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A New Species of *Cryptocoryne* (Araceae) from Borneo

I.B. IPOR, C.S. TAWAN

[1]Faculty of Resource Science & Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak

AND

N. JACOBSEN

Botanical Section, Department of Ecology, The Royal Veterinary and Agricultural University, Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark

Abstract

Cryptocoryne zaidiana Ipor & Tawan, a noteworthy new species from Long Tran, Tinjar, Miri Division, Sarawak, is described and illustrated. This amphibious species grows on mudflats in sandy clay soil of the intertidal freshwater zone of Sungai Mering. Its leaf shape and texture are similar to those of *Cryptocoryne lingua* Engler but differ especially in its spathe characteristics. It has a strongly recurved ovate limb, the upper surface is distinctly covered with purplish and creamy protuberances and it has a distinct creamy collar.

Introduction

In Sarawak *Cryptocoryne* species occur in the inner tidal zone in rivers and streams, on riverbanks of slow and fast flowing rivers or streams and in ditches of swampy and flooded areas. In most places they are found in shaded locations. They are known as *kalakatai* (Iban - Sarawak); *kiambang batu* (Malay-Sarawak and Peninsular Malaysia) and *tropong air* (Banjarmasin-Kalimantan).

The discovery of the new species *Cryptocoryne zaidiana* raises the current total number of *Cryptocoryne* species in Sarawak to fourteen. The eleven species reported by Jacobsen (1985) are *C. ciliata* (Roxburgh) Schott, *C. auriculata* Engler, *C. bullosa* Engler, *C. ferruginea* Engler, *C. keei N.* Jacobsen, *C. lingua* Engler, *C. longicauda* Engler, *C. pallidinervia* Engler, *C. striolata* Engler, *C. zonata* De Wit and *C. grabowskii* Engler. Jacobsen (2002) regards *C. zonata* as *C. cordata* Griffith var. *zonata* (De Wit) N.Jacobsen and *C. grabowskii* as *C. cordata* Griffith var. *grabowskii* (Engler) N.Jacobsen. Recently two other species have been described, *viz. C. uenoi* Y.Sasaki (2002) and *C. yujii* Bastmeijer (2002), which were collected from

Sabal Keruing, Sri Aman Division and Sungai Nibong, Durin, Sibu Division, respectively (Bastmeijer, 2005). It is essential to conduct more field work to obtain extensive records of the existence and occurrence, as well as understanding of the natural diverse habitats of *Cryptocoryne* species in Sarawak.

Description of the Species

Cryptocoryne zaidiana Ipor & Tawan ***sp. nov.***

Differt a *C. lingua* folia majore, limbus ovatus, valde recurvatus, protuberance supra sed. **Typus** - Sarawak: Miri Divison, Tinjar, Long Tran, Sungai Mering, whole plant with inflorescence and young syncarp, 2 July 2004, *C.S. Tawan, I.B. Ipor & A. Mohd Rizan CST 2548*, (holotypus, HUMS (Herbarium Universiti Malaysia Sarawak) - in spirit).

Rhizome stout, internode length 1.0–3.0 cm, 4.5–6.8 mm diam., whitish, smooth, adventitious roots contracted at the nodes, new roots whitish and later becoming brownish due to mud stains, 1–14 cm long, **Cataphylls** 1–2 keeled adaxial to the flowering shoot, ovate, 5 cm long, 1.5 cm across at the middle, convolute, base whitish, light greenish upper portion, slightly hyaline near the margin, smooth on both surfaces, base truncate, apex acute. **Leaves** with upper surface green, smooth and a shiny, lower surface smooth and pale green or sometimes slightly purplish; blade ovate, 9.5–13.5 x 4.0–6.0 cm, base truncate-cordate, apex acute, margin entire sometimes slightly wavy near the base; midrib flattened on both surfaces, secondary veins 4 pairs, not prominent, slightly channeled on both surfaces; petiole elongate, 19–23 cm long, 3.6–5.6 mm diam. in middle, leaf sheath *c.* 3.5–4.5 cm long with hyaline margins, middle portion rounded or sometimes angled, upper part slightly flattened, green, lower part usually brownish due to mud stains. **Spathe** 9–14 cm long, pedunculate 1.5–2.5 cm long, 6 mm diam., whitish, smooth; kettle 2–2.8 cm long, constricted about 1/3 from the top; outer surface with a whitish background with faint purplish longitudinal lines, inner surface 1/3 of the upper portion, whitish, 2/3 lower portion sprayed with fine purple spots; tube 4.5–7 cm long, narrow, cylindrical at base 5 mm diam., broader in the upper part, 7.5 mm diam., outer surface faintly purplish, more intense in the upper part; inner surface whitish, slightly twisted, tube fusion line distinct, purple; **limb** strongly recurved, 3.0–4.0 cm long, 1.5–2 cm across (near the collar), ovate, apex apiculate, 3–4 mm long, dark purple, upper surface with protuberances or warty, creamy-whitish, margin and surface towards the apex covered

Figure 1. ***Cryptocoryne zaidiana*** Ipor & Tawan.
A Plant with inflorescence and fruit; **B** inner surface of the kettle; **C** limb surface and collar; **D** spadix showing the male and female flowers; **E** thecae; **F** stamen; **G** syncarp with verrucose surface; **H** seed. (A-F from the holotype *CST 2548*; G-F from the *CST 2549* - drawn from the fresh material).

with distinct dark purple protuberances, lower surface whitish or faintly purplish; collar distinct, creamy; throat surface deep purplish or sprayed with purplish spots, surface smooth. **Female flowers** *c.* 6, stigma ovate-elliptic, purplish; ovary whitish elongate, 3 mm long, 1 mm wide, **Male flowers** *c.* 50, smooth, creamy or light yellow; naked axis spadix 9–10 mm long, purplish; sterile appendix *c.* 1.5 x 1.0 mm, ovate, deep purple; olfactory bodies dark purple; flap ovate, 4–5 x 3–3.5 mm, whitish. **Fruit peduncle** 3.5–6.0 cm long, 3–4.5 mm diam., whitish or sometimes speckled with dark purple spots. **Syncarp** broadly ovoid, 1.5–1.7 cm long, 12–16.5 mm diam., dull green speckled with dark purple, slightly verrucose surface, apex distinctly apiculate, dark green-purple. **Seeds** elongate 6–7 mm long, 1.8–2.0 mm broad at base, dark purple in the upper portion, lower part whitish, surface slightly striated. Embryo with three long, green plumulary processes.

Other specimens studied: Type locality, whole plant with inflorecence, 16 June 2004, *C.S. Tawan , I.B. Ipor & A. Mohd Rizan CST 2545* (HUMS) – in spirit from cultivated plant collected from the type locality; herbarium specimens from the type locality, whole plant with mature syncarp, 2 July 2004, *C.S. Tawan , I.B. Ipor & A. Mohd Rizan CST 2550* (HUMS); whole plant with inflorescence and young syncarp, 2 July 2004, *C.S. Tawan, I.B. Ipor & A. Mohd Rizan CST 2551* (HUMS); whole plant with inflorecence, 2 July 2004, *C.S. Tawan, I.B. Ipor & A. Mohd Rizan CST 2552* (SAR).

Distribution: Endemic in Sarawak, as yet known only from Sungai Mering, Tinjar, Miri Division.

Habitat: *Cryptocoryne zaidiana* occurs in small patches on muddy ground (sandy clay soil) with a litter of leaves and twigs. The river is approximately 5–7 m wide and flooded with a considerable slow current after a period of heavy rain. The riverbank is established with secondary riverine forest (15–18 years after padi planting according to the local people). The forest undergrowth is mainly dominated by bemban, *Donax grandis* (Marantaceae). The river normally becomes shallow or sometimes dries up after dry periods. At this time, this river is a popular place for the local people to '*mansai*' (to fish using round-shaped nets to scoop in the shallow water to catch small fish). This regular activity appears to disturb the habitat of *C. zaidiana*. More severe disturbance is imminent as the area is earmarked for oil palm plantations.

Notes: Cryptocoryne zaidiana shows in its habitat and morphological characteristics certain similarity with *C. lingua*. These two species thrive well on mudflats of riverine clay soil along the fringes of riversides and

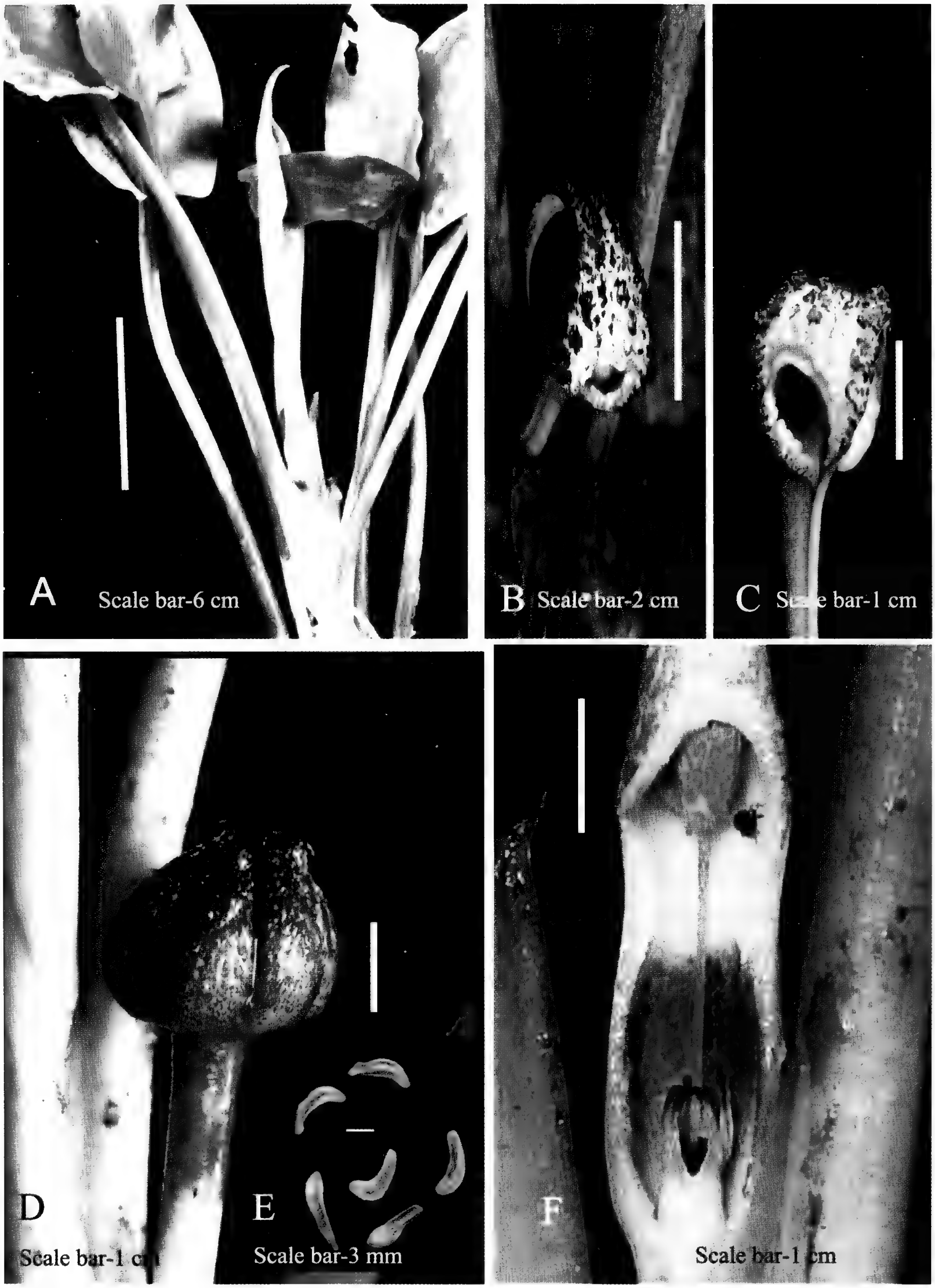

Plate 1. ***Cryptocoryne zaidiana*** Ipor & Tawan.
A Plant with unopened inflorescence; **B, C** limb surface and collar; **D** syncarp with verrucose surface; **E** seeds; **F** the male and the female zones.

ditches. *C. lingua* grows well in a certain level of salinity during short drought spells in the Sungai Sarawak (Ipor, *pers. obs.*). To date, *C. zaidiiana* has only been found in freshwater within the intertidal zone. Both species have spongy leaves but *C. lingua* has an ovate to oblong blade with a truncate base whereas *C. zaidiana* has ovate blades with a truncate to cordate base. This species is different from *C. lingua* in having an ovate, strongly recurved limb with protuberances on the upper surface. *C. lingua* has a caudate, smooth limb without protuberances on the upper surface.

Etymology: This species is named in honour of the late Tun Ahmad Zaidi Adruce, who was the first Chancellor of Universiti Malaysia Sarawak (UNIMAS) and the fifth Governor of Sarawak, in recognition of his great contribution to the state of Sarawak and in particular to research development at UNIMAS during his lifetime.

Acknowlegements

We thank Universiti Malaysia Sarawak for the short-term grant to undertake this project. Our gratitude also goes to the Sarawak Forestry Department for permission to collect the specimens. We should also like to thank Mohd Rizan Abdullah, James Abai and Hidir Marzuki for their help. Our appreciation also goes to Joseph Pao for the botanical illustration.

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A Remarkable New Species of *Homalomena* (Araceae: Homalomeneae) from Peninsular Malaysia

BAHARUDDIN SULAIMAN

School of Biological Sciences, Universiti Sains Malaysia,
11800 Minden, Pulau Pinang, Malaysia

AND

PETER C. BOYCE

Malesiana Tropicals, Suite 4, Level 9, Tun Jugah Tower,
Jalan Abdul Rahman, 93000 Kuching, Malaysia

Abstract

Homalomena pineodora Sulaiman & P.C.Boyce is described as a new species from Peninsular Malaysia. Its similarities to *H. bellula* Schott (Java), *H. elegantula* A.Hay & Herscovitch and *H. hastata* M.Hotta (both Sumatera) and an as yet undescribed *Homalomena* from North Vietnam are discussed.

Introduction

Homalomena is a genus of more than 120 species of terrestrial or lithophytic, seldom rheophytic, clumping, rarely rhizomatous, very rarely climbing, mostly aromatic herbs distributed in the Neo- and Asian tropics. As noted by Hay & Herscovitch (2002), the genus is overwhelmingly Asian in distribution with the greatest number of species occurring in archipelagic Malesia. The taxonomy of *Homalomena* is presently in disarray, the problem compounded by the poor condition of many of the historical types and inadequate understanding of interspecific variability.

There is a tendency in herbaria to apply the names of continental Asian, Sumateran, Javan and Bornean species somewhat indiscriminately while ignoring the high levels of endemism known to exist for other terrestrial aroid genera (e.g., *Alocasia*, *Schismatoglottis*) in these regions. With more fieldwork it is becoming apparent that for these land masses the level of species endemism averages 80% (Boyce, unpublished data) and that species novelty for most terrestrial aroid genera is in excess of 75% (Boyce, unpublished data); there is no evidence to suggest that *Homalomena* is any different: Sarawak alone appears to have at least 80 species of *Homalomena* of which no fewer than 65 are as yet undescribed. Until such time as a full revision of *Homalomena* is attempted, there is still a need to be able to identify the more distinctive taxa. The only practical approach is to describe new taxa as they become apparent with the caveat that at a future date some of these taxa may prove to be unsustainable in light of a more comprehensive and thorough revision.

Despite Furtado's attempts to unravel *Homalomena* in Peninsular Malaysia (Furtado, 1939) and accepting the evidence that *Homalomena* is far more species-rich in archipelagic rather than in continental Asia, much remains to be done in Peninsular Malaysia before it can be said that *Homalomena* is properly understood. That much remains to be discovered was evidenced during fieldwork by the first author at Pondok Tanjung, Selama, Perak, where a collection was made that at first appeared to be a species of *Piptospatha* in that it was growing in a rheophytic habitat and carried nodding inflorescences. However, further examination revealed that the petiolar sheaths were fully adnate to the petiole (adnate basally but otherwise free and long ligulate in *Piptospatha*), the spathe showed no abscission layer between the lower part and the limb (all west Malesian *Piptospatha* shed the upper spathe at anthesis), and that the leaf tissue when crushed emitted a very strong resinous smell (tissue odourless in *Piptospatha*). Examination of fresh inflorescences revealed the pistils were each associated with a staminode confirming, together with the above listed characters, that the plant belongs to the genus *Homalomena*. It is here described.

Homalomena pineodora Sulaiman & P.C.Boyce, ***sp. nov.***
Ab alii *Homalomena* Malesiarum caudice repenti hypogeo pleionathico et inflorescentia cernuua differt. **Typus**: Malaysia, Perak, Pondok Tanjung, Selama, 5° 0'N; 100° 45'E, *B. Sulaiman BS 1259* (holo Universiti Sains Malaysia 10811; iso KEP, SING).

Dwarf creeping evergreen strongly aromatic (terpenoids - reminiscent of *Pinus*) when cut or crushed herb to 25 cm tall; cut surfaces producing copious watery, later sticky, aromatic sap. *Stem* rhizomatous, creeping, *c.* 8–10 mm diam., rooting along its length over the entire surface, oldest parts of stems clothed with papery to fibrous leaf base remains, roots penetrating this fibrous layer, roots also penetrating the leaf bases in the lower active portion; distal active shoot erect to semi-procumbent; active part of shoots densely clothed with spiro-distichous leaves; shoots pleionanthic. *Leaves* clustered towards shoot tips; *petiole* partially clasping the rhizome and then expanding into a persistent petiolar sheath, petiole 8.5–9 cm long, non-sheathing portion *c.* 2.5 mm diam., weakly D-shaped in

Figure 1. Type plant of *Homalomena pineodora* Sulaiman & P.C. Boyce showing the distinctive nodding inflorescences.

cross-section and dorsally shallowly grooved, the groove extending to the insertion of the lamina; *sheath* extending to *c.* 3/4 petiole length, margins hyaline, long-persistent; *lamina* leathery, elliptic to weakly oblongo-elliptic, 9–12 x 4–5 cm, base cuneate to ovate, apex acute with a prominent 3.5–4 mm long tubule, margins minutely hyaline (margins *c.* 0.5 mm wide) and tending to crispulate at the petiole insertion, abaxial surface pale green with up to 5 (mostly 3–4) weakly prominent and slightly darker primary lateral veins on each side of the mid-vein; interprimaries much less prominent and not at all darker than the abaxial lamina; adaxial lamina surface slightly lustrous dark green, primary lateral veins slightly impressed, interprimary veins hardly discernible. *Inflorescences* nodding, two together, maturing sequentially, each subtended by a two-keeled prophyll. *Peduncle* *c.* 5 cm long, 2.5 mm diam., weakly D-shaped in cross-section and expanding distally at the insertion of the spathe. *Spathe* unconstricted, ovate-ellipsoid, inflated and gaping at anthesis, c. 3 x 1.8 cm (rolled) (5.5 cm wide when flattened) ovato-triangular, apex acuminate; spathe exterior glossy bright green, the upper half deeper green, the lower half somewhat yellow-white, at anthesis spathe margins recurved, hyaline and slightly brownish along the edge; spathe interior glossy greenish white. *Spadix* 20 x 8 mm, stipitate, stipe *c.* 1 mm. *Pistillate flower zone* 6 x 6 mm with a zone of very slender-stalked globose-claviform 0.1 x 0.2 mm glossy white staminodes basally. *Ovaries* compressed-globo-cylindrical, 0.2 x 0.4 mm, stigma sessile, circular and slightly umbonate, overhanging the ovary, 0.7 x 0.4 mm, ovaries pale green, stigma translucent greenish white. *Male flower* zone ovoid, 10 x 7 mm, fertile to the apex, flowers comprised of two stamens, rarely one stamen aborted, 0.4 x 0.5 mm, connective barely prominent, male flowers pale cream. *Infructescence and seeds* not observed.

Distribution: Peninsular Malaysia (NW Perak), known only from the type collection.

Habitat: Riverside, growing in clumps on an inundated site under forest canopy. Sea level.

Notes: The rhizomatous stems, pleionanthic shoots and inflorescences nodding at anthesis immediately distinguish *Homalomena pineodora* from any *Homalomena* hitherto described from Peninsular Malaysia and adjacent peninsular Thailand. Rhizomatous creeping stems are a feature of two species described from Sumatera (*H. elegantula* A.Hay & Herscovitch, *H. hastata* M.Hotta,) and one from Java (*H. bellula* Schott). Among characters that distinguish these species from *H. pineodora* are hapaxanthic shoots (all), inflorescences erect at anthesis (all), hastate leaves (*H. hastata*), apically geniculate petioles (*H. elegantula*) and smaller (1 cm long) spathes (*H. elegantula*). An as yet undescribed *Homalomena* from Ba Vi, north Vietnam, has rhizomatous creeping stems, pleionanthic shoots and nodding inflorescences but differs from *H. pineodora* by the longer petioles with the petiolar sheath *c.* 1/4 the length of the petiole, broader ovato-cordate leaf laminae, a longer, narrower spadix and a markedly different smell produced by the crushed tissue (the Ba Vi *Homalomena* has a smell resembling *Juniperus* — *H. pineodora* smells of *Pinus*). The odours produced by the damaged tissue of *H. elegantula*, *H. hastata* and *H. bellula* are not recorded.

The specific epithet is from the Latin *pinea* and *odora* meaning 'pine-scented' in allusion to the very strong smell of *Pinus* produced by cutting or crushing the plant tissue.

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Hapaline appendiculata (Araceae: Caladieae) Rediscovered

PETER C. BOYCE, JELEND AK KISAI AND JEPOM AK TISAI

Malesiana Tropicals, Suite 9-04, Tun Jugah Tower,
No. 18, Jalan Tunku Abdul Rahman,
93100 Kuching, Sarawak, Malaysia

Abstract

Hapaline appendiculata Ridl., a species endemic to Sarawak, Borneo, and hitherto known from only three collections, has recently been recollected. An expanded description for the species, first ever published field photographs and a key to *Hapaline* in Borneo is presented.

Introduction

Recent and on-going fieldwork in Sarawak continues to reveal a wealth of novel aroid species and has led to the rediscovery of numerous others known from fewer than five collections. One such recent discovery was that of *Hapaline appendiculata* Ridl., an aroid known from just three previous collections, all fragmentary, and thus seemingly representing one of the rarest aroids in Borneo.

Hapaline

Hapaline is a genus of seven published species occurring from Myanmar to China (Yunnan) and south to western Sarawak. All species so far discovered are diminutive to moderate-sized, slender, tuberous or stoloniferous, clump-forming, terrestrial and seasonally dormant or (rarely) evergreen herbs. See Boyce (1996) for an extensive commentary and generic description.

Hapaline is superficially similar to species of the genus *Typhonium* Schott (tribe Areae), most notably in the sagittate leaves with prominently reticulate venation. In Borneo there are only three *Typhonium* species, all introduced and all associated exclusively with ruderal habitats whereas *Hapaline* is only found in natural forest. Elsewhere in the range of *Hapaline* (e.g., Thailand) there are strikingly similar species of *Typhonium* in natural habitats and confusion is possible between these and *Hapaline*. In these instances the floral characters to distinguish *Typhonium* include the naked spadix appendix (spadix appendix covered in synandrodes: *Hapaline*), the inflated, convolute lower spathe (lower spathe clasping the female flower zone: *Hapaline*), free male flowers (stamens fused into synandria: *Hapaline*) and the female flower zone free (fused to the abaxial lower spathe surface: *Hapaline*).

***Hapaline appendiculata* Ridl.**

Hapaline appendiculata Ridl., J. Straits Branch Roy. Asiat. Soc. 49 (1908 ('1907')) 47; Bogner, Pl. Syst. Evol. 144 (1984): 62 (1984); Boyce, Kew Bull. 51(1) (1996) 63–82 (1996). **Type**: Sarawak, Kuching Division, Puak, Sept. 1890, *Ridley 12411* (holotype SING!; isotype K!).

Slender, tuberous, seasonally dormant perennial herb up to 25 cm tall. **Stem**: tuberous, ± cylindric, *c.* 1.5 x 1 cm; plants frequently producing two to five slender (*c.* 3 mm diam.) stolons to 30 cm long, these rooting terminally and forming additional tubers. **Roots** *c.* 0.25–0.33 mm in diam., mostly spreading through the leaf litter-soil interface. **Leaf** prophyll linear, up to 9 x *c.* 4 mm, acute; cataphylls oblong-lanceolate to linear triangular or triangular, up to 10 cm x 5 mm, attenuate to acute, prophyll and cataphylls at first membranous and pale green, soon darkening and drying papery; petiole 2.5–18 cm x 1–2 mm; leaf blade ovate to hastate or subsagittate, 10–21 x 3.5-8.5 cm, thinly coriaceous or coriaceous, even on the same plant, pale to dark green, occasionally with various greyish to pale green blotchy or/or cloudy markings adaxially, abaxial surface much paler, sometimes suffused reddish purple in which case primary mid-vein and primary lateral veins on abaxial surface purple-red, margins smooth, apex acute to acuminate, posterior lobes rounded to subacute, divergent to almost parallel, sometimes ± absent. **Inflorescence** (1)2–4 together held level with or below the leaves; peduncle 4–25 cm x 0.25–0.5 mm; spathe 2–7 cm long; spathe limb elliptic, 1.6–2.6 cm x 5–7 mm, apex acute to briefly attenuate, base decurrent into lower spathe; lower spathe margins clasping the ovaries, 4–8 x *c.* 1.5 mm; spadix 2.5–3.5 cm x 0.25–1 mm, free portion cylindric, up to 14 mm long, tapering apically into a greatly attenuated appendix to 9 mm long composed of connate synandrodes. **Flowers** synandria irregularly elongate in plan view, 2–3 x 0.5–1 mm; ovaries bottle-shaped, 1.5 x 0.7 mm, two or three in a single row aligned longitudinally along the spadix axis; stigma capitate, *c.* 0.2 mm in diam., papillose; style very short. **Infructescence** carried on declinate to reflexed peduncle, enclosed by the persistent lower spathe, 2 cm x 4 mm, few-berried; berries more or less globular, ripening pale green, *c.* 4 mm in diam, stigmatic remains persistent, not prominent. **Seed** ellipsoid, *c.* 3 x 2 mm, glossy pale brown with a conspicuous white oily raphe.

*Distribution***:** Endemic to Sarawak with four collections to date, these only

Plate 1. *Hapaline appendiculata* Ridl. 1. A typical flowering individual at Tringgus (*Boyce, Kisai & Tisai AR-1017*). Note the greatly elongated appendix comprised of fused synandrodes; 2. A form with little or no posterior leaf lobe development; 3. An example of the leaf variegation present at Tringgus.

from Kuching Division (three collections) and Kapit Division (one collection).

Other specimens seen: SARAWAK. Kuching Division: Krokong, Kampung Tringgus, Sungai Bong, 01° 15' 22.8"; 110° 05' 53.9", 4 March 2005, *P.Boyce, Jelend & Jepom AR-1017* (SAR, UNIMAS); Bau, Bidi, 6 Dec. 1905, *Hewitt 476* (SING!). Kapit Division: Belaga, Long Linau, near Punan Lusong to Long Jakah, 8 Sept. 1978, *Burtt & Woods 11477* (E!).

Ecology: Lowland evergreen moist valley forest on shales and basalt. Only recorded altitude *c.* 150 m asl (Tringgus). Both Bornean *Hapaline* are associated with shale and basalt whereas all other *Hapaline* species (all extra-Bornean) are restricted to karst limestone. *Hewitt 476* is purportedly from a limestone habitat (Bidi). However, repeated visits to the site by the authors have failed to refind *Hapaline* and it is possible that the locality data are in error.

Notes: Based on the paucity of collections, *Hapaline appendiculata* appears to be one of the rarest aroids in Borneo. However, considering its diminutive size, the periodically dormant nature of the plant and the fact that aroids have received scant attention from field workers since Ridley's time, it is equally possible that it is simply overlooked during fieldwork. It is worth noting that the Kuching and Kapit collections of *H. appendiculata* are 340 km apart with much of the intervening forest botanically unexplored.

Hapaline appendiculata was not visible during several previous visits by the authors to Tringgus although on the trip that lead to the collection discussed here it was abundant and flowering gregariously.

The method of seed dispersal is unknown although the oily raphe suggests ant dispersal, as occurs in other aroid genera with similar seed, e.g., *Biarum* Schott and *Eminium* Schott (both Mediterranean). The first author has observed morphologically similar seed of *Zingiber pseudopungens* R.M.Sm. and *Z. pachysiphon* B.L.Burtt & R.M.Sm. (Zingiberaceae) being carried by solitary foraging ants of the genus *Campanotus*.

Hapaline appendiculata differs from *H. celatrix* P.C.Boyce (Brunei) by its seasonally dormant habit, thinly coriaceous leaves and greatly elongated sterile appendix. The habitat of *H. celatrix* is briefly seasonally-dry riverine forest on shale. Both known localites of *H. celatrix* are more exposed (higher light levels) and presumably less humid for at least part of each day than the habitats of *H. appendiculata*. In neither locality is *H. celatrix* abundant.

Plate 2. ***Hapaline appendiculata*** **Ridl.** 4. A form with hastate concolorous leaves: 5. Showing the range of variation in leaf shape and markings present at Tringgus. These individuals were collected within 20 metres of one another.

Key to the Two Species of *Hapaline* in Borneo

1a. Spadix sterile apex greatly elongated, exceeding spathe limb; foliage thinly coriaceous .... ***H. appendiculata***
1b. Spadix sterile apex not greatly elongated, not exceeding spathe limb; foliage thickly coriaceous .... ***H. celatrix***

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Begonia bataiensis Kiew, a New Species in Section *Leprosae* (Begoniaceae) from Vietnam

TRUONG QUANG TAM

Institute of Tropical Biology
85 Tran Quoc Toan, Quan 3
Hochiminh City, Vietnam

RUTH KIEW

AND

J.J. VERMEULEN

The Singapore Botanic Gardens
1 Cluny Road, Singapore 259569

Abstract

Begonia bataiensis Kiew with long, cylindric, fleshy fruits is the fourth species to be described in the largely Chinese section *Leprosae.*

Introduction

The great majority of *Begonia* species have dry capsular fruits that are conspicuously winged and that dehisce to release the seeds. The only Asian sections with berries (fleshy fruits that do not dehisce) are sect. *Sphenanthera* and sect. *Leprosae*, which differ primarily in fruit shape - turbinate in sect. *Sphenanthera* and narrowly cylindric in sect. *Leprosae.* This new species, *Begonia bataiensis* Kiew, with its cylindric, fleshy, indehiscent fruit therefore falls within sect. *Leprosae*.

Begonia sect. *Leprosae* accommodates, besides this new species, three others, *B. leprosa* Hance, *B. longicarpa* K.Y.Guan & D.K.Tian and *B. cylindrica* D.R.Liang & X.X.Chen (Shui *et al.*, 2002). Apart from *B. longicarpa*, which has been collected from the Lao Cai Province, in the extreme north of Vietnam, just across the border from China, the other two are confined to southern China (Shui *et al.*, 2002). This new species therefore extends the distribution of this section much further south to Kien Giang Province in southwest Vietnam.

While sharing the character of the fleshy, narrowly cylindric fruit, it is quite unlike the other three species in habit - the other three attain a much larger size and are plants with rhizomes, leaves with a ferrugineous indumentum and dichasial inflorescences that are shorter than the leaves as compared with *B. bataiensis*, which is stemless, has a basal tuber that produces just one or two or up to five small leaves with scattered translucent hairs, and racemose inflorescences longer than the leaves (Plate 1A). In addition, its fruit is not clavate as are those of *B. leprosa* and *B. longicarpa*, but instead are narrowly tapered distally.

It is probable that this section is artificial and that this fruit type has evolved more than once. Indeed, in its habit (stemless with a tuber), its almost symmetric leaves and its racemose inflorescence, this new species more closely resembles species in sect. *Diploclinium* III of Doorenbos *et al.* (1998) than other species in sect. *Leprosae.*

Begonia bataiensis Kiew, ***sp. nov.***

Differt a *Begonia leprosa* tuberiformis (nec rhizomatis), foliis 5–6 cm longis (nec (4–)7.5–15 cm longis) et inflorescentia racemosa (nec dichasia). **Typus**: Vietnam, Ba Tai Hill, Kien Giang Province. *J.J. Vermeulen 2586* (spirit collection *2610*) October 2004 (holo HCMC, iso HN, SING).

Tuberous begonia without a stem. **Tuber** turbinate, mature ones smooth, brown and glabrous, *c.* 10 x 12 mm; young ones white, ellipsoid, *c.* 6 x 12 mm, shoot apex covered in many erect, fleshy stipules, narrowly triangular 3–4 x 1 mm. **Leaves** 1 or 2 or up to 5 per tuber. Petiole pale red, glabrous, 1.5–3.5 mm long, terete. Lamina not oblique, held horizontally; upper surface plain dark green or pale green and flecked by the many raised white hair bases, darker around the margin with white teeth and with a red patch at the base above the junction with the petiole (Plate 1B), the lower surface paler and scintillating or the upper surface brownish red and the lower surface pale rosy purple, in life thin and slightly fleshy, hairs erect on a raised hair base, translucent, uniseriate, *c.* 0.25 mm long, glabrous beneath, ovate, symmetric except that the basal lobes are sometimes unequal, 4.5–6 x 5–6.5 cm, base deeply cordate, basal lobes equal or unequal, not overlapping, 0.5–2 cm long, margin doubly crenate, each tooth tipped by a hair *c.* 0. 5 mm long, apex acute to acuminate; venation basically palmate with 1–2 pairs of veins at the base and *c.* 2–3 pairs of fine veins along the midrib, and 1–2 veins in the basal lobes, veins branching *c.* half-way to the margin, slightly impressed above, slightly prominent beneath, glabrous on both surfaces.

Inflorescences axillary, reddish purple, glabrous, erect and longer than the leaves; racemes 6–12 cm long with peduncles 5.5–9 cm long, cymules spaced 1–1.5 cm apart, lower two cymules comprising one male and one female

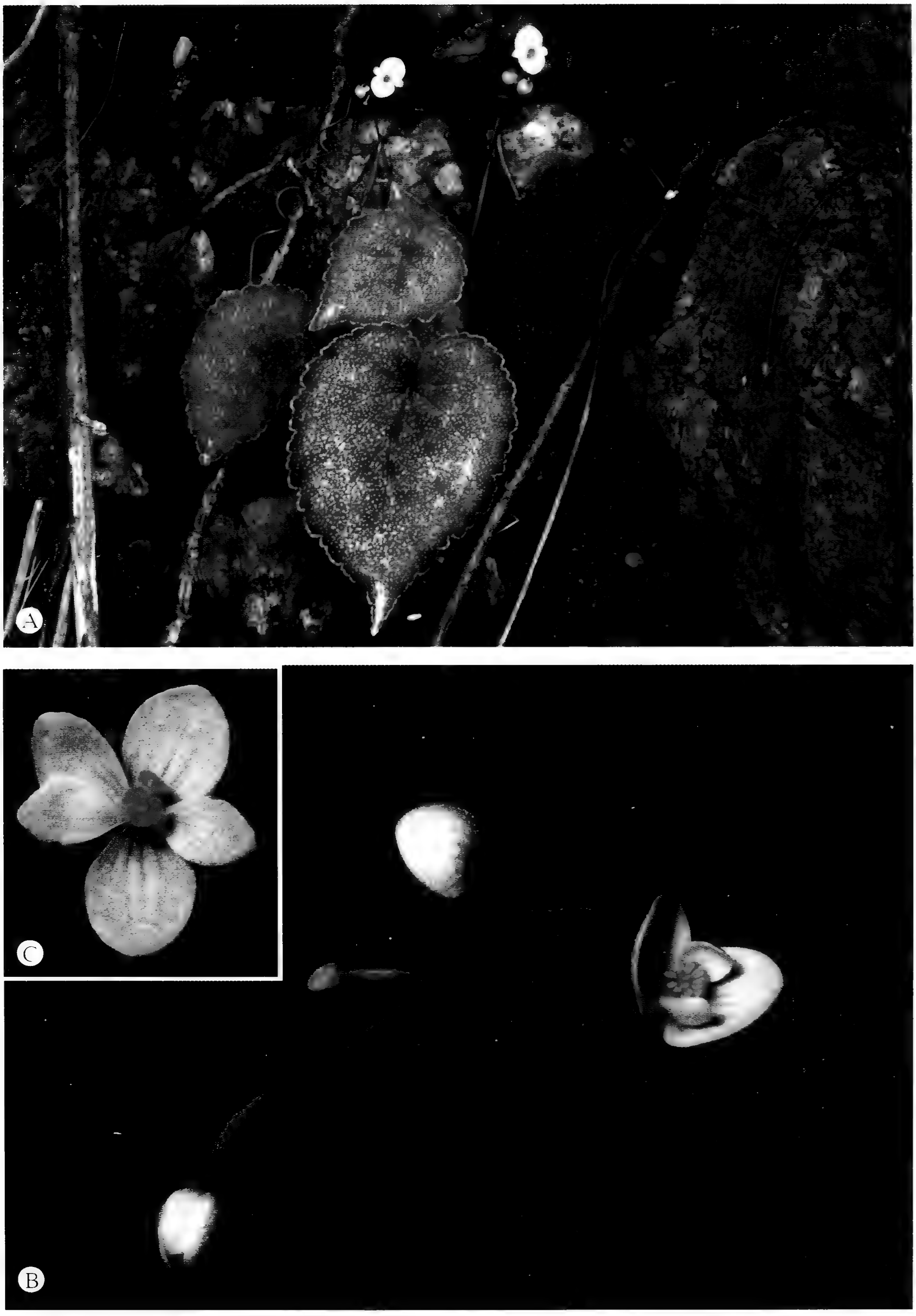

Plate 1. ***Begonia bataiensis*** Kiew. A. Plants in nature with male flower and fleshy cylindric purple fruits. B. Protandrous raceme with the first male flower open. C. Female flower. *J.J. Vermeulen*

flower or a short branch *c*. 2 mm long with three flowers (one female and two male flowers), upper cymules with male flowers only, protandrous. Bract pair broadly ovate, recurved, *c*. 2.5 x 2 mm; bracteoles ovate, *c*. 4 x 1 mm or linear, *c*. 1 mm long. **Male flowers** with pale reddish purple pedicels up to 10 mm long; tepals 4, in bud greenish white and minutely hairy outside, at anthesis glabrous and pure white, margin entire, apex rounded to slightly acute, outer two broadly ovate to circular, 5–6 x 5.5–7 mm, inner two elliptic to slightly obovate, 4.5–5 x 1.75–2.5 mm; stamens *c*. 30–40, cluster hemispherical 2.5–3 mm diam., joined at base for *c*. 0.5 mm, filament 0.5–1 mm, anther pale yellow, obovoid, *c*. 1 mm long, apex emarginate, opening by lateral slits. **Female flowers** with reddish purple pedicel 1.5–2 mm long; ovary deep reddish purple, narrowly cylindric, 7–16 x 1.5 mm, glabrous, locules 3, placentas fleshy and bifid; tepals (4 or) 5, pure white, margin entire, glabrous, apex rounded or slightly acute, outer two broadly ovate to circular, 4–8 x 3–5 mm, inner (two or) three narrowly obovate, 3.5–7 x 1.75–4 mm; styles and stigmas yellow, 2–3.5 mm long, styles 3, almost free to the base, bifid and webbed, stigmas horizontal and sigma-shaped. **Fruit** a fleshy pendent berry, pedicel 1.5–2 mm, stout; berry slender, smooth and cylindric, tapered at both ends, 25–30 x 2–2.5 mm, glabrous, without wings or ribs, indehiscent. **Seeds** truncate, brown and sculptured, *c*. 0.3 mm long, collar cells *c*. half the seed length.

Distribution: Endemic to Ba Tai Hill and Bai Voi (Mo So) Hill, 3 km NNW of Hon Chong, Kien Giang Province, SW Vietnam.

Habitat: Rooting in soil pockets in clefts in limestone rock, well shaded, at *c*. 50 m altitude.

Specimens examined: Ba Tai Hill *J.J. Vermeulen 2587* (spirit collection *2611*) (SING); Bai Voi (Mo So) Hill *Truong Quang Tam MS 056* (HCMC).

Notes: This species was discovered by the first author in October 2000 on the Ba Tai and Bai Voi Hills. It takes its name from Ba Tai Hill. Both are limestone karst hills and Bai Voi Hill is scheduled for quarrying with about two thirds of the hill to be exploited for cement production. *Begonia bataiensis* is therefore highly endangered, because its narrow distribution and small population size make it vulnerable to extinction.

The racemose inflorescence produces female flowers only in the two lowermost cymules. In these cymules, the male flowers open first and have fallen before the female flower opens. Thereafter, a series of cymules is produced that are comprised of only male flowers.

Acknowledgements

J. J. Vermeulen thanks Holcim, the parent company of the Swiss quarrying company, Morning Star, for sponsoring the biodiversity survey of the limestone hills.

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A Correction in *Cleistocalyx* (Myrtaceae)

I. M. TURNER

P.O. Box 20, Winchelsea, East Sussex TN36 4WA, UK

AND

K. N. GANDHI

Harvard University Herbaria, Divinity Avenue, Cambridge, Massachusetts 02138, USA

Abstract

Cleistocalyx nervosus (DC.) Kosterm. is an illegitimate later homonym of *Cleistocalyx nervosus* (Lour.) Blume. Therefore, the new combinations *Cleistocalyx cerasoides* (Roxb.) I.M. Turner and *C. cerasoides* var. *paniala* (Roxb.) I.M. Turner are proposed. *Eugenia cerasoides* Roxb. is lectotypified.

Cleistocalyx nervosus

When Blume described the genus *Cleistocalyx* in 1850 he included two species. These were *Cleistocalyx nitidus* (Korth.) Blume, based on *Jambosa nitida* Korth., and *Cleistocalyx nervosus* (Lour.) Blume, based on *Eugenia nervosa* Lour. Merrill and Perry (1937) resurrected Blume's genus from obscurity, including 21 species in their revision. One of these was *Cleistocalyx operculatus* (Roxb.) Merr. & L.M. Perry based on *Eugenia operculata* Roxb. Roxburgh first used this name in his *Hortus Bengalensis* published in 1814, but lacking a description the name was not properly validated until the posthumous publication of the second edition of *Flora Indica* that appeared in 1832. However, before that in 1828, De Candolle had described the species as *Syzygium nervosum*, referring to Roxburgh's *nomen nudum Eugenia operculata*. Thus the oldest valid name for this species is *Syzygium nervosum* DC. Panigrahi and Mishra (1985) argued that the 1832 publication of *Eugenia operculata* Roxb. represents an illegitimate renaming of *Syzygium nervosum* DC.

Recognising *Syzygium nervosum* DC. as the oldest name available, Kostermans (1987) made the transfer of the epithet to *Cleistocalyx*. However, *Cleistocalyx nervosus* (DC.) Kosterm. is an illegitimate later homonym of Blume's second species of the genus *Cleistocalyx nervosus* (Lour.) Blume. Unfortunately, Kostermans' name has, incorrectly, been taken up by several workers (Turner 1995, Chantaranothai & Parnell 2002, Kress *et al.* 2003). As this is a wide-ranging (India to Australia) and quite common species, it is important to clarify and correct its nomenclature. While Merrill and Perry intended to transfer *Eugenia operculata* Roxb. to *Cleistocalyx*, their combination, *Cleistocalyx operculatus* Merr. & L.M.Perry, can be considered as a *nomen novum* for *Syzygium nervosum* DC. as they cited this name in the synonymy. However, there are a number of synonyms of *Syzygium nervosum* DC. that have priority over *Cleistocalyx operculatus* Merr. & L.M.Perry. The oldest available appears to be *Eugenia cerasoides* Roxb. and this is formally transferred to *Cleistocalyx* below. The correct name for the species in *Syzygium* remains as *Syzygium nervosum* DC. For those who maintain *Eugenia* in the widest sense, the species is correctly *Eugenia cerasoides* Roxb.

A new combination is also made for the variety of the species based on *Eugenia paniala* Roxb. Valid combinations for variety *paniala* have yet to be made in either *Syzygium* or *Eugenia*.

Cleistocalyx cerasoides (Roxb.) I.M. Turner, *comb. nov.*
Basionym: *Eugenia cerasoides* Roxb., Fl. Ind. ed. 1832, 2 (1832) 488. *Syzygium cerasoides* (Roxb.) Raizada, Ind. Forester 84 (1958) 478.
Type: Ic. Roxb. no. 2256 (lecto, designated here, K) (reproduced as Wight Ic. 615).

Syzygium nervosum DC., Prod. 3 (1828) 260. *Cleistocalyx nervosus* (DC.) Kosterm., Bull. Bot. Surv. India 29 (1989) 17 *sphalm. nervosum, comb. illegit., non Cleistocalyx nervosus* (Lour.) Blume, Mus. Bot. 1 (1850) 85. *Cleistocalyx operculatus* Merr. & L.M. Perry, J. Arn. Arb. 18 (1937) 337, *nom. nov. pro S. nervosum* DC.
Type: *Roxburgh s.n.*, herb. Lambert 1816 (holo, G-DC).
Eugenia operculata Roxb., Fl. Ind. ed. 1832, 2 (1832) 486, *nom. illegit. Syzygium operculatum* Nied., Nat. Pflanzenfam. 3(7) (1893) 85, *nom. illegit.*
Type: *Roxburgh s.n.*, herb. Lambert 1816 (lecto, designated by Panigrahi & Mishra 1985, G-DC).

var. ***paniala*** (Roxb.) I.M. Turner, *comb. nov.*
Basionym: *Eugenia paniala* Roxb., Fl. Ind. ed. 1832 (1832) 489. *Eugenia operculata* Roxb. var. *paniala* (Roxb.) Duthie, Fl. British India 2 (1879) 498, *comb. illegit. Cleistocalyx operculatus* Merr. & L.M. Perry var. *paniala* (Roxb.) P. Chantaranothai & J. Parn., Kew Bull. 48 (1993) 591. *Cleistocalyx nervosus* (DC.) Kosterm. [*non* (Lour.) Blume] var. *paniala* (Roxb.) P.

Chantaranothai & J. Parn., Novon 6 (1996) 201, *comb. illegit.*
Type: *Ic. Roxb. no. 2255* (lecto, designated by Chantaranothai & Parnell (1993), K).

Acknowledgements

Dr Martin Cheek is thanked for assistance at the Herbarium, Royal Botanic Gardens, Kew.

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Scaphochlamys calcicola (Zingiberaceae): a New and Unusual Species from Borneo

A.D. POULSEN

Royal Botanic Garden, 20A Inverleith Row, Edinburgh EH3 5LR, Scotland, U.K.

AND

R.J. SEARLE

48 Bartons Drive, Yateley, Hampshire, GU46 6DP, UK.

Abstract

Scaphochlamys calcicola A.D.Poulsen & R.J.Searle is described from the Bau limestone area in Sarawak, Borneo. Its placement within *Scaphochlamys* and relationship with *Boesenbergia* and *Distichochlamys* are discussed.

Introduction

The genus *Scaphochlamys* Baker comprises 27 described species distributed from the southernmost provinces of Thailand, through Peninsular Malaysia, Singapore, and the island of Borneo. The most comprehensive review of the genus is by Holttum (1950) as part of a treatment of the Zingiberaceae in Peninsular Malaysia, which includes 20 species of *Scaphochlamys*. The four species from Borneo were reviewed by Smith (1987), and since then three new species have been described from Thailand (Sirirugsa & Larsen, 1991; Jenjittikul & Larsen, 2002).

The current species was discovered during a botanical inventory of the Bau limestone area conducted by staff of the Sarawak Biodiversity Center in 2001–2002. This project subsequently involved the first author in assisting with the identification of Zingiberaceae material and compiling a preliminary checklist of all species. This list (Poulsen *et al.*, 2004) included a species of *Scaphochlamys* which follow-up fieldwork, including the first author in 2002–2003, has confirmed to be new. During this fieldwork, several flowering individuals were found, photographed and preserved in spirit for further studies essential for making the following description which forms part of a revision of the genus due for publication by the second author.

Scaphochlamys calcicola A.D.Poulsen & R.J.Searle, ***sp. nov.***
Scaphochlamydi sylvestri, *S. occulatae* et *S. breviscapaea* similis. Ab eis inflorescentiis compactis spiraliter dispositis differt.
Typus: Malaysia, Borneo, Sarawak, Kuching Division, Bau area, Gunung Tai Ton (1°24'N; 110°8'E), altitude 50 m, in a recently deforested limestone gorge, 20 June 2003. *Poulsen, Jugah & Clausager 2022* (holo SAR; iso AAU, E, L ,K).

Terrestrial herb 30–60 cm tall. *Rhizome* horizontally creeping above the ground, robust, about 7 mm diam. when dried, sometimes forking, with well-developed anchoring roots (not stilted). Leafy shoots 2–20 cm apart, distinctly unifoliate; *laminate leaf* tightly enclosed by 3(–5) leafless sheaths, the longest to 18 cm, cream at base, flushed green towards apex, becoming brown and papery with age, shredding; these completely hide the much shorter sheath and ligule of the leaf; *sheath* to 3 cm, margin thin and densely ciliate terminating in a ± obscure, bilobed, to 5 mm (when fresh), membranous ligule; *petiole* (measured from the base of the shoot because the ligule is often hard to establish)10–27(–39)cm long, canaliculate; *lamina* 15–37 x 9–18 cm, broadly elliptic to lanceolate, slightly asymmetric, plicate, upper surface plain green, lower surface very pale green and villose (up to 1 mm long, appressed, white hairs, scattered throughout the lower surface but most dense near and on the sides of the midrib); base rounded to slightly cordate and attenuate; apex distinctly acuminate to *c.* 1 cm. *Peduncle* to 1.5 cm, slender, glabrous, hidden at base of the leaf; inflorescence derived from near the leaf base inside the leafless sheaths, flowering from base to apex; *inflorescence head* 7–10 cm long, bilaterally flattened: 1.5–2.0 wide and 0.5–0.6 cm deep, tapering towards a pointed apex, with 8–13 bracts arranged distichously and 0.3–0.7 cm apart on an elongated spike; *bracts* pale green, 2.5–3.2 cm long and 0.9 cm wide near the base, held stiffly upright, boat-shaped, outer surface glabrous or covered in short spiky hairs; apex acute, edges involute and overlapping; bracts subtending (2–)3 flowers; *bracteole* 2.0–3.3 cm (first; second and third decreasing in size), 2-keeled, generally longer and opposite to the bract, wrapped tightly around the flower(s), slit to the base, edges overlapping, covered in short spiky hairs; *calyx* with ovary 12–13 mm long, fissure *c.* 4 mm, with rounded to acute, irregularly tridentate apex with a scattering of short spiky hairs, otherwise glabrous; *corolla tube* 2.4–4 cm long, glabrous, corolla lobes white, linear, 1.5 x 0.5 cm, apex mucronate and hooded; *staminodes* oblong, 1.2 x 0.3–0.4 cm wide, papillose, apex obtuse; *labellum* 1.4–1.7 x 0.9–1.1 cm, spathulate, apex bilobed (indented 3–4 mm), lobes overlapping, white with pale yellow-green centre; *stamen* 11–12 mm; filament 5–7 x 2 mm, anther thecae 4–5 x 1.5 mm, not spurred, dehiscing

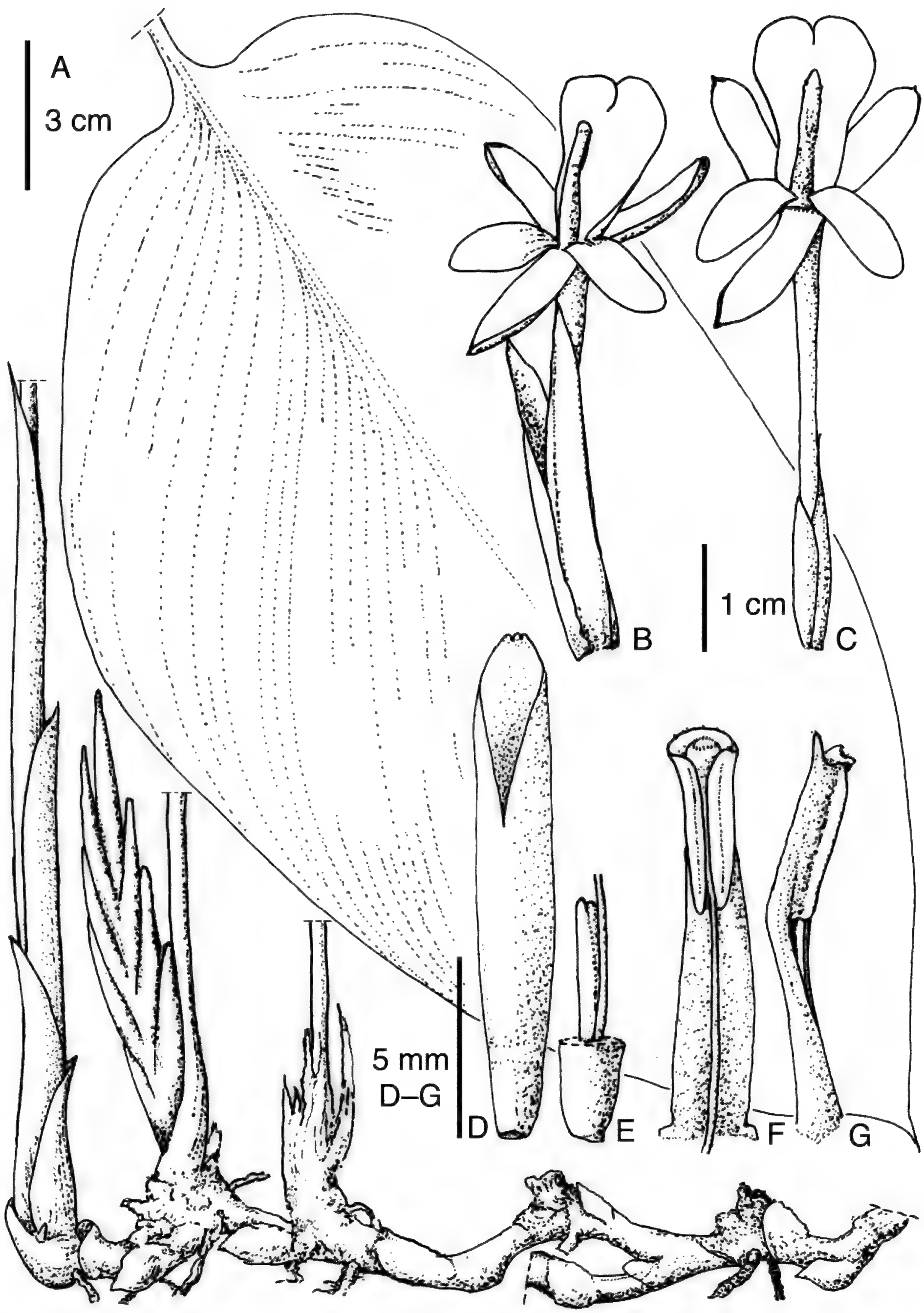

Figure 1. ***Scaphochlamys calcicola*** A.D. Poulsen & R.J. Searle. A. Habit, leaf and inflorescence with the sheaths removed; B & C. Flowers (manipulated). Bract and bracteole removed on flower to the right exposing calyx and second bracteole; D. Ovary and calyx (corolla tube removed); E. Ovary with epigynal gland and base of style; F. Stamen, style and stigma, ventral view; G. Stamen, style and stigma, side view. *Drawn by A. D. Poulsen from the type.*

Table 1. A comparison of key characters between the new species, *Scaphochlamys*, *Distichochlamys* and *Boesenbergia*. Traditionally six characters have been used (Smith, 1987; Newman, 1995) to which we have added the splitting of the bracteole.

	Scaphochlamys	*Scaphochlamys calcicola*	*Distichochlamys*	*Boesenbergia*
Bract arrangement	spiral	distichous	distichous	distichous
Flowering mode	base to apex	base to apex	base to apex	apex to base
Flower arrangement	cincinni	cincinni of 2–3 flowers	cincinni	single
First bracteole (shape and position)	more or less keeled, arising opposite to bract	2-keeled, opposite to bract	2-keeled, opposite to bract, tubular	boat-shaped, arising at right angle to bract
Bracteole splitting	split to base	split to base	tubular, split 2/3	split to base
Labellum	bilobed or entire, lobes overlapping	bilobed, flat, lobes overlapping	bilobed, not saccate lobes not overlapping	usually saccate, entire, rarely emarginate, margin recurved
Base of thecae	with very short free basal spurs	no spurs	no spurs	no spurs

for their entire length; crest rounded, to 2 mm; *stigma* 1 mm across, club-shaped with two dorsal knobs, ostiole ciliate, forward-facing; *ovary* 2 mm, glabrous, epigynous glands 4–5.5 mm, bilobed, needle-shaped. Fruit not seen.

Distribution: Endemic to Borneo in lowland forest. So far, only documented from near Bau, southwest Sarawak.

Ecology and etymology: From information on labels, this species seems to be found exclusively on limestone, which is the reason for the choice of epithet. The species occurs at the base or shoulder of limestone hills, on boulders near streams.

Notes: The 2-keeled bracteole is an unusual character for *Scaphochlamys*. This, however, is characteristic for the genus *Distichochlamys* M.F.Newman, a genus recently described from Vietnam with three species (Newman, 1995; Larsen & Newman, 2001; Rehse & Kress, 2003). Comparing the new taxon to the most closely related genera (Table 1), one could be tempted to think it is actually a species of *Distichochlamys*. However, it does not have the distinctly tubular bracteole of *Distichochlamys*.

Figure 2. ***Scaphochlamys calcicola*** A.D. Poulsen & R.J. Searle. Photographs of *Connie Geri et al. SBC 3849;* same population as the type. Photos: A. D. Poulsen.

Scaphochlamys calcicola also shares the distichous inflorescence and lack of spurs with *Boesenbergia* Kuntze, from which it differs in four other key characters (Table 1).

Preliminary findings from cladistic analysis of the Internal Transcribed Spacer (ITS) region of the nuclear NDA (unpublished data) support the inclusion of the new species within the genus *Scaphochlamys*, and it appears to fall within a subclade consisting of other Bornean species of this genus.

In Sarawak, the material from Bau at first seemed similar to another undescribed limestone species in southwest Sarawak, which Smith (1987) mentioned in her account as *S.* sp. aff. *breviscapa* Holttum (*Burtt 8798*; E!, K!). Both species have shoots with a single, erect, long-petiolate (29 cm long), large leaf (24 x 12 cm). However, the Burtt collection differs by the leaf being ovate with a bluntly pointed apex, the peduncle being longer (*c.* 5 cm) and the spike being compact with spirally arranged bracts. Also, the labellum has purple around the central line of the labellum (similar to at least two other Sarawakean species – *S. petiolata* (K. Schum.) R.M. Sm. and *S. reticosa* (Ridl.) R.M.Sm.). The sterile characters of the Burtt collection bear more similarity to *S. oculata* (Ridl.) Holttum than to *S. breviscapa*.

Of the other species of *Scaphochlamys* mentioned for Sarawak by Smith (1987), none has as large leaves as *S. calcicola*; the most similar being *S. petiolata* in which the lamina is up to 14 x 4 cm – much smaller than *S. calcicola*. Also, the inflorescence of *S. petiolata* is much reduced in comparison. A recent collection, *P.Boyce, J.Kisai & S.Kutuh ZI-658* (E, SAR) from near Serian also has a distichous inflorescence like those of *S. calcicola* but differs in the much smaller, cordate leaves, and the smaller flowers with a lilac labellum. The collection probably represents another new species and indicates that a distichous inflorescence in *Scaphochlamys* is not unique to *S. calcicola.* This collection and others recently made by Boyce illustrate that several new species are likely to be discovered and described from Sarawak in the future.

Considering the unifoliate species in Peninsular Malaysia, the leaf of *S. calcicola* is similar in size and shape to *S. sylvestris* (Ridl.) Holttum, *S. oculata* and *S. breviscapa*. All of these differ by having compact, spirally arranged inflorescences. In addition, *S. sylvestris* has a much longer peduncle (15 cm); *S. oculata* has a slightly longer peduncle (2–5 cm), whereas that of *S. calcicola* is within the range of *S. breviscapa* (1–3.5 cm).

The collection from the type locality shows some variation within the population, e.g. length of corolla and anther crest but the flowers are consistently white with a yellow-green centre. It seems that the colour of the labellum in *S. kunstleri* (Baker) Holttum in Peninsular Malaysia can be quite variable from almost pure white to dark red (Lim, 2001). Future studies on Bornean *Scaphochlamys* should investigate if species with a pale lilac labellum are consistently so or whether they can occasionally be white like *S. calcicola.* Clarification of this issue will be of importance for using this diagnostic character in species identification.

Other specimens examined: SARAWAK. Kuching Division, Bau area: Gunung Apin, 6 Nov 2001 *Malcom Demies et al. SBC 1123* (SAR); Gunung Krian, 27 Nov 2001 *Meekiong Kalu et al. SBC 1613* (SAR); Gunung Lanyang, 10 Apr 2002 *Julia Sang SBC 2919* (SAR); Gunung Poing, 23 Sep 2001 *Julia Sang et al. SBC 343* (SAR), 13 May 2002 *Malcom Demies et al. SBC 1547* (SAR), 11 July 2002 *Meekiong Kalu et al.* 3246 (SAR); Gunung Tai Ton, 27 Mar 2002 *Julia Sang et al. SBC 2654* (SAR), 30 Oct 2002 *Connie Geri et al. SBC 3749* (SAR, SING).

Acknowledgements

The Sarawak Biodiversity Centre (SBC) requested the first author to assist in the study of the Zingiberaceae from the Bau limestone area. SBC also provided permits for his research on Zingiberales elsewhere in Sarawak and his fieldwork was kindly supported by HRH Crown Prince Frederik's Foundation. We should also like to thank staff at SBC and the Forestry Research Centre for logistic and other help, the keepers of the herbaria SAR, K, and AAU, and J. F. Veldkamp for Latinizing the diagnosis. Finally, we should like to thank two anonymous reviewers for constructive comments on the manuscript.

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The Recircumscription of *Curcuma* L. to Include the Genus *Paracautleya* R.M.Sm.

J. ŠKORNIČKOVÁ[1,2] AND M. SABU[1]

[1]Department of Botany, University of Calicut, 673635 Kerala, India.

[2]Department of Botany, Charles University, Benátská 2, Prague, 12802, Czech Republic.

Abstract

Based on recent living material from the type locality, the monotypic genus *Paracautleya* is reduced to synonymy with *Curcuma* and a new combination is made for *C. bhatii* (R.M.Sm.) Škorničk. and M.Sabu. A detailed description of the species, including a colour plate, is given.

