kaa yi	ເຕົ່າກ໊ໍາຢ້
Saccharum sp.	nya oi nou	ຫຍ້າອ້ອຍໜູ		

Schizachyrium brevifolium	nya nyung tia	ຫຍ້າຍຸ້ງເຕັ້ຽ		
Setaria palmifolia	nya mang nya sai hia	ຫຍ້າມ່າງ ຫຍ້າໄສ້ເຮ້ຽ	ti daa	ຕີດ້າ
Sporobolus indicus var. *major*	nya na phak kwai	ຫຍ້າຫນ້າຜາກຄວາຍ	nyor sa pau	ຫຍ້ຊ້າເປົ້	
Tephrosia vogelii			tao ka chi kuu	ເຕົ່າກາຈີກູ
Themeda arundinacea	nya jik jork nyai	[ຫຍ້າຈີກຈອກນ້ອຍ]		
Themeda intermedia	nya faek fap	ຫຍ້າແຝກຟາບ	tao daa	ເຕົ່າດ້າ
Themeda triandra	nya jik jork noi	ຫຍ້າຈີກຈອກນ້ອຍ		
Thysanolaena latifolia	kor khaem	ກໍແຂມ	tao khao sua	ເຕົ່າເຄົ້າຊົ້ວ
Tithonia diversifolia			paa ia	ป่າເອ້ຽ
Vigna umbellata			maa sawng	ม้າຊ໊ວ

Voucher specimens from Xieng Khouang maintained at the Rijksherbarium/Hortus Botanicus, The Netherlands (specimen illustrated italicised)

Andropogon chinensis	*JBH1396*; JBH96-20j
Apluda mutica	JBH1347; JBH1494; *JBH96-23a(creek)*
Aristida cumingiana	JBH1332; *JBH96-23a(plain)*
Arthraxon hispidus	JBH1421; JBH1431; JBH1441; JBH1443; JBH1447; JBH1487; JBH1497; JBH96-14d
Arundinella nepalensis	JBH1342; JBH1346; *JBH1402*; JBH1415
Arundinella setosa	JBH1336; JBH1467; JBH96-9e; JBH96-20g; *JBH96-20k*; JBH96-21Ba; JBH96-21Be; JBH96-22c; JBH96-23e(plain)
Axonopus compressus	JBH1450; *JBH1363*
Bothriochloa bladhii	*JBH1454*; JBH96-20l
Capillipedium assimile	JBH1341; *JBH1389*; JBH1442; JBH1479; JBH96-23e(creek)
Capillipedium parviflorum	*JBH1405*
Centotheca lappacea	*JBH1392*
Chionachne semiteres	*JBH1399*; JBH1400
Chrysopogon aciculatus	
Cymbopogon nardus var. *confertiflorus*	JBH1398; *JBH1462*; JBH96-20f; JBH96-21Bc; JBH96-22f
Cynodon dactylon	*JBH96-14c*
Cyrtococcum accrescens	JBH1387; JBH1439; JBH1468; *JBH1500*
Digitaria fuscescens	*JBH1448*
Digitaria setigera	*JBH1422*
Digitaria violascens	*JBH96-21Bh*
Echinochloa colona	*JBH1430*
Echinochloa crus-galli	JBH1472; JBH96-23c(creek)
Eleusine indica	*JBH1366*

Eragrostis atrovirens	*JBH1464*; JBH1512; JBH96-14a (Mixt.)
Eragrostis brownii	JBH1335; JBH1511; JBH96-21Bg; *JBH96-22a*
Eragrostis ferruginea	*JBH96-14a* (Mixt.)
Eragrostis unioloides	JBH1334; JBH1356; JBH1365; *JBH1390*; JBH1449
Eulalia ?bicornuta	*JBH1333*; JBH1358(Mixt.); JBH1359; JBH1361; JBH1394; JBH1395; JBH96-9f;
Eulalia leschenaultiana	*JBH1510*
Eulalia phaeothrix	*JBH1337*; JBH1357(Mixt.); *JBH1375*; JBH96-9d; JBH96-9g
Eulalia siamensis	JBH1331; JBH1357(Mixt.); JBH1358(Mixt.); JBH1367; *JBH1403*; JBH96-9c; JBH96-20i; JBH96-23f(plain)
Hyparrhenia filipendula	JBH1410; *JBH96-22b*
Hyparrhenia diplandra	JBH1404; JBH1466; JBH96-20e; *JBH96-23c(plain)*
Hyparrhenia newtonii	*JBH1339*; JBH1397; JBH96-9b; JBH96-21Bb; JBH96-23b(plain)
Imperata cylindrica	
Isachne ?albens	JBH1388
Isachne truncata	*JBH1491*
Ischaemum indicum	*JBH96-23d(creek)*
Kerriochloa siamensis	JBH1509; *JBH1515*; JBH96-23g(plain)
Leersia hexandra	JBH1429; *JBH1471*
Microstegium ciliatum	*JBH1385*
Microstegium vagans	JBH1338; JBH1345; JBH1416; JBH1423; *JBH1433*; JBH1469; JBH96-20c
Miscanthus floridulus	JBH 1350; JBH1373; *JBH1383*; JBH1414; JBH1418
Mnesithea cancellata	*JBH1508*; JBH96-20d
Neyraudia arundinacea	*JBH1348*; JBH1419; JBH1456; JBH1496
Ophiuros exaltatus	*JBH1401*
Oplismenus compositus	*JBH1427*; JBH1470
Panicum brevifolium	*JBH1438*
Panicum humile	*JBH1369*
Panicum notatum	JBH1343; JBH1386; JBH1411; JBH1436; JBH1437; *JBH1502*
Panicum sarmentosum	*JBH1384*
Paspalum conjugatum	JBH1368; *JBH1428*
Paspalum scrobiculatum var. *bispicatum*	JBH1360; JBH1364; *JBH1434*; JBH96-14b; JBH96-21Bi
Paspalum urvillei	JBH1453; *JBH1463*
Phragmites karka	*JBH1353*
Pseudosorghum zollingeri	*JBH1477*
Saccharum spontaneum	*JBH1380*; JBH1493
Saccharum sp.	*JBH1420*
Saccharum sp.	*JBH1476*
Saccharum sp.	*JBH1516*
Sacciolepis indica	*JBH1440*