Introduction

The monotypic and narrowly endemic genus *Paracautleya* was established by R.M. Smith in 1977. Its type species, *Paracautleya bhatii* R.M.Sm., was described based on a collection by K.G. Bhat made near Udupi, South India. In relation to the description, Smith discussed possible affinities of *Paracautleya* with four other genera (*Camptandra* Ridl., *Cautleya* Hook.*f.*, *Curcuma* L. and *Roscoea* Sm.) in the tribe *Hedychieae*, which all have a truly versatile anther like *P. bhatii*. Several characters were used to clarify the affinity of *Paracautleya* but unfortunately, many of them were not known satisfactory at the time (Table 1), such as the habit and position of inflorescence, shape of the fertile bract, number of flowers per bract, absence of bracteole, and ovary division.

Kress *et al.* (2002) provided a new classification of the Zingiberaceae based on DNA sequences of the nuclear internal transcribed spacer (ITS) and plastid matK region. However, they lacked samples of a number of rare monospecific genera, *Paracautleya* among them. Based on morphology alone, they tentatively placed the genus *Paracautleya* in the Zingibereae tribe. This was recently confirmed by Ngamriabsakul *et al.* (2004), who elaborated the phylogeny of the tribe Zingibereae using the same nuclear gene as Kress *et al.* (2002) but a different chloroplast gene, *trn*L-F. Their phylogenetic analysis of the combined data set showed that *Paracautleya* grouped with *Curcuma* subg. *Curcuma* whereas the other genera mentioned by Smith (1997) were placed in distant clades. Ngamriabsakul *et al.* (2004) pointed out that all genera recognized in the *Curcuma* complex may be

Table 1. A re-examination of characters in *Curcuma* and *Paracautleya*. Characters and character states stressed by Smith (1997) in bold.

	Cautleya	*Curcuma*	*Paracautleya*	*Roscoea*
Rhizome **Habit**	Swollen fleshy roots Leafy stems	Rhizome and tubers **Leaf tuft** (forming pseudostem or stemless)	Rhizome and tubers **Leaf tuft** (stemless)	Swollen fleshy roots Leafy stems
Leaf sheath	Closed	Open	Open	Closed
Inflorescence	Terminal	**Terminal or radical** or both	**Terminal**	Terminal
Bract	Free	**Pouch-like** or free	**Free** or pouch-like	Free
Bracteole	Absent	**Present** or absent	Present or **absent**	Absent
Flowers	Single	**Cincinni** or single	**Single**	Single
Anther	Spurred, L-shaped, crested	Spurred or not, crested or a vestige present or absent	Spurred, vestige of crest present	Spurred, L-shaped, crested
Epigynous gland apex	Sharp	Blunt	Blunt	Sharp
Ovary	Trilocular	**Trilocular**, rarely imperfectly trilocular	**Imperfectly trilocular**	Trilocular
Placentation	Axile, ovules throughout the axis	**Axile**, many ovules towards the base, less towards the top	**Basal**	Axile, ovules throughout the axis
Capsule	Many-seeded	Few to many-seeded (10 – 25 seeds)	Few-seeded (5-12 seeds)	Many-seeded
Seed	Black to brown, grey or red, angled, aril present or absent	Ovoid, light brown to dark brown, shiny, arillate, aril white, laciniate	Ovoid, light brown, shiny, arillate, aril white, laciniate, usually positioned towards one side	Ovoid, arillate

regarded as a single genus, though there are some morphological characters supporting the separation of each taxon. These characters they suggest are, however, autapomorphic. Distinguishing characters of the genera in the *Curcuma* complex, namely *Curcuma* and *Paracautleya*, as tabulated by Ngamriabsakul *et al.* (2004) included the following: in *Curcuma* adnate bracts, several flowers per bracts, bracteoles present, and labellum emarginate and rarely split *versus* in *Paracautleya* free bracts, one flower per bract, bracteoles absent and labellum split.

The purpose of the present paper is to evaluate whether the morphological evidence based on newly available material still justifies keeping *Paracautleya* separate from *Curcuma*.

Material and Methods

In June 2004, *Paracautleya bhatii* was observed flowering in its type locality. Plants were collected and transplanted to Calicut University Botanic Garden for further observation. During the past four years we have also extensively studied *Curcuma* species throughout the Indian subcontinent both from living flowering material as well as herbarium specimens including type material (BM, BSI, CAL, CALI, E, G, K, L, MH, PDA, PR, SING) paying particular attention to the extreme variability of vegetative and floral characters.

Paracautleya R.M.Sm. versus *Curcuma* L.

Rhizome structure

The genus *Curcuma* has a conspicuous rhizome structure. The main rhizome can be simple or branched and the roots end in round, ovoid root tubers, which may be almost sessile or distant 20–30 cm from the main rhizome or branches. Root tubers are present invariably in both seed-setting and non seed-setting species. They are not capable of sprouting and their exclusive function is to sustain the plant during dry periods when the leafy shoots dries up. Our recent studies reveal that *Paracautleya bhatii* has an ovoid main rhizome usually without branches or with one branch and root tubers, typical for the genus *Curcuma*.

Bract

As described by Smith (1977), unlike *Paracautleya* with singly borne flowers and bracts that do not form pouches, the flowers of *Curcuma* commonly arise in cincinni held within pouches formed by adnate bracts. This traditional diagnostic character of the genus *Curcuma* is based mainly on early descriptions made by Roxburgh (1820) and subsequent workers when only a few species of *Curcuma* were known. However, species lacking this bract formation were described from Sri Lanka (*C. albiflora* Thwaites, and to some extent also *C. oligantha* Trim.). Kress *et al.* (2002) have pointed out that pouched inflorescences are neither unique nor universal in the genus *Curcuma*.

As a matter of terminology, the term 'adnate' is used when two non-homologous entities are fused, while the term 'connate' is appropriate when two homologous entities are fused, e.g. two bracts. Thus, the pouches in *Curcuma* are, in most species, formed by both means on the same inflorescence. It is possible to say that pouches in all *Curcuma* species are formed at their base by being adnate to the inflorescence axis and in most species their sides further up are connate to the basal part of the bracts positioned above them. The degree of connation varies considerably within the genus and may in some species be negligible.

Smith (1977) mentioned that in *Curcuma albiflora* a few free bracts may occur at the base of the inflorescence. We have studied *C. albiflora* from herbarium material (BM, E, G, K, PDA). For most sheets, including type specimens, there is no connation of bracts at all; the bracts form shallow pouches by the basal part being adnate only to the inflorescence axis. Bracts of *C. albiflora* are rarely connate to each other and if so, then only in the uppermost part of inflorescence. Connation of bracts is also very much reduced in the case of *C. oligantha*, where the situation is less obvious than in *C. albiflora*. In *C. oligantha*, one or two free fertile bracts may occur in the basal part of the inflorescence, where the lowest bracts may be joined only to the inflorescence axis and the upper bracts are connate just in its lowermost, *c.* 1–6 mm, portion.

During our fieldwork, we have examined over 30 inflorescences from different populations from the type locality and found that bracts in *Paracautleya bhatii* are mostly free but do form pouches by being adnate at its base to the inflorescence axis. Such a pouch can be almost a third of the bract length, but individuals with their bracts connate for 1–2 mm can also be found and if such are present, they are usually positioned in the upper part of the inflorescence. There is no doubt about the generic identity of *C. albiflora* and *C. oligantha* and therefore the pouched bract character alone is not sufficient to maintain *Paracautleya bhatii* separate from *Curcuma*.

Number of flowers per bract

In the genus *Curcuma*, there are usually two or more flowers subtended by each bract forming a cincinnus while *Paracautleya* has its flowers borne singly. Yet, there is in India a complex of four species, namely *C. reclinata* Roxb., *C. decipiens* Dalzell, *C. inodora* Blatt. and *C. sulcata* Haines, which share in common strongly reduced or missing bracteoles and flowers that are born singly or with a maximum of two per bract.

We have re-collected all these species from their type or near to their type localities. *Curcuma decipiens* (Škorničková *73443* and *73445*; CAL, CALI, K, MH, PR, SING) has 1–2 flowers per bract and the number of flowers may not be consistent throughout the spike. In some plants every bract subtends just one flower, in others bracts subtend two flowers in the basal part of inflorescence and one flower in its upper part. *C. sulcata*

(*Škorničková 73467*; CALI, MH, K, PR, SING), *C. reclinata* (Škorničková *73477*; CAL, CALI, MH, K, PR, SING) and *C. inodora 73403* (Škorničková *73403*; CALI, SING) have only one flower per bract and we did not encounter a single plant that had two or more flowers per bract.

Bracteole

Paracautleya has been distinguished from *Curcuma* on the grounds of its lacking bracteoles (Smith, 1977). Based on earlier generic and specific descriptions of *Curcuma*, there is one boat-shaped bracteole per flower. From our field observations, there are great differences in bracteole size across the genus *Curcuma*. The non-seed setting species usually possess large bracteoles that can reach over 3 cm long while the bracteoles of some seed-setting species can either be well developed (e.g., *C. montana* Roxb.) or more or less reduced. As already mentioned above, *C. decipiens*, *C. inodora, C. reclinata* and *C. sulcata* bracteoles are reduced to 1–2 mm or are often absent. This feature may not be constant within the species or whole population (e.g., the same population includes plants with strongly reduced bracteoles as well as plants where the bracteoles are completely lacking), but it is usually constant within a single plant. In the type locality of *P. bhatii*, we found plants without bracteoles (more common) as well as plants with bracteoles up to 2.5 mm long.

Labellum

An emarginate labellum is commonly found in a number of Indian seed-setting species distributed in Western Ghats area, e.g. *C. oligantha*, *C. mutabilis* Škorničk. *et al.*, *C. pseudomontana* J.Graham, where the split often progresses as the flower ages towards the end of the day and wilts. This is thus not unique to *Paracautleya* contrary to what was tabulated by Ngamriabsakul *et al.* (2004).

Anther structure

Anther structure of *Paracautleya* is similar in structure to several seed-setting *Curcuma* species being versatile, having two anther spurs at its base and, in the adaxial part of the anther, a vestige of a reduced anther crest. The whole morphology of the anther closely resembles, for example, anthers of *C. neilgherrensis* Wight, *C. decipiens* or *C. oligantha.*

Ovary structure

As far as we know, there is no specific work dealing in detail with ovary structure in the genus *Curcuma*. The ovary in Zingiberaceae is tricarpellate (except the tribe *Globbae* and genus *Tamijia*, in which the ovary is unilocular with parietal placentation), and is generally described as trilocular with axile placentation. Hamza (1989) observed that many Zingiberaceae species described with trilocular ovaries and axile placentation, have incomplete septation at the top and are thus unilocular in this region. He did not include any representatives of the genus *Curcuma* in his study, but we have seen similar ovaries when observing transverse sections from different parts of ovaries of different species of *Curcuma* e.g., *C. decipiens*, *C. oligantha*, *C. neilgherrensis*, *C. karnatakensis* Amalraj *et al.* Sections near the base are always trilocular with a large number of ovules, but sections towards the top have a much reduced ovule number or are empty and the septa are not always joined. In *Paracautleya* incomplete septa are clearly visible.

Aril and seed shape

For the genus *Curcuma*, there are few descriptions or drawings of fruits and seeds but we have been able to observe fruits and seeds of more than 15 species. Seeds are ovoid, light brown to dark brown and shiny. The aril is white, laciniate and is rather uniform throughout the genus, although the size of the aril may vary among the species. The only *Curcuma* species with seeds described as exarillate appears in the original description of *C. oligantha* (Trimen, 1885). We have examined the type specimen of *C. oligantha* (PDA) and confirmed the presence of an aril on the seeds from an unopened fruit. Seeds of *Paracautleya bhatii* agree in shape and colour and the presence of a laciniate aril with those observed in the genus *Curcuma*. The laciniate aril in *Paracautleya* is usually positioned towards one side and its size and shape vary slightly within a population. The aril in unripe seeds is smaller than in fully ripe seeds.

Other observations

The inflorescence in *Paracautleya bhatii* is invariably terminal on a long naked peduncle and its leaves are rather narrow. In its general habit it most resembles some of the SE Asian *Curcuma* species, e.g. *C. gracillima* Gagnep., which also has this type of inflorescence and narrow leaves. In the Indian region, the most similar species are perhaps *C. oligantha* (India and Sri Lanka) and *C. albiflora* (Sri Lanka).

While dealing with the ovary and fruit of *Paracautleya bhatii*, we also studied the shape of the epigynous glands. They agree well with those found in the genus *Curcuma* in being linear with a blunt apex. The shape of the stigma and presence of cilia at the ostiole of *Paracautleya bhati* also agrees well with *Curcuma*.

Conclusion

The conclusion is that the generic delimitation of *Paracautleya* as defined by Smith (1977) is not strong enough to warrant keeping it as a separate genus. As well as similarity in habit, we found that the generic diagnostic characters including floral morphology described for *Paracautleya* can be observed in at least some members of the genus *Curcuma*. Thus, its generic status cannot be justified. This necessitates a new combination for the *Paracautleya* species.

Curcuma bhatii (R.M.Sm.) Škorničk. and M.Sabu ***comb. nov.***
***Basionym**: Paracautleya bhatii* R.M.Sm., Notes Roy. Bot. Gard. Edinburgh. 35 (1977) 367; K.G. Bhat, Fl. Udupi. (2003) 634.
Type: India, Karnataka, South Kanara, Manipal, 1.VII. 1975 *Bhat 204* (holo E!; iso BSI!, C, CAL!).

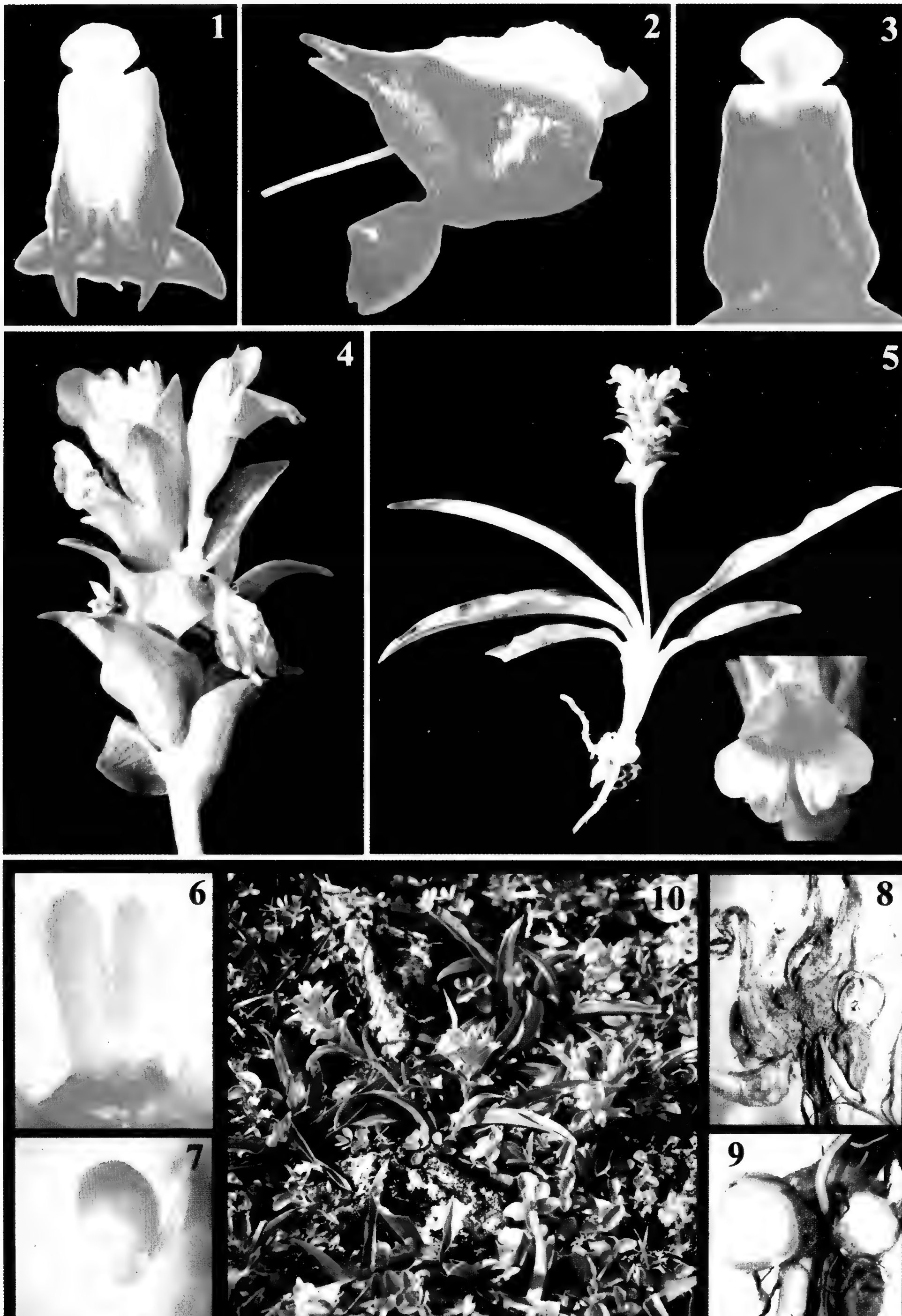
Small rhizomatous herb, 5–20 cm tall. *Rhizome* ovoid mostly unbranched, 5–10 x 4–5 mm, rarely with one branch, which gives rise to a new plant, light brown externally, sheathed by papery remains of leaf sheath bases, creamy yellowish internally, non-aromatic. *Roots* fleshy, root tubers up to 1–2.5 x 0.5 cm, almost sessile to the main rhizome, externally whitish (when young) to brown (when older), internally pure white, non-aromatic. *Pseudostem* 2–5 cm long, formed by leaf sheaths and 1–2 sheathing bracts, whitish, drying soon and becoming light brown, thin and papery, *ligule* 1.5 mm, bilobed, translucent greenish-white, glabrous. *Leaves* 2–5 (–7), sessile or with a very short petiole *c.* 1 cm long (gradually changing into a narrowly attenuate lamina base); *lamina* lanceolate, 5–12 x 0.7–1.5 cm, adaxially green, glabrous, abaxially lighter green, glabrous; margin hyaline, translucent white, *c.* 0.1 mm wide, tip acute, base attenuate, midrib green, glabrous. *Inflorescence* invariably central. Peduncle 3.5–13 cm, *c.* 1–1.5 mm diam., green, glabrous, partly hidden within the pseudostem. Spike 2–5 x 1–2.5 cm, consisting of 5–23 green bracts. Coma inconspicuous, usually only the uppermost 2–3 bracts are sterile and smaller in size than the fertile ones. *Fertile bracts* ovate, 1–1.4 x 0.7–1 cm, tip acute, both sides glabrous, green, usually free especially at the base of inflorescence, but occasionally connate by the lower fifth of bracts (*c.* 1.5–2.5 mm), 1 flower per bract. *Bracteoles* usually absent (reduced), rarely present, one per flower, 0.5–2.5 x 0.5–1 mm, translucent white, glabrous. *Flowers* 1.8–2 cm long, exserted from bracts. *Calyx* 3.5 mm long, obscurely 3-toothed, translucent white with greenish tinge, glabrous. *Corolla tube c.* 9 mm, deep yellow, glabrous; *dorsal corolla lobe c.* 6–7 x 7 mm, triangular-ovate, concave, apex with obscure blunt mucro 0.2 mm, translucent yellow, glabrous, lateral corolla lobes ovate, slightly concave at tip, translucent yellow, glabrous. *Lateral staminodes c.* 7 x 4.5 mm, deep yellow, glandular hairs present on the slightly raised middle portion. *Labellum c.* 9 x 9 mm, emarginate, split 3–4 mm long (opening deeper and wider as the flowers age and wilt), deep yellow. *Anther* versatile, spurred, deep yellow, short glandular hairs present on the sides and adaxially, anther thecae whitish, 1.5 x 0.4 mm; filament 1 mm long, deep yellow, constricted, 2.5 mm broad at base, 1 mm broad at upper part. *Anther* spurs 0.9–1 mm long, yellow. *Anther crest* small, reduced *c.* 0.5 x 0.4 mm, yellow. *Ovary* imperfectly trilocular (trilocular at basal part, septa incomplete in the upper part), *c.* 1.8 x 2 mm, white, glabrous, ovules *c.* 3–8. Stigma *c.* 0.7–0.9 x 0.7–0.9 mm, creamy white, ciliate, not exserted. *Epigynous glands* 2, creamy yellowish, *c.* 1–1.2 mm long, 0.2–0.3 mm diam. *Fruit* a dehiscent capsule, spherical, 5–6 x 5–6 mm light green to whitish, glabrous, calyx persistent. *Seeds* 3.5–4 x 2 mm, greenish creamy (unripe) to light brown (ripe), shiny glabrous, non-aromatic, aril translucent white, laciniate, lobes up to 4 x 0.5–1 mm (smaller in unripe seeds), arranged towards one side.

Other specimens examined: India, Karnataka, Udupi Dt., Manipal, *Škorničková· 73446* (CAL, CALI, K, MH, SING, PR); Manipal, *Sabu s.n.* (CALI); Alevoor, *Bhat 11349* (E!).

Distribution, habitat and phenology: This species is very rare and so far is known to occur only in Karnataka, Udupi District, at its type locality and adjacent territory. *Curcuma bhatii* grows on lateritic slopes in rock crevices in areas that are rich in monsoon rains. Its small size may be due to its habitat, which is unique compared with other *Curcuma* species. It flowers from June to August. This species is highly endangered due to rapid loss of its habitat.

It is notable that maximum diversity of seed-setting *Curcuma* species is along the western side of the Western Ghats, South India, where, for example, *C. oligantha*, *C. vamana* Sabu *et* Mangaly; *C. karnatakensis* Amalraj *et al.*; *C. pseudomontana* Graham, as well as *C. bhatii*, occur. This region is known as one of the world's biodiversity 'hot spots'.

Plate 1. *Curcuma bhatii* (R.M.Sm.) Škornick. and M.Sabu
1. Anther (front view); 2. Anther (lateral view); 3. Anther (back view); 4. Inflorescence with flower in side view (half bract dissected); 5. Whole plant with detail of the flower in front view; 6. Epigynous glands; 7. Detail of the arillate seed; 8. Rhizome structure – main rhizome on the right, root tuber on the left; 9. Rhizome structure dissected – main rhizome on the right, root tuber on the left; 10. *Curcuma bhatii* on its type locality. (Škorničková *73446*). *Photo J. Škorničková.*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New Taxa and Taxonomic Status in *Xanthophyllum* Roxb. (Polygalaceae) from Borneo

W.J.J.O. DE WILDE AND BRIGITTA E.E. DUYFJES

National Herbarium of the Netherlands, Leiden Branch
P.O. Box 9514, 2300 RA Leiden, The Netherlands

Abstract

Thirteen new taxa or taxa with a new status in *Xanthophyllum* (Polygalaceae) from Borneo are described. The ten new species described in this paper are: *X. bicolor* W.J. de Wilde & Duyfjes, *X. brachystachyum* W.J. de Wilde & Duyfjes, *X. crassum* W.J. de Wilde & Duyfjes, *X. inflatum* W.J. de Wilde & Duyfjes, *X. ionanthum* W.J. de Wilde & Duyfjes, *X. longum* W.J. de Wilde & Duyfjes, *X. nitidum* W.J. de Wilde & Duyfjes, *X. pachycarpon* W.J. de Wilde & Duyfjes, *X. rectum* W.J. de Wilde & Duyfjes and *X. rheophilum* W.J. de Wilde & Duyfjes, and the new variety is *X. griffithii* A.W. Benn var. *papillosum* W.J. de Wilde & Duyfjes. New taxonomic status has been accorded to *X. adenotus* Miq. var. *arsatii* (C.E.C. Fisch.) W.J. de Wilde & Duyfjes and *X. lineare* (Meijden) W.J. de Wilde & Duyfjes.

Introduction

During the study of *Xanthophyllum* carried out in the BO, KEP, L, SAN, SAR and SING herbaria for the account of Polygalaceae in the Tree Flora of Sabah and Sarawak, several new taxa were defined. Their taxonomic position within the more than 50 species of *Xanthophyllum* recognised in Sabah and Sarawak will be clarified in the treatment of the family in the forthcoming volume of the Tree Flora of Sabah and Sarawak series. In addition, three new species from Brunei and Kalimantan are also described below.

1. Xanthophyllum adenotus Miq. var. **arsatii** (C.E.C. Fisch.) W.J. de Wilde & Duyfjes, *stat. nov.*
Basionym: *Xanthophyllum arsatii* C.E.C. Fisch., Bull. Misc. Inform., Kew (1932) 176. **Type:** *Arsat BNBFD 1213*, Borneo, Sabah, Lokan [Lukan] (*holo* K).

Distribution: Endemic to Borneo (Sabah, Sarawak, Brunei, Kalimantan).

Ecology: In mixed dipterocarp forest, along streams, on flat land or on ridges, on sandy soil, sandstone, shale or silty clay, at altitudes to 400 m.

Notes: We recognise two varieties of *Xanthophyllum adenotus*: var. *adenotus* and var. *arsatii*. The latter differs from the typical variety in its leaves that have a cuneate or rounded base (not rounded-cordate) with flat (not upturned) margins on both sides of the petiole.

Selection of specimens examined: SABAH - Kinabatangan District, Tangkulap Forest Reserve (e.g *SAN 124676*); Labuk Sugut District, Bidu Bidu Forest Reserve (e.g., *SAN 130719*); Pensiangan District, Sogo Sogo (e.g., *SAN 91117*); Ranau District, Kilimu Forest (e.g., *SAN 65111*); Sandakan District, Kebon China Forest Reserve (e.g., *SAN 37456*), Sipitang District (e.g., *SAN 133578*). SARAWAK - Kapit District, Sungai Mengiong (e.g., *S 29155* and *S 41217*); Kuching District (e.g., *S 20887* and *S 32692*); Lubok Antu District (e.g., *S 33564*); Lundu District, Sungai Sebuloh (e.g., *S 49914* and *S 59969*), Gunung Pueh (e.g., *S 34490*); Miri District, Lambir Hill National Park (e.g., *S 46424*). BRUNEI - Belait District, Sungai Liang Arboretum (e.g., *Niga Nangkat NN 94*), Brunei Town (e.g., *Hotta 13182* and *Sands 5673*); Tutong District (e.g., *BRUN 15060* and *BRUN 15370*). KALIMANTAN - WEST KALIMANTAN, Bukit Baka National Park (e.g., *Church 159*), Gunung Bentuang (e.g., *Yahud ITTO/BA 792*), Gunung Senuyah (e.g., *Suzuki 9675*); CENTRAL KALIMANTAN, Sambas (e.g., *Jarvie 5668*), Sungai Katingan (e.g., *Wiriadinata 3566*), Tumbong Riang (e.g., *Mogea 3626*); EAST KALIMANTAN, Bilatalang (e.g., *Kostermans 12707*), Djenean (e.g., *Endert 4958*), Nunukan Island (e.g., *Meijer 2424*).

2. Xanthophyllum bicolor W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum penibukanensem Heine, *foliis longioribus 14–24 cm longis, basi in petiolo longo attenuata 20-30 mm longo, fructu 2 cm diam. distinctum.* ***Typus:*** *Niga Nangkat NN 182*, Borneo, Brunei, Belait District, Sungai Mau (*holo* KEP; *iso* BRUN, L, SAN, SAR, SING).

Tree to 30 m tall and 32 cm diam. **Twigs** grey. **Bark** dark brown, smooth, inner bark pale yellow. **Axillary buds** 1–3, conical, 2–4 mm long, glabrous, with corky thickenings at base. **Leaves** glabrous, green and shiny above, *contrastingly pale cinnamon* and *papillose beneath*; blade oblong, 14–35 x 4.5–10 cm, *base long-attenuate and forming part of the petiole*, apex rounded to bluntly acute; midrib somewhat raised above; lateral veins 8–12 pairs, indistinct, basal veins hardly reaching the middle of the leaf, intramarginal vein faint; *intercostal venation coarsely reticulate*, faint; glands inconspicuous; *petiole* 20–30 mm long, *consisting of the basal half grey-brown, transversely or longitudinally furrowed or wrinkled, and the distal part smooth yellowish-coloured like the midrib.* **Inflorescences** nearly half as long as the leaves, 6–11 cm long, *unbranched*; axis minutely sparsely appressed hairy, 15–25–

flowered. **Flowers:** 1–3 per bract, bracts minute; *pedicel* 5–10 mm long, appressed fine-hairy or subglabrous; sepals *c.* 4 mm long, subglabrous; petals glabrous, yellowish orange when fresh, brown-orange on drying; ovary ovoid, *c.* 4 mm diam., sparsely minutely appressed hairy, *c.* 2 mm stipitate, style caducous, *ovules 8* (?). **Fruits** globose, 1.5–2 cm diam., 2 mm stipitate, blue when ripe, drying light brown, glabrous; pericarp thin; *fruiting pedicel c.* 10 mm long.

Distribution: Endemic to Borneo (Sabah, Sarawak and Brunei).

Ecology: Mixed dipterocarp, riverbank and hill forest, on peaty or (yellow) sandy clay soil, at low altitudes.

Notes: *Xanthophyllum bicolor* belongs to a group of species with 8-16 ovules per ovary and a pale, whitish, papillose leaf lower surface, to which also belong *X. discolor*, *X. penibukanense* and *X. pulchrum.* It differs from *X. discolor* and *X. penibukanense*, by its long petiole, which is two-coloured as it actually consists of a brown basal part that appears to be the 'true' petiole and a more greenish part which can be regarded as derived from the base of the leaf blade narrowed to the same width as the 'true' petiole. This phenomenon is less conspicuously seen in *X. penibukanense*, and even more so in the unrelated *X. longum*, described below. The lower leaf surface is of a distinctive pale cinnamon, much contrasting with the dark green upper surface. Although known only from few specimens, *X. bicolor* seems to be confined to forest on poor wet soils or peaty riverbank swamp forest, whereas *X. penibukanense* is found mainly in forest on well-drained soils.

Specimens examined: SABAH – Beaufort District (*SAN 43595, SAN 77790* and *SAN 86129*); Tenom District (*SAN 64344*); SARAWAK – Lubok Antu District, Ulu Sungai Engkari (*S 34123*). BRUNEI – Mostly from Belait District (*BRUN 17868, BRUN 17936, Joffre et al. JAA 10, Haslani Abdullah HA 80, Niga Nankat NN 182* [type] and *Niga Nankat NN 369*).

3. Xanthophyllum brachystachyum W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum pedicellatum Meijden, *racemis brevioribus paucifloris c. 5 mm longis, pedicellis 2–4 mm longis differt.* **Typus:** *Normaya & Sirukit S 91521*, Borneo, Sarawak, Marudi District, Sungai Silat Basin, Bukit Palutan *(holo* SAR; *iso* KEP, L, SAN, SING).

Tree to 12 m tall and 9 cm diam. **Bark** smooth, grey-green or whitish, slash bark yellow, tough. **Sapwood** yellow, hard. **Twigs** 0.5–1 mm diam., brown patently hairy, hairs *c.* 0.5 mm long, later glabrescent. **Axillary buds** less than 1 mm long, hairy. **Leaves** green, hairy mainly on midrib, *papillose* beneath; blade narrowly oblong, 3–7(–9.5) x 0.5-1(–2) cm, base narrowly rounded or cuneate, apex long-acute; lateral veins 4–7 pairs, forming a faint intramarginal vein; *intercostal venation reticulate*; glands numerous, minute, *c.* 0.1 mm diam., scattered; *petiole c.* 2 mm long, hairy. **Inflorescences** much shorter than the leaves, *c.* 0.5 cm long, *unbranched*, with 2–4 flowers; axis glabrescent. **Flowers**: *pedicel* 2–4 mm long, subglabrous; sepals sparsely appressed hairy or subglabrous, outer sepals 1.5–2 mm long, inner sepals *c.* 2.5 mm long; petals pale purplish, drying orange brown, (sub)glabrous, *c.* 12 mm long; filaments subglabrous, anthers *c.* 0.5 mm long, with some hairs at base; ovary *c.* 1 mm stipitate, densely light brown half-patently hairy, hairs 0.5–1 mm long, style glabrous in apical part, *ovules* presumably *8 or more*. **Fruits** globose, 1–1.5 cm diam., pale brown, hairy; *fruiting pedicel c. 5 mm long.*

Distribution: Endemic to Borneo (Sabah and Sarawak).

Ecology: Hill mixed dipterocarp forest, at altitudes between 500 and 900 m.

Notes: This species resembles *Xanthophyllum purpureum* Ridl. because its midrib is densely hairy beneath. *X. brachystachyum* is easily distinguished by its strikingly delicate branches (1 mm thick or less) and small leaves, by which it is reminiscent of *X. pedicellatum*. The latter, however, differs by its longer inflorescences with more flowers with longer pedicels, 10–15 mm long (pedicels 2–4 mm long in *X. brachystachyum*). Both *X. pedicellatum* and *X. brachystachyum* can possibly be regarded as derived from delicate ecotypic forms, possibly confined to ridge forest on poor soils, of the very variable *X. purpureum*.

Specimens examined: SABAH–Beaufort District, Mt. Sunggau (*SAN 77425*). SARAWAK–Marudi District, Bukit Palutan (*S 91521* [the type] and *S 91825*); Miri District (*S 3735*).

4. Xanthophyllum crassum W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum vitellinum (Blume) D. Dietr., *foliis crassis coriaceis nervatura inconspicua, inflorescentiis validissimis eramosis differt.* ***Typus:*** *Sugau SAN 134307*, Borneo, Sabah, Kinabatangan District, Bukit Tawai (*holo* SAN).

Figure 1

Shrub or treelet *c.* 2 m tall and *c.* 3 cm diam. **Bark** blackish brown. **Twigs** black, glabrous, 4–5 mm thick. **Axillary buds** long-conical, (2–)4–5 mm

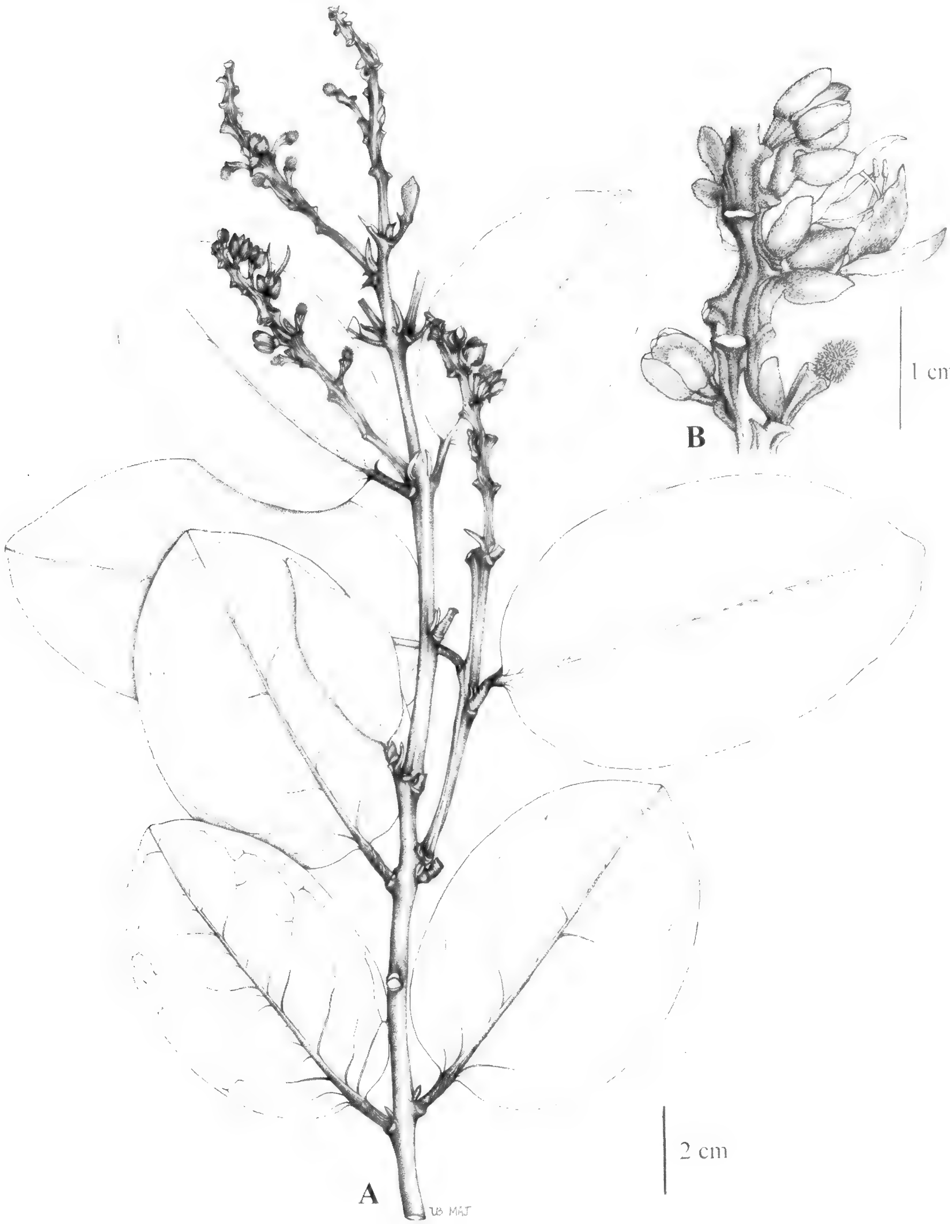

Figure1. *Xanthophyllum crassum* W.J. de Wilde & Duyfjes
A. Flowering leafy twig; B. Part of inflorescence. (from *SAN 134307*)

long, glabrous. **Leaves** thickly coriaceous, glabrous, on drying dark brown above; concolorous and *not papillose* beneath; blade (shortly) (ovate-) elliptic, 6–10(–12) x 6(–7) cm, base broadly rounded, apex rounded with short, broad, blunt tip; midrib slightly raised above; lateral veins 4–7 pairs, *not* forming an intramarginal vein; *intercostal venation reticulate*, flat and indistinct beneath; glands few, scattered, less than 0.5 mm diam.; *petiole* 8–10 mm long, stout, black on drying, without glands. **Inflorescences** *stout, erect,* (almost) *unbranched*, finely yellow-brown appressed hairy; axis 5–7 cm long, 3–4 mm thick, 10–15–flowered. **Flowers** solitary or 2–3 together; *pedicel* short, stout, 4–5 mm long; sepals 5–6 mm long, densely appressed yellow-brown hairy; petals 14–15 mm long, purple-black on drying, partly grey-yellow appressed hairy; stamens and pistil not seen; ovary subglobose, *c.* 2.5 mm diam., densely yellow-brown subpatently hairy, hairs *c.* 0.5 mm long, *ovules 4*. **Fruits** not seen.

Distribution: Endemic to Sabah, where it is known only from the type locality in the Bukit Tawai Forest Reserve, Kinabatangan District.

Ecology: Stunted montane forest over ultrabasic substrate, at *c.* 1250 m altitude.

Notes: *Xanthophyllum crassum* is obviously close to *X. vitellinum*, which has membranous leaves and branched inflorescences. It differs, however, from *X. vitellinum* in its stout habit, (ovate-)elliptic, very coriaceous leaves with faint venation, and stout, erect, almost unbranched inflorescences. It is also similar to *X. rectum* from lowland *kerangas* in west Sarawak, which differs in its prominent and distinct coarsely reticulate leaf venation.

5. Xanthophyllum griffithii A.W. Benn. var. **papillosum** W.J. de Wilde & Duyfjes, *var. nov.*
Iuxta Xanthophyllum griffithii A.W. Benn. *var. angustifolium* Ng, *ramulis 2 mm diam., gemmis axillaribus* 5-*10 mm longis pubescentibus, foliis infra distincte papillosis differt.* ***Typus:*** *Abang Mohtar S 54289*, Borneo, Sarawak, Lundu District (*holo* SAR; *iso* K, KEP, L, MO, SAN).

Synonym: *Xanthophyllum griffithii* A.W. Benn. subsp. *angustifolium* (Ng) Meijden, Leiden Bot. Ser. 7 (1982) 94, *p.p., excluding the collections cited for Peninsular Malaysia.*

Twigs hairy, towards apex 1–2 mm thick. **Axillary buds** long-triangular or oblong (-linear), 5–9(*–10) mm long, hairy*. **Leaves** (ovate or) elliptic-oblong, 5–10(–13) x 2–5 cm, apex acute-acuminate, dull, pale (grey-glaucous) and *distinctly papillose* beneath; petiole 6–12 mm long, hairy. Branches of inflorescences 1–2 mm thick, *densely brown hairy*. **Fruits** *densely* patently *hairy*, sometimes glabrescent; *fruiting pedicel c.* 3 mm long, densely fine-hairy.

Distribution: Endemic to Borneo (Sarawak and Kalimantan).

Ecology: In mixed lowland dipterocarp and heath forest, also close to the sea.

Notes: Two varieties of *Xanthophyllum griffithii*, var. *angustifolium* and var. *papillosum*, can be found in the same area, e.g. at Gunung Santubong, Sarawak, where the former seems to grow at somewhat higher altitudes. The type of *X. griffithii* var. *angustifolium* from Peninsular Malaysia (Ng, 1970, 1972) has axillary buds that are somewhat longer (5–7 mm long), the branches slightly thicker, and the flowers more hairy, as compared to the Bornean material. *Xanthophyllum griffithii* var. *papillosum* comes close to *X. pseudostipulaceum* Merr. from Luzon, the Philippines, but the latter differs in its larger and glabrous axillary buds, and glabrous twigs.

Specimens examined: SARAWAK - Bintulu District (*S 54289*); Kuching district, Gunung Santubong (*S 47097, S 60111, S 91154* and *S 91159*), Bako National Park (*S 6730, S 7006* and *S 54289* [the type], Gunung Matang (*S 81803*); Lundu District, Samunsam Wildlife Sanctuary (*S 40567*). EAST KALIMANTAN, Berau (*Ambriansyah et al. 942, Arifin et al. 1108* and *Kessler et al. 651*).

6. Xanthophyllum inflatum W.J. de Wilde & Duyfjes, sp. nov.
Xanthophyllo flavescenti Roxb. *similis, fructu maiore c. 4 cm diam., infructescentia racemosa eramosa differt.* ***Typus:*** *Ambriansyah AA 2772*, Borneo, Central Kalimantan, Barito River, Batampang Village area, 2° 01 2S 114° 38 2 E *(holo* L; *iso* WAN).

Small tree to 5 m tall and 7 cm diam. **Bark** greyish. **Axillary buds** minute, less than 1 mm long. **Leaves** coriaceous, yellow on drying, glabrous, *not papillose* beneath; blade oblong, 12–20 x 3–5.5 cm, base cuneate, apex acute-acuminate; midrib prominent beneath; *intercostal venation* (in parts of the leaf) *scalariform*; *petiole* 10–15 mm long. **Inflorescences** (infructescences) terminal, *long-racemose, unbranched*, 15–20 cm long, 20–25–flowered (flower-scars). **Flowers** not known. **Fruit** developed near the apex of the infructescence, single, globose, large, 3.5–4 cm diam. (*c.* 7 cm diam. and orange when fresh), glabrous; pericarp *c.* 5 mm thick, somewhat wrinkled, (yellow-)brown on drying; sepals not persistent; *fruiting pedicel* stout, 4–5 mm long. **Seed** single, globose, *c.* 2 cm diam.

Distribution: Endemic to Borneo; confined to Kalimantan where it is known only from the type.

Ecology: Peat swamp forest, at *c.* 25 m altitude.

Notes: This species from peat swamp forest is, in its vegetative characters, closely related to the large, variable species *Xanthophyllum flavescens*, which differs in having branched inflorescences and smaller fruits (1–2 cm diam.) with a thinner pericarp.

7. Xanthophyllum ionanthum W.J. de Wilde & Duyfjes, *sp. nov.*
Xanthophyllo pedicellato Meijden *et X. neglecto* Meijden *similis, foliis infra pubescentibus nec papillosis, basi anguste cuneata, inflorescentia brevi c. 0.5 cm longa pauciflora, pedicellis* 6–8 *mm longis, ovulis 4 differt.* ***Typus:*** *Susanto & Peters 1177*, Borneo, West Kalimantan (*holo* L; *iso* BO, NY).

Treelet, stem 3–6 cm diam. **Axillary buds** long-triangular, *c.* 3 mm long, hairy. **Leaves** green on drying, (sparsely) patently hairy and *not papillose* beneath; blade oblong, 8–13 x 2–4 cm, base long-cuneate, apex acute-acuminate; intercostal venation *reticulate*; *petiole* 5–7 mm long, short-hairy. **Inflorescences** 1 or 2 on the node or on the older wood, *unbranched*, short, 0.5(–1) cm long, pubescent, 3–5-flowered; bracts minute; pedicel 6–8 mm long, hairy; flowers yellow, sepals hairy; ovary ovoid, stipitate, *hairy*, *ovules 4*. **Fruits** (immature) subglobose, *c.* 6 x 5 mm, densely hairy; *fruiting pedicel* 8–10 mm long.

Distribution: Endemic to Borneo; confined to West Kalimantan.

Ecology: Mixed dipterocarp forest, on rocky soil, at 100–300 m altitude.

Notes: The long-pedicelled flowers of the (sometimes paired) short inflorescences give the impression that the flowers are more or less fascicled. *Xanthophyllum ionanthum* resembles *X. beccariana* or *X. pedicellatum* in its similar hairy leaves, but the last two species have a much broader leaf base, purplish flowers and 8–12 ovules per ovary. It is also superficially reminiscent of *X. neglectum*, a largely glabrous species with 4 ovules per ovary.

Specimens examined: WEST KALIMANTAN (*Susanto & Peters 1177* [the type], *Suzuki K9720* and *Suzuki K10071*).

8. Xanthophyllum lineare (Meijden) W.J. de Wilde & Duyfjes, *stat. nov.* **Basionym:** *Xanthophyllum adenotus* Miq. var. *lineare* Meijden, Leiden Bot. Ser. 7 (1982) 101; Fl. Males. 1, 10 (1988) 516. **Type**: *Sinanggul SAN 57294*, Borneo, Sabah, Lahad Datu District, Bukit Silam (*holo* K; *iso* SAN).

Notes: Additional collections made since its original description as a variety of *Xanthophyllum adenotus* indicate that this taxon can best be regarded as a distinct species. It is possibly derived from the widespread *X. adenotus*, but it is different especially in its coriaceous linear leaves. It seems restricted to an environment with divergent ecology, namely, in stunted forest on ultrabasic bedrock on Bukit Silam. Some other local endemic species, like *X. crassum, X. petiolatum* Meijden and *X. rectum*, may similarly be regarded as derived from the widespread *X. vitellinum*, induced by special edaphically defined environments.

Specimens examined: SABAH — Lahad Datau District, Bukit Silam (*Beaman et al. 10030, Rimi Repin et al. SP 6225, SAN 29652, SAN 57294* [the type], *SAN 95535, SAN 109836, SAN 144533* and *Wood SAN A 4182*).

9. Xanthophyllum longum W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum vitellinum (Blume) D. Dietr., *foliis tenuibus concoloribus petiolis gracilibus* 35–40 *mm longis differt.* ***Typus:*** *Sigin, Lideh & Patrick SAN 107165*, Borneo, Sabah, Kinabatangan District, Ulu Sungai Pinangah (*holo* SAN; *iso* KEP, L, SAR).
Figure 2

Tree to 5 m tall and 10 cm diam. **Bark** pale greenish or blackish. **Sapwood** white. **Axillary buds** 1 (or 2), less than 1 mm long, minutely hairy. **Leaves** green on both surfaces, glabrous, except for minutely patently hairy midrib and petiole, *not papillose beneath*; blade (narrowly) oblong, 15-20 x 6–7 cm, base rounded to short-attenuate, apex acute-acuminate; midrib raised above; lateral veins 8–10 pairs, *forming an intramarginal vein*; *intercostal venation reticulate*; glands inconspicuous; petiole *(20-)30–40 mm long*, 1–2 mm thick, the basal portion of *c.* 15 mm brown, the rest slightly narrower and drying as green-yellow as the midrib, glands absent. **Inflorescences** about half as long as the leaves, subapical, *branched*, axes minutely patently hairy. **Flowers** (after anthesis) single; *pedicel* 1–2 mm long; perianth, stamens and pistil unknown; *ovary* globose, densely grey(-brown) patently hairy (hairs *c.* 0.5 mm long), style caducous, *ovules 4*. **Fruits** hairy, brownish, globose, 1.5–1.7 cm diam.; pericarp thin; *fruiting pedicel c.* 4 mm long.

Distribution: Endemic to Borneo (Sabah and Sarawak).

Ecology: Lowland forest, along streams, on undulating land and hillsides.

Notes: *Xanthophyllum longum* resembles *X. vitellinum* but differs, in general aspect, from the latter (and from all other known species in Sabah and Sarawak), by its thin, bright green leaves and extremely long and slender petioles, (20–)30–40 mm long (*versus* 8–14(–16) mm long in *X. vitellinum*). The upper two-thirds of the petiole is obviously derived from the leaf blade as it has the same green-yellow colouring as the midrib; the basal one-third dries brown as is the case in most species of *Xanthophyllum.*

Specimens examined: SABAH - Kinabatangan District, Ulu Sungai Pinangah (*SAN 81178, SAN 95970, SAN 107165* [type], *SAN 107277* and *SAN 107314*); Tawau district (*SAN 95970*). SARAWAK - Limbang District (*Brunig 48*, specimen slightly deviating).

10. Xanthophyllum nitidum W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum vitellinum (Blume) D. Dietr.*, partibus omnibus flavovirentibus, venatione intercostali tenuissima et acuta in folii pagina inferiore nitidi, areolis consimilibus c. 0.5 mm diam. differt.* **Typus:** *Dewol, Tuyok & Langkap SAN 108778*, Borneo, Sabah, Kinabatangan District, Bukit Tawai (*holo* SAN; *iso* A, BO, K, KEP, L, SAR, SING).

Tree to 20(–30) m tall and 20(–35) cm diam. **Twigs** yellow. **Bark** smooth, black, inner bark yellowish. **Sapwood** white. **Axillary buds** *c.* 1 mm long, minutely hairy. **Leaves** *green-yellow*, *shiny above*, concolorous, *not papillose* beneath; blade oblong-lanceolate, 7–11 x 2–4 cm, base cuneate, apex acute–acuminate; midrib above flat; lateral veins 4 or 5 pairs, *intramarginal vein indistinct*; *intercostal venation finely reticulate on both surfaces*, areoles all of about the same size, small, *c.* 0.5 mm diam., glands inconspicuous; petiole 8–12 mm long, transversely wrinkled. **Inflorescences** 5–10 cm long, *branched*, minutely light brown hairy. **Flowers** 2 together at base, other flowers solitary: *pedicel* 2–3 mm long, hairy; perianth, stamens and pistil not known; developing *ovaries* and immature fruit sessile, globose, 4–6 mm diam., (not densely) hairy, light green, *ovules 4*. **Fruit** not known.

Distribution: Endemic to Borneo (Sabah and Kalimantan).

Ecology: Lowland forest, on brown soil over ultrabasic bedrock, at 100–400 m altitude.

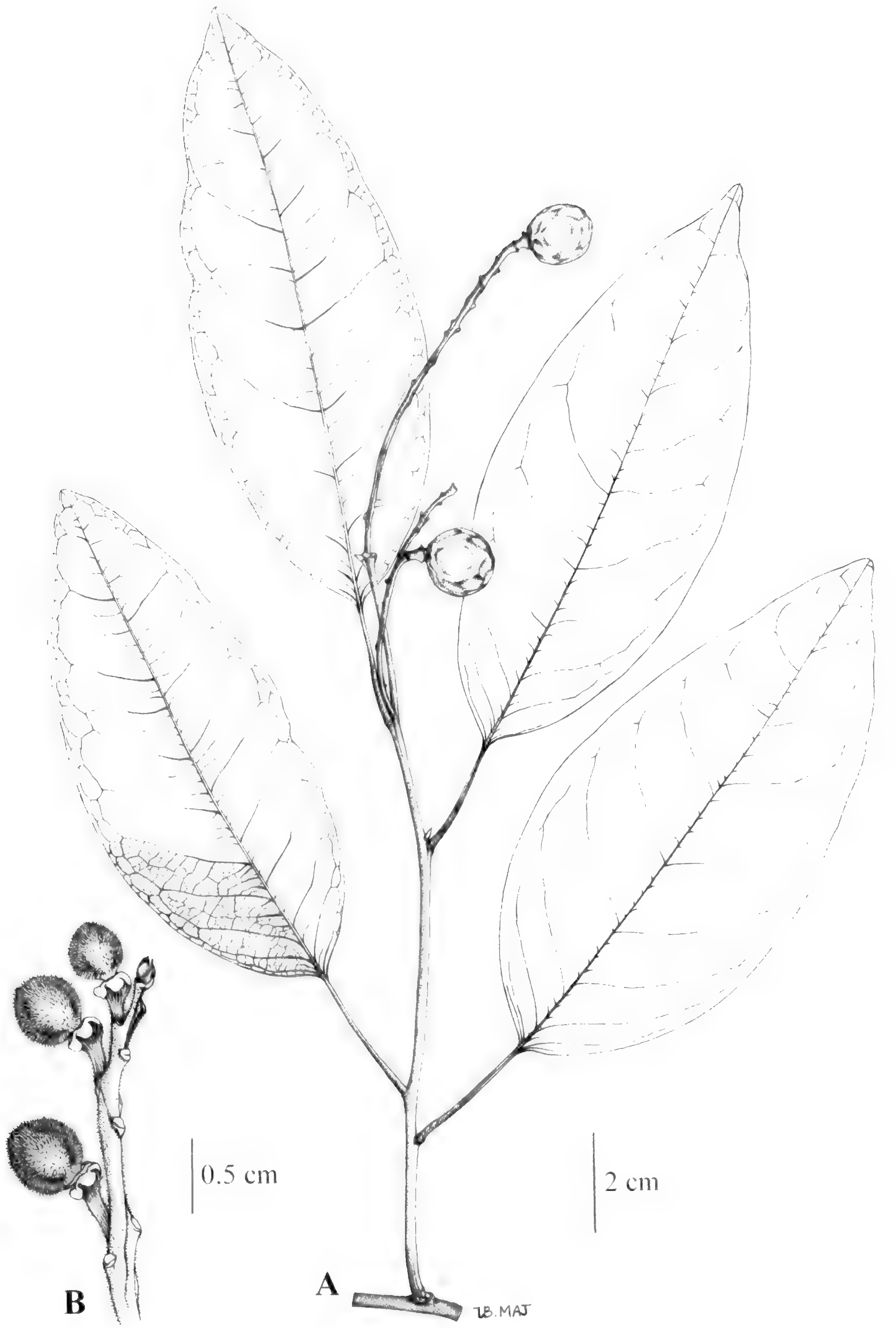

Figure 2. ***Xanthophyllum longum*** W.J. de Wilde & Duyfjes
A. Fruiting leafy twig; B. Part of inflorescence (post-anthesis) with developing ovaries (young fruits). (A from *SAN 107277*, B from *SAN 107165*).

Notes: *Xanthophyllum nitidum* resembles superficially the variable and widespread *X. flavescens* in its overall yellow-green colour of the dried leaves, its yellow twigs, and its widely branched inflorescences. However, it differs from the latter by its ovary, which is hairy all-over (glabrous in *X. flavescens*), shiny aspect of the leaves (not shiny in *X. flavescens*) and finely and regularly areolate-reticulate venation (scalariform in *X. flavescens*). It is also close to *X. vitellinum*, a species with the leaves dull and mostly green-brown on drying and with coarser, irregularly sized areoles. The collections from Sabah are from ultrabasic localities.

Specimens examined: SABAH - Kinabatangan District, Bukit Tawai (*SAN 108778*, the type); Sandakan District, Bukit Tangkunan (*SAN 71499*), Bukit Malawali (*SAN 46624*). EAST KALIMANTAN, Kutai (Arifin AA 968 and *Sidiyasa 1118*).

11. Xanthophyllum pachycarpon W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum tenuem Chodat, *fructu maiore 2–3 cm diam., pericarpio crassiore 5–10 mm crasso differt.* ***Typus:*** *Lai et al. S 69651*, Borneo, Sarawak, Lubok Antu district, Nanga Segara, Sungai Engkari (holo SAR; iso K, KEP, L, SAN, MO).

Tree 12-30 m tall and to 30 cm diam. **Bark** greyish or darkish green, smooth or with large warty lenticels. **Sapwood** orange-yellow. **Twigs** glabrous, smooth, yellowish. **Axillary buds** long-triangular, 1–1.5 mm long, glabrous. **Leaves** glabrous, green-brown or light brown above, *concolorous, not papillose* beneath; blade oblong, 8–16 x 2.5–6 cm, base cuneate, apex acute-acuminate; midrib scarcely raised above, prominent beneath; lateral veins 4–6 pairs, forming an irregular intramarginal vein; *intercostal venation finely and sharply reticulate on both surfaces*; glands inconspicuous; *petiole* 6–12 mm long, longitudinally and transversely wrinkled, glabrous, glands absent. **Inflorescences** much shorter than the leaves, *unbranched*, with 7-10 flowers (flower-scars), axis short hairy, glabrescent. **Flowers** not known. **Fruits** glabrous, globose, 2–3 cm diam, light brown, coarsely wrinkled on drying; pericarp 5–10 mm thick, solid or spongy due to irregularly-sized scattered hollows; *fruiting pedicel* 3–4 mm long. **Seed** 1.

Distribution: Endemic to Borneo (Sabah, Sarawak and W Kalimantan).

Ecology: Mixed dipterocarp forest, on hill ridges and slopes, at altitudes to 650 m, also in forest on brown soil over ultrabasic bedrock.

Notes: This species, for which flowers are unknown, can be readily recognized by its diagnostic large globose fruits, 2–3 cm in diam., which dry light brown with a coarsely, wrinkled surface. The dry pericarp is somewhat woody, 5–10 mm thick, solid or with scattered hollows of various sizes. The venation of the glabrous concolourous leaves is fine and distinct on both surfaces, by which the plant is reminiscent of *Xanthophyllum nitidum*, but in the latter species the distinct venation is still finer, the inflorescences branched and the young fruits densely hairy. In *X. pachycarpon*, the fruits (and presumebly the ovaries) are glabrous.

Specimens examined: SABAH - Keningau District (*SAN 78275* and *SAN 78258*); Kinabatangan District (*SAN 52086, SAN 52099, SAN 53303* and *SAN 54072*); Labuk Sugut District (SAN 82833); Ranau District (*SAN 76778* and *SAN 97680*); Sandakan District (*SAN 51297*); Tenom District (*Aban et al. 65263*). SARAWAK - Belaga District, Sungai Kenaban (*S 3525* and *S 3541*); Lubok Antu District (*S 69651*, the type); Serian District, Sungai Engkabang (*S 27397*). WEST KALIMANTAN - Senawai (*Church et al. 1524*).

12. Xanthophyllum rectum W.J. de Wilde & Duyfjes, *sp. nov.*
Iuxta Xanthophyllum vitellinum (Blume) D. Dietr., *inflorescentiis crassis et validis erectis et eramosis differt.* **Typus:** *Ilias Paie S 17903*, Borneo, Sarawak, Kuching District, Bako National Park, Lintang path (*holo* SAR; *iso* A, BO, K, KEP, L, MEL, SAN, SING).

Tree 5–12 m tall and to c. 20 cm diam.. **Bark** pale grey, smooth or fine-fissured. **Inner bark** yellow-brown. **Twigs** *black*, glabrous, c. 5 mm thick. **Axillary buds** less than 0.5 mm long, subglabrous. **Leaves** coriaceous, dark grey(-green) brown above, chocolate-brown and *not papillose* beneath; blade elliptic-oblong, 7–13 x 3–7.5 cm, base rounded or short-cuneate, apex acute-acuminate (very tip bluntish); midrib above flat or slightly raised; lateral veins 4–7 pairs, *not* forming an intramarginal vein; *intercostal venation reticulate*, *prominent and distinct beneath*; glands absent or inconspicuous; *petiole* 7–12 mm long, without glands. **Inflorescences** *stout, straight, erect, unbranched,* axis 15–20-flowered, 8–13 cm long, 2–8 mm thick, sparsely minutely appressed brown hairy. **Flowers** solitary: *pedicel c.* 1 mm long; sepals *c.* 4 mm long, drying blackish; petals not seen; stamens and mature pistil not seen; *ovary* sessile, (densely) hairy, *ovules 4*. **Fruit** globose, *c.* 1.8 cm diam., smooth, ± shiny, dark-brown, ± sparingly hairy, glabrescent; pericarp thin, seed 1; *fruiting pedicel c.* 2.5 mm long, 3–4 mm thick.

Distribution: Endemic to Sarawak.

Ecology: Lowland heath forest, ridge of dipterocarp forest, and rocky padang.

Notes: Earlier collected specimens of this species were left unnnamed by Ng (in herb. KEP, 1968), but determined by van der Meijden (1982) as *Xanthophyllum vitellinum*, which it resembles. *Xanthophyllum vitellinum* normally has branched inflorescences, but occasionally has unbranched ones, and it has membranous leaves. *Xanthophyllum rectum* is conspicuously stout with thick twigs and coriaceous leaves with prominent venation beneath, the whole plant dries dark brown, with stout, erect and unbranched inflorescences. Apparently, it is confined to low heath forest of the Sampadi Forest Reserve and Bako National Park, at low altitudes, in west Sarawak.

Specimens examined: SARAWAK – Kuching District, Bako National Park, Lintang path (*S 4446* and *S 17903*, the type), Sampadi Forest Reserve (*S 66789*), Selang Forest Reserve (*Brunig 7343*); Lundu District, Bedaun, Sematan (*S 65493*).

13. Xanthophyllum rheophilum W.J. de Wilde & Duyfjes, *sp. nov.*
Xanthophyllo flavescenti Roxb. *differt in foliis lineare-lanceolatis, petiolis 3–4 mm longis, fructu c. 1 cm diam.* **Typus:** *Ridsdale PBU 97*, Borneo, Central Kalimantan, Barito Ulu, 0.02' S 114° 06' E, (holo L; iso BO).

Shrub *c.* 3 m tall. **Axillary bud** minute. **Leaves** glabrous, yellow on drying, lower surface concolorous, *not papillose*; blade lanceolate-linear, *6–12* x *0.5–1 cm*, base attenuate, apex long-acuminate; intercostal venation *reticulate*; *petiole* 3–4 mm long, glabrous. **Inflorescences** *racemose* or *few-branched*, *c.* 7 cm long, (5–)10–15-flowered. **Flowers:** *pedicel* c. 5 mm long; petals cream; *ovary* subglobose, glabrous, except for a few hairs at apex, *ovules 12*. **Fruits** globose, 0.8–1 cm diam., glabrous, blackish on drying.

Distribution: Endemic to Central Kalimantan; known only from the type.

Ecology: Riverine vegetation, at low altitude.

Notes: *Xanthophyllum rheophilum* is close to the broadly defined *X. flavescens*, a species usually with the intercostal venation scalariform and with 5–15 mm-long petioles. The lanceolate-linear leaves with a short petiole make *X. rheophytum* distinctive.

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Taxonomic Notes on Bornean *Cryptocarya* R.Br. (Lauraceae)

F.S.P. NG

Forest Research Institute Malaysia
52109 Kepong, Selangor, Malaysia

Abstract

Cryptocarya is sharply defined from other genera in the Lauraceae by floral morphology and fruit development. The ovary is superior and seated within a deep and distinct hypanthium. The developing fruit remains free from the hypanthium but is completely enclosed by it. The resulting inferior fruit has two walls - an outer wall developed from the hypanthium, and an inner wall derived from the ovary wall. The only other tree genera of Lauraceae in SE Asia with inferior fruits are *Eusideroxylon* and *Potoxylon,* but in these two genera, the ovaries are semi-inferior and the pericarp develops from the 'fusion' of the receptacle and the ovary wall resulting in a single fruit wall.
In Borneo, 15 species of *Cryptocarya* are recognized. Seven species are reduced to synonymy.

Introduction

Cryptocarya is a genus of monoecious trees with leaves alternate or spiral, mostly penniveined but in a few species triveined at the base. The inflorescences are paniculate with first, second, third or, rarely, fourth order branching, are terminal and axillary, and irregularly bracteate (sometimes with a bract subtending every flower, sometimes not). The flowers are bisexual, occupying terminal and lateral positions on the panicles, small in all species (2–3 mm long and 1–2 mm wide in dried specimens), bearing 6 perianth lobes (three outer and three inner), a ring of 6 stamens alternating with 6 glands, and an inner ring of 3 stamens alternating with 3 staminodes, at the rim of a distinct and deep hypanthium (Fig. 1.Aa). The anthers are 2-locular. The ovary is completely surrounded by the wall of the hypanthium but is free from it, and it remains free throughout the development of the fruit (Fig. 1.Ab).

As the fruit develops, the perianth lobes, anthers and staminodes absciss and the hypanthium wall becomes the outer fruit wall. This wall is zoned into a thin skin, a fleshy middle layer and a hard inner layer. Within this, the seed develops within the pericarp, which is dry at maturity. The fruit of *Cryptocarya*, based on the character of the hypanthium wall, can be considered as drupaceous.

Two other tree genera of Lauraceae in Borneo, *Eusideroxylon* and *Potoxylon*, also have drupaceous inferior fruits. Kostermans (1957) described the fruit development of *Eusideroxylon* as follows: "In *Eusideroxylon* the flower tube is shallow, although it completely envelopes the mature fruit". Later, in describing the new genus *Potoxylon,* Kostermans (1978) wrote: "Ovary base immersed in the perianth tube and adnate with it...". Kostermans' comments are based on the definition of the inferior fruit being the result of 'fusion' or 'adnation' of the ovary with a flower tube or perianth tube.

There is no structure in *Eusideroxylon* and *Potoxylon* comparable with the hypanthium of *Cryptocarya.* What we actually see in the flower of *Eusideroxlon* and *Potoxylon* is a semi-inferior ovary, in which about half of the ovule is embedded in the receptacle and half is above it (Fig. 1.Ba, Ca). The fruit is the result of massive enlargement of the receptacle and ovary wall resulting in the perianth lobes, stamens and staminodes persisting as vestiges at the apex of the fruit (Fig. 1.Bb, Cb, Cc). The fruit is a drupe, with its pericarp zoned into a skin-like epicarp, fleshy mesocarp and hard endocarp. The fruits of *Eusideroxylon* and *Potoxylon* are similar in their morphology but differ from the drupaceous fruit of *Cryptocarya* in the receptacle and ovary wall being 'fused' to form the pericarp (Fig. 1.Bb, Cb, Cc), whereas in the fruit of *Cryptocarya* the hypanthium wall remains free from the pericarp (Fig. 1.Ab).

There are 15 species of *Cryptocarya* in Borneo, of which the most common and variable one is *C. ferrea.*

Taxonomic Changes

1. **Cryptocarya ferrea** Blume
Bijdr. Fl. Ned. Ind. (1826) 557. **Type:** *Blume 1559*, Java (holotype L).

This species is probably the commonest and most widely distributed in the genus. It occurs throughout SE Asia and is highly variable in leaf size, leaf shape and angle of inclination of the lateral veins. In this treatment, three varieties, var. *erectinervia*, var. *ferrea* and var. *scortechinii*, are recognised in Borneo, into which most specimens can be placed but many specimens are intermediate and their placement only approximate.

Var. **erectinervia** (Kosterm.) Ng, **stat. nov.**
Basionym: *C. erectinervia* Kosterm., Reinwardtia 7 (1968) 307. **Type**: *Kostermans 9908*, Kalimantan, Samarinda (holo L; iso BO, KEP, SAN).
This variety is characterized by lateral veins acutely inclined and almost

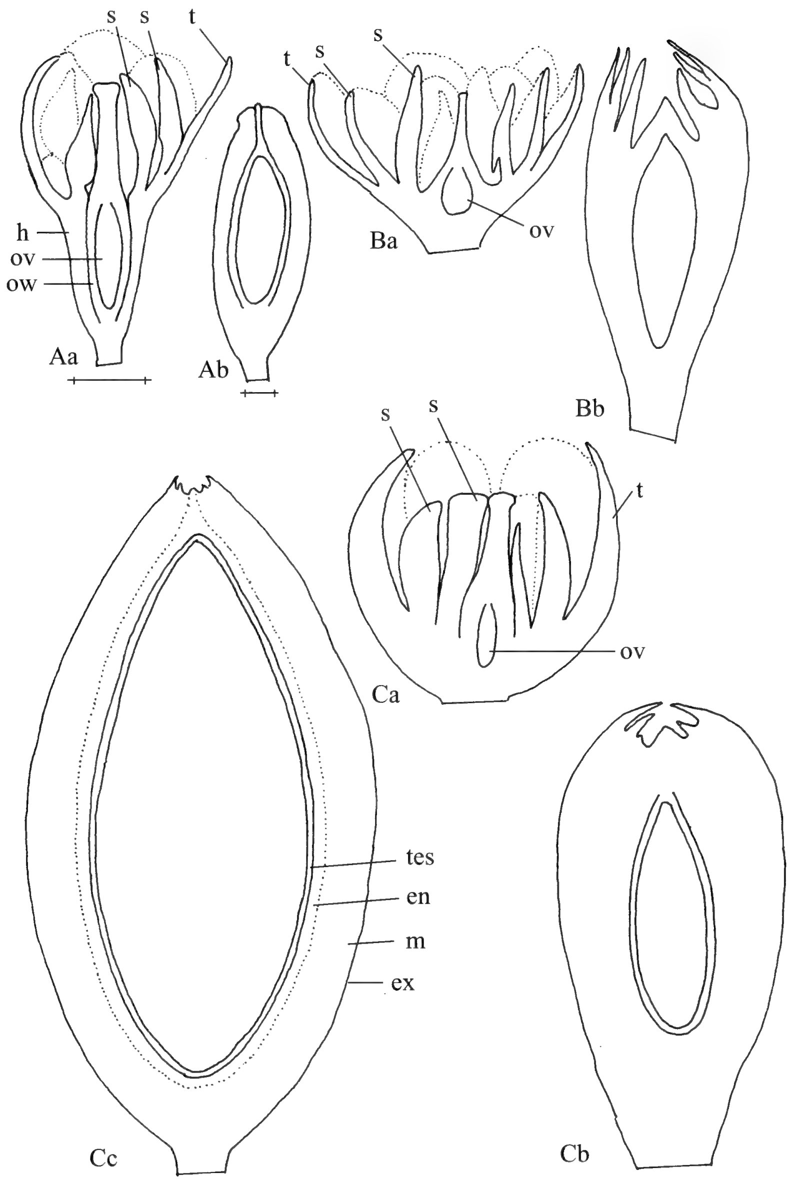

Figure 1. Longitudinal sections of the flowers and fruits of *Cryptocarya*, *Eusideroxylon* and *Potoxylon*

Aa. flower of *Cryptocarya ferrea* var. *ferrea* (*KMS 3299*); Ab. young fruit of *Cryptocarya ferrea* var. *erectinervia* (*SAN 92730*); Ba. flower of *Potoxylon melagangai* (*S 57892*); Bb. young fruit of *P. melagangai* (*SAN 73320*); Ca. flower of *Eusideroxylon zwageri* (*KEP 98302*); Cb and Cc: young and mature fruits of *E. zwageri* (*FSP Ng s.n.*, 14 May 05, freshly fallen, in FRIM plantations.

ov ovule; ow ovary wall; h hypanthium; t tepal; s stamen or staminode; tes testa; en endocarp; m mesocarp; ex exocarp. Scale indicates 1 mm.

straight until they approach the leaf margin; the leaf blades are longer than 15 cm and oblong in shape.

Distribution: Peninsular Malaysia and Borneo. In Borneo: Sabah - Kota Kinabalu, Keningau, Ranau, Sipitang, Tawau (e.g. *SAN 16485*, *SAN 16761*, *SAN 38503* and *SAN 90730*); Sarawak - Sungai Jelalong, Kakus, Mt. Mersing, Tubau (e.g. *S 4947*, *S 21828*, *S 22490* and *S 48984*); Kalimantan - E. Kutei and Samarinda (e.g. *Kostermans 5566*, *5908*, *9931, 9908*).

Var. **scortechinii** (Gamble) Ng, **stat. nov.**
Basionym: *C. scortechinii* Gamble, Bull. Misc. Inform. Kew (1910) 143. **Type:** *King's Collector 6297* (lectotype L = *Sheet No. 003624880761*, here designated).

This variety is characterized by leaves broadly oblong or broadly elliptic, with lateral veins distantly spaced.

Distribution: Peninsular Malaysia and Borneo. In Borneo: Sabah - Lamag, Mostyn, Pulau Sapanggar (e.g. *SAN 23858*, *SAN 35293* and *SAN 57269*); Sarawak - Belaga, Lambir, Lubok Antu, Selampit, Semengoh (e.g. *S 24109*, *S 26987*, *S 44076* and *S 69647*); Brunei – Andulau, Belait, Bukit Puan (e.g. *Wong WKM 950*, *BRUN 578* and *BRUN 2635*).

Var. **ferrea**
New synonyms:
C. tomentosa Blume, Mus. Bot. Lugd. Bat. 1 (1851) 335. **Type:** *Blume s.n.*, Java (holo L = *Sheet No. 8983353*).
C. kurzii Hook. *f.*, Fl. Brit. Ind. 5 (1886) 119. **Type:** *Griffith 1142* (= *Kew Distr. 4274*), Burma, Mergui (holo K).
C. bicolor Merr., Phil. J. Bot. 4 (1909) 255. **Type:** *Hutchinson For. Bur. 6548*, Philippines, Mindanao (holo not seen; iso SING).
C. argentea Gamble, Bull. Misc. Inform. Kew (1910) 144; *C. kurzii* Hook. *f.* var. *argentea* (Gamble) Airy Shaw, Bull. Misc. Inform. Kew (1939) 535. **Type:** *King's Collector 7966*, Perak (holo K; iso SING).
C. tawaensis Merr., Plantae Elmerianae Borneenses. (1929) 89. **Type:** *Elmer 21418*, Sabah, Tawao (holo not seen; iso L, U). (Elmer spelled Tawau as 'Tawao' on the collecting label).
C. kurzii Hook. *f.* var. *subsericea* Airy Shaw, Bull. Misc. Inform. Kew (1939) 535. **Type:** *Richards 2443* Sarawak, Gunung Balapau (holo K; iso SING).
C. borneensis Kosterm., Reinwardtia 7 (1968) 302. **Type:** *Wood SAN 16257*, Sabah, Sipitang (holo L).

This variety is characterized by leaves narrowly elliptic, ovate or obovate, with lateral veins closely spaced.

Distribution: Myanmar, Peninsular Malaysia, Borneo, the Philippines, Java and Sulawesi; probably throughout SE Asia. In Borneo, common throughout Sabah (e.g. *SAN 27336*, *SAN 46277* and *SAN 76444*); Sarawak at Bako, Batang Tinjau, Belaga, Sungai Temulan and Tubau (e.g. *S 39990*, *S 41010* and *SFN 35720*); Brunei at Andulau Forest Reserve (e.g. *BRUN 16914*); Kalimantan at Balikpapan, Gunung Bentuang, Nunukan, Samarinda, Sankulirang (e.g. *Kostermans 5953*, *Kostermans 8937* and *Kostermans 9946*).

2. **Cryptocarya griffithiana** Wight
Icon. 5 (1852) 12, t. 1830. **Type:** *Griffith s.n.*, Malacca (not located).

A widespread species ranging from Myanmar to Sumatra, Peninsular Malaysia, Borneo and the Philippines. Two varieties are recognised, differing consistently only in the length of the bracts that subtend the flowers.

Var. **crassinervia** (Miq.) Ng, **stat. nov.**
Basionym: *Cryptocarya crassinervia* Miq., Fl. Ind. Bat. 1, 1 (1858) 924. **Type**: *Teijsmann s.n.*, Sumatra, Fort de Kock (holo L = *Sheet No. 905229445*).

This differs from the typical variety in the floral bracts shorter than the flowers they subtend.

Distribution: Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo: Sabah - Beaufort, Kalabakan, Kota Belud, Sandakan, Semporna, Sipitang, Tawau, (e.g. *SAN 86242*, *SAN 88178*, *SAN 102650* and *SAN 121972*); Sarawak - Belaga, Kuching, Limbang (Gunung Pagon), Kelabit Highlands, Lambir, Lundu (Bukit Berumput), Simunjan (e.g. *Haviland & Hose 3295*, *S 38465*, *S 46345* and *S 70823*); Brunei - Bukit Apoi and Belait (e.g., *Coode 7921*, *Forman 866* and *Wong WKM 1281*) and Kalimantan - Tumbang Tapi and Bukit Raya (e.g. *Veldkamp 8252* and *Veldkamp 8549*).

Var. **griffithiana**
The typical variety has floral bracts longer than the flowers they subtend. It is rare or possibly extinct in Borneo, being known only by one specimen, *Haviland 870*, from Lundu, Sarawak. The type specimen of this variety could not be found at Kew, but this taxon is well-known in the Malay

Peninsula and there is no doubt about its identity.

3. **Cryptocarya wrayi** Gamble
Bull. Misc. Inform. Kew (1910) 142. **Type:** *Wray 3853*, Peninsular Malaysia, Gunung Bubu, (holotype K).
New synonym: *C. tuanku-bujangii* Kosterm., Reinwardtia 8 (1970) 79. **Type:** *Paie S 26404*, Sarawak, Lawas, path to Gunung Murut (second summit). (holo SAR; iso L, SING).
This is a small tree to 4 m tall, on the summits of mountains. The plants in the Malay Peninsula named *Cryptocarya wrayi* and those in Borneo named *C. tuanku-bujangii* both occupy mountain summits and both have triveined, ovate, coriaceous leaves. I think they are at most only minor geographic variants of the same species.

Distribution: Peninsular Malaysia and Borneo. In Borneo: Brunei - Gunung Pagon Periok (e.g. *Ashton BRUN 2388*) and Sarawak - Batu Lawi, Gunung Murud and Gunung Mulu, (e.g. *S 26404*, *S 38839* and *S 50869*).

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A Synopsis of the Genus *Actinodaphne* Nees (Lauraceae) in Sabah and Sarawak, Malaysia

S. JULIA

Forest Research Centre
KM10, Jalan Datuk Amar Kalong Ningkan,
93250 Kuching, Sarawak, Malaysia

Abstract

In Sabah and Sarawak, a total of 20 species of *Actinodaphne* are recognized including one imperfectly known species. Of these, eight (*Actinodaphne kostermansii* S. Julia, *Actinodaphne percoriacea* S. Julia, *Actinodaphne robusta* S. Julia, *Actinodaphne semengohensis* S. Julia, *Actinodaphne soepadmoi* S. Julia, *Actinodaphne spathulifolia* S. Julia, *Actinodaphne sulcata* S. Julia and *Actinodaphne venosa* S. Julia) are new to science. In addition, two varieties, *Actinodaphne kostermansii* var. *glabrescens* S. Julia and *Actinodaphne sulcata* var. *longipetiolata* S. Julia are also described as new. Relevant references, basionyms, type specimens (if known), synonyms, distribution, ecology and notes for each species occurring in Sabah and Sarawak are provided. An identification list for all specimens examined is given.

Introduction

The genus *Actinodaphne* Nees was established by C. G. Nees von Esenbeck in 1831 based on *A. pruinosa* Nees from Peninsular Malaysia. Since then, a total of 150 binomials have been published by various authors (IPNI, 2005). Of these, 14 binomials were attributed to species from Borneo of which 11 occur in Sabah and Sarawak (Blume, 1851; Miquel, 1858; Merrill, 1921, 1929; Masamune, 1942; Burgess, 1966; Anderson, 1980; Kochummen, 1989; Coode *et al.*, 1996; Argent *et al.*, 1997; and Beaman *et al.*, 2001).

The present study, based mainly on available specimens collected from Borneo and preserved at the BO, KEP, PNH, Kinabalu Park, SAN, SAR and SING herbaria and supplemented with images of type specimens from the data bases/websites of the National Herbarium of the Netherlands, University of Leiden Branch (L), New York Botanic Garden (NY) and Royal Botanic Gardens, Kew (K) resulted in 20 species (including one incompletely known species) being recognized. Of these, eight are new to science and one is a new record for Borneo (*A. johorensis* Gamble). Of the eight new species, four (*A. percoriacea*, *A. semengohensis*, *A. spathulifolia* and *A. sulcata*) are endemic in Sabah and Sarawak, two in Borneo (also occurring in Brunei and/or Kalimantan; *A. kostermansii* and *A. venosa*) and two also occur outside Borneo (*A. robusta*, Peninsular Malaysia and the Philippines and *A. soepadmoi*, Peninsular Malaysia).

The genus *Actinodaphne* comprises about 100 recognized species (Kostermans, 1957; Rohwer, 1993; van der Werff, 2001), distributed from India and Sri Lanka to Myanmar, Thailand, Indo-China, China, Korea, Japan, Malesia and the Solomon Islands.

In Borneo, species of *Actinodaphne* occur in various forest types on different soils, including mixed dipterocarp forest, peat swamp forest, *kerangas* forest, riparian forest and forest on limestone and ultrabasic soils, at altitudes from sea level to 2400 m.

Actinodaphne Nees

Actinodaphne Nees *in* Wallich, Pl. As. Rar. 2 (1831) 61, 68; Gamble, J. As. Soc. Beng. 75, 1 (1912) 112; Merrill, J. Str. Br. Roy. As. Soc., Special Number (1921) 274, Univ. Calif. Publ. Bot. 15 (1929) 78; Ridley, Fl. Malay Penins. 3 (1924) 107; Masamune, En. Phan. Born. (1942) 306; Kostermans, Comm. For. Res. Inst. Bogor (1957) 42; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 124; Burgess, Sabah For. Record 6 (1966) 330; Anderson, Checkl. Trees Sarawak (1980) 220; Corner, Wayside Trees of Malaya 3rd edition, 1 (1988) 382; Kochummen, Tree Fl. Malaya 4 (1989) 102; Rohwer *in* Kubitzki *et al.* (eds.), Fam. Gen. Vas. Pl. 2 (1994) 366; Turner, Gard. Bull. Sing. 47 (1995) 273; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 1 (1997) 301; Beaman *et al.,* Pl. Mt. Kinabalu (2001) 393; van der Werff, Blumea 46 (2001) 125.
Type species: *Actinodaphne pruinosa* Nees.

Terminal (vegetative) buds *perulate*; scales imbricate, often leaf-like, on falling leaving distinct scars just above the whorls of leaves. **Leaves** pinnately veined, usually in whorls of 3–9 or rarely not strictly in whorls; upper surface plane or bullate, often shining, lower surface often glaucous; lateral veins disappearing towards the margin or occasionally joining near the margin at the upper half of the leaf blade; tertiary veins scalariform, subscalariform or reticulate. **Inflorescences** axillary or extra-axillary, usually condensed umbels, pseudo-umbels or glomerules (or the males rarely racemes as in *A. johorensis* Gamble and *A. semengohensis*, or panicles as in *A. montana* Gamble) of sessile or pedicelled flowers borne on short lateral shoots with or without terminal vegetative buds, surrounded by sessile involucral, imbricate bracts which on falling leave distinct scars at the base of the inflorescence. **Flowers** trimerous, unisexual; perianth lobes 6, outer lobes slightly larger than the inner ones; *fertile stamens* in male flowers and staminodes in female flowers usually 9, arranged in 3 whorls, those of the first and second whorls non-glandular, that of the third whorl with stalked glands on each side at the base; *filaments* longer or shorter than anthers, *anthers* 4-locular, the *locules* all introse, arranged in two pairs above each others; *pistillode* in male flower rudimentary and minute or absent; ovary in female flowers superior, narrowed towards the style, stigma peltate, dilated or discoid. **Infructescences** each bearing 1–18 fruits. **Fruits** drupaceous, seated on a flat or shallowly saucer-shaped or deeply cup-shaped, accrescent or non-accrescent cupule with or without a remnant of perianth lobes.

Enumeration of Species Occurring in Sabah and Sarawak

1. **Actinodaphne borneensis** Meisn.

Actinodaphne borneensis Meisn. *in* A.DC., Prodr. 15, 1 (1864) 213; Merrill, J. Str. Br. Roy. As. Soc., Special Number (1921) 274; Masamune, En. Phan. Born. (1942) 306; Burgess, Sabah For. Record 6 (1966) 330; Anderson, Checkl. Trees Sarawak (1980) 220; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149. **Type**: *Lobb s.n.*, Borneo (*holo n.v.*; *iso* K [K000009921]).

Distribution: Endemic in Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In mixed dipterocarp, beach, peat swamp, *kerangas* and submontane forests (including forest on ultrabasic soil) at altitudes from sea level to 1500 m.

Notes: A widespread species in Borneo, characterized by its well-spaced lateral veins of 3–7 pairs, tertiary veins obscure on both surfaces or obscure above, prominulous below, pseudo-umbellate inflorescences each bearing up to 7 flowers, and fruit, which is seated on a shallowly saucer-shaped or deep cup-shaped cupule. The leaves are highly variable in size, ranging from 3.5 x 2 cm to 25 x 8.5 cm.

The species resembles *Actinodaphne pruinosa* Nees and *A. oleifolia* Gamble but can be differentiated from the former by its lax or well-spaced (vs. dense) lateral veins and from the latter by its scalariform (vs. pitted or reticulate) and obscure or prominulous tertiary veins underneath (vs. distinctly prominent).

Kochummen (1989) described specimens from Peninsular Malaysia (*Corner SFN 21345*, *Kiah SFN 32386* and *FRI 13451*) as *A. borneensis*. However, after re-examining the specimens and comparing them with that of the type as well as other specimens of *A. borneensis* collected from Borneo, I am of the opinion that the three specimens from Peninsular

Malaysia belong to *A. malaccensis* Hook.*f.*, which does not occur in Sabah and Sarawak.

2. Actinodaphne diversifolia Merr.

Actinodaphne diversifolia Merr., J. Str. Br. Roy. As. Soc. 85 (1922) 191; Masamune, En. Phan. Born. (1942) 306; Burgess, Sabah For. Record 6 (1966) 330; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149; Beaman *et al.,* Pl. Mt. Kinabalu (2001) 393. **Type**: *Ramos 1838*, Borneo, Sabah, Sandakan District, Sebuga (*holo* K; *iso*, *n.v.*: A, BO).

Distribution: Endemic in Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In beach, peat swamp, *kerangas*, mixed dipterocarp and submontane forests at altitudes to 1200 m.

Notes: Common and widespread in Sabah and well represented in Gunung Kinabalu National Park, Crocker Range National Park and Maliau Basin Conservation Area but it is very rare in Sarawak. Its narrowly elliptic leaves that are hairy on the lower surface readily distinguish the species.

The species resembles *Actinodaphne kostermansii* var. *kostermansii* but can be differentiated by its linear (vs. lanceolate) bud-scales, narrow elliptic, unequal-sided leaves (vs. broadly elliptic; equal-sided) with sharply acute (vs. rounded or broadly acute) base, slightly revolute (vs. strongly revolute) margins, and closely scalariform (vs. distantly scalariform) tertiary veins.

3. Actinodaphne fuliginosa Airy Shaw

Actinodaphne fuliginosa Airy Shaw, Bull. Misc. Inform., Kew (1939) 535; Masamune, En. Phan. Born. (1942) 306. **Type:** *Synge 1893*, Borneo, Sarawak, Dulit Range (*holo* K; *iso* SING).

Distribution: Endemic in Borneo (Sarawak). Very rare and known only from the type specimen from Dulit Range in Sarawak.

Ecology: In open mossy forest on exposed peak at *c.* 1400 m altitude.

Notes: This distinctive species is characterized by its small, 2.5–4.5 x 1.5–2.5 cm, obovate leaves with a rounded apex.

4. Actinodaphne glabra Blume

Actinodaphne glabra Blume, Mus. Bot. Lugd-Bat. I (1851) 344; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 125; Beaman *et al.,* Pl. Mt. Kinabalu (2001) 393. **Type**: *Blume s.n.,* Java (*lecto* L [NHN-L Acc. No. 905220121], designated here).

Distribution: Peninsular Malaysia, Java and Borneo (Brunei, Kalimantan, Sabah, Sarawak).

Ecology: In mixed dipterocarp and riparian forests on alluvial and ultrabasic soils at altitudes to 600 m.

Notes: The species is characterized by its long and narrowly elliptic or oblanceolate leaves with long acuminate or pointed leaf apex. In Borneo, however, there are specimens with rounded, obtuse or shortly acuminate leaf apex (e.g. *S 8151*, *SAN 25354*, *SAN 37438*, *SAN 55839* and *SAN 132242*). Images of type specimens of two other species (*Actinodaphne pubescens* Blume from Java and *A. rumphii* Blume from the Moluccas) strongly suggest that these two species may be conspecific with *A. glabra*. More specimens from the relevant areas for detailed study are, however, needed to elucidate the taxonomic status of the two taxa.

5. Actinodaphne glomerata (Blume) Nees

Actinodaphne glomerata (Blume) Nees, Syst. Laur. (1836) 597; Blume, Mus. Bot. Ludg.- Bat. 1 (1851) 343; Miquel, Fl. Ind. Bat. 1(1858) 968; Gamble, J. As. Soc. Beng. 75, 1 (1912) 116; Ridley, Fl. Malay Penins. 3 (1924) 108; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 124; Burgess, Sabah For. Record 6 (1966) 330; Anderson, Checkl. Trees Sarawak (1980) 220; Corner, Wayside Trees of Malaya 3rd edition, 1 (1988) 220; Kochummen, Tree Fl. Malaya 4 (1989) 104; Turner, Gard. Bull. Sing. 47 (1995) 273; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 1 (1997) 303; Beaman *et al.,* Pl. Mt. Kinabalu (2001) 393. — *Litsea glomerata* Blume, Bijdr. Fl. Ned. Ind. (1826) 566. **Type**: *Blume s.n.,* W Java, Gunung Salak, (*holo n.v.*; *iso* NY [00355279]).

***Syn. nov.*:** *Actinodaphne maingayi* Hook.*f.* var. *macrocarpa* Gamble, J. As. Soc. Beng. 75, 1 (1912) 115; *Actinodaphne sesquipedalis* Hook.*f.* & Thoms. var. *macrocarpa* (Gamble) Ridl., Fl. Malay Penins. 3 (1924) 108. **Type**: *Ridley 11675*, Borneo, Sarawak, Matang (*lecto* SING, designated here)

Distribution: Sumatra, Java, Peninsular Malaysia, Singapore, Borneo (Brunei, Kalimantan, Sabah and Sarawak) and Sulawesi.

Ecology: A very common and widespread species occurring in mixed dipterocarp, riparian and submontane forest at altitudes to 1500 m, on various soil types.

Notes: In Borneo, the leaves of this species are very variable in shape, ranging from obovate to broadly elliptic or suborbicular and in size from 11–41 cm long and 5–23 cm wide, with a length:width ratio of 2:1 to 1:1 depending on their position on the branch and the habitats where the trees grow. However, its thinly coriaceous leaves with a glaucous or brownish undersurface and many-flowered, condensed, glomerulate inflorescences easily distinguish the species. The specimen (*Mikil SAN 38734*) from Mount Kinabalu cited by Beaman *et al.* (2001) as *Actinodaphne sesquipedalis* Hook.*f.* & Thoms. belongs to *A. glomerata*.

6. Actinodaphne johorensis Gamble

Actinodaphne johorensis Gamble, Bull. Misc. Inform., Kew (1910) 313; Gamble, J. As. Soc. Beng. 75, 1 (1912) 117; Ridley, Fl. Malay Penins. 3 (1924) 109; Kochummen, Tree Fl. Malaya 4 (1989) 104; Turner, Gard. Bull. Sing. 47 (1995) 273. **Type**: *Ridley 4419,* Johor, Gunung Panti (*holo* SING; *iso* SING).

Distribution: Peninsular Malaysia and Borneo (Sarawak).

Ecology: Confined to *kerangas* forest at altitudes to 400 m.

Notes: The species was previously known as endemic in Peninsular Malaysia (Johor and SW Pahang). This is a new record for Borneo and is known only from the Kuching, Sri Aman and Lundu Districts, Sarawak.

Actinodaphne johorensis can easily be recognized by its thickly coriaceous, glabrous leaves (except on the midrib and lateral veins), usually glaucous underneath and slightly prominent lateral veins, almost obscure tertiary veins and racemose male inflorescence.

7. Actinodaphne kinabaluensis Kosterm.

Actinodaphne kinabaluensis Kosterm., Reinwardtia 7 (1969) 452; Beaman *et al.,* Pl. Mt. Kinabalu (2001) 394. **Type**: *Chew et al. RSNB 196*, Borneo, Sabah, Gunung Kinabalu (*holo* BO; *iso* K, L, SING).

Distribution: Endemic in Borneo (Sabah); rare and known only from the type.

Ecology: Montane forest at 2400 m altitude.

Notes: Even though this species is known only from one fruiting specimen, it definitely belongs to *Actinodaphne* as shown by its vegetative and fruit characters that conform to those of the genus.

The species can easily be recognized by its thickly coriaceous, densely hairy, bullate leaves and ellipsoid fruits. It is the only *Actinodaphne* species in Sabah and Sarawak with ellipsoid fruit.

8. Actinodaphne kostermansii S.Julia, **sp. nov.**
(André Joseph Guillaume Henri Kostermans, 1906–1981, prominent botanist at the Herbarium Bogoriense)

Actinodaphne diversifoliae similis, perulis lanceolatis (vs. linearibus), foliis late (vs. anguste) ellipticis aequilateris (vs. inaequilateris), basi acuta ad late (vs. argute) acuta, apice acuto ad breviter acuminato (acumine, 0.5–1 cm vs. 1.5–2 cm longo), nervis tertiariis distantiter (vs. arte) scaliformibus differt. **Typus:** *Clemens 50386,* Borneo, Sabah, Kota Kinabalu District, Gunung Kinabalu, Penibukan (holo L).

Tree 6–20 m tall, 7–30 cm diam.; bole straight, *c.* 6 m tall; buttresses absent. **Bark** brownish green or dark grey, smooth; inner bark yellowish, fibrous. **Sapwood** yellowish. **Twigs** drying brown, glabrescent, smooth. **Terminal (vegetative) buds:** scales lanceolate, 10–30 x 4–8 mm, densely hairy. **Leaves** in whorls of 3–5, thickly coriaceous, glabrous or very sparsely hairy above, glabrous or densely hairy below, drying brown or greenish brown above, greyish or brownish below; blade broadly elliptic, (15.5–) 21–31(–39) x 7–15.5 cm, base broadly acute, margin strongly revolute, apex acute or acuminate, acumen 0.5–1 cm long; midrib raised on both surfaces, stronger below, glabrous or sparsely hairy above, glabrous or densely hairy below; lateral veins 7–11 pairs, lax, at an angle of *c.* 30° from the midrib, flat or sunken above, strongly raised below, joining towards margin at the upper half of leaf; tertiary venation slightly distinct or obscure above, distinct below, distantly scalariform; petiole 1.5–3.5 cm long, sparsely or densely hairy, drying black or dark brown. **Inflorescences** and **flowers** unknown. **Infructescences** each bearing 1–7 fruits (in glomerulate arrangement); vegetative terminal buds present. **Fruits** globose, 1.3–1.5 cm diam., drying black; cupule sometimes accrescent, deeply or shallowly saucer-shaped, 1–1.2 cm across, remnant of perianth lobes absent or present;

pedicels 5–7 mm long. **Seeds** globose, 0.8–1 cm diam., drying dark brown.

Distribution: Endemic in Borneo (confined to Brunei and Sabah).

Ecology: Uncommon in mixed dipterocarp, submontane, riparian forests and forest on ultrabasic soil at altitudes to 1400 m.

Notes: Even though inflorescences and flowers are not available, this species is placed in *Actinodaphne* based on its vegetative (e.g. perulate terminal bud, imbricate bud scales, pinnately veined leaves arranged in whorls of 3–5 and distinct bud-scale scars above the whorls of leaves) and fruiting characters.

The species is reminiscent of *A. diversifolia* but differs by its lanceolate (vs. linear) bud-scales, broadly elliptic, equal-sided leaves (vs. narrow elliptic, unequal-sided) with rounded or broadly acute (vs. sharply acute) base, strongly revolute (vs. slightly revolute) margins, and distantly scalariform (vs. closely scalariform) tertiary veins.

In 1977, Kostermans annotated specimen *Clemens 50386* as *A. clemensii,* a new species but he never validated the name of the new taxon. This new species is renamed in honour of Dr. A.J.G.H. Kostermans who made an enormous contribution toward the advancement of our knowledge on the Lauraceae of the Malesian region.

Beaman *et al.* (2001) incorrectly identified the same specimen (*Clemens 50386*) as *A. sesquipedalis* Hook.*f.* & Thoms., a species only known from Myanmar and Peninsular Malaysia and differing from *A. kostermansii* by its oblanceolate, obovate or elliptic-oblong (vs. broadly elliptic) leaves arranged in whorls of 5–13 (vs. in whorls of 3–5) with strongly prominent (vs. obscure or prominulous) tertiary veins.

In Sabah and Sarawak, two varieties are recognized, viz. var. *kostermansii* and var. *glabrescens*.

var. kostermansii

Distribution: Endemic in Borneo (Sabah and Brunei). Found in montane, riparian and mixed dipterocarp forests, at altitudes to 1400 m.

Notes: Leaves and midrib very sparsely hairy above, densely hairy below.

Other specimens examined: **BORNEO – *BRUNEI*,** Temburong District, Amo, Ulu Temburong, *Coode et al. MC 7869* (KEP, SAR); ***SABAH*,** Ranau District, Sosopodon Forest Reserve, *Aban SAN 64101* (SAN).

var. glabrescens S.Julia, **var. nov.**
(Latin, *glabrescens*=becoming glabrous; referring to the leaves)

A var. typica foliis glabris (vs. infra dense pubescentibus) differt. **Typus**: Proctor SAN 98112, Borneo, Sabah, Lahad Datu District, Gunung Silam (holo SAN).

Distribution: Endemic in Sabah and found in mixed dipterocarp forests and forest on ultrabasic soil, at altitudes to 800 m.

Notes: This new variety differs from var. *kostermansii* in having leaves that are glabrous (on both surfaces) or very sparsely hairy (particularly on the midrib and lateral veins below).

Other specimens examined: **BORNEO** – ***SABAH,*** Kota Belud District, Melangkap Tomis, *Lorence Lugas 1922* (BO, KEP, KNP, SAN, SAR), Lahad Datu District, Gunung Silam, *Mujin SAN 37821* (SAN), *Proctor SAN 98060* (SAN), *Proctor SAN 98118* (SAN), *Proctor SAN 100721* (SAN), *Proctor SAN 100729* (SAN), *Proctor SAN 101957* (SAN), *Rimi et al. SP 6276* (KNP), Ranau District, Kinabalu National Park, *Kokawa & Hotta 5603* (SAN).

9. Actinodaphne macrophylla (Blume) Nees

Actinodaphne macrophylla (Blume) Nees, Syst. Laur. (1836) 598; Blume, Mus. Bot. Ludg.-Bat. 1 (1851) 341; Miquel, Fl. Ind. Bat. 1,1 (1858) 965; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 125; Kochummen, Tree Fl. Malaya 4 (1989) 105; Turner, Gard. Bull. Sing. 47 (1995) 273; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 1 (1997) 303. — *Litsea macrophylla* Blume, Bijdr. Fl. Ned. Ind. (1826) 567. **Type**: *Blume s.n.,* Java, Nusa Kambangan (*n.v.*).

Actinodaphne maingayi Hook.*f.*, Fl. Brit. Ind. 5 (1886) 151; Gamble, J. As. Soc. Beng. 75, 1 (1912) 114; Merrill, J. Str. Br. Roy. As. Soc., Special Number (1921) 274; Ridley, Fl. Malay Penins. 3 (1924) 108; Masamune, En. Phan. Born. (1942) 306; Corner, Wayside Trees of Malaya 3rd edition, 1 (1988) 345. **Type**: *Maingay 1258*, Peninsular Malaysia, Malacca (*lecto* K, designated here; *iso* L).

Distribution: Peninsular Malaysia, Singapore, Java and Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In mixed dipterocarp, riparian, *kerangas* and swamp forests, at *c.* 890 m altitude.

Notes: The species is characterized by its thickly coriaceous, broadly elliptic-oblong or oblanceolate leaves, which are densely hairy underneath with very strongly prominent lateral veins and sturdy petiole. *Actinodaphne macrophylla* is very close to *A. sesquipedalis* from Myanmar and Peninsular Malaysia but can be differentiated by its very densely hairy (vs. glabrous) twig, leaves densely hairy underneath (vs. sparsely hairy or glabrous) with very distinctly prominent (vs. almost obscure or slightly prominent) tertiary veins.

10. Actinodaphne myriantha Merr.

Actinodaphne myriantha Merr., Univ. Calif. Publ. Bot. 15 (1929) 78; Masamune, En. Phan. Born. (1929) 306; Burgess, Sabah For. Record 6 (1966) 330; Anderson, Checkl. Trees Sarawak (1980) 220. **Type**: *Elmer 21335*, Borneo, Sabah, near Tawau (*holo* PNH †; *iso* BO, L, MO, SING).

Distribution: Endemic in Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In mixed dipterocarp, peat swamp, and riparian forests at altitudes to 700 m.

Notes: This species resembles *Actinodaphne glomerata* but differs by its narrowly obovate or narrowly elliptic (vs. broadly obovate or broadly elliptic), much longer and narrower leaves with a length:width ratio of 3:1 (vs. length:width ratio of 2:1 or 1:1).

11. Actinodaphne oleifolia Gamble

Actinodaphne oleifolia Gamble, Bull. Misc. Inform., Kew (1910) 313; Gamble, J. As. Soc. Beng. 75, 1 (1912) 121; Merrill, J. Str. Br. Roy. As. Soc., Special Number (1921) 274; Ridley, Fl. Malay Penins. 3 (1924) 111; Masamune, En. Phan. Born. (1942) 306; Burgess, Sabah For. Record 6 (1966) 330; Kochummen, Tree Fl. Malaya 4 (1989) 106; Turner, Gard. Bull. Sing. 47 (1995) 274; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149. **Type**: *Ridley 13728*, Peninsular Malaysia, Pahang, Gunung Berembun (*lecto* K, designated here; *iso* SING).
Actinodaphne gelonioides Ridl., Fl. Malay Penins. 3 (1924) 111. **Type**: *Robinson s.n.*, Peninsular Malaysia, Perak, Gunung Kerbau (*holo* K).
Syn. nov.: *Actinodaphne foxworthyana* Gibbs, J. Linn. Soc. Bot. 42 (1914)

129; Merrill, J. Str. Br. Roy. As. Soc., Special Number (1921) 274; Masamune, En. Phan. Born. (1942) 306; Burgess, Sabah For. Record 6 (1966) 330. **Type**: *Gibbs 3135*, Borneo, Sabah, Kota Belud District, Gunung Kinabalu, Paka Cave (*holo* BM; *iso* K).

Distribution: Peninsular Malaysia and Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In mixed dipterocarp, submontane to upper montane, limestone, *kerangas* and peat swamp forests and forest on ultrabasic soil at altitudes to 1800 m.

Notes: The species is rather similar to *Actinodaphne pruinosa* in its smallish leaves but it is distinct in having obtuse or shortly acuminate leaves, with an acumen 1–1.5 cm long (vs. with an acumen 1.5–3 cm long) and pitted or reticulate (vs. scalariform) tertiary veins that are distinctly prominent on both surfaces (vs. obscure or prominulous above, prominent below).

From the small-leaved *A. borneensis*, the species differs by its dense (vs. lax or well-spaced) lateral veins and reticulate (vs. scalariform) and distinctly prominent (vs. obscure or slightly prominent) tertiary veins.

Specimens that were previously recognized by Kochummen (1989) as *A. oleifolia* and/or *A. gelonoides* (*FRI 10111*, *Holttum SFN 20725*, *Megsay & Kiah SFN 31832*, *Mohd. Shah MS 1461*, *FMS 43076*, *Symington & Kiah SFN 28831*, *Seimund 341*) from Peninsular Malaysia may respresent an undescribed new species differing from *A. oleifolia* by its almost rounded and broader thickly coriaceous leaves.

12. Actinodaphne percoriacea S. Julia, **sp. nov.**
(Latin, *per*=very; *coriaceous*=leathery; referring to the very thick leaves)

Actinodaphne borneensis foliis magnis revocans, foliis glabris (vs. infra sparse pubescentibus), basi rotundata ad truncata (vs. acuta), venis lateralibus densis (vs. laxis ad clare dispositis) facile distinguenda. **Typus**: *Clemens 31493*, Borneo, Sabah, Kota Kinabalu District, Gunung Kinabalu, Penibukan (holo BO).

Small tree or treelet to 6 m tall. **Bark** pale brown, smooth; inner bark yellowish. **Sapwood** yellowish. **Twigs** drying greyish brown, densely hairy when young, sparsely hairy when older, smooth. **Terminal buds**: scales ovate, 3–9 x 3–5 mm, densely hairy. **Leaves** in whorls of 3–5, coriaceous to thickly coriaceous, shiny above, glabrous on both surfaces or sparsely hairy below, drying red-brown on both surfaces, darker above, sometimes glaucous below; blade usually elliptic or ovate, rarely obovate, 5.5–16 x 2.5–8.5 cm, base acute to broadly acute, margin revolute, apex acuminate, acumen 0.5–1.5 cm long; midrib raised on both surfaces, stronger below, glabrous or sparsely hairy below; lateral veins 4–7(–10) pairs, dense, at an angle of 45°–50° from the midrib, flat above, slightly raised below, disappearing towards the margin, sometimes joining near the margin on the upper half of leaf; tertiary venation slightly or distinctly prominent above, slightly prominent below, reticulate or pitted; petiole (0.7–)1–2.5 cm long, drying dark brown. **Inflorescences** umbellate, axillary or borne along twigs between the whorls of leaves, sessile; vegetative terminal bud absent; bracts rounded, ovate or elliptic, 3–4 x 3 mm, densely hairy outside, glabrous inside. **Male flowers:** pedicels 2–4 mm long; perianth lobes ovate or elliptic, 2–3 x 2–2.5 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; stamens sparsely hairy at base, anthers 1–1.2 mm long, filaments 0.8–1 mm long; pistillode *c.* 1.5 mm long. **Female flowers** pedicels *c.* 2.5 mm long, perianth lobes obovate or rounded, 2–3 mm across, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; ovary ovoid, *c.* 0.5 x 0.2 mm, style thick, stigma 0.5–1 mm across, densely hairy; staminodes spathulate, 1.5–2 mm long. **Infructescences** each bearing 3–5 fruits; vegetative terminal buds absent. **Fruits** globose, 0.5–0.8 cm diam., fleshy, drying black; cupule saucer-shaped, 0.3–0.5 cm across, remnant of perianth lobes absent; pedicels to 5 mm long. **Seeds** globose, 0.3–0.4 cm diam., drying black.

Distribution: Endemic in Borneo (Sabah and Sarawak).

Ecology: In montane and limestone forests and also forest on ultrabasic soil at altitudes to 2300 m.

Notes: The species resembles the large-leaved *Actinodaphne borneensis* but can be differentiated by its glabrous (vs. sparsely hairy below) leaves with a broadly acute or truncate (vs. acute) base, dense (vs. lax or well-spaced) lateral veins and reticulate (vs. scalariform) tertiary veins. The leaves of this species are highly variable in size and shape: the larger leaves usually ovate, the medium-sized ones either broadly elliptic or almost rounded and the small-sized leaves elliptic, ovate or slightly obovate. In 1968, Kostermans annotated four specimens (*Clemens 20620, Clemens 31388, Clemens 40072, Clemens s.n.*) as a new species, *A. percoriacea*, but he never validated the name of the new taxon.

Other specimens examined: **BORNEO** - ***SABAH,*** Labuk Sugut District, Gunung Tawai, *Sugau SAN 138834* (SAN), Ranau District, Colombon

Basin, *Clemens 40072* (BO), *Clemens 28933* (BO), *Clemens 30226* (BO), Kamborongo, *Henry SAN 38309* (SAN), Kinabalu National Park, *Carr SFN 27725* (SING), Panar Laban, *Sato 1099* (SAN), *Kostermans SAN 38469* (SAN), *Meijer SAN 46520* (KEP, SAN, SAR), *Sinclair & Kadim 9045* (BO), Penibukan, *Clemens 31388* (BO), *Clemens s.n.* (BO), *Rao 134* (SING), *Wood & Wyatt-Smith SAN A 4491* (KEP, SING), Pig Hill, *Barkman 107* (KNP), Tenom District, Mount Tomanis, *Dolois et al. SP 15067* (KNP); ***SARAWAK,*** Bau District, Bidi Cave, *Clemens 20620* (SAR), *Ridley s.n.* (SING), Lawas District, Gunung Murud, *Julaihi et al. S 80034* (KEP, SAR), *S 80093* (KEP, SAR).

13. Actinodaphne pruinosa Nees

Actinodaphne pruinosa Nees *in* Wall. Pl. As. Rar. 2 (1831) 68; Gamble, J. As. Soc. Beng. 75, 1 (1912) 119; Ridley, Fl. Malay Penins. 3 (1924) 110; Anderson, Checkl. Trees Sarawak (1980) 220; Kochummen, Tree Fl. Malaya 4 (1989) 106; Turner, Gard. Bull. Sing. 47 (1995) 274; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 149; Beaman *et al.*, Pl. Mt. Kinabalu (2001) 394 (*p.p., excl. syn. Actinodaphne foxworthyana* Gibbs). **Type**: *Wallich Cat. 2584b*, Peninsular Malaysia, Penang (*holo* K; *iso* BO, L).

Actinodaphne pruinosa var. *kunstleri* Gamble, J. As. Soc. Beng. 75, 1 (1912) 120; Ridley, Fl. Malay Penins. 3 (1924) 110; Burgess, Sabah For. Record 6 (1966) 330; Turner, Gard. Bull. Sing. 47 (1995) 274. **Type**: *King's collector 6063*, Peninsular Malaysia, Perak, Larut (*holo* K).

Syn. nov.: *Actinodaphne concinna* Ridl., J. Fed. Mal. States Mus. 5 (1914) 44, Fl. Mal. Pen. 3 (1924) 110; Kochummen, Tree Fl. Malaya 4 (1989) 104; Turner, Gard. Bull. Sing. 47 (1995) 273. **Type**: *Robinson s.n.*, Peninsular Malaysia, Selangor, Gunung Mengkuang Lebah (*holo* K; *iso* SING)

Distribution: Peninsular Malaysia, Singapore and Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In peat swamp, *kerangas*, mixed dipterocarp, submontane to upper montane forests at altitudes to 4000 m.

Notes: The species closely resembles *Actinodaphne oleifolia* and *A. borneensis* but differs from both in having characters discussed under the notes for *A. oleifolia* and *A. borneensis.*

14. Actinodaphne robusta S.Julia, **sp. nov.**
(Latin, *robustus*=robust; referring to the leaves)

Actinodaphne macrophyllae in habitu similis, foliis obovatis ad late ellipticis (vs oblanceolatis ad elliptice oblongis), venis lateralibus valde ascendentibus sed paucioribus differt. **Typus**: *Ilias S 41159*, Borneo, Sarawak, Kapit District, Ulu Sampurau, Bukit Sampandai (holo SAR; iso KEP, SAN).

Tree 12–33 m tall, 30–35 cm diam.; bole straight, *c.* 7.5 m tall. **Bark** brown, scaly; inner bark red-brown, granular. **Sapwood** whitish. **Twigs** drying dark brown or greyish, sparsely or densely hairy, smooth. **Terminal buds:** scales elliptic or ovate, 15–20 x 10–15 mm, densely hairy. **Leaves** in whorls of 5–7, coriaceous to thickly coriaceous, glabrous above, densely hairy below, drying dark brown on both surfaces or greenish brown below; blade usually broadly obovate or rarely elliptic, (16.5–)22–40(–49) x 7.5–14(–18) cm, base acute to attenuate, margin strongly to slightly revolute, apex acuminate, acumen 0.5–1 cm long; midrib raised on both surfaces, stronger below, glabrous or sparsely hairy above, densely hairy below; lateral veins 7–15 pairs, lax, at an angle of 45°–50° from the midrib, flat or sunken above, strongly raised below, joining near the margin on the upper half of leaf; tertiary venation obscure or slightly distinct and impressed above, distinct below, distantly scalariform; petiole 2.5–6 cm long, drying brownish or dark brown, densely hairy. **Inflorescences** glomerulate, borne along twigs between whorls of leaves; peduncle *c.* 3 mm long; vegetative terminal bud absent; bracts ovate or elliptic, *c.* 4 x 3 mm, densely hairy outside, glabrous inside. **Male flowers** unknown. **Female flowers**: pedicels 2–3 mm long; perianth lobes ovate-rounded, 2–2.5 mm across, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; ovary ovoid, 2–3 mm, style thick, stigma 1–2 mm across, densely hairy; staminodes spathulate, 1.5–2.5 mm long. **Infructescences** each bearing 2–8 fruits; vegetative terminal bud present. **Fruits** globose, 1–1.8 cm diam., fleshy, yellowish when mature, drying black or dark brown; cupule saucer-shaped, 0.7–1.5 cm across, remnant of perianth lobes absent or sometimes present; pedicels 4–5 mm long. **Seeds** globose, 1.2–1.5 cm diam., drying black.

Distribution: Peninsular Malaysia, Borneo (Kalimantan and Sarawak) and the Philippines.

Ecology: In mixed dipterocarp forest, at altitudes to 1100 m.

Notes: The new species resembles *Actinodaphne macrophylla* but differs in having obovate or broadly elliptic leaves (vs. oblanceolate or elliptic-oblong) and markedly ascending but fewer lateral veins.

Other specimens examined: **PENINSULAR MALAYSIA** – Johore, Labis Forest Reserve, *Saw FRI 36355* (KEP), Mersing, *Teo & Din KL 4940* (KEP), Pahang, Jerantut, Taman Negara, Lata Berkoh, *Ang FRI 23426* (KEP); **BORNEO** – ***SARAWAK***, Miri District, Bakong, Ulu Mamut, *Ilias S 24362* (KEP, SAN, SING); ***EAST KALIMANTAN***, Gunung Ilas Bungaan, *Kostermans 13741* (BO).

15. Actinodaphne semengohensis S.Julia, **sp. nov.**
(of Semengoh Forest Reserve, Sarawak)

Actinodaphne pruinosae similis, foliis oblanceolatis ad anguste ellipticis (vs. ellipticis ad obovatis) in verticillis non strictis (vs. 3–6 in verticillis strictis) dispositis, inflorescentiis masculis umbellatis ad glomerulatis (vs. racemosis) facile distinguenda. **Typus**: *Anderson & Asah S 12724,* Borneo, Sarawak, Kuching District, Semengoh Forest Reserve (holo SAR; iso BO, SAN, SING).
Figure 1

Tree 15–24 m tall, 18–50 cm diam.; bole straight, *c.* 20 m tall; buttresses absent. **Bark** brown, smooth; inner bark ochre or brownish, fibrous. **Sapwood** yellowish or whitish. **Twigs** drying greyish brown or black, sparsely hairy, smooth. **Terminal buds:** scales ovate, 3–4 x 2–3 mm, densely hairy. **Leaves** not strictly in whorls, coriaceous, glabrous above, glabrous or sparsely hairy below, drying dark brown above, glaucous below; blade oblanceolate or narrowly elliptic, (5–)7.5-9.5(–12) x (1.8–)2–2.5(–3) cm, base sharply acute, margin flat, apex acute or acuminate, acumen 0.5–1.5 cm long; midrib raised on both surfaces, stronger below, glabrous above, sparsely hairy below; lateral veins 4–6 pairs, lax, at an angle of 30º–40º from the midrib, slightly raised on both surfaces, inconspicuously joining towards the margin; tertiary venation obscure on both surfaces; petiole 1–2 cm long, drying dark brown. **Male inflorescences** racemose, axillary or borne along twigs between the whorls of leaves; peduncle 3–5 mm long; vegetative terminal bud absent; bracts ovate-rounded, 3–4.5 x 2–2.5 mm, densely hairy outside, glabrous inside. **Male flowers:** pedicels 1–1.5 mm long; perianth lobes elliptic or ovate-rounded, 1.5–2 x 1–1.8 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; stamens sparsely hairy at base, anthers 1–1.5 mm long, filaments *c.* 0.5 mm long; pistillode absent. **Female inflorescences, flowers** and **fruits** unknown.

Distribution: Endemic in Borneo (Sarawak and Sabah).

Ecology: In primary mixed dipterocarp and submontane forests at altitudes to 1500 m.

Notes. The species resembles *Actinodaphne pruinosa* but can be distinguished by its oblanceolate or narrowly elliptic (vs. elliptic or obovate) leaves arranged in pseudo-whorls (vs. in whorls) and racemose (vs. umbellate or glomerulate) male inflorescences. (Although the original description of *A. pruinosa* described the inflorescence as racemose, at least in the male inflorescence, racemose inforescences have not been observed in Bornean specimens, which are consistently umbellate). It is also reminiscent of *A. oleifolia* but differs by its pseudo-whorled (vs. whorled) leaves with obscure (vs. distinctly pitted or reticulate) tertiary veins and racemose (vs. umbellate) male inflorescences.

Other specimens examined: **BORNEO – *SABAH*,** Keningau District, Trus Madi, *Meijer SAN 122587* (SAN), Ranau District, Kinabalu National Park, *Chow & Madani SAN 74527* (SING), *Meijer SAN 57510* (SAN); ***SARAWAK*,** Kuching District, Semengoh Forest Reserve, *Bojeng S 14620* (BO, SAN, SAR, SING), *Rosli S 16425* (BO, SAN, SAR, SING), *Rosli S 16453* (BO, SAN, SAR, SING), *Othman Ismawi S 57220* (SAN, SAR).

16. Actinodaphne soepadmoi S.Julia, **sp. nov.**
(Engkik Soepadmo, 1993–present, Coordinator/Chief Editor of the Tree Flora of Sabah and Sarawak Project)

Actinodaphne glabram approximata, foliis late obovatis (vs. ellipticis vel elliptice oblongis vel oblanceolatis) indice longitudinis/latitudinis 2:1 (vs. 3–4:1) facile distinguenda. **Typus**: *Julia & Sirukit S 91375,* Borneo, Sarawak, Kuching District, Semengoh Forest Reserve (holo SAR; iso KEP).
Figure 1

Tree 20–30 m tall, 15–40 cm diam.; bole straight, *c.* 15 m tall; buttresses 0.5–0.6 m tall, *c.* 6 cm wide, not spreading. **Bark** blackish or reddish brown, smooth or with sparse rings; inner bark brownish, granular. **Sapwood** yellowish. **Twigs** drying blackish, sparsely hairy, sparsely lenticellate. **Terminal buds:** scales lanceolate, 10–15 x 4–6 mm, densely hairy. **Leaves** in whorls of 5–6, thickly coriaceous, shiny above, glabrous on both surfaces or sparsely hairy below, drying brown on both surfaces or greenish brown above, glaucous below; blade plane, obovate, 14.5–20.5 x 4.5–9 cm, base acute, margin strongly revolute, apex rounded or bluntly acute; midrib

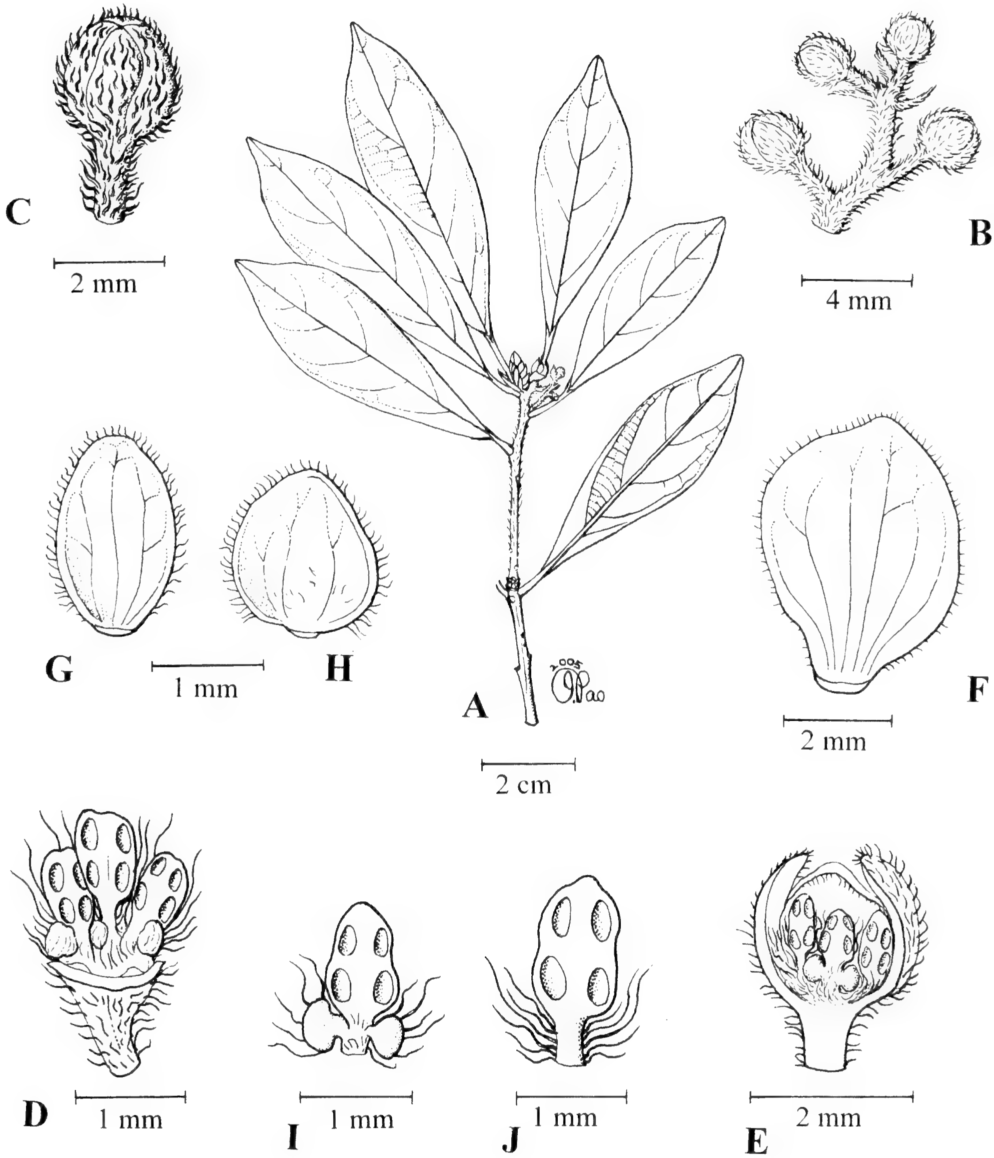

Figure 1. ***Actinodaphne semengohensis.*** A, leafy twig; B, male inflorescence; C, male flower; D, male flower showing stamens; E, longitudinal section of male flower; F, bract; G & H, perianth lobes; I, stamen with glands; J, stamen without gland (all from *S 12724*)

sunken above, strongly raised below; lateral veins 6–8 pairs, lax, at an angle of 40°–45° from the midrib, slightly sunken above, strongly raised below, disappearing towards the margin, sparsely hairy on both surfaces; tertiary venation distinct on both surfaces, closely scalariform; petiole 2–6 mm long, drying dark brown, sparsely hairy. **Male inflorescences** and **flowers** unknown. **Female inflorescences** glomerulate, borne along twigs between the whorls of leaves; peduncle 5–14 mm long; vegetative terminal bud present; bracts ovate or rounded, 3.5–5 x 5–6 mm, sparsely hairy outside, glabrous inside. **Female flowers**: pedicels 2–3 mm long; perianth lobes ovate, 2–4 x 1.5–4 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; ovary ovoid, *c.* 1.5 x 0.5 mm, style thick, stigma 0.8–1.5 mm across, densely hairy; staminodes spathulate, 1–1.5 mm long. **Infructescences** each bearing 1–4 fruits; vegetative terminal bud present. **Fruits** globose, 0.7–1.5 cm diam., fleshy, yellow turning to red when mature, drying black; cupule sometimes swollen, saucer-shaped, 0.6–1.3 cm across, remnant of perianth lobes absent; pedicel 5–12 mm long. **Seeds** globose, 0.8–1 cm diam., drying dark brown.

Distribution: Peninsular Malaysia and Borneo (Sarawak).

Ecology: In mixed dipterocarp forest at altitudes to 300 m.

Notes: Even though the male inflorescence and flower are not available, this species is placed in *Actinodaphne* based on the combination of its vegetative characters (perulate buds, bud scales leaving scars above the whorled leaves) and the characters of its female inflorescence and trimerous flower.

Actinodaphne soepadmoi resembles *A. glabra* but differs in having obovate (vs. oblanceolate or narrowly elliptic) leaves. The new species is also reminiscent of *Actinodaphne myriantha* but can be distinguished by its obovate (vs. obovate-elliptic or narrowly elliptic) leaves having an obtuse or almost rounded (vs. acute or acuminate) apex.

Kochummen (1989) identified and described a single collection (*Ridley 16125*) from Gunung Tahan, Peninsular Malaysia as *A. obovata*. In comparing the specimen with the type image and description of *A. obovata* (Wall. *ex* Nees) Blume, it is concluded that the specimen does not belong to *A. obovata* but to *A. soepadmoi*.

This new species is named in honour of Dr. E. Soepadmo for his dedication and contribution to the knowledge of the Tree Flora of Sabah and Sarawak.