Schizachyrium brevifolium	JBH1412; *JBH96-22g*
Setaria palmifolia	JBH1382; JBH1391; *JBH1432*; JBH96-21Bd
Setaria parviflora	*JBH96-21Bd*
Sorghum nitidum	JBH1340; JBH1393; *JBH1495*; JBH96-22d
Sporobolus indicus var. *major*	JBH1355; *JBH1413*
Themeda arundinacea	JBH1417; *JBH1460*
Themeda intermedia	JBH1349; *JBH1379*
Themeda triandra	JBH1461; *JBH96-9a*; JBH96-20n; JBH96-21Bf
Thysanolaena latifolia	JBH1381; *JBH1455*

References

Baaijens, G.J. and Veldkamp, J.F. (1991). *Sporobolus* (Gramineae) in Malesia. *Blumea* **35**, 393-458.

Bor, N.L. (1960). *The Grasses of Burma, India, Ceylon and Pakistan.* (Pergamon Press: Oxford).

Clayton, W.D. (1998). World Grass Flora database in DELTA format. Royal Botanic Gardens, Kew, UK.

Clayton, W.D. and Renvoize, S.A. (1982). *Flora of Tropical East Africa. Gramineae (Part 3).* A.A. Balkema: Rotterdam).

Gibson, T. (1995). Livestock component of the LAO/UNDCP/IFAD Xieng Khouang Highland Development Programme. Final Report to UNDCP.

Gibson, T. (1997). The Plain of Jars: an example of phosphorus deficiency for forages and livestock. *SEAFRAD News* **4**, 2.

Gilliland, H.B. (1971). *A Revised Flora of Malaya Volume 3. Grasses of Malaya.* (The Botanic Gardens: Singapore).

Hacker, J.B., Simon, B.K. and Phengvichith, Vanthong. (1996). The pek savannas of the Lao Peoples Democratic Republic - ecology and floristics. CSIRO Division of Tropical Crops and Pastures Genetic Resources Communication No. 23.

Hô, Pham-Hoàng and Du'o'ng, Nguyen-Van (1960). *The Flora of Vietnam (in the South of the 17th parallel).* (Faculty of Sciences: Saigon).

Koning, R. de and Sosef, M.S.M. (1985). The Malesian species of *Paspalum* L. (Gramineae). *Blumea* **30**, 279-318.

Lazarides, M. (1980). *The Tropical Grasses of Southeast Asia. Phanerogramarum Monographiae* **Tomus XII.** (J. Kramer: Vaduz, Germany).

Mannetje, L. 't and Jones, R.M. (1992). *Plant Resources of South-East Asia No 4. Forages.* (Pudoc: Wageningen).

Schmid, M. (1958). Flora agrostologique de l'Indochine. *l'Agronomie Tropicale* **13**, 1-51, 143-237, 300-359, 459-522, 631-672, 687-703.

Tothill, J.C. and Hacker, J.B. (1983). *The Grasses of Southern Queensland.* (University of Queensland Press: Brisbane, Australia).

Veldkamp, J.F. (1973). A revision of *Digitaria* Haller (Gramineae) in Malesia. *Blumea* **21**, 1-80.

Veldkamp, J.F. (1994). Miscellaneous notes on Southeast Asian Gramineae. IX *Setaria* and *Paspalidium*. *Blumea* **39**, 373-384.

Veldkamp, J.F. (1996). *Panicum, Whiteochloa* (Gramineae, Paniceae) in Malesia. *Blumea* **41**, 181-216.

Index

Plant names in italics are names that appear in the literature but which are now no longer used. Page numbers in italics show illustrations