Other specimens examined: **PENINSULAR MALAYSIA** – Pahang,

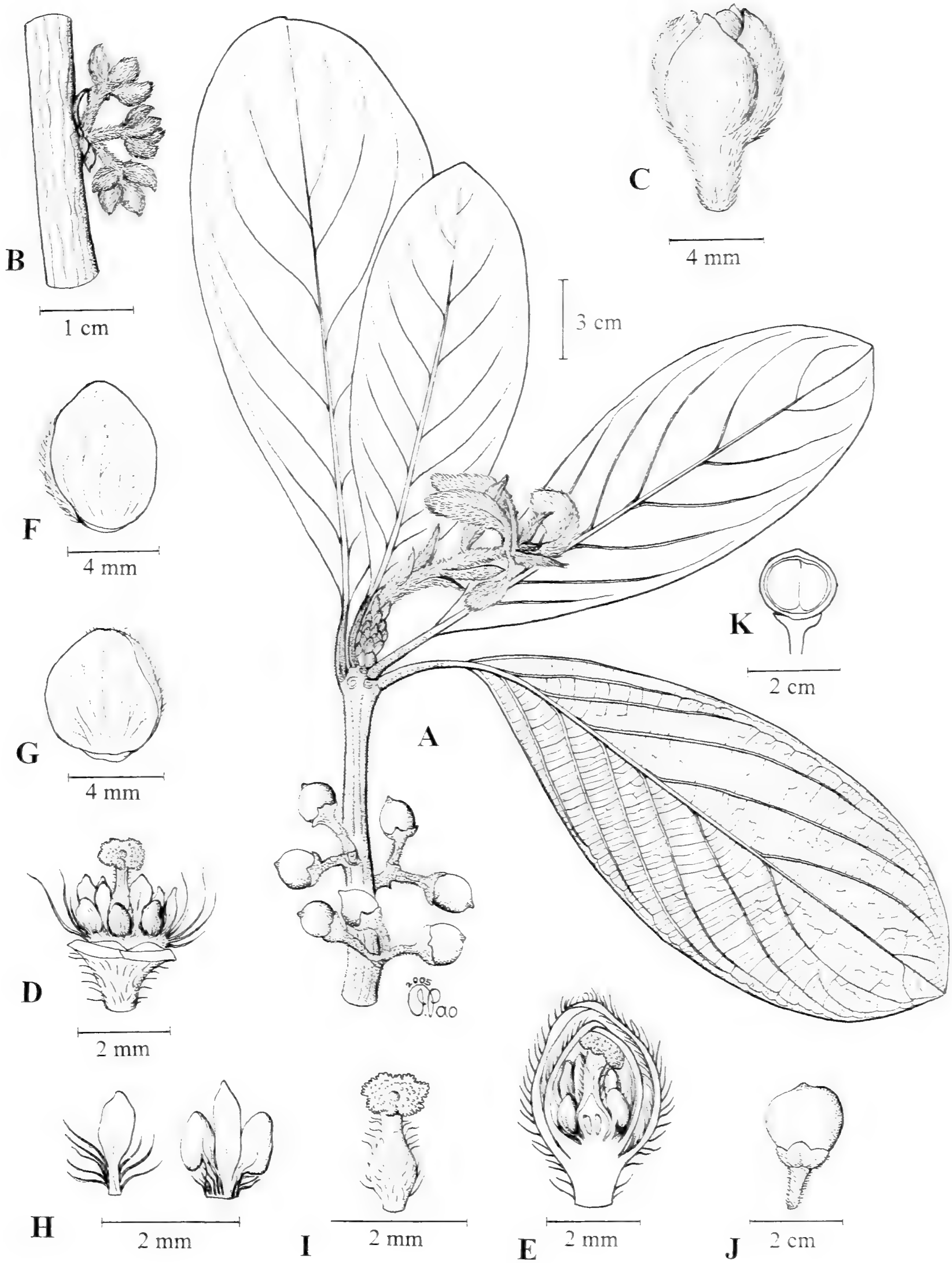

Figure 2. ***Actinodaphne soepadmoi.*** A, fruiting leafy twig; B, female inflorescence; C, female flower; D, longitudinal section of female flower showing pistil and staminodes; E, longitudinal section of female flower; F-G, perianth lobes; H, staminodes; I, pistil; J, fruit; K, longitudinal section of fruit (A from *S 37704*, B-I from *S 91375*, J & K from *S 45548*)

Gunung Tahan, *Ridley 16125* (SING). **BORNEO – *SARAWAK*,** Kuching District, Semengoh Forest Reserve, *Ilias S 37704* (KEP, SAN, SAR), Belaga District, Sungai Iban, *Bernard S 45548* (KEP, SAN, SAR).

17. Actinodaphne spathulifolia S.Julia, **sp. nov.**
(Latin, *spathulatus*=spathula-shaped, *folium*=leaf)

Actinodaphne fuliginosam revocans, foliis oblanceolatis (vs. obovatis) maioribus (5–7.5 cm longis, 2.5–4 cm latis, vs. 2.5–4.5 cm longis, 1.5–2.5 cm latis), costa venis lateralibus tertiariisque conspicuis (vs. obscuris) differt. **Typus**: *Latiff et al. ALM 4178,* Borneo, Sarawak, Marudi District, Kelabit Highlands, Bario (holo SAR).

Tree or treelet 4–33 m tall. **Twigs** drying black, densely hairy when young, sparsely hairy when older, smooth. **Leaves** in whorls of 4–5, thickly coriaceous, glabrous on both surfaces, drying shining and greenish brown above, greyish brown below; blade oblanceolate, 5–7.5 x 2.5–4 cm, base cuneate or sharply acute, margin strongly revolute, apex rounded; midrib sunken above, raised below, sparsely hairy below; lateral veins 5–6 pairs, lax, at an angle of c. 40° from the midrib, sunken above, raised below, disappearing towards the margin; tertiary venation obscure on both surfaces; petiole 1.2–1.5 cm long, drying black. **Male inflorescences** and **flowers** unknown. **Female inflorescences** glomerulate, axillary or borne along twigs between the whorls of leaves; vegetative terminal bud absent; bracts elliptic, 2.5–3 x 2–2.2 mm, sparsely hairy outside, glabrous inside. **Female flowers** (young)**:** pedicels 1.8–2 mm long; perianth lobes ovate-rounded, 1–1.5 x 1–1.2 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; ovary ovoid, *c.* 0.8 x 0.4 mm, style *c.* 0.4 mm long, stigma *c.* 0.3 mm across, densely hairy; staminodes spathulate, 0.8–1 mm long. **Infructescences** and **fruits** unknown.

Distribution: Endemic in Borneo (Sabah and Sarawak).

Ecology: In *kerangas* and submontane forests at altitudes to 1800 m.

Notes: Even though the male inflorescence and flower are not available, this species is placed in *Actinodaphne* based on the combination of its vegetative characters (perulate buds, bud scales leaving scars above the whorled leaves) and the characters of its female inflorescence and trimerous flowers.

The species resembles *A. fuliginosa* but differs by its oblanceolate (vs. obovate) and broader, 2.5–4 cm wide (vs. 1.5–2.5 cm) leaves with prominent (vs. obscure) midrib, lateral veins and tertiary veins.

Other specimens examined: **BORNEO** - ***SABAH***, Ranau District, Kinabalu National Park, *Kitayama 4480* (KNP); ***SARAWAK,*** Marudi District, Kelabit Highlands, Bario, *Nooteboom & Chai 2150* (KEP, SAR).

18. Actinodaphne sulcata S. Julia**, sp. nov.**
(Latin, *sulcatus*=grooved; referring to the midrib and lateral veins on upper leaf surface)

Actinodaphne kinabaluensi foliis bullatis similis, foliis obovatis (vs. ellipticis), fructibus globosis (vs. ellipsoideis) differt. **Typus:** *Nooteboom & Chai 2245*, Borneo, Sarawak, Marudi District, Kelabit Highlands (holo SAR; iso KEP).

Tree or treelet 3–10 m tall, 1.5–17 cm diam.; bole straight, *c.* 4 m tall. **Bark** creamy or brownish, smooth; inner bark greenish, granular. **Sapwood** yellowish or whitish. **Twigs** drying greyish or dark brown, sparsely or densely hairy when young, sparsely hairy when older, smooth or sparsely large-lenticellate. **Terminal buds**: scales ovate, 5–10 x 3–5 mm, densely hairy. **Leaves** in whorls of 3–5, thickly coriaceous, glossy and glabrous above, sparsely hairy below, drying red-brown or greenish brown above, brown below; blade bullate, obovate, 10–15(–19) x 4–7(–8.5) cm, base sharply acute, margin revolute, apex acuminate, acumen 0.5–1.5 cm long; midrib sunken or flat above, strongly raised below, glabrous or sparsely hairy below; lateral veins 7–10 pairs, lax, at an angle of 40º–45º from the midrib, strongly sunken above, strongly raised below, disappearing towards the margin or joining near the margin in the upper half of leaf; tertiary venation distinct on both surfaces or sunken above, distantly scalariform; petiole 0.6–1(–5) cm long, sparsely or densely hairy, drying dark brown or black. **Inflorescences** umbellate (female) or racemose (male), axillary or borne along twigs between the whorls of leaves, subsessile; vegetative terminal bud absent; bracts ovate-rounded, 3–4 x 3.5–4 mm, sparsely hairy outside, glabrous inside. **Male flowers**: pedicels *c.* 5 mm long; perianth lobes elliptic or elliptic-oblong, 3–3.5 x 1.2–2.2 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; stamens sparsely hairy at base, anthers 0.8–1.2 mm long, filaments 0.8–1.2 mm long; pistillode 0.6–0.8 mm long. **Female flowers**: pedicels *c.* 5 mm long, perianth lobes elliptic or oblong, 3–3.5 x 1.5–2.2 mm, outer lobes slightly larger than the inner ones, densely hairy outside, glabrous inside; ovary ovoid, *c.* 2 x 1.5 mm, style thick, stigma 0.8–1 x 0.8 mm, densely hairy; staminodes spathulate, 1.5–2.5 mm long. **Infructescences** each bearing 1–5 fruits; vegetative terminal bud absent. **Fruits** globose, 0.6–0.8 cm diam., drying black; cupule swollen, saucer-shaped, 0.5–0.8 cm across, remnant of perianth lobes absent; pedicel 5–8 mm long. **Seeds** globose, 0.3–0.5 cm diam., drying dark brown.

Distribution: Endemic in Borneo (Sabah and Sarawak).

Ecology: In mixed dipterocarp and submontane forests at altitudes to 1400 m.

Notes: The species resembles *Actinodaphne kinabaluensis* in its bullate leaves but differs in having globose fruits (vs. ellipsoid) and obovate leaves (vs. elliptic leaves).
In Sabah and Sarawak two varieties, var. *sulcata* and var. *longipetiolata*, are known.

var. sulcata

Distribution: Endemic in Borneo (Sabah and Sarawak). In mixed dipterocarp and submontane forests, at altitudes 1200–1400 m.

Other specimens examined: **BORNEO** — ***SABAH***, Sipitang District, Bukit Rimau, *Pius & Ubaldos SAN 143457* (KEP, SAN, SAR, SING), Long Miau, Meligan, *Dewol & Kambira SAN 141813* (SING); ***SARAWAK***, Lawas District, Ulu Sungai Belaban, Gunung Murut, *Ilias S 26424* (SAR).

var. longipetiolata S.Julia, **var. nov.**
(Latin, *longi*=long, *petiolatus*=petiole)

A var. typica foliis petiolisque longioribus, 3–5 cm longis (vs. 0.6–1 cm longis) differt. **Typus**: *Julius et al. SAN 132805,* Borneo, Sabah, Sipitang District, Maligan Forest Reserve (holo SAN; iso KEP, SAR).

Distribution: Endemic in Borneo (Sabah) and known only by the type specimen. Found in mixed dipterocarp forest, at *c.* 1400 m altitude.

Notes: This variety can be distinguished from var. *sulcata* by its longer (3–5 cm vs. 0.6–1 cm), sparsely hairy (vs. densely hairy) petiole.

19. Actinodaphne venosa S.Julia, **sp. nov.**
(Latin, *venosus*=conspicuously veined; the leaves)

Actinodaphne malaccensi e Malaysia peninsulari similis, ramulis glabris (vs. dense ferrugineo-tomentosis), foliis ellipticis ad oblanceolatis (vs. elliptice oblongis ad lanceolatis) venis tertiariis conspicuis (vs. obscuris ad inconspicuissimis) facile distinguenda. **Typus**: *Ampuria SAN 32859,* Borneo, Sabah, Beluran District, near Tidog Camp (holo SAN; iso BO, KEP, SING).

Tree or treelet, (2–)4–35 m tall, (5–)15–45 cm diam.; bole straight, 2–9 m tall; buttresses absent. **Bark** brownish, greenish or greyish, smooth; inner bark yellowish, fibrous. **Sapwood** yellowish. **Twigs** drying dark brown or greyish brown, densely hairy when young, sparsely hairy when older, smooth or sometimes fissured or sparsely large-lenticellate. **Terminal buds**: scales ovate, lanceolate or linear, 3–5 x 1–2 mm, densely or sparsely hairy. **Leaves** in whorls of 3–5, thinly coriaceous, sometimes shiny above, glabrous on both surfaces or sparsely hairy below, drying brownish, greenish brown or reddish brown on both surfaces or glaucous below; blade obovate or elliptic, 9.5–16.5(–18) x 3–6(–9) cm, base acute, margin flat or slightly revolute, apex acuminate or shortly cuspidate, acumen *c.* 1 cm long; midrib sunken or flat above, strongly raised and sparsely hairy below; lateral veins 4–7(–9) pairs, dense, at an angle of 30°–40° from the midrib, slightly or strongly sunken above, strongly raised below, joining towards the margin; tertiary venation distinct on both surfaces, sunken above, closely scalariform; petiole 1.2–2(–2.5) cm long, drying brown or black, sparsely hairy. **Inflorescences** umbellate, borne along twigs between the whorls of leaves, sessile; vegetative terminal bud absent; bracts rounded or ovate, 1.5–3 x 1–2 mm, sparsely to densely hairy outside, glabrous inside. **Male flowers**: pedicels 2–4 mm long; perianth lobes ovate or elliptic, 1–2 x 0.8–1 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; stamens sparsely hairy at base, anthers *c.* 1.5 mm long, filaments *c.* 1.5 mm long; pistillode *c.* 1.5 mm long. **Female flowers:** pedicels 1–2 mm long, perianth lobes ovate or elliptic, 1–2 x 0.5–1 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; ovary ovoid, *c.* 1 x 0.5 mm, style thick, stigma *c.* 0.5 mm across, densely hairy; staminodes spathulate, *c.* 1 mm long. **Infructescences** each bearing 1–4 fruits; vegetative terminal bud absent. **Fruits** globose, 0.6–1.5 cm diam., fleshy, drying black; cupule saucer-shaped, 0.5–0.8 cm across, remnant of perianth lobes present or absent; pedicel 3–7 mm long. **Seeds** globose, 0.5–1 cm diam., drying black.

Distribution: Endemic in Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Ecology: In mixed dipterocarp, submontane, riparian forests and forest on ultrabasic soil at altitudes to 1300 m.

Notes: The new species resembles *Actinodaphne malaccensis* Hook.*f.* from Peninsular Malaysia but can readily be distinguished by its glabrous (vs. densely rusty-tomentose) twig, elliptic or oblanceolate (vs. elliptic-oblong or lanceolate) leaves with distinctly prominent (vs. obscure or very faintly visible) tertiary veins. The species also resembles *A. borneensis* and *A.*

pruinosa but differs from the former by its thinly coriaceous (vs. coriaceous or thickly coriaceous) leaves, dense (vs. lax or well-spaced) lateral veins and distinct (vs. obscure) tertiary veins, and from the latter in having leaves with a length:width ratio of 2:1 (vs. length: width ratio of 3:1) and sunken lateral veins (vs. flat) above. In vegetative characters the species is also close to *A. montana* Gamble from Peninsular Malaysia but differs by its strongly impressed (vs. raised) lateral veins on upper surface of leaves and umbellate (vs. paniculate or racemose) inflorescence.

Other specimens examined: **BORNEO** - ***SABAH***, Beaufort District, Klias, *Meijer SAN 31411* (SAN), Lumat, *Daud & Karim SAN 77929* (SAN), Kinabatangan District, Maliau Basin, *Ming & Sidkan, MB 814* (SAN), Ulu Sungai Pingas-pingas, *Sumbing SAN 110950* (SAN), Kuala Penyu District, Klias, *Meijer SAN 31411* (SAN), Labuk Sugut District, Beluran, *Ampuria SAN 32859* (BO, KEP, SAN, SING), Lungmanis, W*ood A 3994* (KEP, SING), Lahad Datu District, Binuang, *Nordin SAN 54576* (SAN), Danum Valley, *Dewol SAN 129455* (SAN), *Dewol SAN 134978* (SAN), *Campbell 214* (SAN), Gunung Silam, *Agam, SAN 37165* (SING), Kalumpang Forest Reserve, *George et al. SAN 123904* (SAN), *Agam SAN 40863* (BO, SAN), *SAN 37165* (SAN, SING), Madai Forest Reserve, *Nordin SAN 47763* (SAN), Segama, Bukit Belachan, *Chai SAN 31722* (KEP, SAN, SAR, SING), Ulu Sungai Tabin, *Dewol SAN 129528* (SAN), *James SAN 35358* (SAN), Ranau District, Gunung Kinabalu, *Clemens 31728* (BO), *Clemens 32292* (BO), Semporna District, Mount Pock Forest Reserve, *Nordin SAN 54463* (SAN), Tambunan District, Trus Madi, *Kamaruddin & Latiff KMS 1782* (SAN), Tawau District, *Elmer 20947* (BO, PNH, SING), Betoton, *Orolfo BNB 3221* (PNH); ***SARAWAK***, Bau District, *Mamit S 29592* (BO, SAR), Kapit District, Bukit Kumbong, *Runi et al. S 60068* (SAN, SAR), Belaga District, Upper Rejang, *Clemens 21861* (BO, SAR), Kapit District, Ulu Sungai Melatai, *Yii S 48364* (SAR), Kuching District, Padawan, Gunung Siruruh, *Yii S 55270* (SAN, SAR), Bako National Park, Telok Asam, *Purseglove P 4973* (SAR), Limbang District, Sungai Ensungei, *Rena et al. S 42875* (KEP, SAN, SAR), *Rena et al. S 42934* (KEP, SAN, SAR), Lubok Antu District, Nanga Sumpa, *Christensen 1493* (SAR), Marudi District, Gunung Mulu National Park, *Chai S 39750* (KEP, SAN, SAR), *Chai S 39667* (KEP, SAN, SAR), *Yii & Talib S 58659* (KEP, SAR), Sri Aman District, Lingga, G. Lesung, *Hansen 1019* (KEP, SAN, SAR); ***BRUNEI***, Belait District, Melilas, *Atkins et al. SA 539* (KEP, SAN, SING); ***KALIMANTAN***, Without locality, *Kostermans 8977* (BO) and *Kostermans s.n.* (BO), Kutai, Belajan River, *Endert 1927* (BO) and Sungai Wain, *Kostermans 4328* (BO).

Incompletely Known Species

20. Actinodaphne sp. 1

Twigs drying black, densely hairy when young, sparsely hairy when older, smooth. **Terminal buds**: scales ovate, *c.* 3 x 2 mm, sparsely hairy. **Leaves** in whorls of 3–5, thickly coriaceous, shiny and glabrous above except on the midrib and lateral veins, sparsely hairy below, drying greyish brown above, brown below; blade elliptic, 7.5–10 x 3–4 cm, base acute, margin strongly revolute, apex acute; midrib raised on both surfaces, stronger below; lateral veins 4–5 pairs, lax, at an angle of *c.* 45° from the midrib, flat or sunken above, raised below, disappearing towards the margin; tertiary venation distinct on both surfaces, sunken above, distantly scalariform; petiole 0.8–1 cm long, drying black, densely hairy, glabrescent. **Male inflorescences** and **flowers** unknown. **Female inflorescences** racemose, borne along twigs between the whorls of leaves; peduncle 3–5 mm long, densely hairy; vegetative terminal bud present; bracts ovate, *c.* 0.3 x 0.2 mm, densely hairy outside, glabrous inside. **Female flowers:** pedicels 2–3 mm long; perianth lobes elliptic, *c.* 1.5 x 1 mm, outer lobes slightly larger than the inner ones, thin, densely hairy outside, glabrous inside; ovary ovoid, *c.* 0.5 x 0.3 mm, style thick, *c.* 1 mm long, stigma *c.* 0.4 mm across, densely hairy; staminodes spathulate, *c.* 1 mm long. **Infructescences** and **fruits** unknown.

Distribution: Known only from a single collection (*Chew et al. RSNB 1840*) from Gunung Kinabalu, Sabah.

Notes: This taxon resembles *Actinodaphne kinabaluensis* but differs in having plane (vs. bullate) leaves, shorter petiole and yellowish (vs. brownish) hairs on the leaf undersurface. The species is placed in *Actinodaphne* based on the combinations of its vegetative (perulate buds, bud scales leaving scars above the whorled leaves) and reproductive characters (trimerous flowers). However, to formally describe the specimen as a new species more specimens are needed to elucidate its taxonomic status, as there is a possibility that this incompletely known species may represent a variety of the already known species.

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Identification list of specimens examined

The number after the collector and/or serial number refers to the following *Actinodaphne* taxa.

1 = *A. borneensis* Meisn.
2 = *A. diversifolia* Merr.
3 = *A. fuliginosa* Airy Shaw
4 = *A. glabra* Blume
5 = *A. glomerata* (Blume) Nees
6 = *A. johorensis* Gamble
7 = *A. kinabaluensis* Kosterm.
8a = *A. kostermansii* S. Julia var. *kostermansii*
8b = *A. kostermansii* S. Julia var. *glabrescens* S. Julia
9 = *A. macrophylla* (Blume) Nees
10 = *A. myriantha* Merr.
11 = *A. oleifolia* Gamble
12 = *A. percoriacea* S. Julia
13 = *A. pruinosa* Nees
14 = *A. robusta* S. Julia
15 = *A. semengohensis* S. Julia
16 = *A. soepadmoi* S. Julia
17 = *A. spathulifolia* S. Julia
18a = *A. sulcata* S. Julia *var. longipetiolata* S. Julia
18b = *A. sulcata* S. Julia *var. sulcata*
19 = *A. venosa* S. Julia
20 = *A. sp. 1*

Achmad 1356: 5 — Anderson *s.n.*: 1; Anderson *s.n.*: 4 — Ando *et al.* AKK 30: 9; AKK 42: 9 — Argent & Amiril 9320: 11 — Ariffin ARK 35: 5 — Ariffin & Arbainsyah AA 977: 10 — Atkins *et al.* SA 439: 5; SA 450: 1; SA 539: 19.

Balajadia BNB 3061: 13; 7068: 5 — Barkman 107: 12 — Benedict SP 5939: 13 — BRUN 565: 2; BRUN 1465: 1; BRUN 2412: 5; BRUN 10384: 13; BRUN 15026: 1; BRUN 15055: 5; BRUN 16933: 5; BRUN 16634: 5; BRUN

16209: 1; BRUN 18061: 13; BRUN 18285: 9.

Campbell EG 199: 5; EG 214: 19; 271:12 — Chew CWL 452: 4; CWL 507: 5; CWL 1212: 4 — Christensen 1493: 19 — Christensen & Apu 486: 13; 582: 13 — Church 424: 5; 473: 5 — Church & Mahyar 1879: 10 — Clemens 111: 4; 20042: 13; 20157: 13; 21859: 4; 21860: 4; 21861: 1; 26668: 5; 27707: 11; 28814: 5; 29408: 5; 20620: 12; 28933: 12; 29116: 11; 30008: 13; 30226: 12; 31159: 2; 31278: 1; 31364: 2; 31388: 12; 31493: 12; 31728: 19; 32292: 19; 33629: 11; 33798: 11; 35113: 11; 30467: 13; 32437: 13; 32490: 13; 32613: 13; 34340: 13; 37707: 13; 40072: 12; 50386: 8a; Clemens *s.n.*: 12 — Coode *et al.* MC 7590: 11; MC 7869: 8a — Cousens 69770: 9 — Curtis 1020: 13.

Daim 302: 2; 635: 13; 639: 2; 643: 5; 673: 5; 692: 13; 966: 13 — De Vogel 1702: 5 — Dewanie 51: 2 — Dolois *et al.* SP 15067: 12 — Dransfield JD 7467: 2 — Dransfield *et al.* JD 7096: 5; JD 7171: 13.

Elmer 20947: 19; 21238: 10; 21335: 10; 21802: 10; 21809: 10 — Enchai 10382: 5 — Endert 1927: 19; 2249: 5; 3330: 9; 4733: 5; 5149: 10 — Enggoh 10421: 5.

Forman & Blewett LLF 805: 9 — FMS 17513: 13; FMS 20441: 11; FMS 34480: 4; FMS 36677: 5; FMS 37221: 4; FMS 37392: 9; FMS 37393: 13; FMS 41203: 5; FMS 41223: 5; FMS 42900: 5; FMS 48728: 5; FMS 49161: 5 – FRI 2036: 9; FRI 2073: 13; FRI 3237: 11; FRI 6135: 11; FRI 8150: 6; FRI 12721: 11; FRI 13229: 13; FRI 13725: 13; FRI 13889: 13; FRI 16998: 11; FRI 19870: 11; FRI 20395: 13; FRI 20684: 11; FRI 21864: 13; FRI 23426: 14; FRI 36355: 14; FRI 41338: 1; FRI 124124: 9.

Gadoh KL 837: 5 — Geh GSY 802: 5 — Geofarry *et al.* SP 17178: 2 — Gibbs 3135: 2 — Gusili SP 9937: 13.

Hallier 1032: 5; 1059: 5; 1713: 13; ß 1859: 13 — Hansen 801: 5; 1019: 19 — Haviland 629: 5; Haviland 737: 5; Haviland 1756: 10; Haviland 1944: 13; Haviland 2490: 13; Haviland 3328: 10 — Haviland … Hose 3647A: 6 — Henry & Sidkan MB 96: 11; MB 116: 11 — Hotta 13948: 5 — Hou 415: 10.

Jacobs 5086: 5 — John Sugau SIP-B 69: 4 — Junghuhn*s.n.*: 5.

Kamaruddin KA 30: 2 — Kamaruddin & Latiff KMS 1782: 19 — Keith 7088: 5 — KEP 10770: 2; KEP 20503: 13; KEP 51761: 13; KEP 55426: 2; KEP 64756: 13; KEP 66577: 11; KEP 78898: 13; KEP 84780: 9; KEP 85040: 13; KEP 85056: 13; KEP 94469: 13; KEP 94823: 13; KEP 99378: 13; KEP 104628: 13 — Kessler PK 917: 10 – King's Collector 6172: 9; 6435: 5; 7349: 11 — Kinsun 469: 4 — Kirkup *et al.* DK 438: 1; DK 749: 1 — Kitayama 4480: 17 — Kokawa & Hotta 5603: 8b — Koorders 2788: 5; 3264: 5; 3619: 5; 3707: 5; 3718: 5; 5146: 5; 10960: 5; 10966ß: 5; 13817ß: 5; 13924: 5; 14151: 5; 26772: 5; 30515: 5; 137814: 5 — Kostermans 3208: 9; 4328: 19; 4412: 10; 4558: 10; 4696: 2; 4888: 12; 4957: 5; 5146: 5; 5285: 5; 5352: 4; 5479: 5; 5788: 9; 5859: 5; 5986: 9; 6007: 4; 6815: 4; 6954: 2; 7333: 13; 7361: 9; 7544: 13; 7560: 9; 7615: 13; 8116: 1; 8953: 4; 8789: 5; 8977: 19; 8942: 5; 9064: 13; 9069: 13; 9106: 10; 9242: 1; 9929: 5; 10054: 13; 10608: 5; 10676: 1; 12660: 5; 12875: 13; 12901:

11; 13088: 13; 13230: 5; 13479: 5; 13741: 14; 21013: 5; 21402: 5; 21640: 5; 23020: 5; 23932: 5; *s.n.*: 19 — Kuswata 964: 5; 1021: 1.

Latiff *et al.* ALM 4178: 17 — Leighton 13: 10; 133: 13 — Lim *et al.* LSP 1184: 4 - Lobb *s.n.*: 1 — Lomudin 510: 1 — Lorence Lugas 876: 4; 970: 13; 1922: 8b; 2387: 4.

Mahyar *et al.* 1172: 13 - Maingayi 1258: 9; 1275: 9 — McDonald & Ismail 4050: 4 — Ming & Sidkan, MB 814: 19 — Ming & Sidkan MB 814: 19 — Mogea & de Wilde 3823: 13 — Mohd Nur 11232: 11 — Mohd. Shah 3502: 13 — Mohd Shah & Ahmad Shuker MS 3253: 4 — Mohizah & Yahud ITTO/BC 69: 4 — Murata B-2600: 11.

Native Collector 1690: 13; 2174: 6 — Norazami AZ 17: 2 — Nooteboom & Chai 1895: 4; 2150: 17; 2245: 18b — Orolfo BNB 3221: 19.

Pereira JTP 327: 2; JTP 372: 11 — Phillipps SNP 1926: 13; SNP 3029: 11 — Podzorski SMHI 757: 14 — Poore H 308: 13 - Purseglove P 4973: 1.

Ramlanto & Fanani 678: 5 — Ramos 1159: 1; 1216: 5; 1838: 2 - Rao 134: 12 — Reksodihajo 750: 5 — Reza RA 129: 5 — Ridley 4419: 7; Ridley 6296: 5; Ridley 6741: 5; 11675: 5; 13728: 11; 13783: 5; 16125: 16; Ridley *s.n.*: 12; *s.n.*: 5 — Ridsdale SMHI 21: 4; SMHI 1514: 14 — Rimi & Geofarry SP 8112: 11 — Rimi *et al.* SP 6276: 8b; SP 6284: 11; SP 6311: 11; 7374: 13; SP 9289: 11; TS 6573: 1 - Robinson *s.n.*: 11 — RSNB 13: 2; RSNB 137: 13; RSNB 196: 7; RSNB 1251: 2; RSNB 1840: 20; RSNB 4113: 5; RSNB 4383: 11; RSNB 4567: 5; RSNB 4660: 11; RSNB 4754: 11; RSNB 4832: 11.

S 97: 10; S 448: 10; S 1455: 4; S 1583: 10; S 2179: 1; S 4437: 6; S 4607: 11; S 4778: 5; S 8151: 4; S 8294: 1; S 9160: 13; S 12724: 15; S 13131: 6; S 14620: 15; S 16425: 15; S 16453: 15; S 16988: 13; S 17624: 5; S 18227: 4; S 18727: 1; S 19079: 11; S 19114: 1; S 20874: 10; S 22164: 1; S 22182: 4; S 22783: 1; S 24362: 14; S 25437: 13; S 26424: 18b; S 27391: 10; S 28414: 9; S 28492: 5; S 29592: 19; S 33554: 5; S 33793: 13; S 34520: 5; S 34665: 10; S 34763: 5; S 35668: 1; S 37704: 16; S 38318: 1; S 38403: 5; S 39667: 19; S 39750: 19; S 39796: 11; S 40211: 4; S 41159: 14; S 41423: 4; S 41895: 4; S 42735: 13; S 42875: 19; S 42934: 19; S 43657: 13; S 44704: 5; S 45548: 16; S 46397: 1; S 46625: 5; S 47646: 11; S 47657: 2; S 47783: 13; S 48364: 19; S 49318: 5; S 49612: 11; S 50107: 4; S 50590: 11; S 50767: 11; S 50903: 11; S 51430: 5; S 53909: 5; S 55270: 19; S 55804: 11; S 55966: 11; S 55968: 11; S 56471: 5; S 56785: 11; S 57220: 15; S 57433: 9; S 57441: 10; S 57789: 5; S 57863: 4; S 58659: 19; S 59021: 1; S 60068: 19; S 61440: 5; S 62161: 4; S 64289: 5; S 64898: 4; S 65472: 6; S 66173: 5; S 66829: 5; S 68074: 13; S 71953: 11; S 73105: 6; S 74442: 5; S 74624: 11; S 76324: 9; S 76964: 13; S 78301: 9; S 80034: 12; S 80093: 12; S 80192: 11; S 80210: 13; S 81713: 5; S 81888: 13; S 87548: 6; S 88004: 14; S 88190: 13; S 91375: 16; S 94780: 5 — S A 906 (Egon): 13 — SAN A 470: 4; SAN A 1147 (Cuadra): 5; SAN A 1309 (Cuadra): 5; SAN A 2264: 5; SAN A 2797(Kadir): 5; SAN A 2892: 5; SAN

A 3302 (Kadir & Jiran): 5; SAN A 3568 (Kadir): 5; SAN A 3874: 1; SAN A 3994: 19; SAN A 4491: 12; SAN A 4765: 10; SAN A 10512 (Enggoh): 5 — SAN 16576: 4; SAN 16856: 5; SAN 17570: 9; SAN 19213a: 5; SAN 20624: 2; SAN 21233: 13; SAN 21279: 5; SAN 21817: 1; SAN 22264: 5; SAN 22827: 9; SAN 23284: 1; SAN 23340: 5; SAN 25343: 1; SAN 25354: 4; SAN 26348: 5; SAN 26484: 4; SAN 27158: 5; SAN 27438: 4; SAN 28365: 5; SAN 29110: 13; SAN 30304: 4; SAN 30650: 2; SAN 31059: 5; SAN 31411: 19; SAN 31614: 5; SAN 31722: 19; SAN 32029: 5; SAN 32859: 19; SAN 33160: 5; SAN 34426: 5; SAN 35088: 5; SAN 35358: 19; SAN 35650: 2; SAN 36546: 5; SAN 36583: 5; SAN 37056: 1; SAN 37165: 19; SAN 37683: 13; SAN 37821: 8b; SAN 38309: 12; SAN 38469: 12; SAN 38508: 13; SAN 38734: 5; SAN 38823: 1; SAN 39269: 2; SAN 40863: 19; SAN 42206: 2; SAN 42400: 5; SAN 43164: 4; SAN 43345: 5; SAN 44718: 5; SAN 46313: 5; SAN 46520: 12; SAN 47327: 1; SAN 47402: 10; SAN 47763: 19; SAN 48181: 1; SAN 48287: 1; SAN 48992: 5; SAN 49248: 10; SAN 50065: 5; SAN 50564: 5; SAN 51016: 1; SAN 52516: 4; SAN 52789: 10; SAN 53552: 5; SAN 53921: 5; SAN 54463: 19; SAN 54576: 19; SAN 55793: 5; SAN 55839: 4; SAN 57104: 2; SAN 57143: 10; SAN 57510: 15; SAN 58090: 5; SAN 58182: 5; SAN 60576: 5; SAN 61467: 4; SAN 62093: 1; SAN 62541: 1; SAN 64101: 8a; SAN 67566: 13; SAN 70344: 13; SAN 71505: 2; SAN 71760: 5; SAN 72002: 2; SAN 72064: 2; SAN 72067: 11; SAN 72771: 5; SAN 74278: 1; SAN 74279: 1; SAN 74338: 13; SAN 74527: 15; SAN 75940: 10; SAN 76177: 12; SAN 76181: 13; SAN 76235: 4; SAN 77929: 19; SAN 78186: 2; SAN 78482: 2; SAN 79487: 2; SAN 79943: 5; SAN 80030: 1; SAN 80201: 2; SAN 80226: 5; SAN 81172: 5; SAN 81642: 5; SAN 81966: 1; SAN 82057: 5; SAN 82412: 11; SAN 84457: 5; SAN 84766: 5; SAN 86368: 1; SAN 86369: 1; SAN 86759: 4; SAN 87194: 11; SAN 87905: 10; SAN 87977: 10; SAN 89151: 5; SAN 90022: 13; SAN 90937: 5; SAN 92438: 5; SAN 93077: 5; SAN 93277: 2; SAN 98060: 8b; SAN 98112: 8b; SAN 98118: 8b; SAN 99879: 2; SAN 100721: 8b; SAN 100729: 8b; SAN 101957: 8b; SAN 102413: 2; SAN 103000: 1; SAN 105188: 1; SAN 106127: 5; SAN 106867: 11; SAN 108848: 2; SAN 110950: 19; SAN 111238: 2; SAN 113851: 13; SAN 114046: 2; SAN 114125: 13; SAN 114150: 2; SAN 114274: 2; SAN 114308: 5; SAN 116415: 13; SAN 116423: 13; SAN 117957: 5; SAN 118442: 13; SAN 118833: 13; SAN 120110: 2; SAN 120336: 11; SAN 122207: 13; SAN 122587: 15; SAN 122626: 11; SAN 122851: 2; SAN 123433: 13; SAN 123918: 5; SAN 123904: 19; SAN 123986: 11; SAN 124769: 2; SAN 125360: 2; SAN 126094: 13; SAN 126440: 1; SAN 128051: 2; SAN 128635: 13; SAN 128848: 5; SAN 129455: 19; SAN 129528: 19; SAN 130104: 13; SAN 130202: 2; SAN 132242: 4; SAN 132805: 18a; SAN 134978: 19; SAN 135198: 2; SAN 136926: 13; SAN 137056: 1; SAN 138834: 12; SAN 138879: 11; SAN 139425: 11; SAN 139568: 13; SAN 141813: 18b; SAN 143457: 18b — Sands *et al.* 5328: 11 — Sathvinderjit SKK 8: 13 — Sato 1099: 12 — Sato

et al. 23: 13 — SFN 27137: 5; SFN 27291: 4; SFN 27686: 13; SFN 27725: 12; SFN 36060: 4; SFN 40926: 5; SFN 11314: 9 — Schultze 35a: 2 — Shashi *et al.* DSD 28: 2 — Sidiyasa *et al.* 1195: 10 – Sinclair & Kadim 9045: 13; 10522: 10 — Slooten 2274: 10 — Soejarto 69: 5 – Soepadmo ES 964: 11 — Soepadmo & Mahmud ES 1049: 11 — Steenis 17393: 5 – Stevens PSF 393: 1; PSF 201: 1 — Stevens *et al.* PSF 482: 13 — Synge 1893: 3.
Tagawa *et al.* 321: 5 — Tandom BNB 4822: 1 — Teo & Din KL 4950: 14, KL 4940: 5 — Teo & Remy KL 4086: 5 — Teysmann *s.n.*: 1.
Van Balgooy 4022: 5.
Wallich Cat. 2584b: 13 — Webb 715: 1 — Webb *et al.* MB 159: 13 — Wong WKM 20: 1; WKM 36: 1; WKM 68: 5; WKM 144: 1; WKM 163: 1; WKM 835: 5; WKM 1116: 1; WKM 1368: 11 — Wong & Dransfield WKM 499: 9 — Wood 761: 1 — Wong & Wyatt-Smith W 81: 11 — Wray 280: 13.
Yabainus *et al.* SP 16287: 13.
Zainuddin AZ 17: 2; AZ 4918: 2; AZ 4984: 1 — Zainuddin *et al.* AZ 5674: 10 — Zazmee ZASZ 3: 2.

List of basionyms, synonyms and accepted names of *Actinodaphne* species in Sabah and Sarawak

Basionyms and synonyms are given in italic and the accepted names in bold and italic.

A. borneensis Meisn.
A. concinna Ridl. = ***A. pruinosa*** Nees
A. diversifolia Merr.
A. foxworthyana Gibbs = ***A. oleifolia*** Gamble
A. fuliginosa Airy Shaw
A. gelonioides Ridl. = ***A. oleifolia*** Gamble
A. glabra Blume
A. glomerata (Blume) Nees
A. johorensis Gamble
A. kinabaluensis Kosterm.
A. kostermansii var. ***glabrescens*** S. Julia
A. kostermansii var. ***kostermansii***
A. macrophylla (Blume) Nees
A. maingayi Hook.*f.* = ***A. macrophylla*** (Blume) Nees
A. maingayi Hook.*f.* var. *macrocarpa* Gamble = ***A. glomerata*** (Blume) Nees
A. myriantha Merr.
A. oleifolia Gamble
A. percoriacea S. Julia
A. pruinosa Nees
A. pruinosa Nees var. *kunstleri* Gamble = ***A. pruinosa*** Nees
A. robusta S. Julia
A. semengohensis S. Julia
A. sesquipedalis Hook.*f.* & Thoms. var. *macrocarpa* (Gamble) Ridl. = ***A. glomerata*** (Blume)

Nees
A. soepadmoi S. Julia
A. spathulifolia S. Julia
A. sulcata S. Julia var. ***longipetiolata*** S. Julia
A. sulcata S. Julia var. ***sulcata***
A. venosa S. Julia
Litsea glomerata Blume = ***A. glomerata*** (Blume) Nees
Litsea macrophylla Blume = ***A. macrophylla*** (Blume) Nees

A Synopsis of the Bornean Species of *Microcos* L. (Tiliaceae)

R. C. K. CHUNG, E. SOEPADMO

Forest Research Institute Malaysia
52109 Kepong, Selangor, Malaysia

AND

A. L. LIM

Institute of Biological Sciences, University of Malaya
50603 Kuala Lumpur, Malaysia

Abstract

In preparing the treatment of the family Tiliaceae for the Tree Flora of Sabah and Sarawak Project, a revision of the genus *Microcos* in Borneo was conducted resulting in 27 species being recognised for Borneo, of which 25 species occur in Sabah and Sarawak; two (*M. laurifolia* and *M. tomentosa*) are newly recorded, three (*M. creaghii*, *M. elmeri* and *M. ovato-lanceolata*) are reduced to synonymy and one (*M. longipetiolata*) is excluded from the genus. Fifteen species are endemic to Borneo. A complete list of exsiccatae, nomenclatural (typification and synonymy) and taxonomic notes and distribution of the recognised species are provided.

Introduction

The genus *Microcos* L. was founded by Linnaeus in 1753 based on the Sri Lankan species, *M. paniculata* L. In 1767, Linnaeus reduced *Microcos* to the synonymy of *Grewia* L. In the past few decades, the delimitation and taxonomic status of *Microcos* and *Grewia* have been the subject of controversy. Recently, Bayer *et al.* (1999), Chung (2002, 2003), Bayer & Kubitzki (2003) and Chung *et al.* (2003, 2005) recognised *Microcos* as distinct from *Grewia* based on morphological, wood anatomical, leaf epidermal, pollen morphological characters and combined analyses of plastid *atp*B and *rbc*L DNA sequences.

Microcos species are found mainly in the Malesian region, with their centre of distribution probably in Borneo. Burret (1926) using morphological characters of the flower (such as the pedicel length, stamen number, ovary shape, ovule number per locule, and style length) recognised two subgenera within *Microcos*: subgen. *Microcos* Burret (species from Africa, Asia and West Malesia) and subgen. *Eumeriandra* Burret (species from the Moluccas and New Guinea).

Up to 2005, a total of 97 binomials for *Microcos* had been published, representing taxa from tropical Africa to Indo-Malesia (The International Plant Names Index, 2005). Twenty-one binomials have been published for plants occurring in Borneo (Merrill, 1921; Masamune, 1942; Anderson, 1980; Ashton, 1988; Whitmore *et al.*, 1990; Kessler *et al.*, 1992; Kessler & Sidiyasa, 1994; Coode *et al.*, 1996; Argent *et al.*, 1997). In this paper, we recognise 27 species as occurring in Borneo.

Microcos L.

Microcos L., Sp. Pl. 1 (1753) 514, Gen. Pl. ed. 5 (1754) 230; Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 756; Merrill, Univ. Calif. Publ. Bot. 15 (1929) 185; Masamune, En. Phan. Born. (1942) 449; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 393; Meijer, Bot. News Bull. Sandakan 7 (1967) 107; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Phengklai, Thai For. Bull., Bot. 16 (1986) 15, Fl. Thailand 6, 1 (1993) 33; Whitmore *et al.*, Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 357; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66; Kessler & Sidiyasa, Trees Balikpapan-Samarinda Area, Tropenbos ser. 7 (1994) 228; Turner, Gard. Bull. Sing. 47 (1995) 487; Coode *et al.*, Checkl. Flow. Pl. Gymno. Brunei (1996) 323; Boer & Sosef *in* Sosef *et al.*, Pl. Resources of South-East Asia 5, 3 (1998) 378. – *Grewia* L. subgen. *Microcos* (L.) J.R.Drumm. *in* Gamble, Fl. Madras 1, 1 (1915) 114. – *Grewia* L. sect. *Microcos* (L.) Wight & Arn., Prodr. Fl. Ind. Orient. 1 (1834) 81; King, J. Roy. As. Soc. Beng. 60, 2 (1891) 109. **Type species:** *Microcos paniculata* L.

Arsis Lour., Fl. Cochinch. ed. 1, 1 (1790) 335. **Type species:** *Arsis rugosa* Lour., Indo-China (= *Microcos paniculata* L.).

Fallopia Lour., Fl. Cochinch. ed. 1, 1 (1790) 335. **Type species:** *Fallopia nervosa* Lour., China, Canton [= *Microcos nervosa* (Lour.) S.Y.Hu].

Omphacarpus Korth. *in* Temminck, Verh. Nat. Gesch. Ned. Bezitt., Bot. 6 (1842) 192, Verh. Nat. Gesch. Ned. Bezitt., Bot. 5 (1842) *t.* 42. – *Grewia* L. sect. *Omphacarpus* (Korth.) Miq., Fl. Ind. Bat. 1, 2, 2 (1859) 204; King, J. Roy. As. Soc. Beng. 60, 2 (1891) 109. **Type species:** *Omphacarpus opacus* Korth., Borneo, Kalimantan [= *Microcos opaca* (Korth.) Burret].

Inodaphnis Miq., Fl. Ind. Bat., Suppl. 3 (1861) 357. **Type species:** *Inodaphnis lanceolata* Miq., Sumatra [= *Microcos lanceolata* (Miq.) Burret].

Grewia L. *p.p.*: King, J. Roy. As. Soc. Beng. 60, 2 (1891) 108, *p.p.* (*excl. G. umbellata* Roxb.); Ridley, Fl. Malay Penins. 1 (1922) 299, *p.p.* (*excl. G. umbellata* Roxb.); Kochummen *in* Whitmore, Tree Fl. Malaya 2 (1973)

396, *p.p.* (*excl. G. acuminata* Juss., *G. viminea* Wall. *ex* Burret *et G. sclerophylla* Roxb. *ex* Don); Corner, Wayside Trees Malaya 3rd edition, 2 (1988) 732, *p.p.* (*excl. G. umbellata* Roxb.).

Distribution: The genus comprises about 80 species occurring in tropical Africa (not Madagascar), India, Sri Lanka, Myanmar, Indo-China, S China, Hainan, Thailand, and throughout Malesia (except Lesser Sunda Islands). In Malesia, some 42 species are known with two centres of diversity: 36 species in the West Malesia and 16 species in the Moluccas and New Guinea. In Borneo there are 27 species with 15 endemics; Sarawak has 22 species with one endemic; Sabah 18 species with one endemic; Brunei 16 species (none endemic) and Kalimantan 16 species (none endemic).

Notes: Two basic inflorescence types are seen in *Microcos* (Chung 2001, 2003): Type A panicle where only first-order branches are conspicuous, and Type B panicle where at least two orders of branching are conspicuous.

Two domatia types, pocket- or sac-type, are found on the abaxial leaf surface either in the axils of basal pair of secondary veins or of other secondary veins in some species of *Microcos*.

Four main types of non-glandular trichomes were observed in *Microcos* (Chung, 2002), namely, simple, tufted (branched from the base upwards), stellate (star-shaped) and cushioned stellate trichomes.

1. Microcos antidesmifolia (King) Burret

Microcos antidesmifolia (King) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 780; Turner, Gard. Bull. Sing. 47 (1995) 487; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323. – *Grewia antidesmifolia* King, J. As. Soc. Beng. 60, 2 (1891) 113; Ridley, Fl. Malay Penins. 1 (1922) 302; Kochummen *in* Whitmore, Tree Fl. Malaya 2 (1973) 397, *p.p.* (*excl. syn. G. antidesmifolia* King var. *hirsuta* King); Corner, Wayside Trees Malaya 3rd edition, 2 (1988) 733; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 441, *p.p.* (*excl. syn. G. antidesmifolia* King var. *hirsuta* King and *M. subepetala* Stapf *ex* Ridl.); Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 355; Kochummen, Tree Fl. Pasoh (1997) 428. **Type:** *King's Collector 4029*, Peninsular Malaysia, Perak, Larut (lecto K., here designated).

Distribution: Peninsular Malaysia and Borneo.

Notes: In leaf shape, distance of the basal pair of secondary veins, and fruit. *Microcos antidesmifolia* is closely related to *M. triflora* but differs in the leaf texture (chartaceous vs. subcoriaceous), basal pair of secondary veins running parallel to midrib at the base (absent vs. present), domatia type in the axil of basal pair (pocket-type vs. sac-type), petiole (not swollen vs. swollen), and the floral characters.

A species with two recognised varieties, in Borneo only var. *hirsuta* is known. The other, var. *antidesmifolia*, occurs in Peninsular Malaysia.

var. hirsuta (King) Burret

Microcos antidesmifolia var. *hirsuta* (King) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 780. – *Grewia antidesmifolia* King var. *hirsuta* King, J. As. Soc. Beng. 60, 2 (1891) 113; Ridley, Bull. Misc. Inform., Kew (1933) 489. **Type:** *King's Collector 10185*, Peninsular Malaysia, Perak (lecto K, here designated).

Microcos elmeri Merr., Univ. Calif. Publ. Bot. 15 (1929) 186; Masamune, En. Phan. Born. (1942) 450; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323, *p.p.*, ***syn. nov.*** – *Grewia elmeri* (Merr.) P.S.Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 443; Anderson, Checkl. Trees Sarawak (1980) 338; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 356. **Type:** *Elmer 20911*, Borneo, Sabah, Tawau (A, BO, GH, K, L, NY, SING, UC).

Microcos creaghii Ridl., Bull. Misc. Inform., Kew (1933) 490, ***syn. nov.***; Masamune, En. Phan. Born. (1942) 449. **Type:** *Creagh s.n.*, Borneo, Sabah, Sandakan (K).

Distribution: Peninsular Malaysia (confined to Perak) and Borneo (Sarawak, Sabah, Brunei, and Kalimantan).

2. Microcos borneensis Burret

Microcos borneensis Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 772; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 357; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323. – *Grewia borneensis* (Burret) P.S.Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 442; Anderson, Checkl. Trees Sarawak (1980) 338. **Type:** *Haviland 2837*, Borneo, Sarawak, Kuching (holo K; iso BO [3X], K, SAR, SING).

Distribution: Endemic in Borneo (confined to Sarawak and Brunei).

Notes: Burret (1926) erroneously cited *Hose 2837* as the type. However, the correct type specimen for this species is *Haviland 2837* (see Steenis, 1954) and the collection date of this specimen matches well with that cited by Burret (1926). Two sheets of this collection (at flower-bud stage) were examined at K. The sheet with the notes "flowers yellow" is the holotype, while the sheet with the notes "near *M. florida* of Sumatra, venation of leaves is different. It is not *Motleys 1216* or *1260*" is the isotype.

Microcos borneensis is closely related to *M. riparia* but the latter differs from the former by its larger and thicker leaves with a greater number of secondary veins (5–7 pairs), and longer inflorescences (3–8 cm long), lower part of the androgynophore is longer (1.5–2 mm long) and concave in side view, sparsely stellate-hairy style to between 1/4 and 1/2 its length, longer fruit (2.5–2.7 mm long) with 5–7 mm long pseudostalk, thicker mesocarp (5–6 mm thick), thinner endocarp (*c.* 0.5 mm thick), always with one fertile pyrene, and inconspicuous sterile pyrene.

3. Microcos cinnamomifolia Burret

Microcos cinnamomifolia Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 770; Merrill, Univ. Calif. Publ. Bot. 15 (1929) 187; Masamune, En. Phan. Born. (1942) 449; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 357; Kessler & Sidiyasa, Trees Balikpapan-Samarinda Area, Tropenbos ser. 7 (1994) 228; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323; Boer & Sosef *in* Sosef *et al.*, Pl. Resources of South-East Asia 5, 3 (1998) 380. – *Grewia cinnamomifolia* (Burret) P.S.Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 443; Anderson, Checkl. Trees Sarawak (1980) 338; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 2 (1997) 641. **Type:** *Beccari PB 1617*, Borneo, Sarawak (lecto K, here designated; isolecto BO, L).

Distribution: Endemic in Borneo (Sarawak, Sabah, Brunei, and Kalimantan).

Notes: A very distinct species, it is the only *Microcos* with only a basal pair of secondary veins that reach almost to the apex of the blade. Nevertheless, it appears to be allied to *M. laurifolia*, with which it shares almost the same leaf shape (narrowly elliptic to elliptic or lanceolate to ovate).

4. Microcos crassifolia Burret

Microcos crassifolia Burret, Notizbl. Bot. Gart. Berl. –Dahl. 9 (1926) 780, *p.p.*; Merrill, Pl. Emer. Born. (1929) 186, *p.p.*; Masamune, En. Phan. Born. (1942) 449; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl.

Kalimantan 2, 1 (1990) 357; Kessler & Sidiyasa, Trees Balikpapan-Samarinda Area, Tropenbos ser. 7 (1994) 228. – *Grewia pyriformis* Merr., J. Str. Br. R. As. Soc. 86 (1922) 327, *p.p.*, *nom. illegit.*, *non G. pyriformis* Elmer, Leafl. Philip. Bot. 8 (1915) 2841. **Type:** *Ramos 1704*, Borneo, Sabah, Sandakan (holo K; iso L, US).

Distribution: Endemic in Borneo (confined to Sarawak, Sabah and Brunei).

Notes: In overall appearance, this species quite closely resembles *Microcos pachyphylla* from Borneo. However, it is sufficiently different to be maintained as a separate species (see note in *M. pachyphylla*). Oblong, ellipsoid or ovoid fruit galls, measuring 17–20 x 9–15 mm are sometimes found in this species.

5. Microcos dulitensis Airy Shaw

Microcos dulitensis Airy Shaw, Kew Bull. (1949) 159. – *Grewia dulitensis* (Airy Shaw) P.S.Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 443; Anderson, Checkl. Trees Sarawak (1980) 338; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 355. **Type:** *Richards 1767*, Borneo, Sarawak, Mt. Dulit (holo K; iso BO, SING).

Distribution: Endemic in Borneo (Sarawak). Reported only from Mt. Dulit and Usun Apau plateau.

6. Microcos fibrocarpa (Mast.) Burret

Microcos fibrocarpa (Mast.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 782; Phengklai, Thai For. Bull., Bot. 16 (1986) 54, f. 24; Phengklai, Fl. Thailand 6, 1 (1993) 38, f. 24; Turner, Gard. Bull. Sing. 47 (1995) 487; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323, *p.p.*; Boer & Sosef *in* Sosef *et al.*, Pl. Resources of South-East Asia 5, 3 (1998) 380, *p.p.* (*excl. syn. Microcos reticulata* Ridl.). – *Grewia fibrocarpa* Mast. *in* Hooker *f.*, Fl. Brit. India 1, 2 (1874) 391; King, J. As. Soc. Beng. 60, 2 (1891) 111; Ridley, Fl. Malay Penins. 1 (1922) 301; Kochummen *in* Whitmore, Tree Fl. Malaya 2 (1973) 397; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 444, *p.p.* (*excl. syn. M. reticulata*); Corner, Wayside Trees Malaya 3rd edition, 2 (1988) 733; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 356. **Type:** *Maingay 1080*, Peninsular Malaysia, Malacca (lecto K [with flower buds and fruits], here designated; isolecto K [with flower buds], K [with fruits]).

Distribution: India (*fide* Phengklai 1993), peninsular Thailand, Peninsular Malaysia, and Borneo (Sarawak, Sabah and Kalimantan).

Notes: This species is easily confused with *Microcos reticulata*, but can be distinguished by the distantly and obscurely serrulate leaf margin, impressed midrib and secondary veins above, 1–1.5 mm long and glabrous lower part of the androgynophore, broadly ovoid or globose ovary, which is broadly ovate in cross section. It has soft indumentum on the twigs, lower leaf surface and infructescences.

7. Microcos gracilis Stapf *ex* Ridl.

Microcos gracilis Stapf *ex* Ridl., Bull. Misc. Inform., Kew (1938) 229; Masamune, En. Phan. Born. (1942) 450; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323, *p.p.* – *Grewia gracilis* (Stapf *ex* Ridl.) P.S.Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 444; Anderson, Checkl. Trees Sarawak (1980) 338; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 356. **Type:** *Haviland 1509*, Borneo, Sarawak, Kuching (holo K; iso A, SING).

Distribution: Endemic in Borneo (Sarawak, Sabah, Brunei, and Kalimantan).

Notes: *Microcos gracilis* is closely related to *M. sumatrana* in having exclusively Type A panicles, glabrous lower part of the androgynophore, globose ovary, and densely stellate-hairy obovoid fruits. It is different in its basal pair of secondary veins reaching between 1/4 and 1/2 the length of the blade (vs. up to *c.* 1/4 in *M. sumatrana*), petiole 0.5–1 mm long and not swollen at the distal end (vs. 1–1.5 mm, and slightly swollen at the distal end), narrowly elliptic and 0.5–1 mm wide involucral bracts of the inner whorl (vs. oblanceolate, 1–1.5 mm wide), oblong sepals (vs. linear or oblanceolate), oblong or obovate petals (vs. lanceolate), and in cross section the ovary is elliptic with three shallow ridges (vs. circular).

8. Microcos henrici (Baker *f.*) Burret

Microcos henrici (Baker *f.*) Burret, Notizbl. Bot. Gart. Berl.-Dahl., 9 (1926) 781, *p.p.*; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 323, *p.p.* – *Grewia henrici* Baker *f.*, J. Bot. 62 (1924) 13. **Type:** *Forbes 3014*, Sumatra, Palembang, Rupit River, Bingin (holo L [no. 908.144.547]; iso BO, GH, L [nos. 908.144.548, 908.140.1977, 409613], SING).

Distribution: Sumatra (Jambi and Palembang) and Borneo.

Notes: Two subspecies are recognised: subsp. *henrici* (represented by *Forbes 3014* and *Posthumus 1036*), which is endemic in Sumatra, and subsp. *acuta* R.C.K.Chung from Borneo.

subsp. acuta R.C.K.Chung

Microcos henrici (Baker *f.*) Burret subsp. *acuta* R.C.K.Chung, Kew Bull. 58 (2003) 242, fig. 5. **Type:** *Kostermans 12681*, Borneo, Kalimantan, Kutei, Belajan River, Tabang (holo L [no. 958.349.186]; iso L [no. 960.24.012], SING).
Grewia sp. 1, Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 447.

Distribution: Endemic in Borneo (confined to Sarawak, Sabah and Kalimantan).

9. Microcos hirsuta (Korth.) Burret

Microcos hirsuta (Korth.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 782; Merrill, Univ. Calif. Publ. Bot. 15 (1929) 185; Masamune, En. Phan. Born. (1942) 450; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 357; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66; Cheek & Turner, Kew Bull. 50 (1995) 129; Turner, Gard. Bull. Sing. 45 (1993) 221, Gard. Bull. Sing. 47 (1995) 487; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 324, *p.p.* – *Omphacarpus hirsutus* Korth. *in* Temminck, Verh. Nat. Gesch. Ned. Bezitt., Bot. 6 (1842) 193, Verh. Nat. Gesch. Ned. Bezitt., Bot. 5 (1842) *t.* 42. – *Grewia omphacarpa* Miq., Fl. Ind. Bat. 1, 2, 2 (1859) 204; Merrill, J. Str. Br. Roy. As. Soc., Spec. No. (1921) 373; Ridley, Fl. Malay Penins. 1 (1922) 301; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 445, *p.p.*; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 356. – *Grewia hirsuta* (Korth.) Kochummen, *in* Whitmore, Tree Fl. Malaya 2 (1973) 39, *nom. illegit. et nom. superfl.*, *non G. hirsuta* Vahl, Symb., Bot. 1 (1790) 34; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 240. **Type:** *Korthals s.n.*, Borneo, Kalimantan, Doesoen River (lecto L [no. 908.253.200], here designated; isolecto L [nos. 944.56.122–124, 908.253.353, 908.253.341–342]).

Grewia palembanica Miq., Fl. Ind. Bat., Suppl. 3 (1861) 405. **Type:** *Teijsmann HB 3658*, Sumatra, Palembang, Muara Enim (BO, L [no. 908.253.799], U *n.v.*).

Distribution: Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sarawak, Sabah, Brunei, and Kalimantan).

Notes: *Microcos hirsuta* is closely related to *M. phaneroneura* (see note under *M. phaneroneura*).

10. Microcos kinabaluensis R.C.K.Chung

Microcos kinabaluensis R.C.K.Chung, Kew Bull. 58 (2003) 330, fig. 1. **Type:** *Chew & Corner RSNB 4994*, Borneo, Sabah, Mt. Kinabalu, Mesilau River (holo SING; iso SAN, US).

Distribution: Endemic to Borneo (Mt. Kinabalu, Sabah).

11. Microcos latifolia Burret

Microcos latifolia Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 781. – *Grewia latifolia* Mast. *in* Hooker *f.*, Fl. Brit. India 1, 2 (1874) 392, *non G. latifolia* F.Muell. *ex* Benth. *in* Bentham & Mueller, Fl. Austral. 1 (1863) 271; King, J. As. Soc. Beng. 60, 2 (1891) 112; Gagnepain *in* Lecomte, Not. Syst. 1 (1909) 132; Ridley, Fl. Malay Penins. 1 (1922) 300. – *Grewia blattaefolia* Corner, Gard. Bull. S.S. 10 (1939) 262; Kochummen *in* Whitmore, Tree Fl. Malaya 2 (1973) 399; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 442, *p.p.*; Corner, Wayside Trees Malaya 3rd edition, 2 (1988) 733; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 355; Kochummen, Tree Fl. Pasoh (1997) 429. – *Microcos blattaefolia* (Corner) R.S.Rao, J. Bomb. Nat. Hist. Soc. 48 (1949) 300, *p.p.*; Turner, Gard. Bull. Sing. 45 (1993) 221, Gard. Bull. Sing. 47 (1995) 487; Boer & Sosef *in* Sosef *et al.*, Pl. Resources of South-East Asia 5, 3 (1998) 380. **Type:** *Maingay 3150* (= Kew Distr. No. 249), Peninsular Malaysia, Malacca (lecto K, here designated).

Distribution: Peninsular Malaysia, Singapore and Borneo (confined to Sarawak and Brunei).

Notes: *Microcos latifolia*, a highly variable species with respect to vegetative characters, is sometimes confused with *M. globulifera* from Peninsular Malaysia. Two rather distinct entities can be recognised. The first, represented by specimens collected from Peninsular Malaysia and Singapore are characterised by elliptic to broadly elliptic leaves with an acute or obtuse apex and impressed hairy midrib and secondary veins above; and the second by specimens from Sarawak and Brunei which have narrowly elliptic leaves with acuminate apex, and raised glabrous midrib and secondary veins above.

The name *Microcos latifolia* (Mast.) Burret (Burret, 1926: 781) is an illegitimate name because it was based on an illegitimate basionym (*Grewia latifolia* Mast., 1874, *non G. latifolia* Benth. & F.Muell, 1863). In accordance with the International Code of Botanical Nomenclature 2000 (St. Louis Code) Art. 58.3 with Ex. 2 (Greuter *et al.*, 2000), the correct name for the species is *Microcos latifolia* Burret with no parenthetic author citation.

The epithet of "*blattaefolia*" is not to be changed to "*blattifolia*" since Corner (1939) avowedly based it on *Blatta*, the Latin name for the cockroach used by Pliny, Vergil, Horace, etc., and has nothing to do with *Blatti* Adanson, a listed rejected name in the synonymy of *Sonneratia nom. cons*.

12. Microcos latistipulata (Ridl.) Burret

Microcos latistipulata (Ridl.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 795; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Turner, Gard. Bull. Sing. 47 (1995) 487; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 324, *p.p.* – *Grewia latistipulata* Ridl., Bull. Misc. Inform., Kew (1924) 262, Fl. Malay Penins. 5 (1925) 293; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 444, *p.p.* (*excl. syn. M. crassifolia* Burret *et M. pachyphylla* Merr.); Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 356. **Type:** *Burkill SFN 7826*, Peninsular Malaysia, Selangor, Klang (holo K; iso SING).

Distribution: Sumatra, Peninsular Malaysia and Borneo.

Notes: A species with two recognised varieties: var. *latistipulata* is known only from Peninsular Malaysia and Borneo and var. *lanceolata* (Ridl.) Burret from Sumatra.

var. latistipulata

Distribution: Peninsular Malaysia and Borneo (confined to the east coast of Sabah).

Notes: *Microcos latistipulata* is characterised by the coriaceous and glabrous leaves, as well as by the distinctly sharply prominent midrib and secondary veins beneath, and glabrous pyriform fruits with pseudostalk. Specimens of var. *latistipulata* from Borneo differ from the Peninsular Malaysian ones by their glabrous lower part of the androgynophore (vs. stellate-hairy) and glabrous ovary (vs. stellate-hairy). However, the presence of a number of specimens with intermediate characters means that the populations in Peninsular Malaysia and Borneo should be grouped under var. *latistipulata*. Some of these intermediate specimens are: *Charington SAN 24716*, *Elmer 20310* and *Meijer SAN 25133*.

13. Microcos laurifolia (Hook.*f.* *ex* Mast.) Burret

Microcos laurifolia (Hook.*f.* *ex* Mast.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 771; Phengklai, Thai For. Bull., Bot. 16 (1986) 56, f. 25, Fl. Thailand 6, 1 (1993) 39, f. 25; Turner, Gard. Bull. Sing. 47 (1995) 487; Boer & Sosef *in* Sosef *et al.*, Pl. Resources of South-East Asia 5, 3 (1998) 381. – *Grewia laurifolia* Hook. *f.* *ex* Mast. *in* Hooker *f.*, Fl. Brit. India 1, 2 (1874) 392; King, J. As. Soc. Beng. 60, 2 (1891) 114; Baker *f.*, J. Bot. 62 (1924) 13; Kochummen *in* Whitmore, Tree Fl. Malaya 2 (1973) 399; Corner, Wayside Trees Malaya 3rd edition, 2 (1988) 733; Kochummen, Tree Fl. Pasoh (1997) 429. **Type:** *Maingay 1647*, Peninsular Malaysia, Malacca (lecto K [with flower buds], here designated; isolecto K [with fruits]).

Distribution: India (*fide* Phengklai 1993), peninsular Thailand (*fide* Phengklai 1993), Sumatra, Peninsular Malaysia, and Borneo (confined to Brunei).

Notes: The specimen from Brunei (*Dransfield et al. JD 6825*) represents a new record of the species for Borneo. The young twigs, petioles, midrib and secondary veins of this specimen are covered with simple hairs (vs. glabrous, except for the sparsely minutely stellate-hairy petioles for the Peninsular Malaysian specimens).

Morphologically, *M. laurifolia* is closely allied to *M. florida* (Miq.) Burret and *M. loerzingii* Burret (from Sumatra), *M. pyriformis* (Elmer) Burret (from the Philippines) and *M. kinabaluensis* (from Borneo; see Chung (2003) for further details).

Microcos florida differs from *M. laurifolia* by its hairy sac-type domatia (vs. glabrous pocket-type), densely stellate-hairy ovary (vs. sparsely covered with glandular trichomes in buds and less in flowers), fruits with a short remnant of style (vs. without a style remnant), endocarp of less than 0.5 mm thick (vs. 0.5–1 mm thick), and consistently 1 fertile pyrene (vs. 1–2).

Microcos laurifolia can be distinguished from *M. loerzingii* by its equilateral leaf base (vs. inequilateral, i.e. with halves or sides unequal in shape and size), thinner (1–1.5 mm) petioles (vs. *c.* 2 mm thick), sparsely simple- or minutely stellate-hairy petioles (vs. glabrous), ovary sparsely covered with glandular trichomes (vs. densely stellate-hairy), and glabrous style (vs. sparsely stellate-hairy).

From *M. pyriformis*, *M. laurifolia* differs by the concolourous subcoriaceous leaves (vs. discolourous chartaceous leaves), pyriform fruits with distinct pseudostalk (vs. obovoid without pseudostalk), smaller fruits 1.5–2 x 0.8–1.3 cm (vs. 2.5–3 x 1.8–2 cm), thinner (1–1.5 mm) mesocarp (vs. 4–6 mm thick), thinner (0.5–1 mm) endocarp (vs. 1–2 mm thick), consistently with 1–2 fertile pyrenes (vs. 1), and shorter (4–6 mm) fertile pyrenes (vs. 8–10 mm long).

Baker *f.* (1924), Ashton (1988) and Kessler *et al.* (1992) reported that *M. laurifolia* occurs in Palembang, Sumatra (specimens *Baker f. 3005* and *3146*), Sarawak (*Ridley s.n.*) and Kalimantan (*S 292*) respectively. However, during this study we could not locate these specimens in order to confirm their identity.

Ridley (1938) identified one collection from Sarawak (*Beccari PB 3473*) as that of *M. laurifolia*. Careful study of the specimen revealed that it belongs to *M. riparia*.

14. Microcos membranifolia R.C.K.Chung

Microcos membranifolia R.C.K.Chung, Kew Bull. 58 (2003) 336, fig. 3. **Type:** *Singh SAN 30672*, Borneo, Sabah, Sandakan, Sungai Binuang (holo KEP; iso K, SAN, SAR, SING).

Distribution: Endemic in Borneo (confined to Sarawak and Sabah).

15. Microcos opaca (Korth.) Burret

Microcos opaca (Korth.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 781; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 357; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66. – *Omphacarpus opacus* Korth. *in* Temminck, Verh. Nat. Gesch. Ned. Bezitt., Bot. 6 (1842) 193. – *Grewia opaca* (Korth.) Miq., Fl. Ind. Bat. 1, 2, 2 (1859) 204; Merrill, J. Str. Br. Roy. As. Soc., Spec.

No. (1921) 373; Masamune, En. Phan. Born. (1942) 449; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 446. **Type:** *Korthals s.n.*, Borneo, Kalimantan, Gunung Sakoembang (lecto L [no. 908.253.752], here designated; isolecto L [no. 908.253.767]).

Distribution: Endemic in Borneo (confined to Sarawak, Sabah and Kalimantan).

Notes: This species is sometimes confused with *M. henrici* subsp. *acuta* because of its leaf shape, inequilateral leaf blade, and flattened midrib above. *Microcos opaca* is sufficiently different in its inflorescence type, filament and style indumentum, ovary shape, and fruit shape. Additionally, it has acuminate leaves and the acumen with blunt tip.

16. Microcos ossea Burret

Microcos ossea Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 779; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 357; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 324, *p.p.* – *Grewia ossea* (Burret) P.S.Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 446, *p.p.*; Anderson, Checkl. Trees Sarawak (1980) 338. **Type:** *Haviland 42*, Borneo, Sarawak, Kuching (lecto K [with flower buds and flowers], here designated; iso BO, K [with young and mature fruits], L [no. 908.254.267], SING).
Microcos paucicostata Burret, Notizbl. Bot. Gart. Berl.-Dahl. 12 (1935) 602; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 358. **Type:** *Clemens 21071*, Borneo, Sarawak, Kapit (A, K, NY, SAR).

Distribution: Endemic in Borneo (Sarawak, Sabah, Brunei, and Kalimantan).

Notes: In his original publication for the species, Burret (1926: 779) did not specify the collector and collection number of the type. However, under the distribution note, he stated that the species was described based on a specimen on loan from K collected from a small tree near Kuching on 2 March 1893. We have examined specimens deposited at BO, K, L, and SING and found that *Haviland 42* bears the same notes on the habit, locality and date of collection. Based on this, we concluded that *Haviland 42* is the type of *Microcos ossea* Burret and here designate it as such.

17. Microcos pachyphylla Merr.

Microcos pachyphylla Merr., Univ. Calif. Publ. Bot. 15 (1929) 187; Masamune, En. Phan. Born. (1942) 450. **Type:** *Elmer 21880*, Borneo, Sabah, Tawau (holo US; iso A, BO, K, L, NY, SING).

Distribution: Endemic in Borneo (confined to Sabah, Brunei and E Kalimantan). This species is common in Sabah and Kalimantan but rare in Brunei. In Sabah, it is found mainly in the east coast districts (Sandakan and Tawau), with one collection from Beaufort on the west coast.

Notes: *Microcos pachyphylla* is closely related to *M. crassifolia*. In both species the leaf is coriaceous and glabrous, the mesocarp is dorsilaterally ribbed, and the specimens of fruits are often infested with galls. The former, however, differs from the latter in having leaves shiny on both surfaces (vs. not shiny), short petioles of less than 12 mm long (vs. 7–18 mm long), and globose fruits (vs. ellipsoid or obovoid). Fruit galls, ovoid to broadly ovoid or occasionally ellipsoid to oblong and measuring (9–)12–14 x 9–12 mm, are often found in this species.

18. Microcos pearsonii (Merr.) Burret

Microcos pearsonii (Merr.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1927) 1171; Merrill, Univ. Calif. Publ. Bot. 15 (1929) 185; Masamune, En. Phan. Born. (1942) 450; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 358; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 324. – *Grewia pearsonii* Merr., Philipp. J. Sci. 30 (1926) Bot. 83; Masamune, En. Phan. Born. (1942) 449; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 447. **Type:** *Wood 1216*, Borneo, Sabah, Kudat, Lingkongan River (holo UC [barcode UC 232336]).

Distribution: Endemic in Borneo (confined to Sarawak, Sabah, and Brunei).

Notes: The collections from Sarawak and Brunei have longer (9–15 mm long) and sparsely stellate-hairy petioles and differ from the "typical" collections from Sabah which have shorter petioles (2–7 mm long) and are densely stellate-hairy. A number of collections (e.g., *Dewol & Donggap SAN 129474* from Sabah and *Nielsen & Balslev 1109* from Brunei) have the secondary veins and tertiary venation impressed above which differ from those of the "typical" collections.

Microcos pearsonii, with its cordate leaf base, is distinctive among the Bornean species of *Microcos*. It is closely allied to *M. erythrocarpa* and *M. malayana* from Peninsular Malaysia, but differs from both by its cordate leaf base, type of indumentum of the twigs, veins, petioles, inflorescences and infructescences, and by its floral characters.

19. Microcos phaneroneura Burret

Microcos phaneroneura Burret, Notizbl. Bot. Gart. Berl.-Dahl. 12 (1934) 163; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 358; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66. **Type:** *Hallier 2868*, Borneo, Lianggagang (holo BO [with white specimen tag.; iso BO [without white specimen tag], SING).

Distribution: Endemic in Borneo (confined to Sarawak, Brunei and Kalimantan).

Notes: *Microcos phaneroneura* is closely related to *M. hirsuta* in the smooth twigs, basal pair of secondary veins reaching between 1/4 and 1/2 the length of the blade and forming an angle of less than 45° from midrib, lanceolate petals, and smooth in the lower part of the androgynophore. However, the former differs from the latter by its chartaceous leaf (vs. subcoriaceous), sparsely simple- and stellate-hairy leaf above (vs. glabrous), impressed secondary veins and tertiary venation (vs. flattened), exclusively Type A panicles (vs. mixture), lanceolate involucral bract lobes of the outer whorl (vs. ovate), narrowly elliptic involucral bracts of the inner whorl (vs. oblanceolate), acuminate petals (vs. with shallow 2–3 teeth), and sparsely stellate-hairy lower part of the androgynophore with cylindrical side view (vs. glabrous with concave side view).

20. Microcos reticulata Ridl.

Microcos reticulata Ridl., Bull. Misc. Inform., Kew (1933) 490, *p.p.*; Masamune, En. Phan. Born. (1942) 450; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 324. **Type:** *Creagh s.n.*, Borneo, Sabah (holo K; iso K).

Distribution: Sumatra and Borneo (Sarawak, Sabah, Brunei, and Kalimantan). Very common in Borneo.

Notes: Two sheets of *Creagh s.n.* collection (at flower-bud stage) were examined at K. The sheet with a white envelop and a determination slip by

J.R. Drummond is considered the holotype, while the other sheet without the envelop and Drummond's determination slip is the isotype.

Ridley (1933) cited specimen *Anderson 160* from Sarawak as belonging to *M. reticulata*. However, this specimen has elliptic leaves with an unequal base and pyriform fruits with narrowed pseudostalk, and thus matches well with *Haviland 1685* belonging to *M. stylocarpoides* Burret, a species restricted to Sarawak and Kalimantan.

21. Microcos riparia (Boerl. & Koord.) Burret

Microcos riparia (Boerl. & Koord.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 795; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241. – *Grewia riparia* Boerl. & Koord. *in* Koorders-Schumacher, Syst. Verz. 2 (1911) 35. **Type:** *Koorders 10450b*, Sumatra (holo BO).

Microcos ovato-lanceolata Burret, Notizbl. Bot. Gart. Berl.-Dahl. 12 (1934) 163, ***syn. nov.***; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 358; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 2 (1997) 641. **Type:** *Hallier 1314*, Borneo, Kalimantan, Sungai Keniboeng (BO [3X]).

Distribution: Sumatra, Peninsular Malaysia (only recorded in Rompin FR, Pahang) and Borneo (confined to Sarawak and E Kalimantan, recorded in the area around Sungai Keniboeng, Sungai Kenepai, and Wanariset Research Institute).

Notes: Burret (1934) distinguished *Microcos ovato-lanceolata* from *M. riparia* solely by its lanceolate to ovate leaves with obtuse to rounded base (vs. broadly ovate with truncate base in *M. riparia*). Detailed study on the available specimens of both species showed that these distinguishing characters of the leaves intergrade. In addition, the fruits of the two species also possess many similar characters. In conclusion, *M. ovato-lanceolata* is here reduced to the synonymy of *M. riparia.*

Sterile specimens of *M. riparia*, especially those with small leaves, can be easily confused with *M. borneensis.* However, the latter can be distinguished by its glabrous older twigs and leaves, chartaceous leaves, and brown leaf colour when dried (see note under *M. borneensis*).

22. Microcos stylocarpoides Burret

Microcos stylocarpoides Burret, Notizbl. Bot. Gart. Berl.-Dahl. 12 (1934) 162; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1

(1990) 358; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 2 (1997) 641 [cited as (*Grewia?*) *Microcos stylocarpoides* Burret]. **Type:** *Hallier 756*, Borneo, Kalimantan, Soemedoene (holo BO).

Distribution: Endemic in Borneo (confined to Sarawak and Kalimantan).

Notes: *Microcos stylocarpoides* is closely related to *M. henrici* subsp. *acuta*. In both taxa the leaves are subcoriaceous, elliptic or obovate, and with flattened midrib and secondary veins above. In addition, the side axes of the inflorescences bear bracteole and peduncle scars, the lower part of the androgynophore is obovate in side view, and the style is sparsely stellate-hairy for at least a quarter of its length. *Microcos stylocarpoides* differs from *M. henrici* subsp. *acuta* mainly in having obovoid flower buds (vs. narrowly oblong), linear sepals (vs. oblong), subglobose or broadly ellipsoid ovary without ridges (vs. ellipsoid with 6 distinct and sharp ridges), and pyriform fruits without ridges (vs. ellipsoid or obovoid with 6 distinct ridges).

23. Microcos subcordifolia R.C.K.Chung

Microcos subcordifolia R.C.K.Chung, Kew Bull. 58 (2003) 339, fig. 4. **Type:** *Kirkup & Thomas DK 727*, Borneo, Brunei, Tutong, Lamunin, Kampung Menangah (holo KEP [barcode 77837]; iso BRUN, KEP [barcodes 77838–77840]).

Distribution: Endemic in Borneo (confined to Sarawak and Brunei).

24. Microcos subepetala Stapf *ex* Ridl.

Microcos subepetala Stapf *ex* Ridl., Bull. Misc. Inform., Kew (1938) 228; Masamune, En. Phan. Born. (1942) 450. **Type:** *Haviland 1885*, Borneo, Sarawak, Kuching (holo K).

Distribution: Endemic in Borneo (confined to Sarawak and Sabah).

Notes: The species is characterised by its glabrous twigs, conspicuously small elliptic or ovate leaves, glabrous and subcoriaceous leaves with hardly prominent venation, 4–6(–8) secondary veins, dense Type A or Type B panicles, and glabrous ovary. Specimens from Sarawak consistently have four pairs of secondary veins and pocket-type domatia, while those from Sabah have 4–8 pairs of secondary veins and domatia are absent.

The species is closely related to *M. antidesmifolia* var. *hirsuta* in leaf shape but can be distinguished by its subcoriaceous leaves with a pointed tip, densely flowered inflorescences, broadly obovoid flower buds, cup-shaped lower part of the androgynophore, and glabrous ovary.

25. Microcos sumatrana (Baker *f.*) Burret

Microcos sumatrana (Baker *f.*) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 783; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 358; Kessler *et al.*, Checkl. Tree Fl. Balikpapan-Samarinda Area (1992) 66. – *Grewia sumatrana* Baker *f.*, J. Bot. 62 (1924) 13. **Type:** *Forbes 2684*, S Sumatra, Palembang, Batoe Pantjeh, Moesi River (lecto L [no. 908.140.744], here designated; isolecto L [nos. 908.140.1824, 409657]).

Distribution: Sumatra and Borneo (Sarawak, Sabah, Brunei, and Kalimantan).

Notes: See note under *M. gracilis.*

26. Microcos tomentosa Sm.

Microcos tomentosa Sm. *in* Rees, Cycl. 23, 2, 46 (1813) 2; Jack *in* Hooker, Bot. Misc. 1, 3 (1830) 281, *t.* 60; Don, Gen. Hist. 1 (1831) 551; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 393; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Phengklai, Thai For. Bull., Bot. 16 (1986) 52, f. 23; Phengklai, Fl. Thailand 6, 1 (1993) 37, f. 23; Turner, Gard. Bull. Sing. 47 (1995) 487. – *Grewia paniculata* Roxb. *ex* DC., Prodr. 1 (1824) 510; Blume, Bijdr. Fl. Ned. Ind 3 (1825) 115; Roxburgh, Fl. Ind. ed. 1832, 2 (1832) 591; Miquel, Fl. Ind. Bat. 1, 2, 2 (1859) 203; Masters *in* Hooker *f.*, Fl. Brit. India 1, 2 (1874) 393 (*excl. Ins.* Philipp.); King, J. As. Soc. Beng. 60, 2 (1891) 110; Pierre, Fl. Forest. Cochinch. 11 (1888) *t.* 153; Gagnepain *in* Lecomte, Not. Syst. 1 (1909) 131 (*excl. Ins.* Philipp.), *in* M.H.Lecomte, Fl. Indo-Chine 1, 5 (1911) 544; Koorders, Exkurs.-Fl. Java 2 (1912) 577; Koorders & Valeton, Bijdr. Boomsoort. Java 1 (1894) 225, Atlas Baumart. Java 2, 8 (1914) figs. 393 & 394; Ridley, Fl. Malay Penins. 1 (1922) 300; Kochummen *in* Whitmore, Tree Fl. Malaya 2 (1973) 397; Whitmore & Tantra, Tree Fl. Indon., Checkl. Sumatra (1986) 241; Corner, Wayside Trees Malaya 3rd edition, 2 (1988) 734. **Type:** *Roxburgh s.n. in Herb. EIC 1097B*, buds & fl., Peninsular Malaysia, Penang (holo K-W, photo; iso BR [barcode BR-S.P. 817069], photocopy).
Grewia blumei Hassk. *in* Hoeven & de Vriese, Tijdschr. Nat. Geschied. 12

(1845) 130; Miquel, Fl. Ind. Bat. 1, 2, 2 (1859) 203. **Type:** *Teijsmann s.n.*, Java (*n.v.*).
Grewia cumingiana Turcz., Bull. Soc. Natural. Moscou 1854, 31, 1 (1858) 231. **Type:** *Cuming s.n.*, Peninsular Malaysia (B†).

Distribution: Myanmar (*fide* Phengklai 1993), S China (*fide* Phengklai 1993), Indo-China (*fide* Phengklai 1993), Thailand, Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, and the Philippines (*fide* Phengklai 1993). In Peninsular Malaysia, this species is common throughout except in the southern states.

Notes: *Microcos tomentosa* is a new record for Borneo with single collection from Kalimantan (*de Vriese 111* = L sheet nos. 899.300.63 & 899.300.64). It is closely related to *M. paniculata* in having peduncles, which arch out and droop, and in its curved-striate exocarp. However, the two species can be distinguished by characters of their leaves, flowers and fruits.

27. Microcos triflora (Blanco) R.C.K.Chung

Microcos triflora (Blanco) R.C.K.Chung, Kew Bull. 58 (2003) 346. – *Helianthemum triflorum* Blanco, Fl. Filip., ed. 2 (1845) 309, Fl. Filip., ed. 3, 2, 12/13 (1878) 208, *non Grewia triflora* (Bojer) Walp., Repert. Bot. Syst. 5, 1 (1845) 119; Merrill, Sp. Blancoan. (1918) 250. **Type:** *Sp. Blancoan. 864*, the Philippines, Luzon Laguna, Mt. Maquiling (neo US [barcode US 904559], "illustrative specimen" of Merr., Sp. Blancoan. (1918) 250, designated by Chung, 2003; isoneo L [no. 921.22.116], PNH†].
Grewia stylocarpa Warb. *in* Perkins, Fragm. Fl. Philipp. 1 (1904) 104; Gagnepain *in* Lecomte, Not. Syst. 1 (1909) 131; Merrill, Philipp. J. Sci. 1 (1906) Suppl. 90, Sp. Blancoan. (1918) 250, Enum. Philipp. Fl. Pl. 3, 1 (1923) 27; Anderson, Checkl. Trees Sarawak (1980) 338; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 447. – *Microcos stylocarpa* (Warb.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 780; Whitmore *et al.* (eds.), Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 358; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 324; Boer & Sosef *in* Sosef *et al.*, Pl. Resources of South-East Asia 5, 3 (1998) 381. **Syntypes:** *Warburg 11870*, the Philippines, N Luzon, Malunu (B†, PNH†); *Warburg 13072*, the Philippines, C Luzon, Tayabas, Sampaloc (B†, PNH†).

Distribution: Borneo, the Philippines and Sulawesi.

Notes: Two varieties are recognised in Borneo.

a. var. triflora

Distribution: Borneo (Sarawak, Sabah, Brunei, and Kalimantan), the Philippines and Sulawesi.

b. var. longipetiolata (Merr.) R.C.K.Chung

Microcos triflora (Blanco) R.C.K.Chung var. *longipetiolata* (Merr.) R.C.K.Chung, Kew Bull. 58 (2003) 347. – *Grewia stylocarpa* Warb. var. *longipetiolata* Merr., J. Str. Br. R. As. Soc. 76 (1917) 97; Merrill, J. Str. Br. Roy. As. Soc., Spec. No. (1921) 373; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 447. – *Microcos stylocarpa* (Warb.) Burret var. *longipetiolata* (Merr.) Burret, Notizbl. Bot. Gart. Berl.-Dahl. 9 (1926) 780; Merrill, Univ. Calif. Publ. Bot. 15 (1929) 186; Masamune, En. Phan. Born. (1942) 450. **Type:** *Villamil 243*, Borneo, Sabah, Kalabakan watershed (holo K; iso BO, SING, US).

Microcos havilandii Ridl., Bull. Misc. Inform., Kew (1938) 228; Masamune, En. Phan. Born. (1942) 450. **Type:** *Haviland 2332*, Borneo, Sarawak, Kapit, Rejang (A, K, SAR, SING).

Distribution: Endemic in Borneo (Sarawak, Sabah and Brunei).

Excluded species

Microcos longipetiolata Kosterm., Reinwardtia 6, 3 (1962) 301. **Type:** *Meyer SAN 19494* (holo K; iso SAN), Borneo, Sabah, Tawau, Tawau FR = *Scaphium longipetiolatum* (Kosterm.) Kosterm. (Sterculiaceae). See: Kostermans, Bull. Bot. Surv. India 7 (1965) 128.

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Identification list

The number after the collector numbers refers to the following *Microcos* taxa. When the number of the collection is not available or unknown then the dates or sheet numbers are mentioned between brackets.

1 = *M. antidesmifolia* var. *hirsuta*
2 = *M. borneensis*
3 = *M. cinnamomifolia*
4 = *M. crassifolia*
5 = *M. dulitensis*
6 = *M. fibrocarpa*
7 = *M. gracilis*
8 = *M. henrici* subsp. *acuta*
9 = *M. hirsuta*
10 = *M. kinabaluensis*
11 = *M. latifolia*
12 = *M. latistipulata* var. *latistipulata*
13 = *M. laurifolia*
14 = *M. membranifolia*
15 = *M. opaca*
16 = *M. ossea*
17 = *M. pachyphylla*
18 = *M. pearsonii*
19 = *M. phaneroneura*
20 = *M. reticulata*
21 = *M. riparia*
22 = *M. stylocarpoides*
23 = *M. subcordifolia*
24 = *M. subepetala*
25 = *M. sumatrana*
26 = *M. tomentosa*
27a = *M. triflora* var. *triflora*
27b = *M. triflora* var. *longipetiolata*

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Wilkie 9544: 9 – Winkler 735: 8 – Wong SAN 68153: 12; SAN 68160: 4; WKM 379: 16; WKM 704: 19; WKM 1244: 27b; WKM 1290: 16; WKM 1544: 9; WKM 1545: 11; WKM 1564: 7; WKM 1947: 1; *s.n.* (03/10/1988): 3 – Wood 1216: 18; 1281: 18; 1989: 17; 2273: 27a; SAN 15063: 3; SAN 15174: 3; SAN 15278: 17; SAN 16126: 1; SAN A 1980: 1; SAN A 1992: 3; SAN A 2913: 9; SAN A 3682: 1; SAN A 3963: 27a; SAN A 4047: 27a; SAN A 4709: 14; SAN A 4723: 20; SAN A 4730: 12; SAN A 4788: 20; SAN A 4840: 1 – Wood

1216: 18 – Wood & Charington SAN 16511: 27a – Wood & Kadir SAN 17212: 27a – Wood & Kapis SAN 16928: 3 – Wood & Wyatt-Smith SAN A 4290: 12 – Wright S 23891: 19; S 27985: 6; S 29113: 18.

Yahud *et al.* S 61960: 1; S 82558: 2 – Yap SAN A 716: 12 – Yii S 37887: 9; S 41139: 15; S 42004: 16; S 45938: 16; S 55824: 27a; S 61492: 14 – Yii & Alex S 66403: 16 – Yii & Shalih S 64337: 16 – Yii *et al.* S 37752: 7; S 49164: 27a.

Zain SAN 61339: 27a; SAN 64703: 27a.

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The accepted names are in roman type, the synonymy and excluded names in *italics*. The numbers after the names refer to the numbered species in this synopsis; (gen) = taxa listed under the generic synonyms; (ag) = accepted taxa listed under the genus; (x) = excluded taxa.

A Correction: *Begonia nubicola* Kiew (Begoniaceae) is renamed *B. oreophila* Kiew

RUTH KIEW

The Singapore Botanic Gardens,
Singapore 259569

The Cloud Begonia, *Begonia nubicola* Kiew, is a unique begonia in Peninsular Malaysia in that it lives on a dry coastal hill on boulders at the headwaters of intermittent streams at the exact elevation where the cloud cap forms on most mornings. Hence, 'nubicola' (cloud-dwelling) is a most apposite name. Unfortunately, this name was already used for a Venezuelan begonia (L.B. Smith & B.G. Schubert, Mem. New York Bot. Gard., 9 (1957) 354) so that *B. nubicola* Kiew is a later homonym. It is here proposed to rename this species, *B. oreophila* Kiew as follows:

Begonia oreophila Kiew, *nom. nov.*
Begonia nubicola Kiew, Begonias of Peninsular Malaysia. (2005) 275 *non* L.B. Smith & B.G. Schubert (1957).
Type: *Kiew RK 5091*, 31 Aug 2000, Bukit Labohan, Trengganu (holo SING; iso K, KEP).

Two New Species Resembling *Bulbophyllum plumatum* Ames and *B. mirum* J.J. Sm. (Orchidaceae)

J.J. VERMEULEN

Singapore Botanic Gardens
Singapore 259569

AND

P. O'BYRNE

14 Clementi Crescent
Singapore 599517

Abstract

Two new species of *Bulbophyllum* (Orchidaceae) are described, both similar to *B. plumatum* Ames and B. *mirum* J.J. Sm. *Bulbophyllum scotinochiton* J.J.Verm. & P. O'Byrne is from Sumatra, Indonesia; *B. thiurum* J.J.Verm. & P. O'Byrne is from Johore, Peninsular Malaysia. Pictures of all four species are given.

Introduction

Bulbophyllum scotinochiton, described below, has been available in trade for several years now, usually under the name *Bulbophyllum mirum* J.J. Sm. Recently, the provenance of *B. scotinochiton* has become known, adding to our knowledge about this species. It can now be formally described. The Sumatran forests that appear to have yielded *B. scotinochiton* are quickly disappearing. Besides illegal logging, the thick peat on the forest floor is collected on a large scale to be used as garden mulch in nearby towns. The collectors take care to hide their activities by leaving untouched a strip of forest bordering the road. Elsewhere, large tracts of forest are slowly dying because the canopy trees have lost their foothold.

The second species, *B. thiurum*, is said to occur in the Endau Rompin State Park in the Johore lowlands, Malaysia. Locally, it has been traded as 'the yellow *B. plumatum*', but very recently plants have also appeared on the European market. Rumours suggest that, regrettably, the population is already depleted.

Bulbophyllum scotinochiton J.J. Verm. & P. O'Byrne, *sp. nov.* - Plate 1.2
Bulbophyllum scotinochiton J.J. Verm. & P. O'Byrne, a *Bulbophyllo miro* inflorescentia uniflora, floribus *c.* duplo majore (*c.* 5 cm longis) differt. -

TYPE: Indonesia, Sumatra, Lake Toba area, *SBG-O 0921* (SING, holo.).

Roots below the pseudobulbs. *Rhizome* creeping, *c.* 2.5 mm diam., sections between pseudobulbs 2.5–3 cm long, bracts soon rotting away. *Pseudobulbs* distant, ovoid, 1.3–1.5 x 0.7– 1.1 cm, distinctly and rather sharply 4-angled. *Petiole* 0.3–0.4 cm long. *Leaf blade* elliptic to ovate, 3.8–4.5 x 2.1–2.4 cm, index (length/width) 1.5–2.2; subacute. *Inflorescence* porrect to patent, c. 10 cm long, 1-flowered. *Peduncle c.* 5 cm, bracts *c.* 4, the longest *c.* 10 mm long. *Floral bracts c.* 5 mm long, acute. *Flowers* not fully opening. *Pedicel* and *ovary c.* 10 mm long, basal node ± flush with the surface of the rhachis. *Median sepal* ± porrect, ovate, *c.* 19 x 12 mm, index 1.5–1.6; top acute, margins entire, base narrowly attached, rather thin, glabrous. *Lateral sepals* adnate along the upper margins in the top half of the sepal, each oblique, more or less elliptic, *c.* 50 x 10 mm, index *c.* 5, top obtuse, base narrowly attached; adaxially glabrous, abaxially finely papillose; otherwise as the median sepal. *Petals* porrect, transversely elliptic, *c.* 1.3 x 2.7 mm, index 0.4–0.5; rounded, top margin reflexed, entire, with *c.* 12 appendages, base broadly attached; very thick, surface glabrous; appendages mobile, more or less elliptic, up to 5.5 x 1 mm, subacute, margins slightly erose, base very narrowly attached; thin, glabrous. *Lip* recurved about half way, general outline subtriangular, *c.* 3.3 x 2.2 mm, index *c.* 1.5 (all without artificial spreading); obtuse, margins entire; very thick, glabrous; adaxially more or less flat near the base, with 2 more or less parallel, inconspicuous, low, rounded ridges about half-way up the length of the lip, surface convex towards the tip; abaxially with a distinct, retuse ridge over most of the length of the lip. *Column c.* 3.2 mm long, stigma without ridges inside, with 2 distinct, longitudinal, short, rounded teeth at its base, column foot without teeth. *Stelidia c.* 1 mm long, triangular, acute, with a small, triangular, obtuse tooth along the upper margin and a distinct, deltoid, obtuse wing along the lower margin. *Anther* abaxially with a distinct crest near the attachment and a distinct, transverse crest overtopping the front margin, surface somewhat papillose, front margin drawn out, truncate, entire. *Pollinia* 4, the inner ± as long as the outer, drop-shaped, the outer ellipsoid-ovoid; no appendages present.

Colour: Median sepal white, slightly greenish in centre, with large blackish purple spots and blackish purple margins. Lateral sepals white near the base, but suffused with purple towards the tip, tip itself blackish purple; lateral sepals entirely covered with small purple spots. Petal appendages pinkish purple towards the base, white at the tip. Lip pale greenish, purple near the base. Column pale greenish.

Habitat: Understorey epiphyte in mossy montane forest dominated by oaks. Altitude *c.* 1500 m.

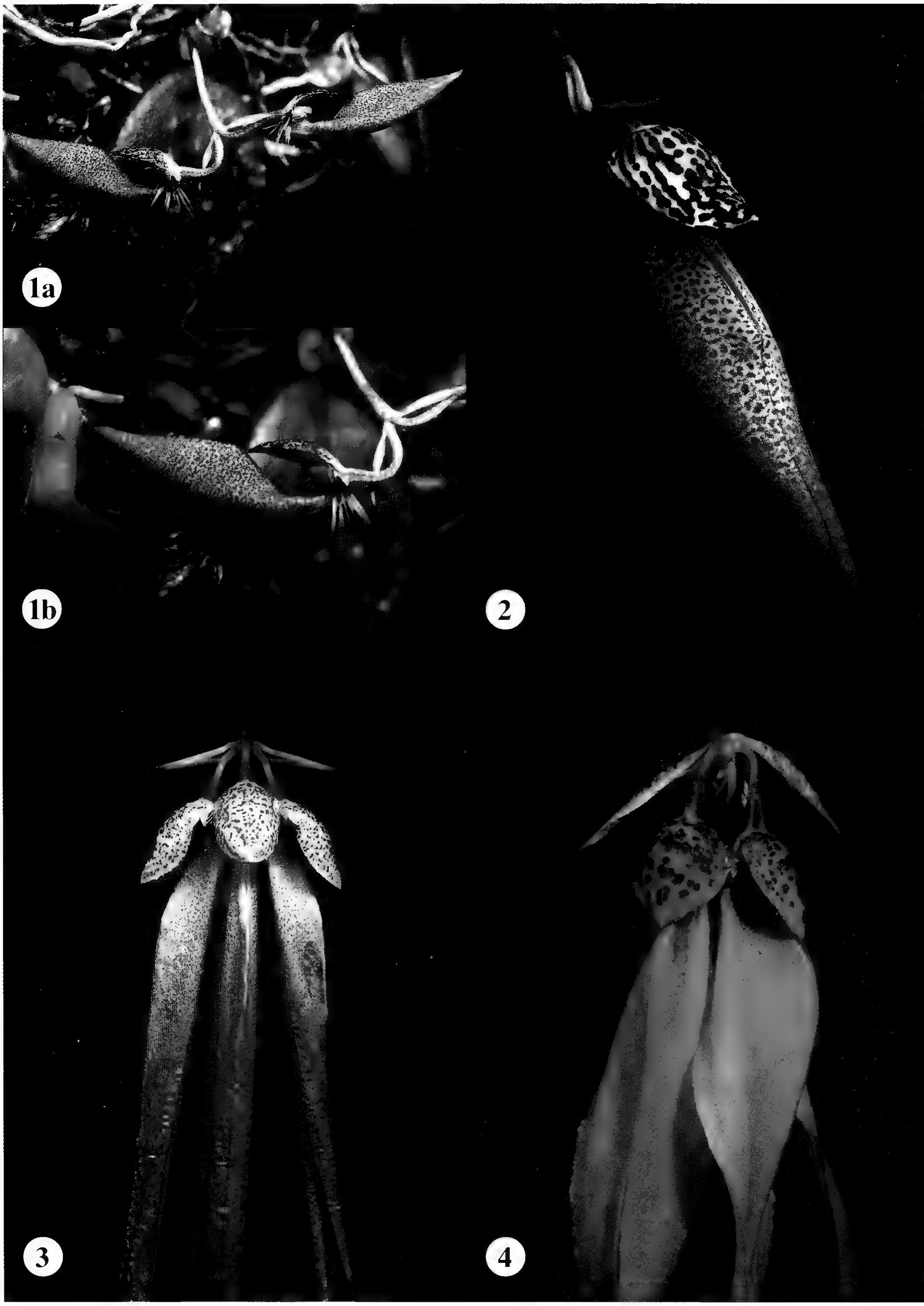

Plate 1. Four *Bulbophyllum* species.
1a, b. *Bulbophyllum mirum* J.J. Sm. (*SBG-O 4762)*; 2. *Bulbophyllum scotinochiton* J.J. Verm. & P.O'Byrne (*SBG-O 0921*); 3. *Bulbophyllum plumatum* Ames (*SBG-O 5395*); 4. *Bulbophyllum thiurum* J.J. Verm. & P.O'Byrne (*SBG-O 5395*). *Photos* : *J.J. Vermeulen*

Distribution: INDONESIA: Sumatra, Lake Toba area (2 specimens seen).

Notes: *Bulbophyllum scotinochiton* is most similar to *B. mirum* J.J.Sm. It differs in always having 1-flowered inflorescences and distinctly larger flowers: median sepal *c.* 19 mm long (6–8 mm in *B. mirum*); lateral sepals *c.* 50 mm long (20–26 mm in *B. mirum*). The petals and the lip, however, are about the same size in both species. The information on *B. mirum* was compiled from specimens from Indonesia (Java), and Malaysia (Peninsula and Sabah); *B. scotinochiton* clearly falls outside the size range of *B. mirum*. Additional differences between the two may be found in the more distinct, deltoid wing along the lower margin of the stelidia, as well as the somewhat wider appendages on the petals in *B. scotinochiton* (*c.* 1 mm wide; *c.* 0.5 mm wide in *B. mirum*).

Bulbophyllum thiurum J.J. Verm. & P. O'Byrne, *sp. nov.* — Plate 1.4
Bulbophyllum thiurum J.J. Verm. & P. O'Byrne, a *Bulbophyllo plumato* sepalis lateralibus basi ovatis apicibus longe attenuates differt. – TYPE: Malaysia, Johore, *SBG-O 5395* (SING, holo.).

Roots below the pseudobulbs. *Rhizome* creeping, *c.* 1.5 mm diam., sections between pseudobulbs 1.2–2.3 cm long, bracts little persistent. *Pseudobulbs* distant, ovoid, 1.6–2.3 x 0.7–0.9 cm, obtusely 3–4-angled. *Petiole* 0.3–0.7 cm long. *Leaf blade* elliptic to ovate, 5.2–8.5 x 2.1–2.6 cm, index (length/width) 2.5–3.4; obtuse. *Inflorescence* a subumbellate raceme, *c.* 20 cm long, 3–4-flowered. *Peduncle c.* 10 cm, bracts *c.* 5, the longest *c.* 9.5 mm long. *Rhachis* nodding, somewhat thickened, *c.* 1.2 mm long. *Floral bracts c.* 7–8 mm long, acute. *Flowers* not fully opening. *Pedicel* and *ovary c.* 5.5 mm long, basal node on a *c.* 0.5 mm-long thickened stump. *Median sepal* ± porrect, more or less orbicular, *c.* 6 x 6 mm, index *c.* 1; top shortly acuminate, margins entire, base narrowly attached, rather thick, glabrous. *Lateral sepals* proximally adnate along the upper (for 1 cm starting 0.5 cm from its base) and lower (for 1 cm, starting at the base) margin, each oblique, ovate at the base, with a long drawn-out top part, *c.* 94 x 6.5 mm, index 14–15, tip acute, base narrowly clawed; thin, glabrous; otherwise as the median sepal. *Petals* porrect, more or less elliptic, *c.* 1.7 x 1.3 mm, index 1.3–1.4; rounded, entire, with *c.* 36 appendages, base rather broadly attached; thick, surface glabrous; appendages somewhat mobile, ellipsoid-obovoid, up to *c.* 1 x 0.2–0.3 mm, tip obtuse, base tapering into a stalk of 1–1.5 mm, surface consisting of large vesicles which become more elongate, almost hair-like, towards the tip of the appendage. *Lip* recurved about half way, general outline subtriangular, *c.* 1.7 x 1.2 mm, index *c.* 1.4 (all without artificial spreading); obtuse, margins entire; thick; adaxially about flat near the base, with 2 about parallel, inconspicuous, low, rounded ridges about half-way up the length of the lip, surface convex towards the tip, adaxial surface finely and shortly pubescent; abaxially with a rather distinct, retuse ridge over most of the length of the lip, surface glabrous. *Column c.* 1.7 mm long, stigma without ridges inside, with 2 starting along its sides, converging towards its base and continuing on to the column foot, column foot without teeth. *Stelidia c.* 0.5 mm long, triangular, acute, upper margin erose, lower margin with a distinct, deltoid, obtuse wing. *Anther* abaxially with an inconspicuous crest, surface somewhat papillose, front margin drawn out, truncate, entire. *Pollinia* 4, the inner slightly shorter than the outer, all drop-shaped; no appendages present.

Colour: Flowers lemon yellow; median sepal with reddish spots, lateral sepals with a patch of fine specks near the base, petals with pinkish appendages. No scent.

Habitat: Epiphyte in lowland swamp forest.

Distribution: MALAYSIA: Johore (1 specimen seen); according to local nurserymen a population occurs in the Endau Rompin State Park area.

Notes: *Bulbophyllum plumatum* Ames is most similar. *B. thiurum* differs in having the lateral sepals fused close to their base only, and along the upper as well as the lower margins. In *B. plumatum*, these are fused over a considerable part of their length, but along the upper margin only. The shape of the lateral sepals is also different: wide and ovate in *B. thiurum*, tapering into a caudate top part; but strap-shaped and barely widened near their base in *B. plumatum*. Besides the appendages on the petals, *B. thiurum* has almost hair-like vesicles near the top; in *B. plumatum* all vesicles, up to the tip of the appendage, are rounded.

Book review: John Elliott. 2005 **Orchid Hybrids of Singapore 1893-2003**. The Orchid Society of South East Asia, Singapore. ISBN 981 05 1752 1. Price: Singapore dollars $120 (about £40 British pounds)
Orders to ossea@pacific.net.sg

Three hundred and four pages in hardback with stunning, glossy, pictorial dust jacket, containing text written with eloquence and flair; 750 beautifully rendered colour photographs with brief and elegant annotated descriptions of 2,100 orchid hybrids raised in Singapore. Wow! This is a landmark book, not only in tracing the history of orchid breeding in Singapore, the history of the Orchid Society of South East Asia through 77 often turbulent years and the rise of the orchid cut-flower trade, but also (and especially) for recording and documenting these hybrids with the fascinating minutiae of their disputed parentages, their raisers and whom they were named after.

If I may begin at the end; the genius is in the index where the orchids are listed in alphabetical order of the hybrid (grex) name. This a real bonus at a time when the names of genera and hybrid genera are in the process of being changed more frequently than a butterfly flaps its wings. The new names given to the hybrid genera containing *Paraphalaenopsis* have not been accepted, and the old names that commemorate famous names in the history of Singapore's orchid history have been retained. John Elliott cogently argues the case for a reversal of the International Orchid Registrar's recent name changes which may become even more confusing to ordinary growers when the status of *Euanthe*, *Papilionanthe*, *Ascocenda* etc., are revised in the next edition of *Genera Orchidacearum*.

The glory is in the main text, where the hybrids are listed, illustrated and described by genus, in chronological order of registration so one may the more easily see the changes in breeding over the years since Vanda Miss Joaquim was registered in 1893. Information, information, information is the joy of the reviewer. While it is a magnificent 'coffee-table book' it is so full of information, from the origins of Vanda Miss Joaquim (was it an artificial or a natural hybrid?) to the recording of great dedication (Christiera Ramiah commemorates a gardener, Muthiya Pillai Ramiah who worked for 50 years in the Singapore Botanic Gardens' nursery) that every page is worth reading as well as admiring.

There are biographical vignettes of the great Singapore orchidists of the past - Holttum, Galistan and Laycock and we are introduced to the orchidists of today: Dr Tan Wee Kiat VMH (Victoria Medal of Honour of the Royal Horticultural Society, Gold Medallist of the American Orchid Society); Tan Jiew Hoe (generous sponsor of this book, son of Tan Hoon

Siang past-President of OSSEA and raiser of Vanda Tan Chay Yan 'Pride of Singapore' FCC/RHS); Peggy Tan (Vice-President of OSSSEA) who designed it and who with Wendy Chew compiled pictures and information; Syed Yusof Alsagoff (past President of OSSEA; raiser of 154 hybrids including the only FCC ever awarded by OSSEA, and the inspiration behind this book); Dr Yam Tim Wing (Senior Researcher, Orchid Breeding) Singapore Botanic Gardens, who carries on the Gardens' long tradition of orchid breeding) - but one can, as the author notes, only list a few.

What a galaxy of talent must exist in Singapore to produce such beautiful hybrids, and such a book! I loved it. Buy it. Treasure it. Imitate it (if you can).

Henry Oakeley
Chairman
Royal Horticultural Orchid Committee
Wisley, U.K.

Book review: Duistermaat, H. 2005. **Field Guide to the Grasses of Singapore (Excluding the Bamboos).** Gardens' Bulletin Singapore, Suppl. **57**: 1–177, illus. ISSN 0374-7859, SING$ 30 (inclusive of p&p) from The Library, Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569.

The grasses are economically the most important family of flowering plants in the world. It is therefore a pity that recent Malesian taxonomists take so little interest in them (except for some students of bamboos). The publication of this Guide is therefore a great occasion for the area. About 700 herbaceous grasses have been reported for Malesia, so the 134 treated here may seem comparatively few, but because many of these have a very wide distribution, the Guide therefore has a much wider application than to the tiny island of Singapore alone.

The introduction is well-illustrated and the keys seem to work well. Turf grasses generally do not get the chance to flower, so identification with the usual keys is impossible. A novelty here is a key based on vegetative characters. Another more extensive key to all species in the Guide based on vegetative characters given at the end is also something new. The argument for these two keys is that neglected lawns are invaded by other species.

The genera and species are arranged alphabetically by their scientific names. Usually a very brief synonymy is given, but the descriptions are extensive and analytical. The first occurrence is noted. It is remarkable that, although collecting in Singapore started in the early 19th century, many 'firsts' are from the end of that period or early 20th century. The difference in time may be that the older collections are not present in The Singapore Herbarium (SING) and the Herbarium of the National University of Singapore (SINU) on which this treatment was mainly based. This reminds me of a report (perhaps a reader can tell me who published it and where?) that the 19th century British colonial army had no hay and straw for their horses so it was imported from Burma, whereby most of the species now widespread in the Malay Peninsula were introduced at that time.

Of great advantage are the numerous figures of the spikelets, where the glumes have been shaded for better contrast. They were prepared by J.J. Vermeulen, otherwise known for his taxonomic studies and marvellous drawings in orchidology and malacology. He also made some of the excellent colour photographs.

These, together with the careful introduction and the various keys, make the excuse that grasses are 'difficult' a rather lame one.

The common weed *Eragrostis cumingii* has been reduced to *E. brownii*. I can well understand that, for in the herbarium the differences are slight and cumbersome: mainly in the basal branching system, which often is lacking, size of the anthers, and the colour of the caryopsis. Apparently in the field there are no supporting habitual characters. Current studies indicate that the correct name for what I and others previously have called *E. amabilis* is *E. tenella* after all (Veldkamp, unpublished). Figures 60 and 63 of *E. atrovirens* and *E. gangetica* are misleading, as only one or no glumes at all are depicted. In Figure 66 the fine sculpture of the lemmas of *E. unioloides* should have been accentuated whereby the species is immediately distinct from all others and especially from *E. montana* (which, as is shown, subtly differs by the shape of the glumes and lemmas, too, for the cognoscendi).

There is a challenge to experimenters with the diaspores of *Mnesithea glandulosa* and *Rottboellia cochinchinensis*: the joints of the fragile racemes have a knob at the base, which is an elaiosome and attracts ants: do they carry them off? Contrary to the remark here (p. 90), Beumee [Handl. 4e Congr. Ned.-Indie Nat. Wet. (1927) 419] already reported it for both.

Other ant plants may be the bottle-brush species of *Setaria*. Harvester ants (*Camponotus* spp.) cut up the inflorescences and take the spikelets to their lairs as I observed with *S. italica* here in Europe. Collect both ants and grass!

It might be noted that *Panicum maximum*, according to recent studies, is actually a *Urochloa* with the first record for Singapore by Hullett, 27 Jan 1894.

J.F. Veldkamp
National Herbarium of the Netherlands
University of Leiden Branch
The Netherlands

Book review: Rui-Liang Zhu and May-Ling So. 2001. **Epiphyllous Liverworts of China.** Nova Hedwigia Beiheft 121. 2001. 418 pp. + 140 figures and 5 tables. J. Cramer. Berlin/Stuttgart. ISBN 3-443-51043-4 (Paper).

This is a very well written and fully illustrated flora of epiphyllous liverworts found in China. A total of 168 epiphyllous species belonging to 28 genera in 10 families are recognized, described, and illustrated. Of these, 43 species are obligate epiphyllous liverworts, with the rest either as accidental or facultative epiphyllous taxa. For each species, the distribution inside China and their worldwide range are enumerated. Dichotomous keys to the families, genera and species are presented. Two new species and one new variety, and full synonymy for each taxon, of which 10 are new synonyms, are proposed. The volume also contains several nomenclatural changes and new lectotypifications. A glossary and index to scientific names help a great deal in understanding the technical terms and in accessing the rich information provided by this well-done revision.

Undoubtedly, the presence of epiphyllous liverworts forms one interesting and unique visual phenomenon of the wet tropical rain forest. Biologically speaking, this group of tiny plants and their adaptations to grow on the wet surface of leaves of numerous plants has been a challenging area of investigation for more than a century. Although many of the species of hepatic epiphyllae are not a natural group from the phylogenetic point of view, nevertheless, their repeated occurrence across the wide tropical rainforest belt represent a remarkable convergent pattern of evolution. As such, the reader is recommended to be educated first on this topic by reading carefully the introductory discussion of the morphological characteristics of epiphyllous liverworts and their adaptations to the phyllosphere, as well as the summary on the ecology and distribution of epiphyllous liverworts, found on pages 9–30, before attempting to use the volume for any taxonomic identification.

Although the epiphyllous liverwort flora described in this volume is based on the Chinese materials, more than a hundred of the species recognized are, however, widespread in E and SE Asia. As such, the flora is an up-to-date reference and useful guide to the study of epiphyllous liverworts in Malesia, including Singapore.

In using the volume to key out some of my epiphyllous liverworts collected from Nee Soon Swamp in Singapore, I have found the species description too lengthy and the many measurements of leaf sizes and leaf cells too detailed to be of great help to the reader who often needs to decide on a species determination under time pressure. In the end, I have resorted many times to base my conclusion about the species identity on the short paragraphs of taxonomic synopsis and the diagnostic comments that are concisely and sufficiently written for each taxon. Having said this, the excellent and accurately executed line drawings of the species are very useful in illustrating the species concept, especially for beginners.

My other enquiry pertains to the five centres of occurrence of epiphyllous liverworts in China, presumably, these are the local areas with high species number and diversity of epiphyllous liverworts. They are identified as (1) Hainan, (2) Taiwan, (3) southwestern Zhejiang and northern Fujian, (4) southern Yunnan, and (5) northwestern Yunnan and southeastern Xizang. An oversight in this part of the discussion lies in the failure of the authors to indicate the exact number of epiphyllous taxa reported from each of the five centres. Instead, the richness of the taxa for the five centres is represented in the map (Fig. 10) by the proportional length of bars. It becomes difficult to estimate, by visual judgment of the comparative length of the five bars, the differences in the number of taxa, say between Centre 1 & 2 or Centre 2 & 3. Additionally, my own limited experience with the study of tropical mosses in China has called my attention to the richness of tropical bryophytes in Guangdong Province. Does the omission of a Guangdong Centre represent a reality or an artifact of under-collecting of epiphyllous liverworts in this province?

In collaboration with outsiders, resident Chinese plant taxonomists have in recent years published many excellent floristic revisions and modern systematic monographs that have shown the world the great diversity and richness of their indigenous flora. This volume adds more evidence to this fact by revealing convincingly the little known and yet very diverse world of epiphyllous liverworts that exists in the wet tropical forests in China. Workers in E and SE Asia can only thank the two authors for rendering a great service in producing such a magnificent piece of summary work based on their many years of hard work in the field and careful observation of minute taxonomic characters under the microscope for each of the species described. A copy of this supplement volume of the journal *Nova Hedwigia* is a must for libraries specializing on tropical botanical literature.

Benito C. Tan
Department of Biological Sciences
National University of Singapore
Singapore

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The Gardens' Bulletin publishes original research findings and reviews of progress in the fields of plant taxonomy, horticulture and allied subjects. Contributions must be original and the material must not have been submitted for publication elsewhere.

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Stone, B.C. 1994. Additional notes on the genus *Glycosmis* (Rutaceae). *Gardens' Bulletin Singapore*. **46**: 113-119.

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Ridley, H.N. 1930. *The Dispersal of Plants Throughout the World*. L. Reeve, Ashford, U.K.

For literature citations in taxonomic papers, the following style is required:

Medinilla alternifolia Blume, Mus. Bot. Ludg.-Bat. I:1 (1849) 19.
Sterculia acuminatissima Merr., Philip. J. Sci. 21 (1922) 524.

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A New Bornean *Paraboea* (Gesneriaceae) Species Endemic to Niah National Park, Sarawak and Further Plant Records from Niah

KATHARINE G. PEARCE

32 Lorong Kumpang 4
93200 Kuching, Sarawak, Malaysia

Abstract

Paraboea culminicola K.G. Pearce, endemic to the Subis limestone at Niah, was first collected in 1932 and subsequently in 1961, 1962 and 2002. The species is described and illustrated. In addition, a list is provided of 357 taxa (356 species) from Niah represented by specimens in the herbarium of the Sarawak Forestry Corporation (SAR), bringing the total number of taxa recorded for Niah National Park to *c.* 550 and the total number for the Park and its vicinity to *c.* 700; the total number of taxa associated with limestone at Niah to 281; and the total of Borneo endemics found in the Park to 19 taxa.

Introduction

Paraboea in Borneo is currently represented by 14 described species. All but one (*P. paraboeoides* (Kranzlin) B.L.Burtt) are found on limestone and typically the species have restricted distributions, are described from a single or few collections and from remote locations (Burtt, 1984; Xu & Burtt, 1991).

In limestone locations in Sarawak for which data are available, more than one *Paraboea* species co-exist on the same hill (west Sarawak with *P. clarkei* B.L.Burtt and *P. havilandii* (Ridl.) B.L.Burtt (Kiew *et al.* 2004) and Mulu with *P. banyengiana* B.L.Burtt, *P. candidissima* B.L.Burtt, *P. effusa* B.L.Burtt and *P. meiophylla* B.L.Burtt (Burtt, 1982) and now on the Niah limestone with *P. speluncarum* B.L.Burtt (Burtt, 1971) and the new species, *P. culminicola* K.G.Pearce, here described.

In preparation of the checklist of plants from the Niah National Park, (Pearce, 2004), based on botanical field investigations and examination of herbarium specimens carried out as part of the Sarawak Forest Department/DANIDA Project 'Support to Wild Life Master Plan Implementation through the Improved Management of Totally Protected Areas in Sarawak, Malaysia', a re-examination of the *Paraboea* specimens showed that one specimen from near the summit of Bukit Kasut did not conform to any species yet described from Sarawak. It was neither *P. speluncarum*, which is endemic to the Park, nor did it fit the description for *P. treubii* H.O. Forbes as suggested by Burtt (1971). This prompted a further look at other Niah *Paraboea* specimens in SAR with the conclusion that it is a distinct new species, here described as *P. culminicola*.

The Niah National Park includes the striking Gunung Subis limestone massif that reaches 394 m elevation and Bukit Kasut, a smaller limestone hill 220 m high. The Great Cave, world famous for its edible birds nests and prehistoric remains, and sometimes called 'Niah Caves' on herbarium labels, is located in the northern part of the Gunung Subis massif.

This new species was first collected in 1932 (*Synge 589*) and subsequently in 1961 (*Anderson S16045*) and 1962 (*Burtt & Woods B2023*). In 1971, Burtt described *Paraboea speluncarum* (then placed in the genus *Boea*) from Niah Caves. In the same paper he mentioned *Paraboea treubii* (H.O.Forbes) B.L.Burtt originally described from Karangnata, Sumatra (Forbes, 1882) ascribing it to the three specimens from 'Niah Caves' and Gunong Subis, together with *Henderson SFN 19459*, a specimen from Gua Tipus, Pahang, Peninsular Malaysia. At the time, Burtt considered that *Boea havilandii* (a monocarpic species from west Sarawak) 'may well be' a synonym of *B. treubii* as he then understood it, although he noted that *B. havilandii* differed in 'detail of indumentum and nervature on the underside of the leaf'.

In 1982, Burtt described four new species of *Paraboea* from Gunung Mulu National Park, Sarawak (*P. banyengiana*, *P. candidissima, P. effusa and P. meiophylla*). Burtt noted that *P. effusa is* 'similar to *P. treubii* (H.O. Forbes) B.L.Burtt but differs from this in its habit, which is not monocarpic, and its glabrous sepals'. In 1984, Burtt published revised generic concepts for *Boea* Lam and its allies, citing additional specimens from Gua Musang, Kelantan for *P treubii.*

In 1991, Xu and Burtt described a new species, *P. nervosissima*, from Peninsular Malaysia, based on specimens from Gua Tipus and Gua Musang. Kelantan. However, they made no mention of the Niah specimens. This left the three Niah specimens (*Synge 589*, *Anderson S 16045* and *Burtt & Woods B 2023*) doubtfully as *P. treubii*. A further Niah specimen deposited at SAR (*Sonny Tan & E. Wright S 27279*) and a DANIDA SWMPI Project plot specimen from the summit of Bukit Kasut, Niah National Park, also represent this taxon.

This new species differs from *Paraboea havilandii* in the felty rather than woolly tomentum covering the leaf undersurface, the shorter petiole (3–6 mm long not 7–10 mm long), the greater number of pairs of leaf veins (> 30 not 15–16 pairs) and more elongate calyx (> 3 times rather than 2 times as long as wide at the midpoint) and shorter fruit (inclusive of persistent style 1.5–2 cm, not 3.5 cm long). The new species differs from *P.*

effusa in its greater number of veins (> 30 pairs rather than 12–21 pairs), relatively narrower calyx lobes (3–5 times rather than up to 2.5 times as long as wide at the midpoint) and shorter fruit (1.5–2 cm, not 2.8 cm long). It is therefore a distinct new species and is described below.

Paraboea culminicola K.G.Pearce, **sp. nov.**

Paraboea culminicola K.G.Pearce, *sp. nov.* a *P. havilandii* (Ridl.) B.L.Burtt et *P. effusa* B.L.Burtt nervis foliorum magis numerosis (>30-jugis non 12–21) et fructibus brevioribus (1.5–2 cm non 2.8–3.5 cm) distincta et etiam a *P. culminicola* petiolis brevioribus (3–6 mm longis non 7–10 mm) differt. **Typus:** Southern slopes of Gunong Subis, near Sekaloh river; Miri District; Fourth Division *Sonny Tan & E. Wright S 27279* (holo SAR).

Unbranched herb, 75–120 cm tall. *Stem* woody, with or without shrivelled remains of dead leaves persisting below, with close, felty indumentum of matted hairs. Young parts with a network of fine, cobwebby white hairs, eventually lost. *Leaves* in whorls of 4; petiole winged, to 7–10 mm long; blade discolorous, adaxial surface reddish grey-brown, with fine, cobwebby white hairs eventually lost (barely visible at 10x magnification, thickly scattered globose, glistening (apparently) glandular hairs), abaxial surface with a pale cinnamon-brown, close, thin felty, persistent indumentum, oblanceolate, somewhat falcate, 25–30 x 5.5–6 cm, base with wings decurrent on the petiole, margin entire to obscurely dentate, veins *c.* 35 pairs, prominent below. *Inflorescence* a terminal panicle, its branches subtended by more or less sessile foliose bracts, axes tomentose as the stem, lowest branches 20–40 cm long, *flowers* with pedicel to 2.2 cm long, calyx 2–5.5 mm long, split almost to the base, lobes narrowly triangular, 3–5 or more times as long as the width at the midpoint, apices incurved, corolla in life pinkish cream or very pale blue, tube *c.* 2 mm long, the two posterior lobes *c.* 8 x 6 mm divided by a 2 mm-long sinus, the anterior lip *c.* 1.1 cm long, trilobed, median lobe 6 x 6 mm; stamens arising at the mouth of the tube, filaments *c.* 3 x 0.5 mm, flat, anthers transverse, cohering face to face, 4 x 2.5 mm, beaked; ovary *c.* 1.5 mm, glabrous, narrowed to a glabrous style 3.5–6 mm long. *Fruit* a capsule to 2 cm long, glabrous, spirally twisted.

Distribution: Borneo – SARAWAK: endemic to the Subis limestone

Habitat: On bare, exposed limestone rocks or on mor soil at or near the summit of limestone hills or pinnacles at 120–220 m altitude.

Notes: Paraboea culminicola is named for its habitat (at or near summits) and to contrast its habitat as one of a pair of *Paraboea* species endemic to Niah, the other being *P. speluncarum.* It would not be confused with *P. speluncarum*, which has leaves with *c.* 20 pairs of veins, which tend to be obscured by a thick woolly indumentum on the abaxial leaf surface.

Other specimens examined:
SARAWAK: Miri District, Niah National Park - *Anderson S16045* (SAR), southern slopes of Gunung Subis, near Sekaloh river; Bukit Kasut DANIDA/SWMPI Plot Specimen Plot 20 No. 1 (SAR).

Further Plant Records from Niah

A checklist of plant species occurring at or in the vicinity of Niah National Park, Sarawak, (Pearce, 2004), included *c.* 343 taxa (not all identified to species), represented by >300 collections made during recent investigations in the Park as part of the DANIDA/SWMPI Project Support to Wild Life Master Plan Implementation through the Improved Management of Totally Protected Areas in Sarawak, Malaysia (2000 – 2003) and >100 other records, chiefly earlier SAR collections.

A second checklist presented here includes an additional 357 taxa not listed in the earlier checklist, represented by >450 specimens in the SAR collection. The majority of these have been collected by the Sarawak Forest Department. Of these, 115 taxa are noted as being associated with limestone. This brings the total number of limestone-associated taxa at Niah to *c.* 281 (Pearce, 2004 reported 167 taxa associated with limestone for Niah, now 166 with the confirmation of *S 89270* as *Calanthe triplicata*).

Not all the specimens here cited were collected from what is now Niah N.P. About 180 specimens, mostly collected from Ulu Sg. Sekaloh, may have been located up to 15 km from the Park, the distance Sg. Sekaloh extends beyond the Park boundary. These specimens are mostly trees, collected in the 1960s, some from logging areas, and include many dipterocarp species. They indicate the richness of dipterocarp forest and some dimensions reached by trees in this area. A portion of this mixed dipterocarp forest is still protected in the Park's south west. Approximately 144 of the species in this checklist are represented only by such 'park vicinity' specimens.

The *c.* 90 tree and *c.* 21 epiphyte species from the Park listed here serve to provide a more complete picture of the flora of Niah N.P., the herb and shrub flora having been well-collected through the efforts of G.D. Haviland, C. Hose, Ahmad, W.M.A. Brooke, B.L. Burtt, the DANIDA/SWMPI Project and others.

Figure 1. *Paraboea culminicola* **K.G.Pearce.** A. Shoot tip with inflorescence; B. leaf; C. indumentum of the lower leaf surface; D. flower, E. front view of flower, F. L.S. flower; G. flower after the corolla has fallen; H. stamens; I. fruit after dehiscence. (A-H *DANIDA/SWMPI Plot Specimen Plot 20 No. 1*; I. *S27279*).

However, species identifications of *Psychotria, Gnetum* and *Saurauia* remain uncertain.

At least 35 taxa here listed are Borneo endemics. Of these, seven (*Endocomia virella* W.J. de Wilde, *Gonystylus calophyllus* Gilg, *Paraboea culminicola* Pearce, *Shorea calcicola* P.S.Ashton, *S. seminis* (de Vr.) Slooten, *Vatica badiifolia* P.S.Ashton, *Voacanga havilandii* Ridley and *Zizyphus borneensis* Merr.) occur within the Park, bringing the number of Borneo endemics found within the Park to 19 (Pearce, 2004).

This second checklist of taxa is not the last word on species that occur in Niah N.P. and in its vicinity. Some specimens collected from Niah are not represented at SAR (e.g. those collected by P.M. Synge in 1932 (Pearce, 2003)). Furthermore, some specimens recorded in the SAR card index file representing species not already included in this or the earlier (Pearce, 2004) checklist could not be located on the shelves.

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Appendix – Checklist of Plants Collected from Niah National Park

Note: descriptions of plants and habitats from field notes have been merged when there are more than one specimen.
MDF = Mixed Dipterocarp Forest; P.F. = Permanent Forest
G. = Gunung; Sg. = Sungai; Kg. = Kampung
* species associated with limestone at Niah National Park
E species endemic to Borneo

ACANTHACEAE

**Borneacanthus grandifolius* Bremek.
Shrub 1 m tall. At base of limestone hill near river, alluvial soil, also limestone scree below cave, mineral soil. Southern slopes of G. Subis near Sekaloh River *Sonny Tan & E. Wright S 27261*; Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31960.*

Hygrophila angustifolia R.Br.
Flat, wet ground at foot of hill. G. Subis, Niah *B.L. Burtt & P.J.B. Woods* B 2022.

Hygrophila salicifolia (Vahl) Nees
Niah *Haviland 3513A*.

Pseuderanthemum crenulatum Radlk.
G. Subis area, Niah *Mohidin S 21676.*

**Ptyssiglottis caudata* (Stapf) B. Hansen
Limestone. Valley in front of Niah Caves *B.L. Burtt & P.J.B. Woods B 2013.*

**Ptyssiglottis frutescens* Hallier
Shrublet 60–100 cm tall. Lower slopes of limestone hill, numerous limestone boulders. G. Subis area, Niah *Mohidin S 21679*; Southern slopes of G. Subis near Sekaloh River *Sonny Tan & E. Wright S 27271*.

Ptyssiglottis psychotriifolia (Stapf) B. Hansen
G. Subis area Niah *Mohidin S 21667.*

Rungia salaccensis Valeton
1–1.3 m tall. In jungle on wet ground. Kg. Tangap, Niah *Ahmad 26;* G. Subis area, Niah *Mohidin S 21655*.

Staurogyne sp.
G. Subis area, Niah *Mohidin S 21654.*

ADIANTACEAE

**Adiantum caudatum* L.
Limestone. Niah *C. Hose s.n.*; G. Subis area, Niah *Mohidin S 21695.*

**Adiantum hosei* Baker
Small terrestrial fern. In damp, shady crevices of limestone rockface at 67 m a.s.l. Great Cave, G. Subis, Niah *J.A.R. Anderson S 31938.*

**Taenitis cordata* (Gaudich.) Holttum
Small terrestrial fern. In shaded, dry rock crevices on damp, shaded limestone rockface at 67 m a.s.l., Great Cave, G. Subis, Niah *J.A.R. Anderson S 31945.*

AGAVACEAE

Dracaena elliptica Thunb.
G. Subis area, Niah *Mohidin S 21675.*

ALANGIACEAE

Alangium javanicum (Blume) Wangerin var. *javanicum*
Tree 18 m tall, 45 cm girth. Lowland MDF 150 m a.s.l., soil sandy clay. Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40127.*

ANACARDIACEAE

**Buchanania arborescens* (Blume) Blume
Tree 3 m tall, 20 cm girth. Limestone hill summit 110 m a.s.l. *Yii Puan Ching S 40184.*

Parishia maingayi Hook.*f.*
Tree 31 m tall, 75 cm girth. G. Subis P.F., Niah *J.A.R. Anderson & Chew Wee Lek S 16022.*

Semecarpus glaucus[E] Engl.
Tree 5.3 m tall, 12.5 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26136.*

ANNONACEAE

Alphonsea ?johorensis J. Sinclair

Tree 17 m tall, 37 cm girth. MDF with reddish clay loam soil. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29271.*

Cyathocalyx magnifica Diels
Tree 8.7 m tall, 17.5 cm girth. Lowland dipterocarp forest, alluvial soil beside stream. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27877.*

Dasymaschalon blumei Finet & Gagnep.
Treelet 4 m tall. Primary lowland dipterocarp forest, clay sandy soil beside river. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 27873.*

Desmos teijsmannii Merr.
Climber on tree. Riverine forest also MDF near stream on steep slope. Along Sg. Niah, Niah N.P. *Paul Chai S 40057, Yii Puan Ching S 40121.*

**Enicosanthum coriaceum* (Hook.*f.* & Th.) Airy Shaw
Tree 8 m tall, 30 cm girth. Primary forest, lower flanks of limestone mountain. G. Subis, Niah *J.A.R. Anderson S 31646.*

Goniothalamus uvarioides Ridl.
Shrub 2.3 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg Sekaloh, Niah river *Sibat ak Luang S26121.*

Monocarpia borneensis J.B. Mols & P.J.A. Kessler
Tree 22 m tall, 45 cm girth. MDF with reddish clay loam soil. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29268.*

Polyalthia sumatrana (Miq.) Kurz
Tree 23 m tall, 90 cm girth. Primary lowland dipterocarp forest on clay loam soil. G. Subis area, Niah *Mohidin S 21644;* Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26104, Erwin Wright S 29120.*

Pseuduvaria pamattonis (Miq.) Su & Saunders
Tree 18 m tall, 39 cm girth. Lowland MDF 150 m a.s.l., soil sandy clay. Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40126.*

**Stelechocarpus cauliflorus* (Scheff.) R.E. Fr.
Treelet 5 m tall. On steep slope of limestone hill at 80 m a.s.l. Niah N.P. *Bernard Lee S 40078.*

Uvaria littoralis Blume
Climber on tree. On mudstone outcropping from riverbank also riverine forest. Nangau Sekalan, Ulu Sungei Sekaloh, Niah river *J.A.R. Anderson S 27599*; along Sg. Niah, Niah N.P. *Yii Puan Ching S 40114.*

APOCYNACEAE

**Kopsia arborea* Blume
6 m tall, 27 cm girth. In exposed situation on limestone cliff at 117 m alt. G. Subis, Niah *J.A.R. Anderson S 16033.*

Voacanga havilandii[E] Ridley
Tree 17 m tall, 45 cm diam. On wet podsolic soil. Niah N.P. *Rena George S 39934.*

AQUIFOLIACEAE

Ilex cymosa Blume
Tree 3 m tall, 25 cm girth. Riverine forest. Along Niah river, Niah *Yii Puan Ching S 40146.*

**Ilex malaccensis* Loes.
Small tree or shrub. Summit ridge of limestone 267 m alt., limestone strongly dissected and covered by 15–23 cm 'mor' layer. Sg. Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31929.*

ARACEAE

Homalomena elliptica Hook.*f.*
G. Subis area, Niah *Mohidin S 21630.*

**Homalomena griffithii* Hook.*f.* forma *acuminata* (Ridl.) Furtado
Herb on limestone rock. Foot of limestone at 17 m a.s.l. G. Brangin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40176.*

Homalomena rostratum Griff.
Boggy ground at edge of primary forest. Pengkalan Lobang to Niah Caves *B.L. Burtt & P.J.B. Woods B 1999.*

**Scindapsus coriaceus* Engl.
Epiphytic shrub 60—100 cm tall. Limestone hill, lower summit ridge, limestone pinnacles and 'mor' soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27563.*

ARECACEAE

Pinanga mooreana J. Dransf.
Palm 7 m tall. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29126.*

ASPLENIACEAE

**Asplenium filicipes* Copel.
Small terrestrial fern. On limestone rocks, ravine between two limestone hills, limestone pavement and small heavily eroded limestone hillocks. G. Subis area, Niah *Mohidin S 21620*; Outside Great Cave, G. Subis, Niah *J.A.R. Anderson 31906.*

**Asplenium phyllitidis* D. Don.
In side (sic) Gua Tulang on rock *Ahmad 103.*

**Asplenium squamulatum* Blume
Epiphytic fern on small tree. Damp and shaded at base of limestone rock face at 67 m a.s.l. Great Cave, G. Subis, Niah *J.A.R. Anderson S 31943.*

**Asplenium thunbergii* Kunze
Small terrestrial fern. On rocks, also epiphytic at base of small trees, ravine between two limestone hills, limestone pavement and small heavily eroded limestone hillocks. Outside Great Cave, G. Subis, Niah *J.A.R. Anderson 31904.*

**Asplenium* aff. *unilaterale* Lam.
Small terrestrial fern. Slope between caves, limestone rocks, on residual soil not

on limestone, in semi-shaded locality, habitat semi-exposed, trees mainly felled. Great Cave, G. Subis, Niah *J.A.R. Anderson 31914.*

ASTERACEAE

Blumea balsamifera (L.) DC.
2 m tall. In jungle on wet ground. Kg. Tangap, Niah *Ahmad 18.*

Sparganophorus vailantii Crantz
Wet, flat ground at foot of hill. G. Subis, Niah *B.L. Burtt & P.J.B. Woods B 2023.*

Synedrella nodiflora Gaertn.
At path side. Niah Caves *B.L. Burtt & P.J.B. Woods B 2011.*

BIGNONIACEAE

Deplanchea bancana (Scheff.) Steenis
Tree 40 m tall, 200 cm girth. Primary forest, alluvial soils, sandy, approaching kerangas type. Path from Pangkalan to Great Cave, Niah *J.A.R. Anderson 16427.*

BORAGINACEAE

**Tournefortia* sp.
Small climber or scrambler. Hanging on limestone cliff face. Outside Great Cave, G. Subis, Niah *J.A.R. Anderson S 31917.*

BURMANNIACEAE

Burmannia sp.
G. Subis area, Niah *Mohidin S 21638.* (Mixed collection)

Gymnosiphon aphyllum Blume
G. Subis area, Niah *Mohidin S 21638* (Mixed collection).

BURSERACEAE

**Canarium odontophyllum* Miq.
Tree 20 m tall, 65 cm girth. On steep slope of limestone hill at 80 m a.s.l. Niah N.P. *Bernard Lee S 40073.*

Santiria apiculata A.W. Benn. var. *apiculata*
Shrub 3 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26133.*

Santiria mollis[E] Engl.
Tree 23 m tall, 120 cm girth. MDF with reddish clay loam soil. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29272.*

CAPPARACEAE

**Crateva magna* (Lour.) DC.
Tree 10 m tall, 53 cm girth. On steep slope of limestone hill at 80 m a.s.l. Niah N.P. *Bernard Lee S 40074.*

CECROPIACEAE

Poikilospermum cordifolium (Barg.-Petr.) Merr.
Large climbing epiphyte to 10 m. Disturbed belian forest, alluvial soils at base of

limestone hill. Between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson S 27582.*

**Poikilospermum scabrinervium* (Barg.-Petr.) Merr.
Woody herb to 2 m tall. On limestone rock *c.* 50 m a.s.l. Niah N.P. *Bernard Lee S 40087.*

Poikilospermum suaveolens (Blume) Merr.
Climber 15–27 m tall entwined round tree. MDF with reddish clay loam soil. Ulu Sg. Sekaloh, Niah Benang ak *Bubong S 27885, Erwin Wright S 29275.*

CELASTRACEAE

Bhesa paniculata Arn.
Tree 20 m tall, 60 cm girth. MDF on clay loam soil, 100 m alt. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26068.*

Kokoona sp.
Tree 25 m tall, 100 cm girth. Lowland MDF 80 m a.s.l., soil sandy loam. Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40130.*

Lophopetalum glabrum^{E} Ding Hou
Tree 15 m tall, 40 cm girth. Primary MDF on gentle slope, clay loam soil. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S* 26124; Niah N.P. *Bernard Lee S* 40072.

**Reissantia grahamii* (Wight) Ding Hou
Creeper. Limestone hill summit 110 m a.s.l. G. Brangin, Niah N.P. *Yii Puan Ching S 40185.*

**Siphonodon celastrineus* Griff.
Tree 10 m tall, 40 cm girth. On near vertical slope of limestone hill, dry and in partial shade, 67 m alt. G. Subis, Niah *J.A.R. Anderson S 16034.*

CHRYSOBALANACEAE

Maranthes corymbosa Blume
Tree 18 m tall, 90 cm girth. MDF remnant forest. Niah N.P. *Bernard Lee S 40067.*

CLUSIACEAE

Garcinia parvifolia Miq.
Tree 17 m tall, 60 cm girth. On mudstone outcropping from river bank. Nangau Sekalan, Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27288, Erwin Wright S 29264.*

COMBRETACEAE

Combretum tetralophum C.B.Clarke
Climber on tree. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40115.*

CONNARACEAE

Agelaea borneensis Merr.
Small climber. MDF, clay loam soil, sedimentary rocks, 100 m alt. Ulu Sg. Sekaloh,

Niah river *E. Wright S 27251.*

Connarus grandis Jack
Climber 23 m tall. MDF. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29273.*

Ellipanthus beccarii Pierre var. *peltatus*[E] (Schellenb.) Leenh.
Tree 7 m tall, 12.5 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26109.*

Rourea mimosoides Planch. f. *obtusifolia* Leenh.
Climber on tree. Riverine forest and river bank on sandy clay soil. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson 27295*; Along Niah River, Niah N.P. *Yii Puan Ching S 40148.*

COMMELINACEAE

Amischotolype marginata Hassk.
Large herbaceous creeper. Alluvial soil at base of limestone hill near river. Southern slopes of G. Subis, near Sekaloh River *Sonny Tan & E. Wright S 27258.*

CONVOLVULACEAE

Erycibe bullata Ridl. *ex* Hoogl.
Tree 5.7 m tall, 10 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26119.*

Erycibe glomerata Blume
Treelet 2.4 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29107.*

CUCURBITACEAE

**Gynostemma pentaphyllum* (Thunb.) Makino
Small climber climbing by tendrils to 7 m. Swampy area near stream, alluvium with limestone influence, 33 m a.s.l. Path from Pangkalan Lobang to Great Cave, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26073.*

DAVALLIACEAE

Davalia solida (G. Forst.) Sw.
Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40155.*

DENNSTAEDTIACEAE

Lindsaea scandens Hook. var. *terrestris* Holttum
Fronds dark shining green above, paler below. In loose litter on forest floor. Pengkalan Lobang to Niah Caves *B.L. Burtt & P.J.B. Woods B 2002.*

DICHAPETALACEAE

Dichapetalum setosum Leenh.
Climber to 17 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26106.*

DILLENIACEAE

Dillenia excelsa Martelli (Jack) Gilg var. *pubescens* (Corner) Corner *ex* Masamune
Tree 17 m tall, 25 cm girth. Primary lowland dipterocarp forest on clay loam soil.

Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26147.*

Tetracera korthalsii Miq. var. *subrotunda* (Elmer) Hoogl.
Climber on tree. Along river bank, riverine forest. Along Niah river, Niah N.P. *Yii Puan Ching S 40141.*

DIPTEROCARPACEAE

Anisoptera costata Korth.
Tree 17 m tall, 210 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Edwin Wright S 29127*

Anisoptera grossivenia [E] Slooten
Tree to 27 m tall, 230 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat, Banyeng & Adenan S 26164, S 26167.*

Dipterocarpus acutangulus Vesque
Tree 32 m tall, to 203 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat, Banyeng & Adenan S 26168, S 26170.*

Dipterocarpus applanatus [E] Slooten
Tree 30 m tall, 273 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22553, Benang & Adenan S 22594.*

Dipterocarpus caudatus Foxw. ssp. *penangianus* (Foxw.) P.S.Ashton
Tree 32 m tall, 85 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m alt. Ulu Sg. Sekaloh, Niah river *Sibat, Banyeng & Adenan S 26173.*

Dipterocarpus caudiferus Merr.
Tree to 33 m tall, 315 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22590, S 22591, S 22592.*

Dipterocarpus elongatus Korth.
Tree to 30 m tall, 133 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Banyeng & Adenan S 22573.*

Dipterocarpus verrucosus Foxw. *ex* Slooten
Tree to 30 m tall, 225 cm girth. Lowland MDF on clay loam soil, 100–150 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22559, S 22560, Adenan bin Dillah & Banyeng ak Nudong S* 26151; Sg Sekaloh, Niah N.P. *Yii Puan Ching S 40125.*

**Hopea plagata* (Blanco) Vidal
Tree 23 m tall, 148 cm girth. On limestone. South side of G. Subis in Sekaloh River, Niah *Sibat & Adenan S 22568.*

Parashorea cf. *lucida* (Miq.) Kurz
Tree 23 m tall, 188 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m alt. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22588.*

Shorea almon Foxw.
Tree 30 m tall, 308 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river*Adenan bin Dillah & Banyeng ak Nudong S 26153, S 26163, Banyeng & Adenan S 22576.*

Shorea argentifolia [E] Symington
Tree 33 m tall, 285 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Banyeng & Adenan S 22578, Sibat & Adenan S 26175.*

Shorea cf. *atrinervosa* Symington
Tree 33 m tall, 193 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat, Banyeng & Adenan S 26171, Sibat & Adenan S 26176.*

Shorea balanocarpoides Symington
Tree 23 m tall, 88 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 26174.*

Shorea beccariana [E] Burck
Tree 31 m tall, 323 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22554, Sibat, Banyeng & Adenan S 26166.*

**Shorea calcicola* [E] P.S. Ashton
G. Subis, Miri District, Sg. Sekaloh. *Sylvester S 27282.*

Shorea confusa [E] P.S. Ashton
Tree 27 m tall, 330 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Banyeng & Adenan S 22575.*

Shorea domatiosa [E] P.S. Ashton
Tree 33 m tall, 318 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l.. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22593, Benang & Adenan S 22597, S 22598.*

Shorea faguetiana F.Heim
Tree 27 m tall, 208 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22587.*

Shorea faguetioides [E] P.S. Ashton
Tree 30 m tall, 208 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Banyeng & Adenan S 22579, S 22580, Adenan bin Dillah & Benang ak Bubong S 26161.*

Shorea fallax [E] Meijer
Tree 23 m tall, 128 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Adenan bin Dillah & Benang ak Bubong S 26160.*

Shorea ferruginea [E] Dyer *ex* Brandis
Tree 30 m tall, 88 cm girth. Primary lowland dipterocarp forest on clay loam soil,

100 m alt. Ulu Sungei Sekaloh, Niah river *Adenan bin Dillah & Banyeng ak Nudong S 26154.*

Shorea macroptera Dyer
Tree 30 m tall, 233 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Benang & Adenan S 22595, Adenan bin Dillah & Banyeng ak Nudong S 26156.*

Shorea macroptera Dyer ssp. *macropterifolia*[E] P.S. Ashton
Tree 30 m tall, 140 cm girth. Primary lowland dipterocarp forest on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Adenan bin Dillah & Benang ak Bubong S 26157, S 26159.*

Shorea mecistopteryx[E] Ridl.
Tree 33 m tall, to 350 cm girth. Primary lowland dipterocarp forest or MDF on reddish clay loam soil, 100 m alt. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22557, S 22589, Benang & Adenan S 22585, Adenan bin Dillah & Banyeng ak Nudong S 26152, E. Wright S 29278.*

Shorea ochracea[E] Symington
Tree 33 m tall, to 488 cm girth. Primary lowland dipterocarp forest or MDF on reddish clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Benang & Adenan 22600, Adenan bin Dillah & Benang ak Bubong S 26158.*

Shorea parvistipulata[E] F.Heim ssp. *albifolia* P.S. Ashton
Tree 30 m tall, to 320 cm girth. Primary lowland dipterocarp forest or MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Sibat & Adenan S 22561, Adenan bin Dillah & Benang ak Bubong S 26162.*

Shorea pauciflora King
Tree 27 m tall, to 293 cm girth. Primary lowland dipterocarp forest or MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah *Benang & Adenan S 22599.*

Shorea saggitata[E] P.S. Ashton
Tree 23 m tall, to 233 cm girth. Primary lowland dipterocarp forest or MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah *Sibat & Adenan S 22558.*

**Shorea seminis* (de Vr.) Slooten
Tree 27 m tall, 2 m girth. Alluvial soils by Sg. Sekaloh at base of limestone cliff. On southern slope of G. Subis in Sekaloh river, Niah *Sibat & Adenan S 22567.*

Shorea smithiana[E] Symington
Tree 33 m tall, to 323 cm girth. Primary lowland dipterocarp forest or MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah *Banyeng & Adenan S 22577, S 22581, S 22586.*

Shorea superba[E] Symington
Tree 33 m tall, to 325 cm girth. Primary lowland dipterocarp forest or MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah *Sibat & Adenan S 22556, Adenan bin Dillah & Banyeng ak Nudong S 26155.*

Vatica badiifolia[E] P.S. Ashton

Tree 31 m tall, to 298 cm girth. Primary lowland dipterocarp forest or MDF on clay loam soil, 100 m a.s.l.. Ulu Sg. Sekaloh, Niah *Sibat, Banyeng & Adenan S 26165.*

**Vatica globosa*[E] P.S. Ashton
Limestone. Niah *G.D. Haviland & C. Hose Hav. 3159.*

DRYOPTERIDACEAE

**Tectaria brooksii* Copel.
Small terrestrial fern. On dry, shaded vertical bare limestone rock also cave and large overhang 100 m up on steep limestone hill, light dry soil partly composed of guano and damp also shaded limestone rockface at 67 m as.l. G. Subis, Niah *Mohidin S 21690 J.A.R. Anderson S 16024*; Gua Pangomah, G. Subis, Niah *J.A.R. Anderson S 31687*; Great Cave, G. Subis, Niah *J.A.R. Anderson S 31949.*

**Tectaria* melanorachis (Baker) Copel.
Terrestrial fern. On damp and shaded limestone rockface at 67 m a.s.l. Great Cave, G. Subis, Niah *J.A.R. Anderson S 31944.*

**Tectaria pleiosora* (Alderw.) C. Chr.
Terrestrial fern 60–100 cm high. Markedly shaded localities on vertical limestone rock, cave and large overhang 100 m up on steep limestone hill, light dry soil partly composed of guano also on residual soils in semi-exposed position, slope between caves, limestone rocks and residual soil, trees mainly felled. Gua Pangomah, G. Subis, Niah *J.A.R. Anderson S 31689*; Great Cave, G. Subis; Niah *J.A.R. Anderson S 31915.*

**Tectaria* sp.
Terrestrial fern. On limestone rock, foot of limestone at 17 m a.s.l. G. Brangin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40180.*

EBENACEAE

**Diospyros cauliflora* Blume
Tree 13 m tall, 38 cm girth. On summit of dry limestone rock at base of limestone hill. Near Great Cave, G. Subis, Niah *J.A.R. Anderson S 16026.*

Diospyros foxworthii Bakh.
Tree to 27 m tall, 67 cm girth. Primary MDF on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27881, Edwin Wright S 29115.*

Diospyros korthalsiana Hiern
Tree 20 m tall, 60 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Edwin Wright S 29102, S 29141.*

**Diospyros venosa* Wall. *ex* A.DC.
Tree 7 m tall, 30 cm girth. On 'mor' layer near summit of limestone hill. G. Subis, Niah *J.A.R. Anderson S 16050.*

ELAEOCARPACEAE

Elaeocarpus obtusus Blume
Tree 30 m tall, 150 cm girth. Ulu Sg. Sekaloh, Niah river *Banyeng ak Nudong S*

26144.

Elaeocarpus submonoceras Miq. ssp. lasionyx (Ridl.) R. Weibel
Tree 3 m tall, 20 cm girth. Riverine forest. Along Niah river, Niah N.P. *Yii Puan Ching S 40140.*

ERICACEAE

**Vaccinium leptanthum* Miq.
Epiphyte or straggling shrub. Near or on summit of limestone hill. G. Subis, Niah *J.A.R. Anderson S 16048*; G. Brangin, Niah N.P. *Yii Puan Ching S 40181.*

EUPHORBIACEAE

Agrostistachys longifolia (Wight) Benth. *ex* Hook.*f.* var. *leptostachya* (Pax & K. Hoffm.) Whitmore
Tree 7 m tall. Summit of small sandstone hill, primary forest on clay loam soil. Between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson S 27592.*

**Antidesma leucopodum* Miq.
G. Subis area, Niah *Mohidin S 21646.*

Antidesma cf. pendulum Hook.*f.*
Tree 7 m tall, 10 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 27862.*

**Aporosa grandistipulata* Merr.
Tree *c.* 3 m tall, 5 cm diam. Limestone area, relatively open *Dipterocarpus* forest. G. Subis, to right of Sg. Sekalau, at footpath from Kuala Sekalau to Bukit Drusau *H.P. Fuchs 21271.*

Aporosa nigricans Hook.*f.*
Tree 7 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sonny Tan & E. Wright S 26101.*

Aporosa nitida Merr.
Tree 8 m tall, 15 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29118.*

**Aporosa prainiana* King *ex* Gage
Tree *c.* 7 m tall, to 10 cm thick. Limestone area 100 m a.s.l., also clay loam soil, sedimentary rocks relatively open MDF. Ulu Sg. Sekaloh and to right of Sg. Sekalau at footpath from Kuala Sekalau to Bukit Drusau, G. Subis *H.P. Fuchs 21264, 21287;* J.A.R. *Anderson, Sonny Tan & E. Wright S 26064, E. Wright S 27255.*

Baccaurea lanceolata (Miq.) Muell.-Arg.
Tree 17 m tall, 55 cm girth. Alluvial soils by Sg. Sekaloh at base of limestone cliff. S. side of G. Subis, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27552.*

Baccaurea sarawakensis Pax & K. Hoffm.
Tree 12 m tall, 30 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27859.*

Baccaurea trunciflora Merr.
Tree 7 m tall, 20 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Banyeng ak Nudong S 26142.*

Cleistanthus pyrrhocarpus Airy Shaw
Slender tree to 8 m tall. MDF between two steep slopes at 85 m a.s.l. Niah N.P. *Yii Puan Ching S 40070.*

Glochidion rubrum Blume
Tree 8 m tall, 35 cm girth. Riverine forest *c.* 17 m a.s.l., loamy soil. Kuala Sg Sekaloh, Niah N.P. *Yii Puan Ching S 40102.*

Drypetes crassipes Pax & K. Hoffm.
Tree 17 m tall, 100 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26129, Erwin Wright S 29121.*

Koilodepas longifolium Hook.*f.*
Tree 7 m tall, 15 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29117.*

Macaranga bancana (Miq.) Muell.-Arg.
Tree 7 m tall, 30 cm girth. Riverine forest *c.* 17 m a.s.l., soil loamy. Kuala Sg Sekaloh, Niah N.P. *Yii Puan Ching S 40108.*

**Mallotus dispar* (Blume) Muell.-Arg.
Bushy tree 7 m tall 25 cm girth. On limestone rocks, base of limestone hill also ravine between two limestone hills, limestone pavement and small, heavily eroded limestone hillocks. G. Subis, path to Great Cave *J.A.R. Anderson S 31693*; Outside Great Cave, G. Subis, Niah *J.A.R. Anderson S 31910.*

**Mallotus korthalsii* Muell.-Arg.
Tree *c.* 3 m tall, 8 cm diam. In small river valley between limestone boulders, relatively open *Dipterocarpus* forest, 150 m a.s.l. G. Subis to right of Sg. Sekalau, at footpath from Kuala Sekalau to Bukit Drusau *H.P. Fuchs 21272, 21273.*

Mallotus wrayii King *ex*. Hook.*f.*
Tree 7 m tall, 12.5 cm girth. MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26063.*

Margaritaria indica (Dalziel) Airy Shaw
Tree 10 m tall, 40 cm girth. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40160.*

**Neoscortechinia sumatrensis* S. Moore
Tree 17 m tall, 15 cm diam. with stilt roots. On limestone. Along the plankwalk to Niah Cave, Niah N.P. *Rena George S 39936.*

Pimelodendron griffithianum (Muell.-Arg.) Benth.
Tree 11.7 m tall, 18 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river. *Sibat ak Luang S 26135.*

Ptychopyxis grandis Airy Shaw

Tree 8.3 m tall, 30 cm girth. Primary lowland or MDF on clay loam soil. Ulu Sg. Sekaloh, Niah river. *Benang ak Bubong S 26112, Erwin Wright S 29149.*

**Sauropus androgynus* (L.) Merr.
Shrub 1 m tall. Cave and large overhang 100 m up on steep limestone hill, light dry soil, partly composed of guano. Gua Pangomah, G. Subis, Niah *J.A.R. Anderson S 31682.*

Trigonostemon merrillianus Airy Shaw
Tree 3 m tall, 10 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26123, Erwin Wright S 29123.*

FABACEAE

**Bauhinia endertii* K. & S.S. Larsen Creeper on limestone or climber on tree. Riverine forest along Sg Niah also limestone hill summit 110 m a.s.l. Niah N.P. *Yii Puan Ching S 40157*; G. Brangin, Niah N.P. *Yii Puan Ching S 40182.*

Bauhinia excelsa (Blume *ex* Miq.) Prain
Climber to 40 m tall on tree, 30 cm girth at base. Mudstone outcropping from river bank of Nangau Sekalan also disturbed belian forest, alluvial soils at base of limestone hill. Ulu Sg Sekaloh, Niah River *J.A.R. Anderson S 27291*; Between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson S 27581.*

Derris elegans Benth.
Climber. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40117.*

**Dialium indum* L.
Tree 25 m tall, 200 cm girth. Foot of limestone 17 m a.s.l. G. Brangin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40173.*

Parkia sumatrana Miq.
Niah *G.D. Haviland & C. Hose Haviland 3273.*

**Saraca declinata* (Jack) Miq.
Tree to 20 m tall and 60 cm girth. Base of limestone hill on limestone rocks and lower slopes of steep limestone hill, numerous limestone boulders also primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26150*; South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27554*; G. Subis, path to Great Cave *J.A.R. Anderson S 31694.*

**Whitfordiodendron niewenhuisii* (J.J. Sm.) Dunn
Climbing shrub. Limestone area, relatively open *Dipterocarpus* forest, 150 m a.s.l. G. Subis to right of Sg. Sekalau, at footpath from Kuala Sekalau to Bukit Drusau *H.P. Fuchs 21262.*

FAGACEAE

Lithocarpus meijeri Sopadmo
Tree 23 m tall, 240 cm girth. Primary forest on ridge at 133 m a.s.l. Niah *Dan bin Hj. Bakar S 16524.*

FLACOURTIACEAE

Casearia rugulosa Blume
Tree 4 m tall, 7.5 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29142.*

Hydnocarpus subfalcata Merr.
Tree 13.3 m tall, 45 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29110.*

**Osmelia philippina* (Turcz.) Benth.
Tree 10 m tall, 28 cm girth. On limestone rocks near river and alluvial soils at base of limestone hill in disturbed belian forest. On southern slopes of G. Subis in the Sekaloh river. Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26083*; between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson S 27579.*

Pangium edule Reinw.
Tree 33 m tall, 90 cm girth. On alluvial soil at base of limestone hill. Just beyond Great Cave, G. Subis. Niah *J.A.R. Anderson S 16428.*

Ryparosa acuminata Merr.
Tree 7 m tall 13 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26122.*

Ryparosa kostermansii Sleumer
Tree 17 m tall, 75 cm girth. MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26054.*

FLAGELLARIACEAE

Flagellaria indica L.
Climber on tree. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40113.*

GESNERIACEAE

**Paraboea culminicola*^{E} K.G. Pearce
Large herb 75–120 cm tall. On bare, exposed limestone rock near summit of limestone pinnace or crest of limestone hill, 'mor' soil, 170 m a.s.l. Niah *J.A.R. Anderson S 16045;* Southern slopes of G. Subis, near Sekaloh river *Sonny Tan & E. Wright S 27279.*
Included in Pearce, 2004 as *Paraboea* sp.

GNETACEAE

Gnetum cuspidatum Blume
Woody climber *c.* 33 m long, 15 cm girth on large tree. Riverine forest *c.* 17 m a.s.l., soil loamy also primary lowland dipterocarp forest on clay loam soil. Kuala Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40107*; Ulu Sg. Sekaloh, Niah River *Erwin Wright S 29105.*

**Gnetum diminutum* Markgr.
Climber to 27 m. Slopes of limestone hill, immediately below cliff, 133 m a.s.l., litter layer overlying limestone boulders also limestone hill, lower summit ridge, limestone pinnacles and 'mor' soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27560*; Sg. Sekaloh, G. Subis, Niah

J.A.R. Anderson 31954.

Gnetum gnemonoides Brongn.
Entwined round tree. Mudstone outcropping from river bank. Nangau Sekalan, Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27286.*

**Gnetum klossii* Merr. *ex* Markgr.
Climber to 13 m. Lower slopes of steep limestone hill, numerous limestone boulders. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27556*

Gnetum loerzingii Markgr.
Scrambler to 13 m high. Remnant forest near river bank. Niah N.P. *Bernard Lee M.H. S 40066.*

Gnetum macrostachyum Hook.*f.*
Climber 27 m high. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26116.*

HYMENOPHYLLACEAE

Crepidomanes bipunctatum (Poir.) Copel.
G. Subis area, Niah *Mohidin S 21625.*

Crepidomanes christii (Copel.) Copel.
G. Subis area, Niah *Mohidin S 21614.*

HYPERICACEAE

Cratoxylon formosum (Jack) Dyer ssp. *formosum*
Tree *c.* 10 m tall, 10 cm girth. Riverine forest along Sg. Niah. Niah N.P. *Yii Puan Ching S 40152.*

ICACINACEAE

Cantleya corniculata (Becc.) R.A. Howard
Tree 20 m tall, 80 cm girth. Lowland MDF, 80 m a.s.l., soil sandy loam. Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40131.*

**Gomphandra cumingiana* (Miers) F.-Vill.
Treelet 5 m tall, 8 cm girth. 17 m below summit ridge of limestone hill, limestone outcropping and 'mor' soil present, also lower slopes of limestone hill, numerous limestone boulders and primary lowland dipterocarp forest on clay loam soil. Southern slopes of G. Subis near Sekaloh river, Niah *Sonny Tan & E. Wright S 27263*; Ulu Sungei Sekaloh, Niah river *Erwin Wright S 29104*; *J.A.R. Anderson S 31934.*

LAMIACEAE

Anisomeles indica O. Kuntze
In secondary growth on ground. Niah *Ahmad 47.*

Pogostemon auricularis (L.) Hassk.
Niah *Haviland 3598.*

LAURACEAE

Litsea lancifolia (Roxb. *ex* Wall.) Hook.*f.*
Tree 8 m tall, 25 cm girth. MDF with reddish clay loam soil. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29262.*

Nothaphoebe sarawacensis Gamble
Tree 4 m tall, 45 cm girth. Along Sg Niah, Niah N.P. *Yii Puan Ching S 40119.*

LECYTHIDACEAE

Barringtonia lanceolata[E] (Ridl.) Payens
Tree 12 m tall, 25 cm girth. MDF on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29124.*

Barringtonia macrostachys (Jack) Kurz
Tree 8 m tall, 38 cm girth. MDF with reddish clay loam soil. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29269.*

LEEACEAE

Leea indica (Burm.*f.*) Merr.
Treelet 2.7 m tall. Lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27879.*

LORANTHACEAE

Lepeostegeres beccarii (King) Gamble
Epiphyte. Riverine forest. Along Niah river, Niah N.P. *Yii Puan Ching S 40149.*

**Macrosolen beccarii* Tiegh.
Parasite on small tree. On limestone rocks near river. On southern slopes of G. Subis in Sekaloh river, Niah J.*A.R. Anderson*, *Sonny Tan & E. Wright S 26081.*

Trithecanthera cf. xiphostachys Tiegh.
Large parasite in crown of *Pometia pinnata* at 20 m. Alluvial soils by Sg. Sekaloh at base of limestone cliff. On southern slopes of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26097.*

MALVACEAE

Sida acuta Burm.*f.*
In secondary growth on ground. Rumah Pasang, Niah *Ahmad 49.*

Urena lobata L. ssp. *lobata* f. *sinuata* (L.) Borss.
120–150 cm tall. In jungle on wet ground. Rumah Pasang, Niah *Ahmad 19.*

MARANTACEAE

Phrynium capitatum Willd.
Herb 1 m tall. In jungle on ground, also alluvial soil at base of limestone hill near river. Rumah Pasang, Niah *Ahmad 41*; Southern slopes of G. Subis near Sekaloh river, Niah *Sonny Tan & E. Wright S 27257.*

Schumannianthus dichotomus (Roxb.) Gagnep.
Shrub *c.* 2 m high. Secondary shrubby vegetation along small creek to right of Sg. Sekalau, to left of footpath from Kuala Sekalau to Bukit Drusau, near Kuala Skaloh longhouse, limestone area, G.Subis *H.P. Fuchs 21284.*

MELASTOMATACEAE

Dissochaeta annulata Hook.*f.* *ex* Triana
G. Subis area. Niah *Mohidin S 21636.*

Dissochaeta hirsuta Hook.*f.* *ex* Triana
Climber on tree. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40124.*

Dissochaeta rostrata Korth.
Climber entwined round tree. Lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27878.*

Medinilla macrophylla Blume
Epiphyte 27 m high on tree. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26105.*

**Memecylon paniculatum* Jack
Tree *c.* 6 m tall, 10 cm thick. Limestone area, relatively open *Dipterocarpus* forest, 150 m a.s.l. G. Subis, to right of Sg. Sekalau, at footpath from Kuala Sekalau to Bukit Drusau *H.P. Fuchs 21263.*

Memecylon scolopacinum[E] Ridl.
Shrub 2 m high. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26130.*

**Pachycentria microsperma* Becc.
Epiphyte on limestone hill summit. Limestone hill summit 110 m a.s.l. G. Brangin. Niah N.P. *Yii Puan Ching S 40183.*

Plethiandra motleyi Hook.*f.*
Epiphyte 8 m high on *Dipterocarpus oblongifolia*. Mudstone outcropping from river bank. Nanagu Sekalan, Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27287.*

**Plethiandra robusta* (Cogn.) Nayar *ex* Bakh.
Epiphyte 23 m high on tree trunks, and on rocks. Limestone hill, lower summit ridge, limestone pinnacles and 'mor' soil also primary lowland dipterocarp forest on clay loam soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27562*; Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29109.*

Pternandra crassicalyx J.F. Maxwell
Tree 8 m tall, 15 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26131.*

Pternandra multiflora Cogn.
Tree 15 m tall, 60 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29135.*

Pternandra rostrata (Cogn.) M.P. Nayar
Tree to 12 m tall, 28 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27855, Erwin Wright S 29129.*

MELIACEAE

**Aglaia elaegoinidea* (A. Juss.) Benth.
Tree 7 m tall, 20 cm girth. Partially exposed situation on dry limestone cliff. Niah *J.A.R. Anderson S 16032.*

Aglaia elliptica Blume
Tree. Riverbank on sandy clay soil. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27297.*

**Aglaia odoratissima* Blume
Tree to 27 m tall, 90 cm girth. MDF with reddish clay loam soil, also lower slopes of limestone hill with numerous limestone boulders, steep slopes of limestone hill with deep litter layer and narrow limestone ridge at 130 m a.s.l. Ulu Sg. Sekaloh *Sibat ak Luang S 26149, Benang ak Bubong S 27861, Erwin Wright S 29274*; Southern slopes of G. Subis near Sekaloh river *Sonny Tan & E. Wright S 27276, J.A.R. Anderson & Sonny Tan S 27573;* Niah N.P. *Paul Chai S 40059.*

**Aglaia speciosa* Blume
Tree 7 m tall, 25 cm girth. Knife-edge ridge near summit of limestone hill, limestone pinnacles and deep (45 cm) 'mor' soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27569.*

Aglaia tomentosa Teijsm. & Binn.
Tree 6 m tall, 8 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Banyeng ak Nudong S 26140.*

Chisocheton ceramicus (Miq.) C.DC.
Tree 15 m tall, 50 cm girth. Riverine forest. Along Niah river, Niah N.P. *Yii Puan Ching S 40144.*

Chisocheton sarawakanus (C.DC.) Harms
Treelet 5 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29148.*

**Dysoxylum alliaceum* (Blume) Blume
Tree to 33 m tall and 180 cm girth. Steep slopes of limestone, numerous limestone boulders, deep litter layer also primary lowland dipterocarp forest on clay loam soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27576*; Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29114.*

Dysoxylum brachybotrys Merr.
S. Subis area, Niah *Mohidin S 21643.*

Sandoricum borneense Miq.
Tree 18 m tall, 70 cm girth. Riverine forest. Along Niah river, Niah N.P. *Yii Puan Ching S 40145.*

Walsura dehiscens T.P. Clark
Tree 13 m tall, 40 cm girth. Lowland MDF 80 m a.s.l., soil sandy loam. Sg Sekaloh, Niah N.P. *Yii Puan Ching S 40128.*

MENISPERMACEAE

Fibraurea tinctoria Lour.
Climber to 5 m on *Agrostistachys*. Primary tropical heath forest, 33 m a.s.l. Path from Pangkalan Lobang to Great Cave, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26070.*

MONIMIACEAE

**Kibara coriacea* (Blume) Tulasne
Tree to 10 m tall, 25 cm girth or 25 cm diam. Limestone forest at 80 m a.s.l. and along plankwalk to Great Cave. Niah N.P. *Rena George S 39938, Yii Puan Ching S 40200.*

MORACEAE

Ficus aurata (Miq.) Miq.
Tree 5 m tall, 18 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sungei Sekaloh, Niah river *Erwin Wright S 29128.*

**Ficus aurita* Blume var. *auriculifera* (Merr.) Corner
Bushy tree 6 m tall. Base of limestone hill on limestone rocks at 17 m a.s.l. G. Subis area, Niah *Mohidin S 21604*; Path to Great Cave, G. Subis *J.A.R. Anderson S 31695*; G. Brangin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40169.*

Ficus beccarrii King
Tree 3 m tall. Disturbed belian forest, alluvial soils at base of limestone hill. Between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson S 27589.*

**Ficus benjamina* L.
Tree 23 m tall, 90 cm girth or shrub. Vertical exposed limestone cliff, also swampy alluvial soils at base of limestone hill subject to periodic inundation. Niah *J.A.R. Anderson S 16029*; On southern slopes of G. Subis in the Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26087.*

**Ficus binnendykii* (Miq.) Miq. var. *coriacea* Corner
Tree 13 m tall, 28 cm girth. Primary lowland dipterocarp forest on rocks beside waterfall. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 27871.*

Ficus delosyce Corner
Epiphyte 3 m tall, 12 cm girth. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40122.*

Ficus fistulosa Reinw. *ex* Blume
Tree 5 m tall, 12 cm girth. River bank of Nangau Selakan on clay soil. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27600.*

Ficus laevis Blume var. *tomentosa* King
G. Subis area, Niah *Mohidin S 21671.*

Ficus lepicarpa Blume
Tree 8 m tall, 50 cm girth. Swampy alluvial soils at base of limestone hill subject to periodic inundation, also at foot of limestone hill near stream 50 m a.s.l. Ulu Sg. Subis, Niah N.P. *Bernard Lee S 40086*; On southern slopes of G. Subis in the Sekaloh river, Niah *Mohidin S 21609, J.A.R. Anderson, Sonny Tan & E. Wright S 26089.*

Ficus magnoliifolia Blume
Tree 23 m tall, 60 cm diameter. On sandy soil at starting point of path to Niah Cave. Niah N.P. *Rena George S 39932.*

**Ficus pisocarpa* Blume
Climber entwined round tree. Hillslope on limestone rocks, 167 m a.s.l. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27570.*

**Ficus sundaica* Blume var. *sundaica*
Tree 17 m tall. Foot of limestone 17 m a.s.l. G. Brangin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40175.*

Ficus treubii[E] King
Tree 10 m tall, 20 cm girth. On rocks beside swift flowing stream. Niah *Banyeng Bubong S 27869.*

Ficus uniglandulosa Wall. *ex* Miq.
Climber 15 m high. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29132.*

MYRISTICACEAE

Endocomia virella[E] W.J. de Wilde
Tree 20 m tall, 50 cm diam. Along path to Niah Cave, Niah N.P. *Rena George S 39933.*

Gymnacranthera farquhariana (Hook.*f.* & Thom.) Warb. var. *zippeliana* (Miq.) R.T.A.Schouten.
Tree 23 m tall, 50 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sonny Tan & Benang ak Bubong S 26103.*

Knema curtisii (King) Warb. var. *curtisii*
G. Subis area, Niah *Mohidin S 21659.*

Knema latifolia Warb.
Tree 19 m tall, 30 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26107.*

Knema tridactyla[E] Airy Shaw ssp. *tridactyla*
Tree to 5 m tall, 8 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26128, Erwin Wright S 29136.*

Myristica iners Blume
Tree 22 m tall, 150 cm girth. MDF between two steep slopes at 85 m a.s.l. Niah N.P. *Normah Yusoff S 40069.*

Myristica malaccensis Hook.*f.*
Tree 15 m tall, 40 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29145.*

MYRSINACEAE

**Ardisia breviramea* Merr.
Treelet to 2.7 m tall. Lower slopes of limestone hill, large limestone boulders. Sg.

Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31923.*

Ardisia livida Mez
Treelet 6 m, 15 cm girth. MDF on clay loam soil. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26055.*

MYRTACEAE

'Eugenia aff. glanduligera Ridl.'
Tree 49 cm girth. Primary forest, lower slopes of limestone mountain. South side of mountain near Sg. Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31641.*

'*Eugenia prasiniflora* Ridl.'
Niah *Haviland & C. Hose, Haviland. 3127A.*

**Syzygium aff. castaneum* (Merr.) Merr. & Perry
Limestone. Niah *Haviland & C. Hose Hav. 3215.*

* *Syzygium caudilimbum* (Merr.) Merr. & Perry
Tree 10 m tall, 33 cm girth. Knife-edge ridge near summit of limestone hill, limestone pinnacles and deep (45 cm) 'mor' soil, also lower slopes of limestone hill. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27274, S 27572.*

Syzyium foxworthyianum (Ridl.) Merr. & Perry
G. Subis area, Niah *Mohidin S 21666.*

**Syzygium nigricans* (King) Merr. & Perry
Tree 10 m tall, 35 cm girth. Hill slope on limestone rocks, 167 m a.s.l. Ulu Sungei Sekaloh, Niah river *J.A.R. Anderson S 27559.*

Syzygium pycnanthum Merr. & Perry
Tree 10 m tall, 45 cm girth. On mudstone outcropping from river bank and riverbank on sandy clay soil. Nangau Sekaloh, Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27293, S 27596.*

Syzygium remotiflorum (Ridl.) Merr. & Perry
Tree 17 m tall, 60 cm girth. On riverine alluvium. Niah *Dan bin Hj. Bakar S 16526.*

OCHNACEAE

Campylospermum serratum (Gaertn.) Bittrich & M.C.E. Amaral
Tree 3 m tall. Disturbed belian forest, alluvial soils at base of limestone hill. Between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson S 27580.*

PASSIFLORACEAE

Passiflora foetida L.
Climbing on small tree. In jungle on ground. Kg. Tangap, Niah *Ahmad 25.*

PIPERACEAE

**Piper arborescens* Roxb.
Root climber to 5 m. Knife-edge ridge near summit of limestone hill, limestone pinnacles and deep (45 cm) 'mor' soil, South side of G. Subis in Sekaloh river, Niah *Mohidin S 21629; J.A.R. Anderson, Sonny Tan & E. Wright S 27571.*

**Piper vestitum* C.DC.
Shrublet 60 cm high or creeper on slope of limestone hills also on limestone rocks at 50 m a.s.l. and on residual soils. Great Cave, G. Subis. Niah *J.A.R. Anderson S 31919,* G. Brangin, Niah National Park *Yii Puan Ching S 40085, S 40188.*

PITTOSPORACEAE

**Pittosporum ferrugineum* Aiton
Small tree or shrub. On exposed rockface immediately above large cave overhang 100 m up on steep limestone hill, light dry soil, partly composed of guano. Gua Pangoma, G. Subis, Niah *J.A.R. Anderson S 31680.*

POACEAE

Phragmites karka (Retz.) Trin. *ex* Steud.
G. Subis area, Niah *Mohidin S 21635.*

POLYGALACEAE

Xanthophyllum flavescens Roxb.
Tree to 23 m tall, 210 cm girth. Primary lowland dipterocarp forest on clay loam soil, also riverine forest along Sg. Niah. Ulu Sg. Sekaloh and Sg Niah *Sibat ak Luang S 27852, Benang ak Bubong S 27883, S 27884, Erwin Wright S 29131, S 29140, S 29150, Yii Puan Ching S 40151.*

Xanthophyllum velutinum Chod.
Tree 16 m tall, 40 cm girth. Between two steep slopes, MDF at 85 m a.s.l. Niah N.P. *Bernard Lee S 40071.*

PSILOTACEAE

**Psilotum complanatum* Sw.
Epiphyte at low height on tree. Limestone hill, lower summit ridge; limestone pinnacles and 'mor' soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27566.*

PTERIDACEAE

Pteris longipinnula Wall. *ex* J. Agardh
G. Subis area, Niah *Mohidin S 21610.*

**Pteris vittata* L.
On rock near entrance, Niah Cave, Niah *Ahmad 56*; G. Subis area, Niah *Mohidin S 21696.*

RHAMNACEAE

Zizyphus borneensis^{E} Merr.
Climber creeping on tree. Riverine forest *c.* 17 m a.s.l. Kuala Sg. Sekaloh, Niah N.P. *Yii Puan Ching & Bernard Lee S 40106.*

Zizyphus horsfieldii Miq.
Climber entwined round tree. Mudstone outcropping from river bank of Nangau Sekaloh. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson S 27284.*

RHIZOPHORACEAE

**Carallia brachiata* (Lour.) Merr.
Tree 43 cm girth. Lower flanks of limestone mountain, primary forest. South side

of mountains near Sg. Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31642.*

RUBIACEAE

**Acranthera multiflora* Valeton
Succulent herb. On steep slope of limestone hill at 80 m a.s.l. Niah N.P. *Bernard Lee S 40076.*

**Argostemma borragineum* Blume
Herb 15–23 cm tall, stock woody. Crevices on vertical shady limestone rocks and in gully between limestone hill, heavily dissected limestone rocks and pavement, mineral soil very sparse. Pengkalan Lobang to Niah Caves *B.L. Burtt & P.J.B. Woods B 2005*; Gunong Subis *J.A.R. Anderson S 31672.*

**Argostemma havilandii* Ridl.
Herb 7.5 cm tall. On limestone rock face at 67 m a.s.l., damp and shaded. Great Cave, G. Subis, Niah *J .A.R. Anderson S 31946.*

**Canthium* sp.
Tree 10 m tall, 60 cm girth. Narrow limestone ridge at 130 m a.s.l. Niah N.P. *Yii Puan Ching S 40058.*

Cephaelis sp.
Shrublet 30–37 cm tall. Disturbed belian forest, alluvial soils at base of limestone hill. Between mouth of Sg. Sekaloh and G. Subis *J .A.R. Anderson S 27586.*

Chasallia curviflora (Wall.) Thw.
Niah *Haviland & C. Hose Haviland 3454A.*

Coptosapelta sp.
Climber on large tree. Lowland MDF, 80 m a.s.l., soil sandy loam. Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40134.*

**Diplospora singularis* Korth.
Small tree 40 cm girth. Ravine between two limestone hills, limestone pavement and small heavily eroded limestone hillocks. Outside Great Cave, G. Subis, Niah *J.A.R. Anderson S 31909.*

Gaertnera vaginans (DC.) Merr. ssp. *junghuhniana* (Miq.) Beusek.
Tree 3.3 m tall. Primary MDF on reddish clay loam soil. Ulu Sungei Sekaloh, Niah *Banyeng ak Nudong S 26139, Erwin Wright S 29267.*

Geophila aff. hirta (L.) Pearson
Scrambling herb. MDF, yellow clay soil. Niah N.P. *Paul Chai et al. S 40053.*

Hedyotis congesta Wall. & G. Don
Niah *Haviland & C. Hose Haviland 3459A.*

**Hydnophytum formicarum* Jack
Shrublet 67 cm tall. Crest of limestone hill, limestone pinnacles on 'mor' soil. Southern slopes of G. Subis near Sekaloh river *Haviland & C. Hose Haviland 3448, J.A.R. Anderson S 16043, Sonny Tan & E. Wright S 27280.*

Ixora brevicaudata Bremek.
Treelet 2.3 m tall. Lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Mohidin S 21642*; *Sibat ak Luang S 27880.*

Ixora stenophylla (Korth.) Kuntze
Shrub 1 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29116.*

Ixora woodii Bremek.
Treelet 6 m tall, 13 cm girth. Primary MDF on a ridge and on clay loam soil, sedimentary rocks 80—100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 26110*; *Erwin Wright S 27252.*

Lasianthus cf. maingayi Hook.*f.*
G. Subis area, Niah *Mohidin S 21641.*

Lucinaea membranacea King
Treelet 3.3 m high, 8 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29134.*

**Ludekia borneensis* C.E,Ridsdale
Tree 25 m tall, 200 cm girth. Foot of limestone, 17 m a.s.l. G. Brangin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40171.*

**Mitreola sphaerocarpa* (Leenh.) Leenh.
Creeping herb. In shade at base of limestone cliff, 167 m alt. On southern slopes of G. Subis in the Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26096.*

Motleyia borneensis J.T. Johansson
G. Subis area, Niah *Mohidin S 21665.*

Mussaendopsis beccariana Baill.
Tree 30 m tall, 100 cm girth. Primary lowland forest. Niah *J.A.R. Anderson & Chew Wee Lek S 16020.*

**Mycetia javanica* (Blume) Korth.
Fleshy herb or slender shrub to 2 m tall. On limestone at 17 m a.s.l., also in secondary alluvial forest with heavy silty clay soil near riverbank also on broad sloping ravine between two vertical limestone hills with numerous limestone boulders and some residual soil, *c.* 167 m a.s.l.. G. Subis area, Niah *Mohidin S 21605*; Niah Caves *Chew Wee-Lek CWL 316*; On southern slopes of G. Subis, in the Sekaloh river. Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26091*; Niah N.P. *Paul Chai S 40052,* G. Brangin, Ulu Sg. Subis *Yii Puan Ching S 40170.*

Myrmeconauclea strigosa (Korth.) Merr.
Shrub 1.3 m tall. Primary lowland dipterocarp forest on rocks beside swift running stream. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 27868.*

Nauclea parva (Havil) Merr.
Shrub about 3 m tall. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40116.*

**Ophiorrhiza fibrillosa* Ridl.
Herb *c.* 67 cm tall. On broad sloping ravine between two vertical limestone hills with numerous limestone boulders and some residual soil. Niah Caves area *B.L. Burtt and P.J.B. Woods B 2029*; Southern slopes of G. Subis in the Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26095.*

Petunga coniocarpa Korth.
Tree 5 m tall, 10 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26126.*

Pleiocarpidia enneandra (Wight) K. Schum. & Bremek.
Tree 15 m tall, 48 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Banyeng ak Nudong S 26143.*

Pleiocarpidia opaca Bremek.
Tree 6 m tall, 8 cm girth. Primary MDF on clay loam soil, sedimentary rock, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *Banyeng ak Nudong S 26138, E. Wright S 27253.*

Pleiocarpidia sandahanica Bremek.
Tree 21 m tall, 75 cm girth. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river Benyang ak Bubong S 27867.

Porterandia anisophylla (Jack *ex* Roxb.) Ridl.
Tree 13 m tall, 43 cm girth. MDF on clay loam soil, 100 m a.s.l. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26051.*

Prismatomeris beccariana (Baillon) J.T. Johansson.
Treelet 2 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29119.*

**Psychotria elmeri* Merr.
Tree 3 m tall, 10 cm girth. Lower crest of limestone hill, limestone pinnacles on 'mor' soil, 167 m a.s.l. Southern slopes of G. Subis near Sg. Sekaloh Niah *Mohidin S 21617, Sonny Tan & E. Wright S 27593.*

**Psychotria cf. expansa* Blume
Limestone. Niah *Haviland & C. Hose, Haviland 3462A.*

Psychotria laxiflora Blume
Climber. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benyang ak Bubong S 27882.*

**Psychotria pachyphylla* Ridl.
Epiphyte at 1.3 m near base of small tree. Summit ridge of limestone, 267 m a.s.l., limestone strongly dissected and covered by 15–23 cm 'mor' layer. Sg. Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31932.*

**Psychotria sarmentosa* Blume
Creeping herb. Crest of limestone hill, limestone pinnacles and 'mor' soil. Southern slopes of G. Subis near Sekaloh river, Niah *Sonny Tan & E. Wright S 27281.*

Psychotria woodii Merr.

Small tree. In forest on ground. Kg. Tangap, Niah *Ahmad 30.*

**Timonius matangensis* Valeton
Tree 10 m tall, 23 cm girth. Limestone hill, lower summit ridge, limestone pinnacles and 'mor' soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27561.*

Uncaria cordata (Lour.) Merr. f. *sundiaca* C.E. Ridsdale
Climber entwined around tree. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26132.*

Uncaria ferrea DC.
G. Subis area, Niah *Mohidin S 21633.*

Uncaria insignis DC.
Climber creeping on trees. Riverine forest *c.* 17 m a.s.l., soil loamy. Kuala Sg. Sekaloh, Niah N.P. *Yii Puan Ching S 40110.*

Xanthophytum glabrum Axelius
G. Subis area, Niah *Mohidin S 21651.*

RUTACEAE

Clausena excavata Burm.*f.*
Tree 4 m tall, 35 cm girth. Flowers in bud light green, fruits green when young, whitish when mature. Riverain forest. Along Niah River, Niah N.P. *Yii Puan Ching S 40143.*

Glycosmis chlorosperma (Blume) Spreng. var. *elmeri* (Merr.) Tanaka
Treelet 3 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27856.*

Glycosmis superba^{E} B.C. Stone
Tree to 7 m tall, 12.5 cm girth. MDF on clay loam soil at 100 m. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26059* (type specimen), *Benang ak Bubong S 26118.*

**Lunasia amara* Blanco
Slender shrub or treelet 2–3.3 m tall. On 'mor' soil, summit ridge of limestone 130—267 m a.s.l., limestone strongly dissected and covered by 15–23 cm 'mor' layer. Sg. Sekaloh, G. Subis, Niah *J.A.R. Anderson S 31925*; Niah N.P. *Paul Chai S 40061.*

SABIACEAE

Meliosma sumatrana (Jack) Walp.
G. Subis area, Niah *Mohidin S 21674.*

SAPINDACEAE

Dimocarpus longan Lour. ssp. *malesianus* Leenh.
Tree 6 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 26148.*

Guoia bijuga (Hiern) Radlk.

Tree 10 m tall, 40 cm girth. Riverine forest. Along Sg. Niah, Niah N.P. *Yii Puan Ching S 40153.*

**Harpullia cupanioides* Roxb.
Tree 13 m tall, 58 cm girth. Broad sloping ravine between two vertical limestone hills with numerous limestone boulders and some residual soil. On southern slopes of G. Subis, in the Sekaloh river. Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 26093.*

Lepisanthes alata (Blume) Leenh.
Slender tree. On riverbank, riverine forest. Along Niah river, Niah N.P. *Yii Puan Ching S 40142.*

**Lepisanthes fruticosa* (Roxb.) Leenh.
Tree to 17 m tall and 28 cm girth. Primary MDF on clay loam soil at 100 m a.s.l, also on limestone rocks near river. Ulu Sg. Sekaloh, Niah river *J.A.R. Anderson, Sonny Tan & E. Wright S 26057, 26079, Benang ak Bubong S 26113, Sibat ak Luang S 27854.*

SAPOTACEAE

**Isonandra lanceolata* Wight var. *lanceolata*
Tree to 27 m tall and 133 cm girth. Crest of limestone hill, limestone pinnacles and 'mor' soil and narrow limestone ridge at 130 m a.s.l.. Southern slopes of G. Subis. Near Sekaloh river *Sonny Tan & E. Wright S 27278*; Niah N.P. *Paul Chai S 40060.*

Madhuca cf. *spectabilis*[E] P. Royen
Tree 14 m tall, 45 cm girth. MDF on clay loam soil at 100 m a.s.l. Ulu Sg. Sekaloh, Niah River *J.A.R. Anderson, Sonny Tan & E. Wright S 26058.*

**Pouteria obovata* (R.Br.) Baehni
Tree 10 m tall, 38 cm girth. Summit ridge of limestone 267 m a.s.l., limestone strongly dissected and covered by 15–23 cm 'mor' layer. Sg. Sekaloh, G. Subis, Niah *J.A.R. Anderson S 16049, S 31928.*

SAURAUIACEAE

**Saurauia acuminata* Merr.
7 m tall with many arching stems. From limestone bank and also base of limestone hill on limestone rocks. Niah Caves *B.L. Burtt and P.J.B. Woods B 2038*; Path to Great Cave *J.A.R. Anderson S 31692.*

Saurauia cf. ferox Korth.
Treelet 2.7 m tall. Primary lowland dipterocarp forest on clay loam soil. Ulu Sg. Sekaloh, Niah river *Benang ak Bubong S 27863.*

Saurauia reinwardtiana Blume
G. Subis area, Niah *Mohidin S 21680.*

SCROPHULARIACEAE

**Lindernia serrata* (Roxb.) O. Kuntze
Limestone. Niah *Haviland & C. Hose, Haviland 3511A.*

Torenia polygonoides Benth.

Niah *Haviland & C. Hose, Haviland 3508A.*

Vandellia sp.
Niah *Haviland & C. Hose, Haviland 3538A.*

SCHIZAEACEAE

Lygodium borneense Alderw.
G. Subis area, Niah *Mohidin S 21661.*

Lygodium circinnatum (Burm.*f.*) Sw.
In Subis forest on ground, Niah *Ahmad 87.*

Schizaea dichotoma (L.) Sm.
In forest on ground. Rumah Pasang, Niah *Ahmad 42.*

SELAGINELLACEAE

**Selaginella alutacia* Spring
Hanging on limestone rockface. Niah *Lord Medway 8956.*

**Selaginella hewittii* Hieron.
On damp limestone rockface. Niah *Mohiden 8960.*

Selaginella paxii Hieron.
G. Subis area, Niah *Mohidin S 21615.*

Selaginella phanerotricha Baker agg.
G. Subis area, Niah *Mohidin S 21693.*

Selaginella cf. *roxburghii* (Hook. & Grev.) Spring
G. Subis area, Niah *Mohidin S 21699.*

SOLANACEAE

Nicotiana tabacum L.
Cultivated, Niah *Haviland & C. Hose Haviland 3536.*

STERCULIACEAE

**Sterculia coccinea* Roxb.
Tree 3.3 m tall. Base of limestone hill on limestone rocks. Path to Great Cave, G. Subis *J.A.R. Anderson S 31696.*

**Sterculia macrophylla* Vent.
Tree 30 m tall, 120 cm girth. On limestone rocks amidst alluvium by stream at base of limestone hill also on MDF with reddish clay loam soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27578*; Ulu Sg. Sekaloh, Niah *Erwin Wright S 29263.*

**Sterculia megistophylla* Ridl.
Small tree. On limestone rocks or scree *c.* 100 m a.s.l.. Vicinity of Niah Caves *B.C. Stone 13729.*

THEACEAE

Adinandra dumosa Jack

Tree 40 m tall, 300 cm girth. Lowland MDF 80 m a.s.l, soil sandy loam. Sg. Sekaloh, Niah N.P. Yii Puan Ching S 40137.

THELYPTERIDACEAE

Christella arida (D. Don) Holttum
1.3 m long. In Subis forest on ground. Niah *Ahmad 88.*

Christella subpubescens (Blume) Holttum
G. Subis area, Niah *Mohidin S 21621.*

Cyclosorus sp.
G. Subis area, Niah *Mohidin S 21684.*

**Pronephrium simillimum* (C. Chr.) Holttum
Terrestrial fern. In shaded or semi-shaded localities under large overhang 100 m up on steep limestone hill, light dry soil, partly composed of guano. Gua Pangomah, G. Subis, Niah *J.A.R. Anderson S 31690.*

Pronephrium sp.
On rock near entrance Niah Cave. Niah *Ahmad 39.*

THYMELAEACEAE

Gonystylus calophyllus[E] Gilg
Tree 5 m tall. Primary forest at base of sandstone hill, clay loam soil. Between mouth of Sg. Sekaloh and G. Subis, Niah *J.A.R. Anderson 27583.*

**Wikstroemia indica* (L.) C.A. Mey.
Shrub 1.7 m high. Crest of limestone hill, limestone pinnacles and 'mor' soil. Southern slopes of G. Subis, near Sekaloh river *Sonny Tan & E. Wright S 27277.*

TILIACEAE

Brownlowia sp.
Tree 27 m tall. In poorly drained area with dense primary forest. Niah N.P. *Rogstad 729.*

TRIURIDACEAE

Sciaphila sp.
G. Subis area, Niah *Mohidin S 21638.* (Mixed collection)

URTICACEAE

**Elatostema palioneurum*
Limestone. Niah *Haviland & C. Hose Haviland 3318H*

**Elatostema variolaminosum* H. Schr. var. *latum* Schrooter
Herb. On limestone ridge at 130 m a.s.l. G. Branchin, Ulu Sg. Subis, Niah N.P. *Yii Puan Ching S 40165.*

**Pipturus argenteus* (G. Forst.) Wedd.
Shrub *c.* 5 m tall. On limestone *c.* 167 m, also at the foot of limestone hill near stream at 20 m a.s.l. Niah Caves *Chew Wee-Lek CWL 312*: Ulu Sg. Subis, Niah N.P. *Bernard Lee S 40081.*

Pouzolzia zeylanica (L.) Benn.
Niah *Haviland & C. Hose Haviland 3319.*

VERBENACEAE

Clerodendrum fistulosum Becc.
1.3 m tall. In forest on ground. Niah *Ahmad 51.*

**Clerodendrum laevifolium* Blume
Herb or shrub 30—67 cm tall. Limestone forest at 80 m a.s.l. and on limestone in shelter of cave mouth, damp and partially shaded. Northern entrance to Great Cave and G. Subis area, Niah *G.D. Haviland & C. Hose Haviland 3556, Ahmad 79, Mohidin S 21602, J.A.R. Anderson, Sonny Tan & E. Wright S 26071, Yii Puan Ching S 40197.*

Stachytarpheta dichotoma (L.) Vahl
1–1.3 m tall. In jungle on wet ground. Kuala Tangap, Niah *Ahmad 20.*

VITACEAE

Ampelocissus capillaris Merr.
G. Subis Area. Niah *Mohidin S 21668.*

**Tetrastigma diepenhorstii* (Miq.) Latiff
Climber to 13 m tall. Primary lowland dipterocarp forest on clay soil and limestone hill, lower summit of ridge, limestone pinnacles and 'mor' soil. South side of G. Subis in Sekaloh river, Niah *J.A.R. Anderson, Sonny Tan & E. Wright S 27565;* Ulu Sg. Sekaloh, Niah river *Erwin Wright S 29139.*

VITTARIACEAE

**Antrophyum callifolium* Blume
Small terrestrial fern. In Subis forest on ground, also on limestone rocks, slope between caves, limestone rocks and residual soil, and as an epiphytic at base of trees, on trees mainly felled, habitat semi-exposed. Great Cave, G. Subis, Niah *J.A.R. Anderson 31920*; Niah *Ahmad 86.*

Vittaria elongata Sw.
G. Subis area, Niah *Mohidin S 21677.*

WOODSIACEAE

**Diplazium crinitum* (Baker) C.Chr.
Frond 1.3 m long. Below Niah cave on rock. Niah *C. Hose 1230*, *Ahmad 75,* G. Subis area, Niah *Mohidin S 21607.*

ZINGIBERACEAE

Alpinia sp.
2.7 m tall. Flower buds bright red. Lowland dipterocarp forest, alluvial soil beside stream. Ulu Sg. Sekaloh, Niah river *Sibat ak Luang S 27875.*

**Burbidgea stenantha* Ridl.
Herb, stem bronze. On vertical limestone, rooting in crevices, gully between limestone hill, limestone rocks and pavement, heavily dissected, mineral soil very sparse also on limestone wooded rocks. G. Subis *B.L. Burtt and P.J.B. Woods B 2007*; *J.A.R. Anderson 31669.*

Globba affinis Rendle
Herb 25 cm tall. Clayey soil not far from stream. Ulu Sg. Sekaloh, Niah *Erwin Wright S 29270.*

Plagiostachys strobilifera (Bak.) Ridl.
3 m tall. Flower buds bright red, fruits brown. Lowland dipterocarp forest, alluvial soil beside stream. Ulu Sungei Sekaloh, Niah river *Sibat ak Luang S 27874.*

Erratum from 'The Vegetation and Plants of Niah National Park, Borneo'

DRYOPTERIDACEAE
Tectaria andersonii Holttum. *J.A.R.Anderson S 31936* (not *S 31963*).

ORCHIDACEAE
Appendicula undulata Blume var. *longicalcatara* (Rolfe) Ames
Pearce et al. S 89489

Calanthe triplicata (Willemet) Ames
Jamree et al. S 89050, *Pearce et al. S 89270.*

Aglaia soepadmoi Pannell (Meliaceae), a New Species for Borneo

C.M. PANNELL

Daubeny Herbarium (FHO), Department of Plant Sciences,
University of Oxford, South Parks Road, Oxford OX1 3RB, U.K.

More species of *Aglaia* Lour. occur in Borneo than anywhere else in the range of the genus. Sixty species are known from the island, of which 12 are endemic. The species described here is a rare plant recorded from Lundu District in west Sarawak and from Sumatra. It belongs to section *Aglaia*.

Aglaia soepadmoi Pannell, **sp. nov.**
(Engkik Soepadmo, Coordinator and Chief Editor of the Tree Flora of Sabah and Sarawak project)

Aglaia soepadmoi ab *A. eximia* foliolis paucioribus latioribusque siccitate nervatura magis conspicua nervis lateralibus prominentibus et brochidodromis, reti subprominenti, venatione in pagina superiore tota impressa differt. ***Typus**: Othman et al. S 59970*, Borneo, Sarawak, Lundu District, Sungai Sebuloh, fl 15 August 1990 (holotypus SAR!; isotypus KEP!).

Small tree to 7 m. *Twigs* longitudinally channelled, densely covered with dark brown or blackish brown stellate hairs, with pale stellate scales interspersed. Leaves and inflorescences crowded near the apices of the shoots. *Leaves* usually imparipinnate, rarely lacking the terminal leaflet, to 95 cm long, 44 cm wide; petiole 22–28 cm long; the petiole, rachis and petiolules channelled and with hairs and scales like those on the twigs. *Leaflets* 9–11, shiny green above, densely covered with white stellate scales interspersed with dark brown hairs beneath; blades ovate or elliptical, the terminal one often markedly obovate, 15.5–24 x 6–9 cm, base cordate, apex acuminate, acumen acute to 16 mm long, sometime obovate and apex rounded; midrib and lateral veins impressed and reticulation visible above; midrib prominent, lateral veins 11–17 pairs, ascending and markedly curved upwards at the margin, nearly or quite anastomosing, subprominent and reticulation slightly prominent beneath; petiolules 0.5 cm long. *Inflorescences* to 17 x 9 cm, densely covered with indumentum like that on the twigs. *Flowers* sessile, subglobose, *c.* 1.3 x 1.3 mm; calyx divided into 5 lobes, densely covered with reddish-brown stellate hairs and scales outside; petals 5; staminal tube obovoid, with a shallowly lobed aperture *c.* 0.2 mm across; anthers 5, almost as long as the staminal tube, inserted longitudinally and visible through the aperture; ovary subglobose, stigma ovoid with two apical lobes. *Infructescences c.* 18.5 cm long. *Fruits* indehiscent, subglobose, *c.* 2 x 2 cm, densely covered with dark brown stellate hairs with a few white hairs interspersed.

Distribution: Known by two collections from Sumatra and five collections from Sarawak (including the type).

Specimens examined: SUMATRA. South Sumatra, Lampong Prov., Mt Tanggamus, fr. 1 May 1968, *Jacobs 8190* (KEP, L); West Sumatra, Pasaman, Mt Talamau (Ophir), fl., 8 Nov. 1984, *Laumonier YL 6692* (FHO). SARAWAK. Lundu District, Sungai Sebuloh, young fl 15 Aug. 1990, *Othman et al. 59970* (KEP, SAR), young fr 27 Nov. 1991, *Othman et al. S 63857* (SAR); Datu Permanent Forest, fl., 17 May 1980, *Bernard Lee S 41873* (FHO, KEP, SAR); Gunung Gading, fl., 7 June 1991, *Yahud et al. S 54873* (SAR); Gunung Gading, Sekamal, 12 Dec 1995, *S.T. Lai et al. S 54426* (KEP, SAR).

Ecology: Lowland dipterocarp forest, disturbed forest and rocky terrain in beach forest, up to 1100 m altitude.

Notes: *Aglaia soepadmoi* differs from *A. eximia* in having fewer, broader, leaflets, with more conspicuous venation when dry. The lateral veins are prominent and looped at the margins, the reticulation is subprominent. All venation is impressed on the upper surface.

Acknowledgements

The author thanks the following: Dr Engkik Soepadmo, who confirmed to me that this species is distinguishable from *Aglaia eximia* Miq., to the Directors, Curators and staff of the Forest Research Institute of Malaysia and the Forestry Departments of Sabah and Sarawak for inviting me to work in their herbaria, to Dr Robert Mill of Edinburgh Botanic Garden for latinising the diagnosis and to Joseph Pao (SAR) for preparing the illustration.

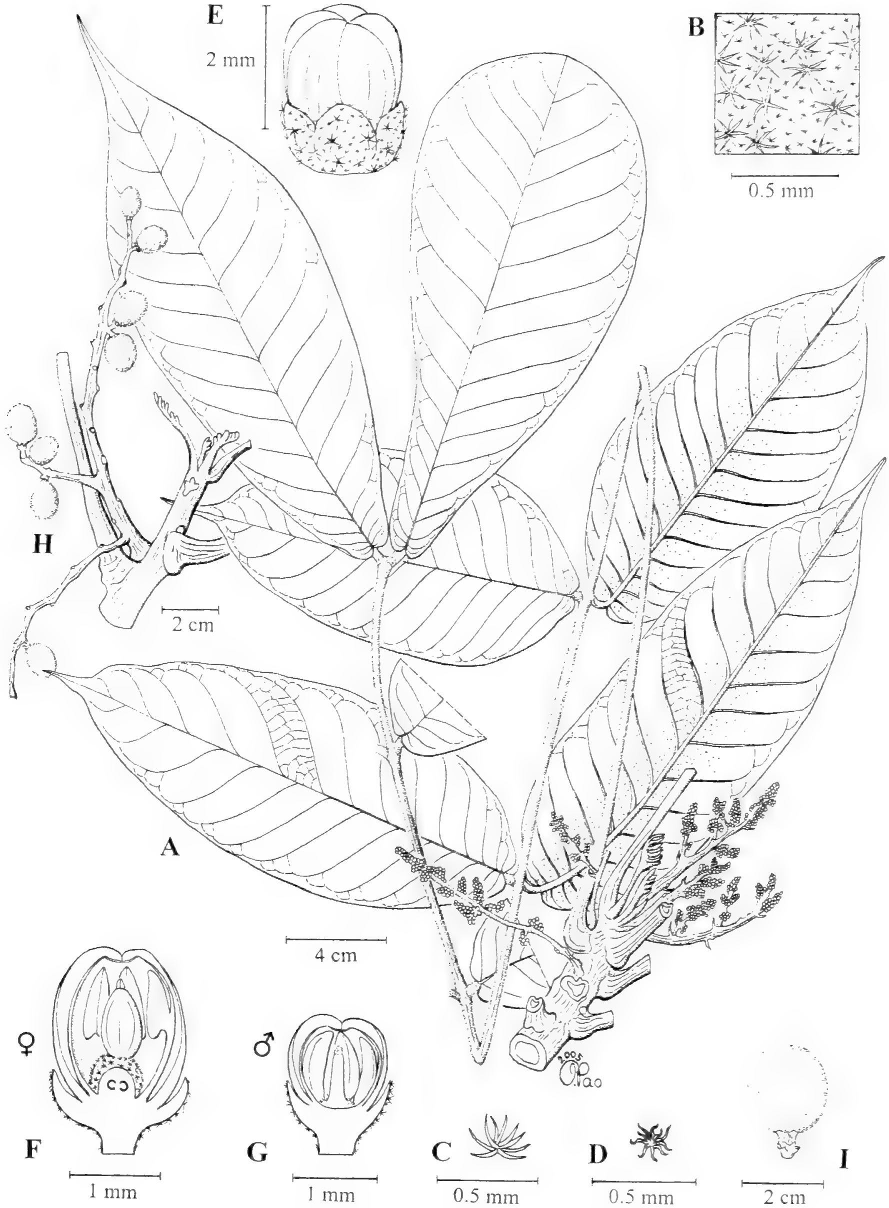


Figure 1. ***Aglaia soepadmoi*** Pannell. A, leafy twig with young male inflorescences; B, detail of lower leaflet surface showing indumentum; C, stellate hair; D, stellate scale; E, female flower; F, longitudinal section of female flower; G, longitudinal section of young male flower; H, young infructescence; I, young fruit. (A, B, C, D and G from *S 41873*; E and F from *S 59970*; H from *S 54426*; I from *M. Jacobs 8190*).

Curcuma roscoeana Wall. (Zingiberaceae) in India

J. ŠKORNIČKOVÁ [1,2] AND M. SABU[1]

[1]Department of Botany, University of Calicut, 673635 Kerala, India

[2]Department of Botany, Charles University, Benátská 2,
Prague, 12802, Czech Republic

Abstract

Collections from the Andaman Islands, formerly determined to *Curcuma kurzii* King *ex* Baker or *C. petiolata* Roxb., match *C. roscoeana* Wall. A detailed description from living material, a colour plate, as well as historical and nomenclatural details are provided and lectotypes are designated for *C. roscoeana* and *C. kurzii.*

General Introduction

The genus *Curcuma* L., with an expected total of *c.* 120 species, occurs throughout tropical and sub-tropical Asia with a few species extending to Australia and the Pacific region (Škorničková *et al.*, 2004). It is of great economic and ornamental importance and at the same time is one of the genera within the family Zingiberaceae with polymorphic species, which has caused confusion with species delimitation.

The first author is revising *Curcuma* in India. To date some 30 species have been reported (Škorničková *et al.*, 1989; Jain and Prakash, 1995; Velayudhan *et al.*, 1996; Škorničková and Sabu, 2002), including several new taxa and new records (Škorničková Balachandran, 1983; Bhat, 1987; Mangaly and Sabu, 1988; Mangaly and Sabu, 1993; Tripathi, 2001; Škorničková *et al.*, 2003a, b; Škorničková *et al.*, 2004).

Our studies show that specific delimitation within the genus, synonymy and even the identities of some of the commonly cultivated taxa are quite confusing and that names are often misapplied. The main reasons include the following.

1. Many taxa described at the beginning of 19th century have scanty protologues and type specimens, if they were cited, are either lost or have deteriorated.
2. The characters used to delimit species in *Curcuma* are not obvious on herbarium sheets. This applies particularly to shape

and colour of the rhizome, position of the inflorescence, colour of the bracts, and floral characters such as the shape of the anther spurs, the colour and shape of floral parts.

3. Notes on herbarium labels made by people not familiar with the floral structure of this genus can be quite misleading.
4. Many species are superficially very similar and, without a detailed description based on living material, are difficult to determine.
5. The huge area of the Indian subcontinent and the rather high variability among seed-setting species result in some species being described repeatedly under different names.

These points demonstrate clearly that fieldwork and observation of flowering material, especially from the type locality or nearby, together with a search for original historical material are key to an accurate understanding of the genus *Curcuma*. During the course of our work we intend to address and clarify individual problems connected with the taxonomy and nomenclature of Indian representatives of the genus.

What is *Curcuma kurzii* King *ex* Baker?

Curcuma kurzii was described by Baker (1890) in *The Flora of British India*, under the heading 'imperfectly known species'. The description is based on King's manuscript and consist of two lines: 'nearly allied to *C. petiolata*, but leaves larger, petioles longer, scape longer, bracts more imbricating, and their tips less spreading. – S. Andaman Islds'. From this we presume that Baker was dealing with herbarium specimens and that he had had no opportunity of seeing live material of *C. kurzii*. It is not surprising that he found this plant closely allied to *C. petiolata* because in general habit these two species are indeed very similar and the fertile bracts of both species form rather deep pouches. Colours and delicate flower parts are very rarely preserved in herbarium material and, as we have confirmed, they are not present on the presumably original material collected by S. Kurz from South Andaman Island at CAL and K. Balakrishnan and Bhargava (1984), Srivastava (1998) and Tripathi and Prakash (1998) treated *C. kurzii* as conspecific with *C. petiolata* Roxb.

During our fieldwork in the Andaman Islands, April–June 2002, we collected sterile specimens of *Curcuma*, assuming that it would be *C. petiolata* based on the earlier work of Balakrishnan and Bhargava (1984). Rhizomes were successfully transplanted to Calicut University Botanical Garden and, in late November 2002, one of them flowered, followed by others in the autumn of 2003 and in 2004. Though we found them identical to the description given by Balakrishnan and Bhargava (1984), they neither matched the protologue, nor the descriptions and colour drawings of *C. petiolata* given by Roxburgh (1820) and others (Roscoe, 1827; Hooker, 1870).

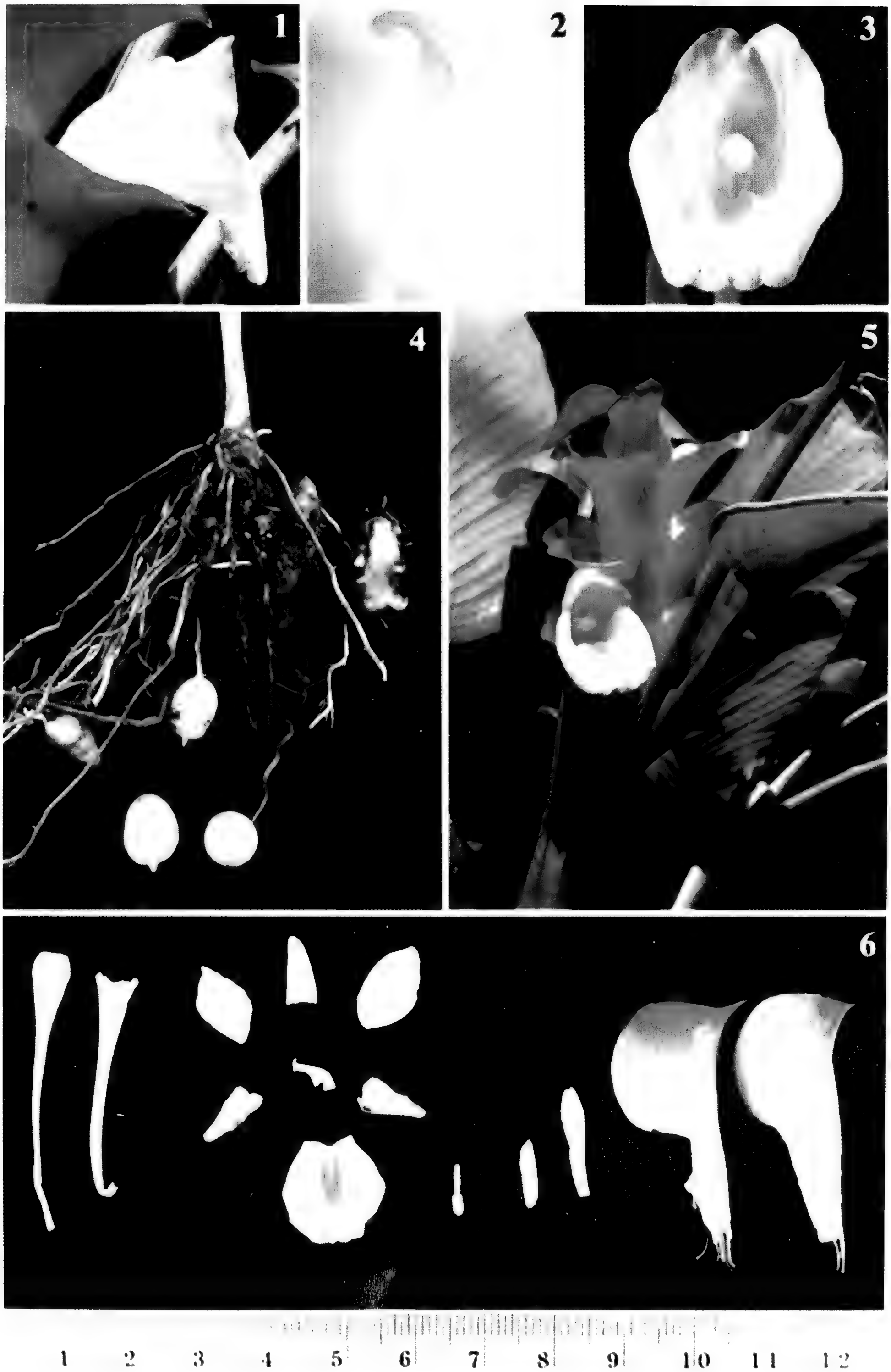
In contrast to the original description of *Curcuma petiolata*, our plants had no distinct coma, the whole inflorescence was bright orange-red, the bracts gradually becoming yellow-green towards the base, and the flowers were longer than the bracts and slightly exserted. Most strikingly, the bracts were arranged in rows. These characters led us to determine our material as the Burmese species *C. roscoeana* Wall. This was confirmed by consulting researchers recently working on the genus *Curcuma* and comparing our plant with photographs of *C. roscoeana* from Thailand and Burma, where this species is found in wild and is widely cultivated.

As other seed-setting taxa, it shows a considerable degree of variability leading to the opinion that there are no grounds for keeping *C. kurzii* as a separate species or even as a distinct variety. Thus, *C. kurzii* is treated here as conspecific with *C. roscoeana* Wall. and as such is an addition to the Indian flora. A detailed description is given to include characters observed from living plants (*Škorničková* and *Prasanthkumar 73309, 73310*), which flowered at CUBG during September-November 2002, 2003 and 2004 (Plate 1.).

Curcuma roscoeana Wall. Pl. Asiat. Rar. I. (1829) 8, t. 9 – *Hitchenia roscoeana* (Wall.) Benth. in Benth.& Hook.*f.* Gen. Pl. 3 (1883) 643. – *Hicheniopsis roscoeana* (Wall.) Loes. Nat. Pflanzenfam. ed. 2, 15(A) (1930) 572. – **Type:** Wallich. Pl. Asiat. Rar. t. 9. (lectotype; designated here).
Curcuma coccinea Wall. *ex* Baker, in Hook. *f.*, Fl. Brit. Ind. 6 (1890) 216, *nom. nudum* (in syn.) *C. kurzii* King *ex* Baker, in Hook. *f.*, Fl. Brit. Ind. 6 (1890) 216, ***syn. nov.*** –**Type:** Andaman Islands, South Andaman, Smith Point, *S. Kurz s.n.* (K!, lectotype, designated here; CAL! [Acc. No. 467218], isolectotype); Andaman Islands, South Andaman, without exact locality, *S. Kurz s.n.* (K!, G!; putative isolectotypes).
C. petiolata auct. non. Roxb. Balakrishnan & Bhargava. J. Bombay Nat. Hist. Soc. 81 (1984) 512; Srivastava S.K. Indian J. Forest. Add. Series X. (1988)16; Tripathi & Prakash. J. Econ. Taxon. Bot. 22 (1998) 468.

Rhizomatous herb, to 90 cm tall. *Rhizome* ovoid without branches (rarely with one branch, which later turns into another main rhizome), *c.* 3–4 x 1–2 cm (increases with age), light brown externally, sheathed by bases of the leaf sheaths, which leave vertical scars after decaying, creamy-yellowish inside, not aromatic. Roots many, penetrating deeply into soil terminating with small ovate tubers 0.5–2 x 0.5–1.5 cm, 2–15 cm from the main rhizome, externally light brownish, glabrous, white internally. *Leafy shoot* 30–90 cm, *pseudostem* 15–25 cm long formed by leaf sheaths and a few sheathing bracts (conspicuous especially at the beginning of the season, later drying and decaying), softly pubescent, hairs 0.2 mm long, green with deep red-violet tinge, *ligule* obscurely bilobed, 1.5–2.5 mm long, greenish translucent, hairy on the margin, hairs 0.5 mm. *Leaves* 3–4 at the beginning of the season, later to 8, *petiole* 7–25 cm long, shorter in the first leaves, gradually longer in older leaves, deeply channelled, green or with reddish-violet tinge, glabrous; *lamina* oblong-ovate, *c.* 16–35 x 5.5–13 cm (first leaves smallest), glabrous on both sides, adaxially green, with prominent veins *c.* 0.7–1 cm apart, abaxially pale green; margin hyaline, white, 0.2 mm broad, tip *c.* 1.5 cm long, acuminate, base rounded to cordate, slightly oblique, midrib green, glabrous. *Inflorescence* always central. *Peduncle* 15–28 cm, green, glabrous, most of it hidden within the pseudostem. *Spike c.* 8–15 x 4–7 cm, cylindrical, consisting of 15–45 bracts arranged in 3–5 serial rows, base of spike attenuate formed by deep pouches of lowermost fertile bracts. Size of the spike and number of bracts and rows increase with the age of plants. *Coma bracts* similar in colour and size to fertile bracts, sterile *c.* 5–7, spirally arranged. *Fertile bracts* obovate-spatulate, *c.* 3.5–4.5 x 2.5–3 cm, deep orange-red in upper part gradually becoming yellow–greenish at their base (character which can be often seen in herbarium specimens as highly glossy yellowish patch at the base of bracts, provided plants were processed by the dry method) lower half forming deep funnel-shaped pouches subtending cincinnus of 2–4 flowers, upper part spreading, glabrous or shortly hairy, usually more hairy outside, margin shortly hairy, hairs 0.2–0.3 mm long. *Bracteoles* one per flower, 5 x 3 mm, hyaline, creamy-white, glabrous. *Flowers* 4.5–5.5 cm long, cream-white with yellow in the centre of lip, slightly exserted from the bracts. *Calyx* 14–16 mm long, translucent white, glabrous, obscurely 3-toothed, unilaterally split 4–5 mm. *Corolla tube* 3–3.5 cm, creamy white, glabrous, dorsal corolla lobe 0.9–1.1 x 0.5–0.7 cm, obtuse, creamy white, glabrous, lateral lobes 0.9–1 x 0.4–0.6 cm, creamy white, glabrous. *Labellum* 1.4–1.6 x 1.7–2 cm, slightly emarginate, split *c.* 1 mm, creamy white with deep yellow patch in the centre, yellow-coloured area raised and swollen, forming a channel in the middle of labellum (especially at the basal part of the labellum). *Lateral staminodes* unequally rhomboid, 12–15 x 8–9 mm, creamy white, glabrous. *Anther c.* 5

Plate 1. *Curcuma roscoeana Wall.* from the Andaman Islands 1. Flower in bract (side view); 2. Anther (lateral view); 3. Flower (front view); 4. Rhizome; 5. Inflorescence (young plant, *c.* 2–3 years old); 6. Flower (dissected). (*Škorničková & Prasanthkumar 73309*). *Photo J. Škorničková.*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mm, yellowish white with yellow at apical part, anther thecae 3–4 mm long, whitish, dehiscing by basal pore, filament 2–3 mm long, 3.5 mm broad at base, 2.5 mm broad at upper part. *Anther spurs* absent. *Anther crest* 1.5 mm long, hyaline, yellow, rounded, terminally recurved. *Ovary* trilocular, 2–2.5 x 1.5–2 mm, white, glabrous, ovules many. *Stigma* 1.4 x 0.7 mm, translucent white, ciliate, cilia 0.3 mm, surrounded by anther crest, not exserted. *Epigynous glands* 2, creamy-white, 4–5 mm long, 0.5 mm diameter. *Fruits* not seen.

Specimens examined: INDIA, North Andamans: Sitanagar forest, 15.V.1982, *M.K. Vasudheva Rao 9032* (CAL, PBL); Laksmipur, 23.XI.1976, *N.G. Nair 4881* (PBL, L-digital image seen); Mayabunder, 6.XII.1992, *B.K. Sinha 16263* (PBL); Mayabunder Dt., Chainpur, 19.V.2002, Skornicková & *Prasanthkumar 73310* (CALI, SING); Mayabunder Dt., Chainpur, 19.V.2002, Skornicková & *Prasanthkumar 73309* (CALI); Middle Andamans: Bakultala, 6.XI.1979, *N. Bhargava 6406* (CAL, PBL, K); Mayabunder, 31.VII.1974, *N. Bhargava 1941* (CAL, PBL); South Andaman: Coatering Cave, *S. Kurz s.n.*, Acc. No. 467217 (CAL); Baboo ghat, 7.VII.1894, *King's coll. s.n.*, 3 nos (CAL); Saroah Creek, Baratang, 25.X.1979, *D. Basu 7351* (PBL); Andamans, *sine loc*: 22.VIII.1898, *G.H. Mann s.n.* Acc. No. *467212* (CAL); *sine loc., HBC s.n.* Acc. No. *467207* (CAL); Bom. Lung. Jang., X.1915, *Parkinson 678* (DD); Jharkhand: Singbhum, IX. 1900, *H.H. Haines 331* (K, CAL); Parasnath, 30. IX. 1873, *C.B.Clarke 20181* (CAL); Chota Nagpur, 4. IX. 1875, *J.J.Wood s.n.* (K); Western Bengal & Behar: *S. Kurz s.n.*, Acc. No. 467109 (CAL); BANGLADESH: *Sine loc., Griffith 5724* (K); BURMA (MYANMAR), Repu Irawaddi ad Scandwya, *Wallich* 6597B (CAL); Upper Burma, 1897, *Veitch & sons s.n.* (K); Rangoon District: Rangoon, *sine dat., M. Sellan s.n.* (E); Hanthawaddy, 25.VIII.1932, *Parkinson 14831* (DD); Prome Road, 24.VIII.1932, *Parkinson 14831* (DD); Kamaynt, 24.VIII.1932, C.E. *Parkinson 14629* (DD); Pegu, *McLeland s.n.*, 2 nos (K); Pegu, *sine dat., sine coll.*, 2 nos (CAL); Minbu District: Dwe Chaung, 23.XI.1937, C.E. *Parkinson 79677* (DD); Tenasserim, Tavoy Dt., Paungdaw, IX. 1961, *Keenan et al. 1502* (E, K); South Tenasserim, Leikpok Chaung Mergui, 1925, *Mr. Braybon's collector 223* (DD); Tenasserim and Andamans, *Herb. Helfer 5711* (CAL); Toungoo Dt., Dongzayit, 4.VII.1911, *J.H.Lace 5391* (CAL, E, K); *sine loc.* 1880 *D. Brandis s.n.* (DD); THAILAND: Chiang Mai, 1965, *Johnston s.n.* (BM); Chiang Mai, Queen Sirikit Bot. Garden, 10. VII. 1999, *C. Ngamriabsakul 41* (E); Hin Dat, Kanburi, 2. VII. 1926, *Put 73* (BM, K); Muang Ngao, Lampang, 15. VII. 1931, *Put 3996* (K); Maehongson, Khon Yuam, 5. IX. 1974, *Larsen & Larsen 34161* (K); Wangka, 2. – 4. VII. 1946, *Kostermans 799* (K); *sine loc.*: VI. 1854, No. 26 (CAL), *sine dat., sine coll.*

(BM); VIII. 1862, *sine coll.* (BM); 1845-47, Galathea Expedition, *Herb. Wallich 841* (C, KIEL).

Distribution: So far only known to occur wild in Myanmar, Thailand and India, but widely cultivated elsewhere for its ornamental value and bred as a cut flower and pot plant. The only confirmed field observations of *Curcuma roscoeana* in India are from the Andaman Islands. It is interesting to note, however, that we have found in CAL and K four herbarium specimens of *C. roscoeana* collected from forests in Jharkhand and West Bengal/Behar by different collectors between 1875 and 1900, which bear the remark 'bracts orange red' or 'spike uniform dark yellow orange' and the shape and arrangement of the bracts leaves no doubt as to their identity. Since then, the species has not been recollected from these areas, even though we made an effort to search near to these localities. Another interesting find at K is a specimen of *C. roscoeana* (*Griffith 5724*) collected in East Bengal (Bangladesh) as part of the Herbarium of the East India Company and distributed by RBG Kew during the years 1863-64. As far as we can ascertain, this is the only evidence of *C. roscoeana* from Bangladesh, but it is not clear if it was collected from wild.

Lectotypification

Wallich described *Curcuma roscoeana* in *Plantae Asiaticae Rariores* (1829) but did not designate type specimens nor cite any herbarium material. The description of *C. roscoeana* is accompanied by a plate (No. 9), an excellent colour icon, where the whole plant as well as the dissected flower are depicted. The type locality is given as "Pegu et ad oram Tenasserim".

Wallich's specimens can nowadays be found in about 46 herbaria, the main set being deposited at K-W (Stafleu and Cowan, 1988). His '*Catalogue*' or more correctly '*Numerical List*' (1829–1832 + supplements 1847–1849) lists all *Curcuma* species between numbers 6594–6613. They were thus published in 1832 (Anon., 1913). There are two entries for *C. roscoeana*, 6597A collected in Rangoon and 6597B marked as Repu Irawaddi ad Scandwya (Burma), both collected in 1826 as per entry in the *Numerical List*. Forman (1997), writing on typification of Roxburgh's names, explained that, for the purpose of interpreting the name of the species, there are many instances where the illustration is far superior to the corresponding specimen and therefore the drawing would be much preferable as the type. While studying Wallich's collections in various herbaria, we have encountered the problem that some of Wallich's duplicates bearing the same number do not always belong to just one taxon. Moreover, some of his sheets comprise mixed collections, which is, for example, obvious in the case of the *C. roscoeana* specimen 6597B deposited in CAL, where only one of the two plants on this sheet belongs to this species, the other being an undeterminable *Curcuma* species with a lateral inflorescence. Considering this confusion with specimens, we therefore propose to designate Plate 9 published together with the original description in *Plantae Asiaticae Rariores* as the lectotype of *C. roscoeana.*

After critical analysis of Wallich's original description and drawing of *Curcuma roscoeana* (Wallich, 1829), we cannot but admit that it fits our Andaman plant including important floral details such as the shape of the anther without basal spurs, but with a well-developed anther crest, which is precisely depicted in Wallich's drawing. Other drawings and descriptions of *C. roscoeana* were published in *Botanical Magazine* No. 4667 (Hooker, 1852), in 1854 by Lemaire in *Le Jardin fleuriste* and a short description without a drawing was published by Dammer (1890). It is interesting to note that the type locality of *C. roscoeana* (Pegu, on the coast of Tenasserim) is just opposite the Andaman Islands. The possibility of plants being introduced into the Andamans cannot be ruled out.

Apparently all specimens of this taxon from the Andamans collected by Bhargava and other workers between 1979–1992 and deposited in PBL (all determined as *C. petiolata*) are identical with several sheets from the Andamans deposited at CAL and K (determined as *C. kurzii* or *C. roscoeana*). They also match all other sheets of *C. roscoeana* deposited at BM, C, CAL, DD, E, K, KIEL and L. Some of the sheets designated as *C. kurzii* were collected by S. Kurz from the Andaman Islands and presumably represent the original material, which was accessible to King and subsequent workers. One sheet at K bears the remark "*C. kurzii sp. nov. King ms.*" Thus, we propose to designate this sheet as lectotype and the other Kurz collections as isolectotypes of *C. kurzii.*

Other historical sheets of this taxon from the Andamans worth mentioning are Dr. King's collections in 1894 designated as *C. kurzii* (CAL) and two other sheets collected by Mr. Mann and an anonymous collector annotated as *C. roscoeana* (CAL).

Recently, *C. petiolata* was reported from Arunachal Pradesh in NE India by Tripathi and Prakash (1998). Their description and illustration do not match well with either *C. petiolata* or *C. roscoeana*, neither does the specimen cited by them (*Tripathi 21838*, CDRI!). Thus, the presence of *C. petiolata* in India has yet to be confirmed. The differences between *C. roscoeana* and *C. petiolata* are shown in Table 1.

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Table 1. Comparison of important morphological characters of *Curcuma roscoeana* Wall., *C. petiolata* Roxb. and *C.* sp.*'petiolata' sensu* Tripathi and Prakash. Main diagnostic characters are in bold.

	C. roscoeana Wall.	*C. petiolata* Roxb.	*C.* sp.*'petiolata' sensu* Tripathi and Prakash
Main rhizome	Ovoid **unbranched**, (rarely with one branch), inwardly creamy-yellowish.	**Branched**, branches few and small, inwardly pale yellow.	**Branched**, branches few, inwardly pale yellow in centre, greyish towards margins.
Inflorescence	*Fertile bracts* **orange-red, with yellow at base, arranged in conspicuous 3-5 rows**. *Coma* **inconspicuous, uppermost sterile bracts orange-red.**	*Fertile bracts* **light green, bracts spirally arranged.** *Coma* **conspicuous, lilac coloured.**	*Fertile bracts* **yellowish, orange at the tip,** arrangement not mentioned. *Coma* **conspicuous, bracts pinkish-orange or pinkish-purplish**.
Flower	Longer than the bracts, **slightly exserted** from the bracts.	Small, **not exserted** from the bracts.	As long as or **shorter than the bracts**.
Anther	**Spurs absent. Anther crest present, prominent.**	**Spurs present. Anther crest present, small.**	**Spurs absent. Anther crest short** (as per description, but missing in illustration).

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The Identity and Distribution of *Curcuma zanthorrhiza* Roxb. (Zingiberaceae)

J. ŠKORNIČKOVÁ [1,2] AND M. SABU [1]

[1]Department of Botany, University of Calicut, Kerala 673635, India

[2]Department of Botany, Charles University, Benátská 2, Prague, 12802, Czech Republic

Abstract

Curcuma zanthorrhiza Roxb., a widely distributed and utilized Asian species, has been misidentified in India for over 100 years. A description and colour plate of *Curcuma zanthorrhiza* are provided, with additional notes on *C. zedoaria* (Christm.) Roscoe and *C. aromatica* Salisb., which are two common misidentifications of *C. zanthorrhiza* in India. It is postulated that it is of South Indian origin and has been widely distributed by the Srivijaya civilisation that spread through SE Asia long before Western domination.

Introduction

Skornicková and Sabu (2005) provided a general introduction to the genus *Curcuma* and pointed out that the identities of many *Curcuma* species described in earlier taxonomic publications from India, including those commonly used and cultivated, are still very often unclear. One such case is discussed here in detail.

A large, handsome *Curcuma* species is widely grown in South India. It has a red patch along the midrib of the leaves that penetrates to the lower surface, a lateral inflorescence, a large branched rhizome and root tubers, which are deep orange colour inside. Resembling true turmeric (*C. longa* L.) in its orange rhizome, this is one of the most common *Curcuma* species used by local women as a face rub, medicine and sometimes also as a substitute for true turmeric.

This species is mostly referred to in both old literature and in recent Indian floras as *Curcuma zedoaria* (Christm.) Roscoe or as *C. aromatica* Salisb. Further investigation shows that descriptions of *C. zedoaria* and *C. aromatica* in the Indian literature are often confusing and misleading. These publications usually contain either a very short description based on earlier works with not many details particularly of diagnostic characters, or else they are obscure and do not match the original descriptions of either species. Descriptions of these two species in Indian floras fit our plant, however, or share a combination of characters appropriate for *C. zedoaria* and *C.*

aromatica. After critical examination of fresh flowering material, it was clear that the plant we have collected several times from different and quite distant localities was neither *C. zedoaria* (Christm.) Roscoe nor *C. aromatica* Salisb., but *C. zanthorrhiza* Roxb. and that there is a need to clarify the distinction between these three species.

Curcuma zanthorrhiza Roxb.

The name *Curcuma zanthorrhiza* first appeared as a *nomen nudum* in Roxburgh's *Hortus Benghalensis* (1814). A few years later Roxburgh described it from cultivated material in the Calcutta Botanical Garden, which had been donated in 1798 by C. Smith from Amboina (nowadays called Ambon) and which flowered for the first time in April and May 1810 (Roxburgh, 1820). The main character that caught Roxburgh's attention was the deep yellow internal colour not only of the branched rhizome, but particularly of the root tubers. Usually, root tubers in *Curcuma* species are either pure white or creamy or yellowish and much lighter in colour than the central part of the rhizome and branches. Another prominent character mentioned in Roxburgh's original description is '*leaves broad lanceolar, and oblong; there is a narrow purple cloud down the middle of them, which penetrates to the underside.*'

Roxburgh (1820) in his original description did not cite any herbarium material. As explained by Forman (1997), the main difficulty in typification of Roxburgh's species lies in locating original material. Roxburgh apparently did not keep his own personal set and his collections can be found in at least 16 herbaria. Moreover, in many cases original labels have been discarded and replaced by newly written ones and, owing to lack of direct evidence, such sheets are less desirable for typification. Yet, for most of the species described by Roxburgh in *Flora Indica* there are fine life-size colour drawings, which usually also depict details of dissected flowers. Their importance has been emphasized by Sealy (1957) and further elaborated by Forman (1997) who concluded that in many cases the Roxburgh drawing is far superior to a corresponding specimen. This is particularly true for gingers considering the difficulties in preparing good and valuable specimens and the particular importance of the colours of various parts of *Curcuma* species (e.g. colour of rhizome, flower parts), which cannot be well preserved in herbarium specimens.

Recently, Newman *et al.* (2004) cited the type for *C. zanthorrhiza* as 'Icones Roxburghianae 2003 (CAL). However, there are two copies of the drawing No. 2003 available, one at Kand one at CAL (Sealy, 1957; Sanjappa, 1994) and *Flora Indica* drawings have never been officially published. Thus, one of them should be selected as the lectotype. We have been granted permission to access the *Icones Roxburghianae* at K only, leaving us unable to verify the presence and identity of a presumably identical CAL icon of *C. zanthorrhiza*.

Valeton (1918) and Holttum (1950) provided more detailed descriptions of *C. zanthorrhiza.* As already pointed out by Valeton (1918), Ridley in his earlier works (1899, 1907, 1909) also erred by associating *C. zedoaria* with the description and vernacular name *Temu Lawas*, both of which should undoubtedly be subsumed under *C. zanthorrhiza*. Subsequently Ridley (1924) cited *C. zanthorrhiza* with its proper vernacular name (*Temu Lawas*) as a cultivated species in the Malay Peninsula, but his description of *C. zedoaria* remained confusing. Based on the quite detailed descriptions of *C. aromatica* provided by Watt (1889) and Dymock *et al.* (1893), there is no doubt that they also misidentified *C. zanthorrhiza* for *C. aromatica* and that the English common names *Wild Turmeric, Yellow Zedoary* and *Cochin Turmeric* quoted by both Watt (1889) and Dymock *et al.* (1893) for *C. aromatica* are in fact common names of *C. zanthorrhiza*.

Curcuma zanthorrhiza Roxb., Fl. Ind. 1 (1820) 25. – **Type:** *Icones Roxburghianae 2003* (lectotype K!, designated here)
Curcuma xanthorrhiza Roxb., Syn. Pl. 1 (1839) 19., *orth. var.*
C. aromatica auctt. non Salisb.: G. Watt, Dict. Econ. Products India 2 (1889) 655–658; W. Dymock, Pharmacographia Indica 6 (1893) 396–398; K.S.Manilal, Fl. Silent Valley. (1988) 311–312.
C. zedoaria auctt. non (Christm.) Rosc.: Ridley, J. Straits Branch Roy. Asiat. Soc. 32 (1899) 119; Materials for a Fl. Malay Penins. (1907) 21; Philipp. J. Sci. 4 (1909) 166; Mangaly & M. Sabu, Rheedea 3 (1993) 168.

Rhizomatous herb to 2 m high. *Rhizome* branched, central part oblong, *c.* 8–10 x 6–8 cm, brownish orange outside, deep bright orange to yellow-orange inside, strongly aromatic with a carrot-like and camphoraceous smell and taste, slightly bitter, rhizome branches 5–15 cm long, 1.5–4 cm in diam., brownish-orange outside, deep yellow-orange to dark orange inside, youngest branches lighter in colour. *Root tubers* present at the end of 1–3 mm thick roots at 5–20 cm from the main rhizome or branches, elliptic, 3–8 x 1.5–3 cm, brown outside, usually with many small roots, deep yellow-orange inside, aromatic (less so than the main rhizome), bitter in taste. *Pseudostem* to 70 cm, green, composed of leaf sheaths and sheathed by 4–5 green bracts, innermost bracts as long as the pseudostem, outer ones gradually decreasing in length, *ligule* 2–3 mm, obscurely bilobed, hyaline, translucent greenish white, glabrous, hairy on the margin, hairs *c.* 0.3–0.5 mm; *leafy shoot* to 2 m tall. *Leaves* at the beginning of the season 1–3, later to 8; *petiole* 5–20 cm (first leaves almost sessile), winged on both sides, glabrous; *lamina* oblong-lanceolate to elliptic-lanceolate, the very first leaves more elliptic, *c.* 30–100 x 10–28 cm, glabrous on both surfaces, adaxially deep green with red patch along both sides of midrib, particularly conspicuous in young leaves, fading with age, abaxially lighter green, the red patch is also lighter but usually visible; midrib glabrous, green to reddish on the upper side, green below; margin translucent white, *c.* 0.7–1 mm wide, glabrous; tip acuminate, 2–3 cm, slightly hairy; base attenuate, decurrent. *Inflorescence* invariably lateral, arising together with the leaves or shortly before. Peduncle 10–30 cm, 0.8–2 cm diam. (without scales), green, glabrous, sheathed by 4–6 green, glabrous sterile bracts, innermost bract longest, outer ones gradually smaller. *Spike c.* 15–25 (–30) x 8–14 cm. *Coma* present, forming upper third of inflorescence length, coma bracts oblong-elliptic, *c.* 10–17, 6.5–8.5 x 2.5–4 cm, pink to deep reddish-pink, shortly hairy on both surfaces, hairs 0.1–0.2 mm long, tip slightly mucronate, hairy, lower coma bracts sometimes fertile, upper ones sterile. *Fertile bracts* roundish-oblong, 5–6 x 4–5 cm, green, tips tinged with pink, almost glabrous, connate to one another in the lower third. *Cincinni* with 5–7 flowers. *Bracteoles* one per flower, ovate, boat-shaped, *c.* 3.5 x 2 cm to 1.5 x 0.7 cm (outer one larger, inner ones are gradually smaller), translucent white, glabrous, but the tip, upper part and margins sparsely hairy. *Flowers* 5–6 cm, as long as the bracts. *Calyx* 10–11 mm long, translucent white sometimes with a slight pink tinge, sparsely hairy, unilaterally split for 4–5 mm, apex with 3 teeth. *Corolla tube* 3–3.8 cm long, outside light yellow in the lower part with a light pink tinge in the upper part, glabrous, inside yellow, constricted c. 2.3 cm above the ovary, constriction densely hairy; *dorsal corolla lobe* 1.5–2.1 x 1.3–2 cm, triangular ovate, concave, glabrous, light pink or pink, apex mucronate, mucro 2–3 mm, lighter in colour, hairy, hairs 0.2–0.3 mm; *lateral corolla lobes* 1.5–1.8 x 1.5–1.7 cm, triangular with a rounded slightly concave tip, glabrous, light pink to pink, usually slightly overlapping each other at the base. *Lateral staminodes* obovate, 1.3–1.5 x 0.9–1.1 cm, light yellow, glandular hairs present on the raised middle portion. *Labellum* 1.7–2 x 1.8–2 cm, obscurely trilobed, lateral lobes folding upwards, emarginate, split *c.* 3 mm, light yellow at the periphery, deep yellow in the centre (golden median band). *Anther* spurred, glandular hairs present on the sides and back part of the anther, anther thecae 3.5–4 mm long, white; filament 4–5 mm long, light yellow, 3.5–4.5 mm at base, 2.5–3

Plate 1. *Curcuma zanthorrhiza* Roxb. 1. Midrib of leaf (adaxially); 2. Midrib (cross section); 3. Midrib of leaf (abaxially); 4. Inflorescence; 5. Habit; 6. Flower in open fertile bract; 7. Dissected flower; 8. Anther (front view); 9. Anther (side view); 10. Ovary and epigynous glands, cross section of ovary in upper left corner. (*'kornikov· 73302 & 84107*) *Photo J. Škorničková.*


1
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mm at the top. *Anther spurs* 3–4 mm long. *Stigma* white, ciliate, exserted from thecae by *c.* 1 mm. *Epigynous glands* two, light yellow, 4–5 mm long, 0.9–1mm diam. *Ovary* 4–5 x 3–4 mm, trilocular, hairy, hairs *c.* 0.3 mm. *Fruits* not seen.

Specimens examined: **AFRICA**: Congo, Eala, 1930, *Corbisier 980* (K); MADAGASCAR: II. 1880, *Hildebrant 3348* (BM); **CHINA**: Fokien, 7. VII. 1909, *Dunn 3547* (K); Wai-yeung, III. 1932, *Tsui 98* (K); **INDIA:** Kerala: Kasargod District: Nileshwar, 12.V.1982, *V.J.Nair 73856* (CAL, MH); Cannanore District: Peria R.F., 17.IV.1966, *J.L.Ellis 27113* (MH); Waynad District: Sulthan Bathery, Beenachi Estate, 14.V.2003, Škorničková *84126* (CALI, SING); Pallakad District: Silent Valley, *Sivarajan SV 10565* (CALI); Pallakad, 10.VI.1983, *sine coll.(J.K. Mangaly?) CU 10364* (CALI); Palai, 10.VI.1983, *J.K. Mangaly CU 10365* (E); Idukki District: Kulamavu, 23.IX.2003, Škorničková *84166* (CALI); Nadukani, 23.IX.2003, Škorničková *84172* (CALI); Kollam District: Dahli, 23.IV.2003, Škorničková *84107* (CALI, SING); Kottayam District, Vazhoor East, 8.IV.2002, *Prasanthkumar 86111* (CALI); Pathanamthitta District, Sabarigiri, 25.I.1984, *M. Sabu CU37315* (CALI); Pamba, Sabarimala R.F., 24.IV.1984, *Vajravelu 83580* (MH); Andaman Islands: Rangat District, Amkunj near Bakultala, 17.V.2002, Škorničková *73302* (CALI, SING); Jharkand: West Singbhum District, Khutpani, 5.VII.2003, Škorničková *73420* (CALI, SING); *sine loc*: Herb. Hort. Bot. Calcuttensis, *sine dat., Acc. No. MH 72400* (MH); Hortus Botanicus Calcuttensis, *sine dat., Acc. No. CAL 467008* (CAL); *sine col. et dat. Acc. No. CAL 466954* (CAL); *sine col.et dat., No. 1612* (DD); presented 1871, *Wight s.n.* (MH); *sine dat., Wight s.n.* (E); **SRI LANKA**: Gangaruwa, 22. VII. 1924, *Siwa 167* (PDA); **CAMBODIA**: Koh Kong, 3. I. 2000, *Meng Monyrak 115* (K); **MALAY PENINSULA**: Johore, 21.V. 1954, *Sinclair 8079* (E); Johore, 21.V. 1954, *Sinclair 40295* (BM, E, K); **SARAWAK**: Lubok Antu, 29. X. 1993, *Christensen 1353* (K); Lundu, 19.IX. 1955, *Purseglove & Shah P 4584* (K, SING); **JAVA:** Buitenzorg, *sine coll., Col. No. 42* (BO); West Java, VII. 2000, *M. Ardiyani 29 MA* (E); **SOUTH KALIMANTAN**: 8. XI. 1996, *Kessler et al. PK1755* (K); **PHILIPPINES**: Mindoro: Mansalay, IV. 1903, *Merril 908* (K); Luzon: San Francisco del Monte, *Loher 682* (K); VI. 1904, *Loher 7003*; 3. V. 1908, *Elmer 7003* (K); V. 1905, *Whitford 1267* (K); Manila, 17. V. 1890, *Loher 683* (K); **ORIGIN UNKNOWN**: 30. VII. 1999, *M. Ardiyani 80 MA* (E); 26. XI. 1978; *H.S. McKee 36132* (E).

Flowering: In India, April and May.

Distribution and habitat: Common in South West India where it grows in the edges of secondary forests or in the undergrowth. It is common in semi-wild conditions e.g., teak plantations, coconut groves, along roadsides and rarely also in high altitude grasslands (*c.* 1000 m a.s.l.), which suggests it is native in South India.

We have collected it also in the Andaman Islands from the garden of a Bengali family. It was certainly cultivated but its origin was obscure. Either it was brought from Bengal by their ancestors or other settlers, who came to the Andamans from South India, may have brought it. One recent collection was from a garden in Jharkhand, Central India, where this *Curcuma* plant is cultivated as a substitute for turmeric, *C. longa*. This is probably a recent introduction.

It is interesting to note that in India up to 1845 *C. zanthorrhiza* Roxb. was recorded only as cultivated in the East India Company's Botanical Garden in Calcutta from an introduction from Ambon (Roxburgh, 1814; Voigt, 1845). Thus, even though most probably native, widely distributed, naturalized, cultivated and commonly used in South India for centuries, *C. zanthorrhiza* is here recorded for the first time from India.

Since Roxburgh's time, *Curcuma zanthorrhiza* has been reported from Java (Valeton, 1918), Peninsular Malaysia (Holttum, 1950), Vietnam (Hô, 1993), Thailand (Larsen, 1996), the Philippines (Madulid, 1996) and China (Wu and Larsen, 2000). It is therefore not surprising that a species so widely distributed and frequently cultivated all over Asia occurs in India.

In addition to literature records, we found specimens looking identical to *Curcuma zanthorrhiza* from different parts of Africa, Madagascar, Sri Lanka, Cambodia, and Borneo (Kalimantan). From remarks on the sheets, it is obvious that most of the material was of cultivated origin.

It is difficult to establish where *Curcuma zanthorrhiza* is native because it is so widely distributed, cultivated and naturalized for centuries all over Asia and can now be found as far away as West Africa. Yet, there might be a historical explanation. During the first centuries A.D., the Srivijaya Civilisation of the Hindu Kingdom in South India started expanding through SE Asia. Based in eastern Sumatra, they dominated the Malacca and Sunda straits, which were the two main sea routes between the Indian Ocean, China Sea and Indonesia, and controlled the trade of the region. They heavily influenced cultures in SE Asia until the 13 century A.D., when Srivijaya had lost control. It is thus not surprising that the SE Asian region was, prior to Western dominance, known as *Greater India.* There is a possibility then that *C. zanthorrhiza* originated in the southern part of the Indian subcontinent and was introduced to other countries in SE Asia, perhaps as part of the spice and medicine trade. Dymock *et al.*

(1893) say that this plant is the *Vana-haridra* of Sanskrit writers (meaning 'wild turmeric') and also mention that it is the '*turmeric-coloured zedoary of Ainslie used by the Mahometans of Southern India as valuable medicine in snake bite...*' and say that it was well known to Rumphius (the Dutch botanist working in Ambon in the 17th century), who called it *Tommon bezaar* or *Tommon primum*. It was from Ambon that it was brought to Calcutta where Roxburgh published it as a valid binomial. Roxburgh did not work in South India so he did not realize it was native in there. And today we know *C. zanthorrhiza* does not occur in Central and Northern India, so he would have had no access to Indian material. This partly explains the long history of misidentifying of *C. zanthorrhiza* in South India.

Etymology & orthography: Greek: zanthos (yellow) rhizos (root or rhizome).

Curcuma zanthorrhiza versus *C. aromatica* and *C. zedoaria*

Curcuma. zanthorrhiza has for a long time been misidentified as *C. zedoaria* and *C. aromatica* in India. They are all early flowering species with a lateral inflorescence, which arises shortly before the leaves appear or simultaneously with leaves, sharing in common the pink conspicuous coma and yellow flowers. The main differences among these species are shown in Table 1.

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Table 1. Comparison of important morphological characters of *Curcuma zanthorrhiza* Roxb.. *C. aromatica* Salisb. and *C. zedoaria* (Christm.) Roscoe. Main diagnostic characters are in bold.

	C. zanthorrhiza Roxb.	*C. aromatica* Salisb.	*C. zedoaria* (Christm.) Roscoe
Main rhizome	branched. inwardly **deep bright orange to yellow-orange colour.**	branched. **inwardly cream to pale brown colour.**	branched. **inwardly cream to white-yellowish colour.**
Root tubers	**deep yellow-orange inside.**	**white inside.**	**white inside.**
Leafy shoot	**to 2 (-2.5 m) tall.**	**to 1.2 m tall.**	**to 1 m tall.**
Lamina	oblong-lanceolate to elliptic-lanceolate. **adaxially green with red patch along the sides of midrib, particularly conspicuous in young leaves, fading with age, protruding underneath.** glabrous, **abaxially lighter green and visible red patch (also lighter then on adaxial side), glabrous.**	oblong-lanceolate to elliptic- lanceolate. **adaxially bright green.** glabrous, **abaxially lighter green, densely shortly pubescent.**	oblong-lanceolate to elliptic- lanceolate. **adaxially green with red patch along the sides of midrib. particularly conspicuous in young leaves, fading with age.** glabrous. **abaxially lighter green. glabrous.**
Flowers	**5—6 cm long, as long as the bracts or slightly exserted.**	**5—6 cm long, longer than the bracts slightly exserted.**	**5—6 cm long, as long as the bracts or slightly exserted.**
Corolla lobes	**conspicuously pink to reddish.**	**white, sometimes with slight pinkish shade toward the tips.**	**nearly white or with very slight pinkish shade.**

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A New Species of *Rhaphidophora* Hassk. (Araceae-Monstereae) from Borneo

P.C. BOYCE

Malesiana Tropicals, Suite 9-04, Tun Jugah Tower,
No. 18, Jalan Tunku Abdul Rahman93100 Kuching, Sarawak, Malaysia

Abstract

Rhaphidophora typha P.C.Boyce, a new species from Borneo distinguished by its remarkably long peduncle and leaves abaxially grey-glaucous, is described and illustrated.

Introduction

Revisionary work on *Rhaphidophora* (Boyce, 1999, 2000a, 2000b, 2001a, 2001b) has highlighted that although Borneo has a relatively few species (13 species excluding the one described here), five (excluding that described here) are endemic compared with 15/1 (total/endemic) in Peninsular Malaysia and 15/4 in Sumatera. Thus Borneo, with the exception of the Philippine Islands (11/7), has the richest level of *Rhaphidophora* endemism in Sunda – although these data are insignificant compared with New Guinea and tropical Australasia (30/29). Boyce (2001a) speculated that the paucity of *Rhaphidophora* species recorded for Borneo was an artefact of inadequate collecting.

Since the above publications, the author has had the opportunity to spend an extended period undertaking fieldwork in Sarawak. While astonishingly productive in locating novel terrestrial aroids, this fieldwork has generally supported the impression that the species complement of climbing aroids in Borneo is, indeed, meagre. Nonetheless, undoubtedly further lianescent novelties still await discovery. One such novelty, a herbarium specimen originating from Brunei, was located during a study visit to the Singapore Herbarium (SING) in Janary 2004 and was subsequently collected in Sarawak. It is described here.

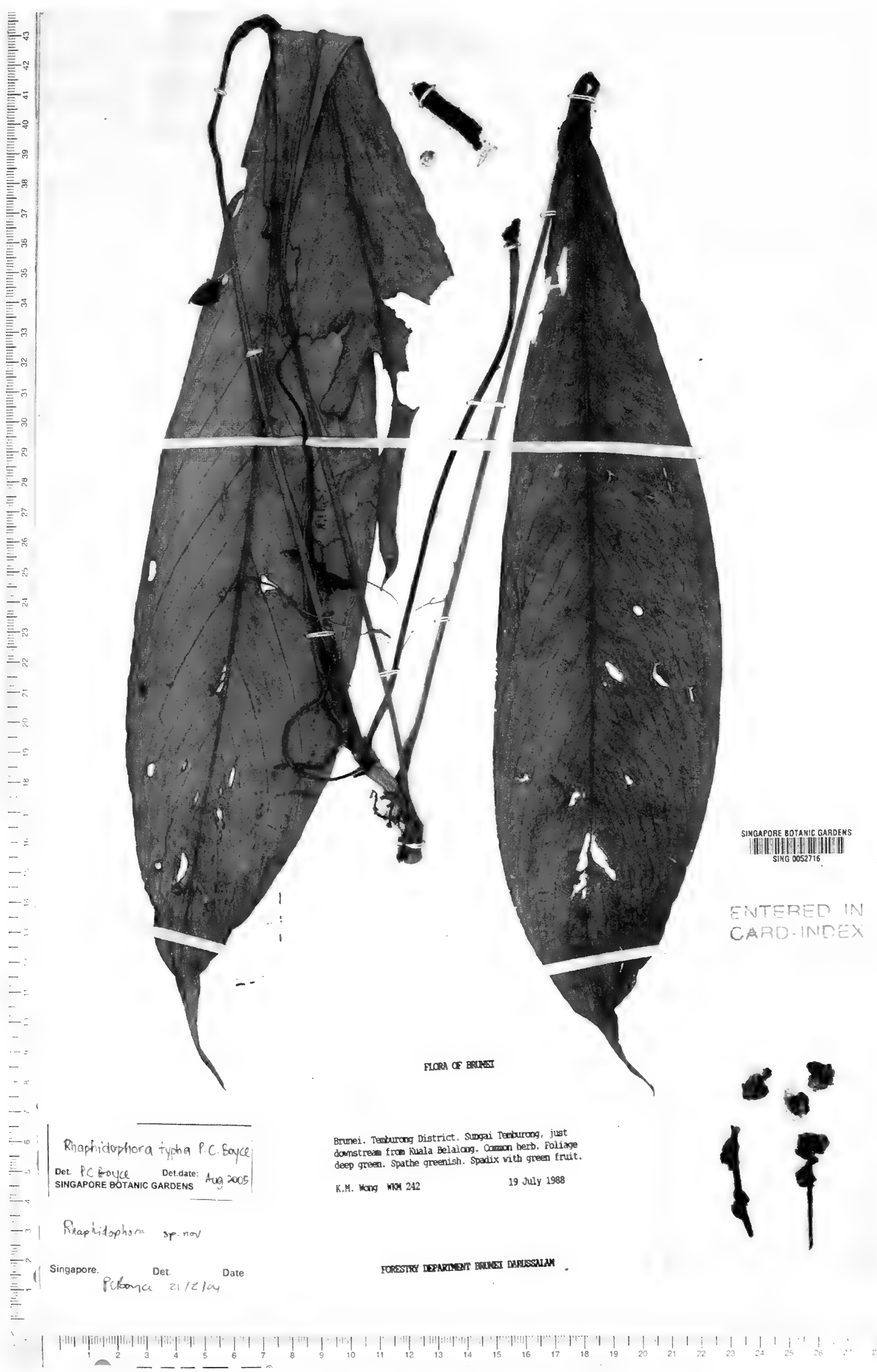
Rhaphidophora typha* P.C. Boyce, *sp. nov.

Rhaphidophora typha a pluribus speciebus generis Borneensibus combinatio foliorum subtus griseo-glauca, veneris laminorum valde reticulatis et pedunculum infloresecentia alta demi petiolorum laminae differt. – TYPUS: Brunei Darussalam, Temburong District. Sungai Temburong, just

downstream from Kuala Belalong. 19 July 1988, *K.M. Wong* WKM 242 (SING, holo!; BRUN!, K!, L!, iso).
Figure 1.

Slender liane to 3 m in height; *seedling stage* and *pre-adult plants* not observed; *adult shoot* clinging and flowering terminally with inflorescence soon displaced (well before infructescence maturity) and thus physiognomically lateral; *stems* smooth, mid- to dark green, with long, sparse petiolar sheath fibre on the most recently matured portions, internodes up to 10.5 cm x *c.* 7 mm, separated on still-leafy portions by deep brown clasping leaf base, this up to 6 mm long; *flagellate foraging stems* not observed; *clasping roots* few, arising from the nodes, velvety; *feeding roots* frequently stilt-like in terrestrial individuals, adhering to the climbing surface and reaching the ground in climbing individuals, smooth; *leaves* spiro-distichous, distally clustered on adult shoots; *cataphylls and prophylls* membranous, soon drying and falling and only rarely persisting as scattered long fibres; *petiole* narrowly canaliculate, 18–24 cm x *c.* 2 mm, smooth, apical geniculum prominent in dried material, up to 3.5 cm long, basal geniculum also prominent, up to 1.5 cm x 6 mm; *petiolar sheath* prominent, extending to the apical geniculum, soon degrading into semi-persistent long fibres; *lamina* entire, narrowly-oblanceolate, 34–35 x 7–7.5 cm, when fresh thinly leathery with adaxial surface matt pale olive-green and abaxial surface obscurely grey glaucous, drying papery with adaxial surface mid-orange-brown and abaxial surface slightly grey-glaucous, base long-decurrent, apex acuminate-attenuate; *midrib* prominently raised abaxially, level adaxially; *primary venation* pinnate, raised abaxially, slightly impressed adaxially; *interprimaries* subparallel to primaries, slightly raised abaxially, ± flush adaxially, forming a weak reticulum distally; *secondary venation* prominently reticulate, raised abaxially; *tertiary venation* a network of broadly spaced tessellate veins arising at *c.* 90 from the midrib and crossing the primaries and interprimaries; *inflorescences* solitary; *peduncle* terete, up to 18 cm x 2 mm; *spathe* not observed but, based on observing young infructescences, seemingly caducous; *spadix* cylindrical, sessile, inserted level on peduncle, 6.5 cm x 6 mm, green in juvenile fruiting stage; *stylar region* rhomb-hexagonal, *c.* 1.5 x 1.2 mm, truncate; *stigma* elliptic, longitudinally orientated, up to 0.75 mm, prominent in dried material; *anthers* not observed; mature *infructescence* not observed.

Figure 1. Rhaphidophora typha ***P.C.Boyce*** Holotype specimen (SING) showing the diagnostic long-pedunculate inflorescence.


SINGAPORE BOTANIC GARDENS
SING 0052716
ENTERED IN CARD-INDEX
FLORA OF BRUNEI
Rhaphidophora typha P.C. Boyce
Det. P.C. Boyce Det.date: Aug 2005
SINGAPORE BOTANIC GARDENS
Brunei. Temburong District. Sungai Temburong, just downstream from Kuala Belalong. Common herb. Foliage deep green. Spathe greenish. Spadix with green fruit.
K.M. Wong WKM 242
19 July 1988
Rhaphidophora sp. nov
Singapore. Det. Date
P.C.Boyce 21/2/04
FORESTRY DEPARTMENT BRUNEI DARUSSALAM

Distribution: BORNEO: Brunei and Sarawak.

Habitat: Although habitat is not recorded on the type, Kuala Belalong is predominantly mixed moist lowland dipterocarp forest on Setap shales with some gallery forest in the valley bottoms and *kerangas* elements on the ridge tops. In Sarawak, *R. typha* occurs in riverine or gallery forest on shales exposed by river action. Altitudes in Kuala Belalong range between 15 and 350 m. The Sarawak collection cited below is from 240 m.

Notes: 1. *Rhaphidophora typha* bears some resemblance to *R. beccarii* (Engl.) Engl. but is readily separable by the much thinner abaxially grey-glaucous leaf laminas, the slender, less thickly-rooted stems (roots arising only at the nodes in *R. typha*, rooting along the internodes in *R. beccarii*), the smooth, not scaly feeding roots and the markedly longer, thinner peduncle. The prominently reticulate secondary and tessellate tertiary venation is also noteworthy. As noted, the ecology of *R. typha* in Brunei is not recorded. In Sarawak it grows as a low climber (rarely up to 3 m) on slender trees, while *R. beccarii* is an obligate rheophyte.

2. There exist in Borneo three further lianescent aroids with glaucous abaxial leaf surfaces with which confusion with *R. typha* might occur. They are: *Scindapsus longipes* Engl., *S. glaucescens* (Engl. & K.Krause) Alderw. and an as yet undescribed *Anadendrum*. *Scindapsus longipes* differs from *R. typha* by the stiffly coriaceous ovate leaf lamina with the primary veins hardly visible while *S. glaucescens* has oblong leaves up to 1 m long with abaxially the primary lateral veins raised but the interprimary and secondary veins hardly visible. Both *Scindapsus* are found only in hill forest on sandstones. The *Anadendrum* has leaves similar in texture and venation to those of *R. typha* but is readily distinguished by the strictly distichous leaf arrangement.

3. The specific epithet is from the Greek *typhe* (cat-tail) and alludes to the proportionately very long-pedunculate inflorescence, the peduncle reaching over half the petiole length, which somewhat fancifully resembles the inflorescence of *Typha* (Typhaceae - Poales). Such inflorescence morphology is very unusual among long-petiolate *Rhaphidophora* and not hitherto recorded for any Bornean species although occurring in a morphologically very different species in the Philippines, *R. monticola* K.Krause.

4. *Rhaphidophora typha* can be fitted into the key to Bornean *Rhaphidophora* (Boyce 2001a) as follows:

3a. Geniculum and abaxial surface of lamina pubescent............................ 4
3b. Geniculum and abaxial surface of lamina glabrous or glaucous 5
4a. Plants flowering on clinging stems. Leaves of mature plants extensively perforated, active shoot tips with black mucilage .... **6 R. foraminifera**
4b. Plants flowering on free lateral stems. Leaves of mature plants lacking or with only with scattered, perforations; active shoot tips lacking black mucilage .... **12. R. puberula**
5a. Leaves always shingling, even in flowering individuals. Flowering on clinging shoots .... **8. R. latevaginata**
5b. Leaves spreading in adult and flowering individuals. Flowering on free or clinging shoots 6
6a. Stems scabrid to asperous. Spathe exterior minutely puberulent .... **9. R. lobbii**
6b. Stems smooth. Spathe (where known) exterior glabrous 7
7a. Abaxial surface of lamina glaucous. Peduncle up to 18 cm long .... **R. typha**
7b. Abaxial surface of lamina never glaucous. Peduncle not exceeding 10 cm long 8
8a = 7a, etc., in Boyce (2001a)

Other specimen seen: SARAWAK. Kapit Division, Nanga Gaat, Rejang Wood Concession, KM 55 road to Camp Gahada, 01° 44' 44.5"N; 113° 28' 32.3"E, 13 May 2004, *P.Boyce, Jeland ak Kisai & Jipomak Tisai AR-374* (SAR).

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Taxonomic Notes on Bornean *Litsea*, *Lindera*, *Neolitsea* and *Iteadaphne* (Lauraceae)

F.S.P. NG

Forest Research Institute Malaysia
52109 Kepong, Selangor, Malaysia

Summary

Litsea Lam., *Lindera* Thunb., *Neolitsea* Merr. and *Iteadaphne* Blume share a combination of many features that distinguish them collectively as a well-defined natural group from the rest of the Lauraceae. However, within the group, the genera are defined on features that are unsatisfactory whether considered individually or in combination.

- The main line of division is anther locule number: four versus two. This feature separates the 4-locular genera *Litsea* and *Neolitsea* from the 2-locular genera *Lindera* and *Iteadaphne*. However, there are several species on one side of the division that are mirrored by species on the other side, differing only by the anther locule number. In this revision, four such sets of twins are united as four species with variable anther locule number. One of these species is *Litsea cubeba* (Lour.) Pers., in which 2-locular and 4-locular anthers can occur even within the same flower.
- Another line of division uses a combination of leaf venation and floral merism, by which triveined dimerous *Neolitsea* has been distinguished from penniveined trimerous *Litsea.* These two-feature states are not fixed, and some authors have defined *Neolitsea* on dimery with or without triveined leaves. However, dimery itself is a variable feature and the type species, *Neolitsea cassia*, has been found to have both dimerous and trimerous flowers.
- *Litsea* species can be distinguished from *Lindera* if the fruit has a prominent cupule, but there are a few *Litsea* species without cupule development (e.g. *Litsea elliptica* and all the species with variable anther locule number), and these have often been misidentified as *Lindera*.
- *Iteadaphne* is distinguished from *Lindera* in its umbellules reduced to a single floret. By default, *Lindera* consists of species with 2–20 florets per umbellule. However, the number of florets in the umbellules is actually variable. The type species of *Iteadaphne* has itself been found to be part of a variable species, *Litsea subumbelliflora* (Blume) Ng, with 2 or 4 anther locules and 1–6

florets per umbellule. Hence *Iteadaphne* is reduced to *Litsea*.

- *Litsea*, *Lindera* and *Neolitsea* should be united as a single natural genus, but their merger would result in a great nomenclatural upheaval. The alternative, adopted here, is to retain them as artificial genera, for nomenclatural stability.
- In writing the account for The Tree Flora of Sabah and Sarawak, 9 new taxa (species or varieties) are described, 47 species are reduced to synonymy and one species is excluded from Lauraceae.

Introduction

Litsea Lam., *Lindera* Thunb., *Neolitsea* Merr. and *Iteadaphne* Blume are collectively distinguished from the rest of Lauraceae by a suite of reproductive characters. The species are nearly always dioecious, rarely polygamous (*Litsea cubeba* (Lour.) Pers., *Litsea lancifolia* (Roxb. *ex* Wall.) Hook. *f.*) The inflorescence is an axillary raceme terminating in a dormant terminal bud. However, instead of flowers, the raceme bears 'involucral buds', each involucral bud consisting of a perianth-like involucre of 4 (sometimes 3 or 5) decussate bracts enclosing 1–20 florets in an umbellule. The stalk of the umbellule is here called a peduncle and the stalks of the florets are called pedicels. At anthesis, each involucral bud behaves like a unified flower, with all its florets opening together to expose a mass of protruding stamens, staminodes and stigmas on an open involucre imitating a perianth. In the female flower, the ovary sits within a hypanthium (perianth tube), with the perianth lobes (small and flimsy), staminodes, and glands arising from the mouth of the hypanthium. The hypanthium is enlarged in fruit to form a cup-like or dish-like cupule in most species of *Litsea* and to some extent in *Neolitsea*, but not in *Lindera*. The number of perianth lobes varies from 3 to 9, with 6 as the most common number, but aberrant specimens have 2 and even no perianth lobes. In the male flowers, the staminodes are replaced by functional stamens and the pistil by a pistillode. The stamens range in number from 3 to 12 and rarely 18, with 9 as the most common number. Glands are usually present, as swollen pads of tissue between the stamens and staminodes, sometimes free standing and sometimes attached to the sides of the filaments; they sometimes look like sessile anthers with bulging but non-functional anther locules.

I recently found a population of *Litsea cubeba* with hermaphrodite flowers in the Bario Highlands, Sarawak. About ten trees were all heavy with fruit, but some also bore flowers toward the twig tips. The flowers had functional stamens (with swollen anther locules opening by uplifted flaps to release pollen) and ovaries containing well-formed ovules. I then re-examined my previous drawings of dissected flowers and confirmed that *Litsea cubeba* has three distinct kinds of flowers: male, female, and hermaphrodite, and that hermaphrodite trees are not only in Sarawak, but also in Ranau, Sabah (*SAN 114166*). I also found a hermaprodite flower in *Litsea lancifolia* var. *lancifolia* in a specimen from Ranau, Sabah (*Matamin Rumuto MR 27*), which I had previously taken to be male.

Within the group, there is abundant evidence that the genera are artificial. The major internal line of division is whether the anthers are 2- or 4-locular. *Lindera* and *Iteadaphne* are 2-locular whereas *Litsea* and *Neolitsea* are 4-locular. This dividing feature stands almost alone, partially supported by the development of cupules in most species of *Litsea* and *Neolitsea* and the non-development of cupules in *Lindera* and *Iteadaphne*. Division by anther locule number has resulted in species of *Litsea* having 'twin species' in *Lindera/Iteadaphne*, differing only in the number of anther locules. In such cases, only male specimens can be identified positively. Female and sterile specimens can only be placed by looking for exact matches in leaves or localities. Twin species could have arisen by parallel evolution in different genera but are more likely to be the result of an arbitrary line of division based on a character that is in fact variable. I have united these twins and placed them in *Litsea*:

1. *Litsea subumbelliflora* (Blume) Ng includes *Litsea lanceolata* (Blume) Kosterm. and *Lindera subumbelliflora* (Blume) Kosterm.
2. *Litsea cubeba* (Lour.) Pers. includes *Lindera pipericarpa sensu auct. non* (Miq.) Boerl., *Lindera oxyphylla* (Nees) Hook.*f.* and *Lindera reticulosa* Kosterm.
3. *Litsea lancifolia* (Roxb. *ex* Wall.) Hook.*f.* and *Litsea sessiliflora* Hook.*f.* have both been found to include male specimens with 2-locular anthers that technically would qualify these specimens to be new species of *Lindera* or *Iteadaphne,* but such 'species' would consist of male specimens only.

Further details are given in the respective species accounts below.

The well-developed cupule is associated with *Litsea* but a few species of *Litsea* (e.g. *Litsea elliptica* Blume, and all the species with variable anther locule number) have weakly developed or undeveloped cupules, and fruiting specimens of these species are often misidentified as *Lindera.*

Neolitsea was included in *Litsea*, until raised to generic level by Merrill (1906). Previously, it had been *Litsea* Lam. sect. *Neolitsea* Benth. The section *Neolitsea* was described by Bentham (in Bentham and Hooker, 1880) as follows: *Folia saepius triplinervia. Flores sepius 2-meri, perianthi segmentis 4, staminibus perfectis 6* (Leaves often triplinerved. Flowers often

2-merous, perianth segments 4, perfect stamens 6). By default, *Litsea* became a genus with penninerved leaves and trimerous flowers. However, dimery is not always associated with triveined leaves, and some authors, e.g. Kostermans (1957) have dropped the triveined character from the definition of *Neolitsea*, leaving dimery as the key character. There are indeed 4 perianth lobes in *N. amabilis* and *N. villosa* but I have found florets with 3, 4 and 6 perianth lobes in *N. cassia,* the type species of *Neolitsea.*

Lindera differs from *Litsea* and *Neolitsea* only by anther locule number, associated with lack of cupule development in fruit. *Lindera* parallels the situation in *Litsea* prior to Merrill in that it consists of two subgroups of species, one with triveined leaves and the other with penniveined leaves. *Lindera* also has dimerous as well as trimerous flowers.

Iteadaphne is distinguished from *Lindera* by its umbellules bearing a single floret. By default, *Lindera* consists of species with 2–20 florets per umbellule. The arbitrariness of this line of division is quite obvious. The number of florets in the umbellule is variable in most, perhaps all species.

Neolitsea amabilis Airy Shaw and *Lindera montanoides* Kosterm. have 1–3 florets per umbellule. Both species have triveined leaves but one is a *Neolitsea* because of 4-locular anthers and the other a *Lindera* because of 2-locular anthers. *Lindera bibracteata* (Nees) Boerl. is consistently uniflorous and could have been placed in *Iteadaphne* but was placed in *Lindera* instead; it has triveined leaves.

The type species of *Iteadaphne* is '*Iteadaphne confusa* Blume' (= *Lindera subumbelliflora* (Blume) Kosterm.), and this has been found to consist of local populations with uniflorous umbellules, mirrored by *Litsea lanceolata* (Blume) Kosterm. with 4 anther locules. The two combined make the widespread *Litsea subumbelliflora* (Blume) Ng that has 2 or 4 anther locules and 1–6 florets per umbellule. This merger has the effect of reducing *Iteadaphne* to *Litsea.* There are two other species of *Iteadaphne* to be accounted for: *Iteadaphne caudata* (Nees) H.W.Li and *Iteadaphne philippinensis* Elmer. These should be examined carefully to see whether they fit into *Lindera, Litsea* or *Neolitsea.* It is likely that they already have 'twin species' in those genera, with which they should be united. *Iteadaphne caudata* has triveined leaves, suggesting a relationship with *Lindera bibracteata.*

Litsea, Lindera and *Neolitsea* could be merged into a single genus, which would be a natural genus because it would share many traits all supporting each other. Such a genus could then be re-sorted into sections (I would expect five or more sections) that are better defined than the current three genera. However, merger would result in considerable nomenclatural upheaval because there are about 400 binomials in *Litsea,* 100 in *Lindera* and 100 in *Neolitsea*. *Lindera* is the oldest name. For the Tree Flora of Sabah and Sarawak, for which this research has been carried out, the preferred option is to maintain *Litsea*, *Lindera* and *Neolitsea* as separate artificial genera.

The following definitions appear to me to be the most practical for conserving existing species names.

Litsea: leaves penniveined; anther locules 4, but allowing for species with anther locules variably 2 or 4; fruits with or without prominent cupules.

Neolitsea: leaves triveined; anther locules 4; fruits with or without prominent cupules.

Lindera: leaves penniveined or triveined; and anther locules 2; fruits without prominent cupules.

New Taxa and Status Changes

Litsea Lam.

1. **Litsea aban-gibotii** Ng, **sp. nov.**
(Named for Aban Gibot, b. 1944, plant collector in the Sabah Forest Department)

Folia infra nitida ob pilos tenues microscopicos (*manifesti magnificatione 15*x). *Fructus in cupulis profundis poculiformibus sedentes.* **Typus:** *Aban Gibot SAN 66744*, Sabah, Papar District (holo KEP; iso SAN).
Figure 1

Small to medium-sized trees. **Leaves** alternate, *undersurface with silky shee n due to closely-packed microscopic hairs* (visible at 15x magnification); blades elliptic or obovate, 9–13.5 x 4–4.8 cm, base cuneate to attenuate, apex acuminate; midrib shallowly impressed above; lateral veins 9–10 pairs; intercostal venation faint, closely scalariform (mostly closer than 0.2 cm); petiole 1.5–2 cm long, up to 0.2 cm thick. **Inflorescences** borne on twigs up to 1.2 cm diam.; raceme axis highly condensed, 0.2–0.4 cm long; **florets** 3 or more per umbellule; peduncles 0.3–0.7 cm long. **Fruits** ovoid, *c.* 1.4 x 1.4 cm; hypanthium at first globose, finally forming a deep cup-shaped cupule covering the basal half to two-thirds of the fruit; pedicel *c.* 0.4 cm long, gradually narrowed downwards from the cupule.

Distribution: Endemic in Borneo: Sabah, Papar District; Sarawak, Bintulu and Lundu Districts; Brunei, Belait District.

Specimens examined: Sabah, Papar (*SAN 66744*); Sarawak, Bintulu (*S 18697*) and Lundu (*S 76785*); Brunei, Belait (*Niga NN 242*, *Niga NN 244*).

Notes: The silky sheen on the leaf undersurface, due to microscopic appressed hairs, is highly characteristic of a small number of *Litsea* species, which includes *L. chewii* Kosterm., *L cuprea* Merr. and *L. staintonii* Kosterm. *L. aban-gibotii* differs from the others by its closely spaced (mostly closer than 2 mm) scalariform intercostal veins.

2. **Litsea accedens** (Blume) Boerl.
Handl. Fl. Ned. Ind. 1, 3 (1900) 145.
Basionym: *Tetranthera accedens* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 383.
Type: *Korthals s.n.*, Borneo (holo not seen; iso U *Acc. No. 188204B*).

Notes: A highly variable species in which three varieties may be recognized:

i. var. *accedens*: intercostal venation reticulate; leaves variable in shape, from elliptic to oblong–elliptic, obovate and lanceolate. Widespread.
ii. var. *kinabaluensis* (Kosterm.) Ng: intercostal venation scalariform; leaves ovate or oblong-elliptic. Endemic to the Kinabalu region of Sabah.
iii. var. *oblanceolata* (Gamble) Ng: intercostal venation scalariform; leaves oblanceolate. Widespread.

i. Var. **accedens**
New synonyms:
Litsea costata (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 144. **Basionym:** *Cylicodaphne costata* Blume, Mus. Bot. Lugd. Bat. 2 (1856) 13. **Type:** *Korthals s.n.*, Borneo (lectotype, here designated, L *Acc. No. 90523333*).
Litsea insignis (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 142. **Basionym:** *Tetranthera insignis* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 382. **Type:** *Korthals s.n.*, Sumatra (lectotype, here designated, *L Acc. No. 905233560*).
Litsea ochracea (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 144. **Basionym:** *Cylicodaphne ochracea* Blume, Mus. Bot. Ludg. Bat. 2 (1856) 13. **Type:** *Korthals s.n.*, Sumatra (holo not seen; iso BO *Acc. No. 1278346*, U *Acc. No. 38210*).

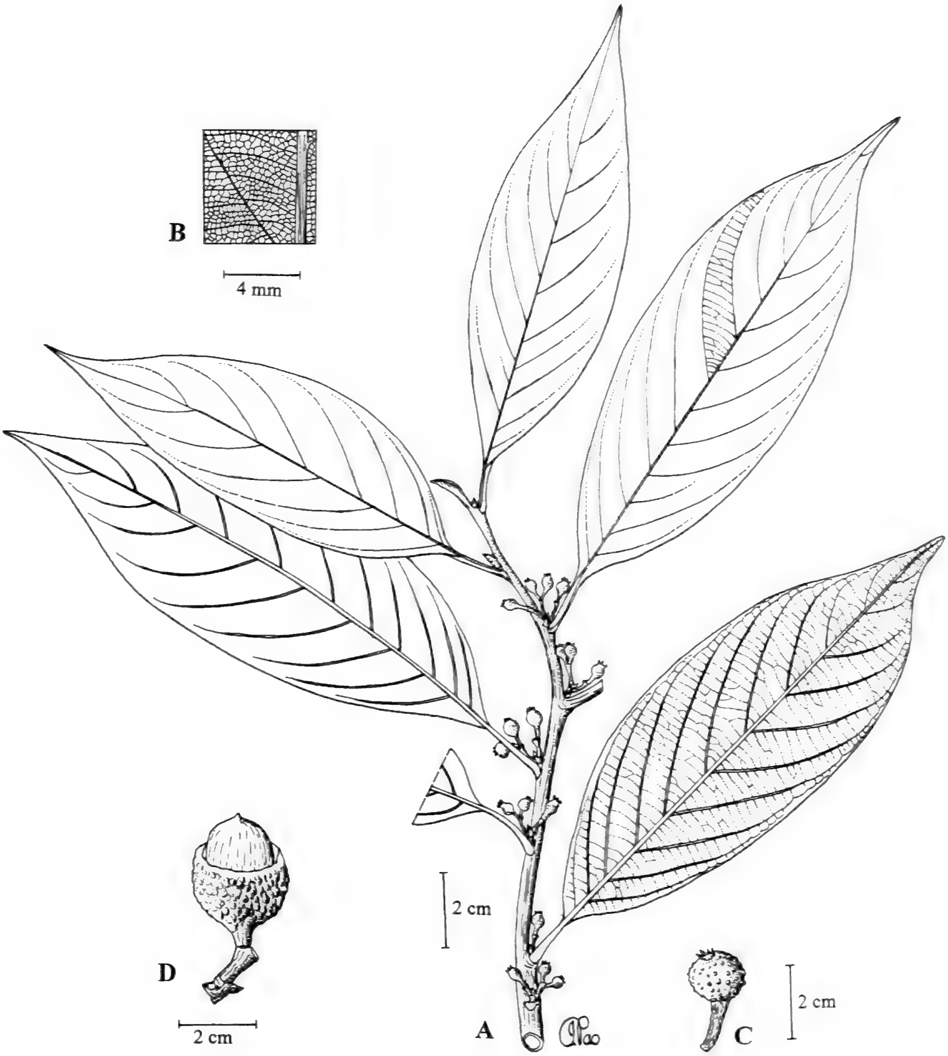

Figure 1. *Litsea aban-gibotii* Ng. A, fruiting (young) leafy twig; B, detail of venation on lower leaf surface; C, young fruit; D, older fruit. (A–B from *SAN 66744*, C from *S 76785*, D from *Niga NN 242*.)

Litsea ridleyi Gamble, Bull. Misc. Inform. Kew (1910) 317. **Type:** *Ridley 5101*, Singapore (lectotype, here designated, SING).
Litsea wrayi Gamble, Bull. Misc. Inform. Kew (1910) 319. **Type:** *Wray 4036*, Perak, Waterfall Hill (lectotype, here designated, SING).
Litsea pentagona Merr., Univ. California Publ. Bot. 15 (1929) 81. **Type:** *Elmer 20666*, Sabah, Tawau (holo not seen; iso BO, NY, SING).

ii. Var. **kinabaluensis** (Kosterm.) Ng, **stat. nov.**
Basionym: *Litsea kinabaluensis* Kosterm., Reinwardtia 7 (1969) 506. **Type:** *Clemens 33053*, Sabah, Gunung Kinabalu (holo BO).

iii.Var. **oblanceolata** (Gamble) Ng, **stat. nov.**
Basionym: *Litsea oblanceolata* Gamble, Bull. Misc. Inform. Kew (1910) 362. **Type:** *King's Collector 2020*, Perak, Larut (lectotype, here designated. K).
New synonyms:
Litsea ochracea (Blume) Boerl. var. *oblanceolata* (Gamble) Kochummen, Tree Flora Malaya 4 (1989) 163.
Litsea perakensis Gamble, Bull. Misc. Inform. Kew (1910) 359. **Type:** *King's Collector 5114*, Perak, Larut (lectotype, here designated, K).

3. **Litsea andreana** Ng, **sp. nov.**
(Named for Andrè Joseph Guillaume Henri Kostermans, 1907–1994, forest botanist in Bogor, Indonesia)

Folia magna obovata ad oblanceolata infra tomentosa 29–50 cm longa 17–19 cm lata basi subcordata. Racemi cauliflori 0.4–1.2 cm longi. **Typus:** *Ilias Paie S 39032*, Sarawak, Niah (holo SAR; iso KEP).
Figure 2

Small to medium-sized tree. **Leaves** *alternate, densely tomentose below; blades broadly obovate to oblanceolate, 29–50* x *17–19 cm, base subcordate*, apex rounded; midrib broad and raised to shallowly impressed above; lateral veins 15–24 pairs; intercostal venation scalariform, prominent below; petiole 1–1.5 cm long, 0.6–0.9 cm thick. **Inflorescences** *borne on the branches and trunk*; raceme axis 0.4–1.2 cm long, c. 0.5 cm thick; **florets** *c.* 7 per umbellule; anthers 4-locular (*S 39032*); peduncles *c.* 0.6 cm long. **Fruit** not seen.

Distribution: Endemic in Borneo: Sarawak, Semengoh FR; Kalimantan, Gunung Bentuang and Sampit.

Specimens examined: Sarawak, Semengoh FR *S 39302*; Kalimantan, G. Bentuang, *Burley et al. 2858* and Sampit *Kostermans 8057*.

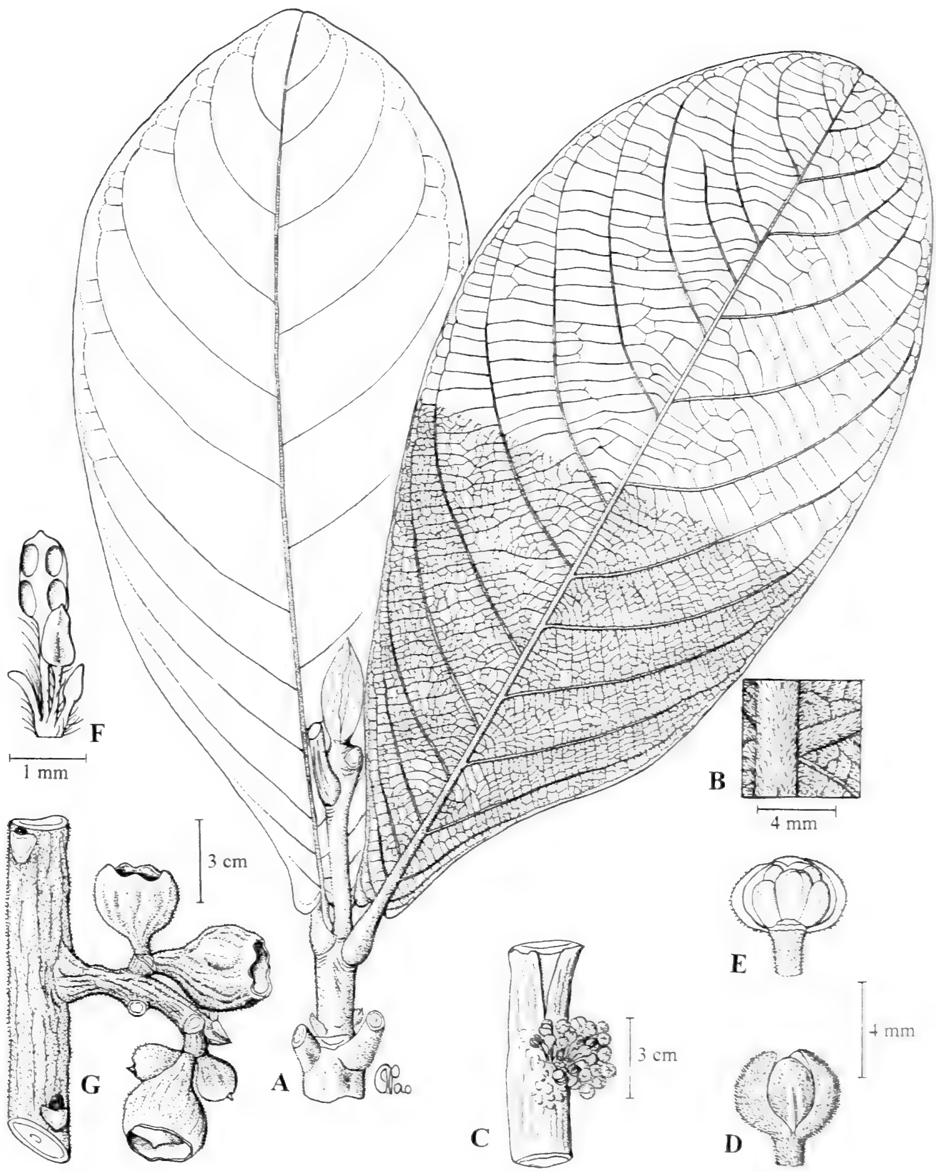

Figure 2. *Litsea andreana* Ng var. *andreana* (A–F): A, leafy twig; B, detail of venation and indumentum on lower leaf surface; C, cauliflorous inflorescence; D, involucral bud; E, umbellule of florets within an involucral bud; F, stamen, staminode and glands; var. *dewolii* Ng: G, young infructescence. (A–F from *S 39032*, G from *SAN 142976*.)

Var. **dewolii** Ng, **var. nov.**
(Named for Dewol Sundaling, b. 1950, plant collector in the Sabah Forest Department)

A varietate typica foliis multo maioribus ad 100 cm longis 35 cm latis, racemis longioribus c. 5.5 cm longis ramis majoribus insidentes differt. **Typus:** *Dewol SAN 142976*, Sabah, Danum Valley (holo SAN; iso KEP).

Leaves to *c.* 100 x 35 cm. **Inflorescences** *borne on large branches*; the *raceme axis c. 5.5 cm long* and *c.* 0.9 cm thick; umbellules and florets not seen. **Fruits** with the basal three quarters enclosed in a cup-like cupule when fresh, completely shrunken into the cupule when dried; cupule densely tomentose, *c.* 2.5 cm wide and *c.* 2 cm deep, non-pedicellate when fresh, basally narrowed into a 0.5 cm-long pedicel when dried.

Distribution: Endemic in Borneo: Sabah.

Notes: Known only from the type specimen.

4. **Litsea cordata** (Jack) Hook.*f.*
Fl. Brit. Ind. 5 (1886) 177. **Basionym:** *Tetranthera cordata* Jack, Malay. Misc. ii (1822) 34. **Type:** unknown (Jack's description).
New synonym: *Litsea elmeri* Merr., Univ. California Publ. Bot. 5 (1929) 82. **Type:** *Elmer 21221*, Sabah, near Tawau (holo not seen; iso SING).

Notes: This is a well-known species and Jack's name has been consistently applied even though the type cannot be located. On the Singapore sheet of *Elmer 21221,* (type of *Litsea elmeri* Merr.) there is a determination slip by Kostermans re-determining the specimen as *L. cordata*. I agree with Kostermans, but the reduction does not seem to have been published.

5. **Litsea costalis** (Nees) Kosterm.
Reinwardtia 7 (1969)501. **Basionym:** *Alseodapne costalis* Nees *in* Wallich, Pl. As. Rar. 2 (1831) 72. **Type:** *Wallich 2594B*, Singapore (holo K; iso BO)

Var. **nidularis** (Gamble) Ng, **stat. nov.**
Basionym: *L. nidularis* Gamble, Bull. Misc. Inform. Kew (1910) 365. **Type:** *King's Collector 6883*, Perak, Larut (lectotype, here designated, K).

Notes: Litsea costalis var. *nidularis* differs from the typical variety in having smaller, narrower leaves and less prominent venation, but there are intermediates, and at least one specimen from Brunei (*Dransfield JD 7249*) bears leaves of both types.

6. **Litsea crassifolia** (Blume) Boerl.
Handl. Fl. Ned. Ind. 3 (1900) 143.
Basionym: *Tetranthera crassifolia* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 386. **Type:** *sin. coll.*, *s. n.*, Java (holo not seen, iso U *Acc. No. 261746B*).
New synonym: *Litsea lithocarpoides* Kosterm., Reinwardtia 7 (1968) 348.
Type: *Clemens 33823,* Sabah, Gunung Kinabalu (holo L; iso BO, K).

Notes: The isotype of *Litsea crassifolia* (U, viewed on the L database website) consists of one detached leaf with no number and no locality. However, the name has been consistently applied in the region and there is no reason to dispute its application. *Litsea lithocarpoides* is merely a high elevation form of *L. crassifolia,* which is already known to occupy a broad elevational range, from sea level white sands and peat swamps to high mountains where soil conditions are similarly sandy or peaty.

7. **Litsea cubeba** (Lour.) Pers.
Syn. Pl. 2 (1807) 4. **Basionym:** *Laurus cubeba* Lour., Fl. Cochin. (1790) 252. **Type:** not seen.
Synonym: *Litsea citrata* Blume, Bijdr. Fl. Ned. Ind. 2e (1826) 565 (reduced by Kostermans in Reinwardtia 10 (1988) 465).
New synonyms:
Lindera pipericarpa auct non (Miq.) Boerl.: Gamble, J. As. Soc. Bengal 75, 2 (1912) 198; Ridley, Flora Malay Pen. 3 (1924) 135; Burkill, Dict. Econ. Prod. Malay Pen. 2 (1936) 1371; Kochummen, Tree Flora of Malaya 4 (1989) 147.
Lindera oxyphylla (Nees) Hook.f., Fl. Brit. Ind. (1886) 183. **Basionym:** *Daphniphyllum oxyphyllum* Nees in Wallich, Pl. As. Rar. 2 (1831) 63. **Type:** *Porter s.n., Penang* (Wallich Cat. 2547, not seen).
Lindera reticulosa Kosterm., Reinwardtia 9 (1974) 102. **Type:** *FRI 5016, Pahang,* Fraser's Hill (holo K; iso K, KEP).
Figure 3

Notes: Litsea cubeba is geographically a very widespread species, ranging from Nepal and Sikkim to Japan and Java.

While reviewing specimens from Borneo and the Malay Peninsula, it struck me that the Bornean specimens identified as *Litsea cubeba* by Kostermans resembled the Peninsular specimens named variously as *Lindera pipericarpa* (Miq.) Boerl, *Lindera oxyphylla* and *Lindera reticulosa.* Similarity in the leaves, fruits and female florets indicated that they are one species in spite of specimens having been placed in two different genera due to difference in anther locule number.

The mystery deepened when I found that Kostermans (1970) had transferred *Lindera pipericarpa* to *Litsea pipericarpa* (Miq.) Kosterm. Kostermans suggested that the earlier authors had not examined the anthers. The lack of a cupule in the fruit would have suggested *Lindera*, but there is another possibility, that the flowers examined by the earlier authors did have two anther locules while those examined by Kostermans had four, making *Litsea pipericarpa* a species with variably 2 and 4 anther lobes.

I examined the type of *Lindera pipericarpa* (now *Litsea pipericarpa*, basionym *Polyadenia pipericarpa* Miq., Fl. Ind. Bat. 1, 1 (1858) 962) in Bogor: *Teysmann, HB 2214, Sumatra*; (=BO *Acc. No. 1277851*) which bears Kosterman's annotations and found that Gamble (1912), Ridley (1924), Burkill (1936) and Kochummen (1989) were all mistaken. *Lindera pipericarpa* has leaves resembling *Anisoptera* (Dipterocarpaceae) in the undersurface that is prominently reticulate-veined, finely tomentose and tinged yellow. It is confined to Sumatra. *Litsea cubeba*, in contrast, has leaves glabrous and glaucous below.

I have transferred all the Malay Peninsula specimens previously identified as *Lindera pipericarpa* to *Litsea cubeba* on the grounds that the anther locule number in *Litsea cubeba* is not a species-defining character, but a variable character expressed differently in different parts of the geographical range of the species. While the Peninsular plants all appear to be 2-locular, the Bornean specimens may be 2-locular (e.g. *SA 1284*, *S 55827*), 4-locular (e.g. *SAN 114245*) or have both conditions within the same floret (e.g. *SAN 114166* and *TK 1122*). In the population of *Litsea cubeba* in Bario, Sarawak, that has hermaphrodite flowers, I found stamens with 2 or 4 anther locules within the same flower, together with abnormal stamens with 1 or 3 locules.

I thought that *Litsea cubeba* with 4-locular anthers might exist as a rare condition in the Peninsula because of two specimens, *Ridley 11390* (Taiping Hills, Perak), and *Ridley 13780* (Telom, Pahang), placed by Gamble (1912) in *Litsea citrata* Blume. These were reported to have 'quadrate anthers'. This reference was overlooked by Ridley (1924) but cited in synonymy by Burkill (1936) under *Lindera pipericarpa,* implying that Burkill disagreed with Gamble over the number of anther locules. Duplicates of the two specimens were located in SING and examined by Julia Sang, who found the anthers to be 2-locular. I nevertheless think that the specimens examined by Gamble were 4-locular, otherwise he would not have said so. In any case, *Litsea citrata* Blume has itself been reduced to *Litsea cubeba* by Kostermans (1988).

In summary, both *Litsea pipericarpa* and *Litsea cubeba* have synonyms in *Lindera* and the reason, I believe, is variation in the number

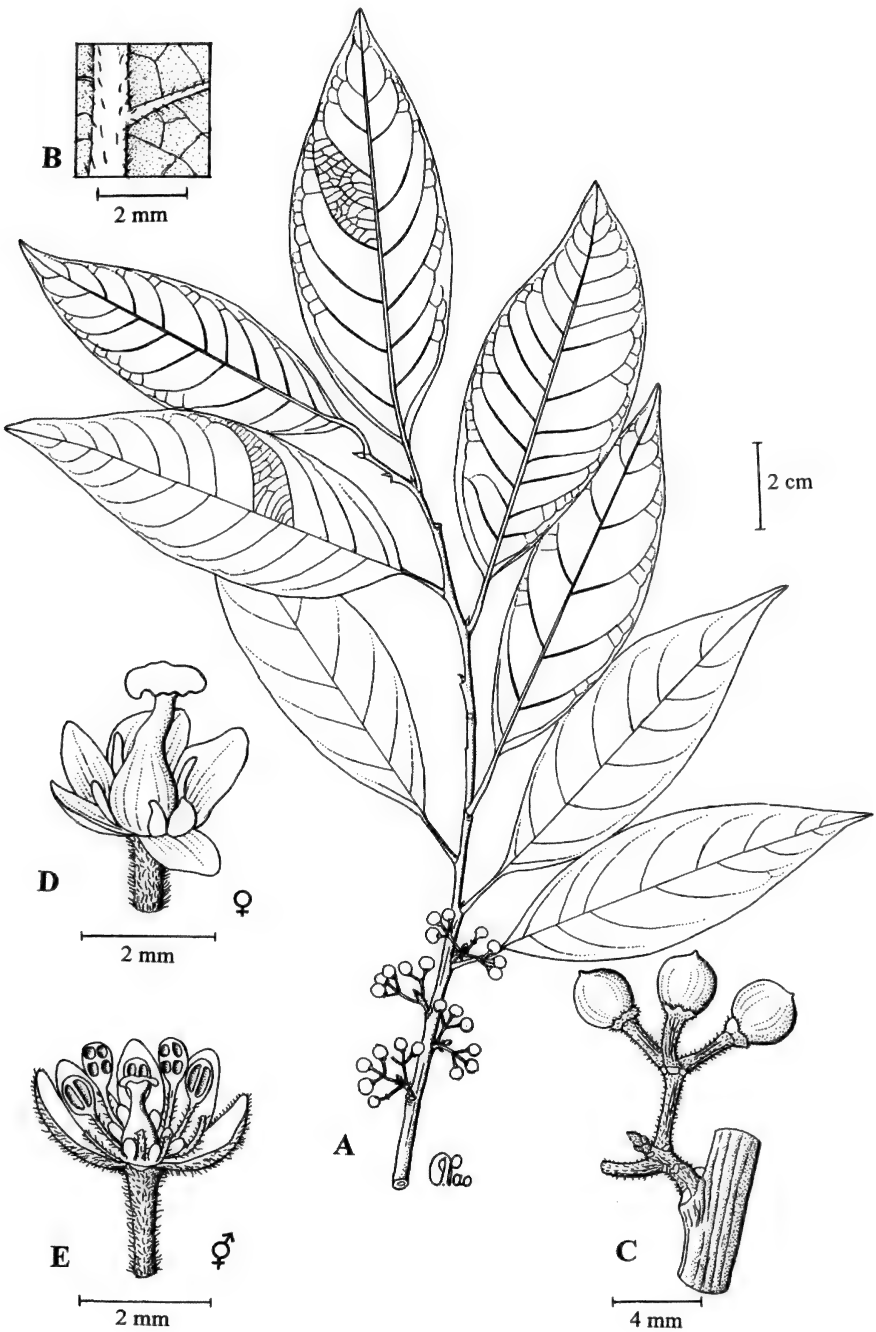

Figure 3. *Litsea cubeba* (Lour.) Pers. A, fruiting leafy twig; B, detail of venation and indumentum on lower leaf surface; C, infructescence; D, female flower; E, hermaprodite flower with stamens variably 2-locular and 4-locular. (A–C from *SAN 60328*, D from *SAN 24022*, E from *SAN 114166.*)

of anther locules, which the authors had not been prepared for.

8. *Litsea elliptica* Blume
Bijdr. Fl. Ned. Ind. 11e (1826) 563. **Type:** *s. coll., s. n.,* Java, Mt Salak (holo *L Acc. No. 905233282;* iso BO *Acc. No. 1274910*).
New synonym:
Litsea pruriens Kosterm., Reinwardtia 8 (1970) 105. **Type:** Kostermans 12675, Kalimantan, W. Kutei, Belajan River (holo BO; iso SING).

Notes:
I can find no consistent difference between *L. elliptica* and *L. pruriens. Litsea elliptica* has small or undeveloped cupules and fruiting specimens are often mistaken for *Lindera* but the males consistently have 4-locular anthers.

9. **Litsea firma** (Blume) Hook. *f.*
Fl. Brit. Ind. 5 (1886) 162. **Basionym:** *Tetranthera firma* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 381. **Type:** *Korthals, s.n.*, Borneo (lectotype here designcted BO *Acc. No. 1245463*).
New synonyms:
Litsea cylindrocarpa Gamble, Bull. Misc. Inform. Kew (1910) 318. **Type:** *King's Collector 6673*, Perak, Larut (lectotype, here designated, SING).
Litsea turfosa Kosterm., Reinwardtia 7 (1968) 353. **Type:** *Lajanjah SAN 44550*, Sabah, Beaufort (holo K; iso SAN, SAR, SING).

Notes: Litsea turfosa and *L. cylindrocarpa* are linked by intermediates to *L. firma* (Blume) Hook. *f.*, forming a single widespread and common species.

10. **Litsea fulva** (Blume) F.Vill.
Nov. App. Fl. Filip. (1880) 181. **Basionym:** *Tetranthera fulva* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 377. **Synt Types:** *s. coll., s. n.* Java and Sumatra (according to Blume), not seen.)

Notes: The typical variety of this species ranges from Sumatra to Java, Borneo and the Philippines, but the new variety described below is endemic to the Kinabalu massif in Sabah.

Var. **corneri** Ng, **var. nov.**
(Named for E.J.H. Corner, 1906–1996)

A varietate typica foliis ovatis vel ellipticis aut subobovatis (vs. obovatorum) *umbellulis fructibusque sessilibus (vs. pedunculatorum) differt.* **Typus:** *Chew & Corner RSNB 4473*, Sabah, Kinabalu, Bembangan River at *c.* 1700 m (holo SING; iso SAN).

Leaves *ovate, elliptic or sub-obovate*; 3–11 x 1.5–4.4 cm, below *hairy all over or on the veins*, base cuneate to rounded, apex acuminate; midrib above sunken into a narrow groove; lateral veins 8–10 pairs; intercostal veins scalariform; petiole 0.4–0.5 cm long. Flowering on the twigs; raceme axis highly condensed 0.1–0.2 cm long; **florets** *c.* 3 per umbellule; peduncle *practically absent* (umbellules practically sessile). **Fruits** ellipsoid, *c.* 1 x 0.7 cm; cupule forming a cup *c.* 0.6 cm wide, *c.* 0.5 cm deep, *non-pedicellate.*

Distribution: Endemic in Borneo: Sabah, Gunung Kinabalu at 1500–2600 m.

Specimens examined: Sabah *Chew & Corner RSNB 151*, *Chew & Corner RSNB 4473*, *Clemens 29564*, *Clemens 31052*, *Clemens 32506*, *Clemens 33811*, *Clemens 35117*, *Sugau JBS 128* and *SAN 117234.*

11. **Litsea garciae** Vidal
Rev. Pl. Vasc. Filip. (1886) 228. **Type:** *Vidal 861*, Philippines (holo not seen; iso L).
New synonyms:
Litsea sebifera auct. non (Willd.) Pers. in Blume, Bijdr. Fl. Ned. Ind. (1825) 560; Gamble, J. As. Soc. Beng; 75 (1912) 176; Ridley, Fl. Malay Peninsula 3 (1924) 128.
Litsea glutinosa auct. non (Lour.) C.B.Rob.: Burkill, Economic Products Malay Peninsula 2 (1936) 1376.
Litsea aurea Kosterm., Reinwardtia 8 (1970) 86. **Type:** *bb 8697*, Sumatra, Palembang (holo BO).
Litsea robusta auct. non Blume: Kochummen, Tree Flora Malaya 4 (1989) 163, *pro parte.*

Notes: This species has had a very confused taxonomic history although it is clearly distinguished by its uniquely asymmetric leaf shape: oblong-ovate to lanceolate, expanded more on one side than the other in the lower half of the leaf. No other *Litsea* species has a leaf like this. Furthermore, the apical buds, when resting are covered by large overlapping silvery-silky reduced leaves. The fruits are among the largest in the genus, depressed globose, up to 4 cm diameter when fresh. An edible variety is grown in Sarawak (Bidayuh name engkalak), Brunei (Brunei Malay name pengalaban), and the Philippines and Java. In Sabah and Peninsular Malaysia, the species is represented by big forest trees (up to 50 m tall), undoubtedly wild and indigenous, but the fruits are not eaten.

This species was first described by Blume (1825) as '*Litsea sebifera* Pers.' and this name was taken up by Gamble (1912) and Ridley (1924). However, *Litsea sebifera* Pers. has turned out to be a different species. The oldest valid name for this species is *Litsea garciae* Vidal. Gamble's description: 'innovations silvery-silky' and leaves 'often unequal at base' undoubtedly fits *Litsea garciae*. Ridley's comment that trees are 'occasionally planted by the Javanese' also points to *Litsea garciae*, because no other *Litsea* species is cultivated in home gardens. Burkill (1936) redetermined this species as '*Litsea glutinosa*', but this was a mistake; the true *Litsea glutinosa* (Lour.) C.B.Rob. has different leaves and much smaller fruits. Kochummen (1989) did not recognise *Litsea garciae* in the Tree Flora of Malaya because he confused it with *Litsea robusta*, which is similar in inflorescence and fruit but different in leaf shape. On re-sorting Kochummen's specimens, about half were found to belong to *L. garciae* and half to *L. robusta*. The latter is rare in Borneo.

12. **Litsea globularia** Ng, **sp. nov.**
(Latin, *globularis*=globe, referring to the fruit)

Folia opposita infra tomentosa. Fructus globosi ad 2.4 cm diam. cupula patelliformi circulari ad 8 mm lata pedunculo 2–12 mm longo pedicello 2–5 mm longo articulato insidenti. **Typus:** *Primack S 42435*, Sarawak, Gunung Mulu (holo KEP; iso A, K, L, SAR).
Figure 4

Medium-sized tree. Leaves opposite, chartaceous, tomentose below especially on the midrib; blades obovate, 8–23 x (3–)5(–8) cm, base rounded, apex acuminate; midrib sunken above and the groove sometimes filled with hairs; lateral veins 9–14 pairs; intercostal venation laxly reticulate; petiole 0.5–1 cm long. **Inflorescences** borne on twigs; raceme axis highly condensed, *c.* 0.1 cm long; **florets** 5 per umbellule; peduncles 0.2–1.2 cm long. **Fruits** globose, to 2.4 cm diam.; cupule forming a circular plate up to 0.8 cm wide; pedicel thick, 0.2–0.5 cm long.

Distribution: Endemic in Borneo: Sabah, Sarawak, Brunei and Kalimantan.

Selected specimens examined: Sabah (*SAN 16397*, *SAN 28910*, *SAN 31923*, *SAN 42841*, *SAN 50511*, *SAN 65214*, *SAN 86964* and *SAN 128632*), Sarawak (*S 4025*, *S 15093*, *S 23019*, *S 33214*, *S 42435*, *S 50511* and *S 62309*); Brunei (*Kirkup DK 942*, *Coode MC 6340*); Kalimantan (*Kostermans 10439*).

13. **Litsea grandis** (Wall. *ex* Nees) Hook. *f.*
Fl. Brit. Ind. 5 (1886) 162. **Basionym:** *Tetranthera grandis* Wall. *ex* Nees *in* Wallich, Pl. As. Rar. 2 (1831) 162 **Type:** '*Wallich 2552*', Penang (holo K).

Notes: This species is now reorganized to have three varieties, linked by intermediates:

i. var. *paludosa*: leaves ovate or elliptic; glaucous below
ii. var. *grandis*: leaves oblong-elliptic, elliptic, or round; not glaucous below; indumentum on twigs and leaf undersurface mid-brown
iii. var. *rufo-fusca*: leaves ovate; not glaucous below; indumentum dark blackish red-brown

i. Var. **paludosa** (Kosterm.) Ng, **stat. nov.**
Basionym: *Litsea paludosa* Kosterm., Reinwardtia 8 (1970) 103. **Type:** *Anderson S 14520*, Sarawak, Simanggang (holo BO; iso SAR, SING).

Notes: This variety includes *Litsea grandis* in Anderson (1963).

ii. Var. **rufofusca** (Kosterm) Ng, **stat. nov.**
Basionym: *L. rufofusca* Kosterm., Reinwardtia 7 (1968) 352, *l.c.* 8 (1970) 109. **Type:** *bb. 33044*, Kalimantan, Sampit area (holo L; iso BO).

14. **Litsea jaswirii** Ng, **sp. nov.**
(Named for Jaswir Singh, b. 1938, plant collector of the Sabah Forest Department)

Folia elliptica basi attenuata apice acuminato. Fructus ovoidei ad obovoidei ad 2.3 cm longi 1 cm diam. plerumque solitarii cupula non profunda prominente stipitata stipite prominenti insidentes. **Typus:** *Jaswir Singh SAN 28253*, Sabah, Kundasang (holo KEP; iso SAN).
Figure 5

Small and medium-sized tree. **Leaves** alternate; blade elliptic 7–13.5 x 2–4.5 cm, glabrous, chartaceous, base attenuate, apex acuminate, the upper and lower halves almost mirror images of each other in size and shape; midrib above flat, striate or shallowly impressed; lateral veins 5–7 pairs; intercostal veins reticulate; petiole 0.8–1.5 cm long. Flowering on the twigs; raceme axis 0.4–1.5 cm; **florets** 3–5 per umbellule; peduncles 0.3–1 cm long. **Fruit** narrow, ovoid, ellipsoid or obovoid, to 2.3 x 1.0 cm; usually 1, rarely 2–3 developed per umbellule; cupule a shallow cup to 0.5 cm wide, pedicel 0.5–1.3 cm long.

Distribution: Endemic in Borneo: Sabah, Gunung Kinabalu.

Specimens examined: Sabah, Kinabalu (*Carr SFN 27216, Chew RSNB 525, Clemens 26367, SAN A 4532, SAN 15272, SAN 28253, SAN 28294, SAN 28917*).

15. **Litsea lancifolia** (Roxb. *ex* Wall.) Hook. *f.*
Fl. Brit. Ind. 5 (1886) 159. **Basionym:** *Tetranthera lancifolia* Roxb. *ex* Wall. *ex* Nees *in* Wallich, Pl. As. Rar. 2 (1831) 65. **Type:** '*Wallich 2532*', India, Silhet (holo K).

Notes: This is one of the four species in which the anther locules may be 4 or 2. The species varies greatly in leaf size, leaf shape, midrib prominence and peduncle length, and has a wide distribution from India to Yunnan, Sumatra, Peninsular Malaysia and Borneo. In this treatment, the Bornean population is divided into four varieties, all linked by intermediates. The species is characterised by *leaves opposite to sub-opposite*, intercostal venation reticulate to sub-scalariform, *fruits ellipsoid or ovoid, small* (*to 8* x *7 mm*), *with hypanthium undeveloped or forming a small cup or cone*, pedicellate or non-pedicellate.

The anthers are 4-locular except in var. *iliaspaiei* where the number is variable, 4 or (rarely) 2 locules.

The four varieties are distinguished as follows:

i. var. *iliaspaiei*: leaves broad, but small and shorter than 8 cm.
ii. var. *lancifolia*: leaves broad, longer than 8 cm, with midrib sunken above.
iii. var. *grandifolia*: leaves broad, longer than 8 cm, with midrib prominent above.
iv. var. *rheophytica*: leaves linear, willow-like.

i. Var**. iliaspaiei** Ng, **var. nov.**
(Named for Ilias Paie, 1936–1986, plant collector in the Sarawak Forest Department)

A varietate typica foliis obovatis ad ellipticis parvis 3.5–7(–8.5) cm longis 1.3–3.2 cm latis differt. **Typus:** *Ilias Paie S 40749*, Sarawak, Bukit Sempadai, (holo KEP; iso SAR).

Small trees to 10 m tall. **Leaves** opposite, glabrous to finely hairy below; blade obovate to elliptic, *small, 3.5–7(–8.5)* x *1.3–3.2 cm*, base cuneate,

Figure 4. *Litsea globularia* Ng. A, fruiting (young) leafy twig; B, detail of venation and indumentum on lower leaf surface; C, young fruit; D, umbellule of florets; E, female flower. (A–B from *S 42435*, C from *S 39856*, D–E from *S 47538*.)

apex acuminate; midrib above sunken; lateral veins 5–10 pairs; intercostal veins reticulate; petioles 0.3–0.4 cm long. Flowering on the twigs, raceme axis highly condensed, 0.1–0.3 cm long; **florets** 1–6 per umbellule; peduncles 0.1–0.6 cm long. **Fruits** ovoid, *c.* 0.7 x 0.6 cm; cupule forming a shallow plate *c.* 0.3 cm wide, on a short *c.* 0.1 cm pedicel.

The anthers may be 4-locular (*S 40749*, *SAN 1769* and *SAN 88274*) or 2-locular (*S 52326*). In the case of the specimen with two anther locules, the number of florets was reduced to one, technically making this specimen an *Iteadaphne*, but in all other respects, it conforms to *L. lancifolia* var. *iliaspaiei*.

Distribution: Endemic in Borneo: Sabah and Sarawak. In hill and lower montane forests at 950–1600 m elevation.

Selected specimens examined: Sabah, *(SAN 31441*, *SAN 119768*, *SAN A 1769* and *Sugau JBS 10)*, Sarawak (*S 21788*, *S 33758*, *S 40749*, *S 47656* and *S 56855)*.

ii. Var. lancifolia

New synonyms:

Litsea varians (Blume) Boerl., *l.c.* (1900) 143. **Basionym:** *Tetranthera varians* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 376. **Type:** *Korthals s. n.*, Borneo (holo not seen; iso BO *Acc. No. 1249188*).

iii. Var. **grandifolia** (Stapf) Ng, **stat. nov.**

Basionym: *Lindera grandifolia* Stapf, Trans. Linn. Soc. Bot. Ser. 2, 4 (1894) 220. **Type:** *Haviland 1334*. Sabah, Kinabalu (holo K; iso SAR).

New synonyms:

Litsea amaroideocarpa Kosterm., Reinwardtia 7 (1968) 345.

Litsea oppositifolia Gibbs, J. Linn. Soc. Bot. 42 (1914) 130. **Type:** *Gibbs 3136*, Sabah, Tenom (holo BM).

Notes: Stapf (1894) based *Lindera grandifolia* on a fruiting specimen. Kostermans transferred *Lindera grandifolia* to *Litsea* but had to give it the new epithet *amaroideocarpa*, because *Litsea grandifolia* had already been used for another species (*Litsea grandifolia* Lecomte in Nouv. Arch. Mus. 5e Ser 5 (1913) 87). However, under its new status as a variety of *L. lancifolia*, Stapf's original epithet is hereby restored.

iv. Var. **rheophytica** (Kosterm.) Ng, **stat. nov.**

Basionym: *Litsea rheophytica* Kosterm., Reinwardtia 7 (1968) 350. **Type:** *Chai P.P.K. S 18951*, Sarawak, Rejang River, Pelagus Falls (holo L; iso

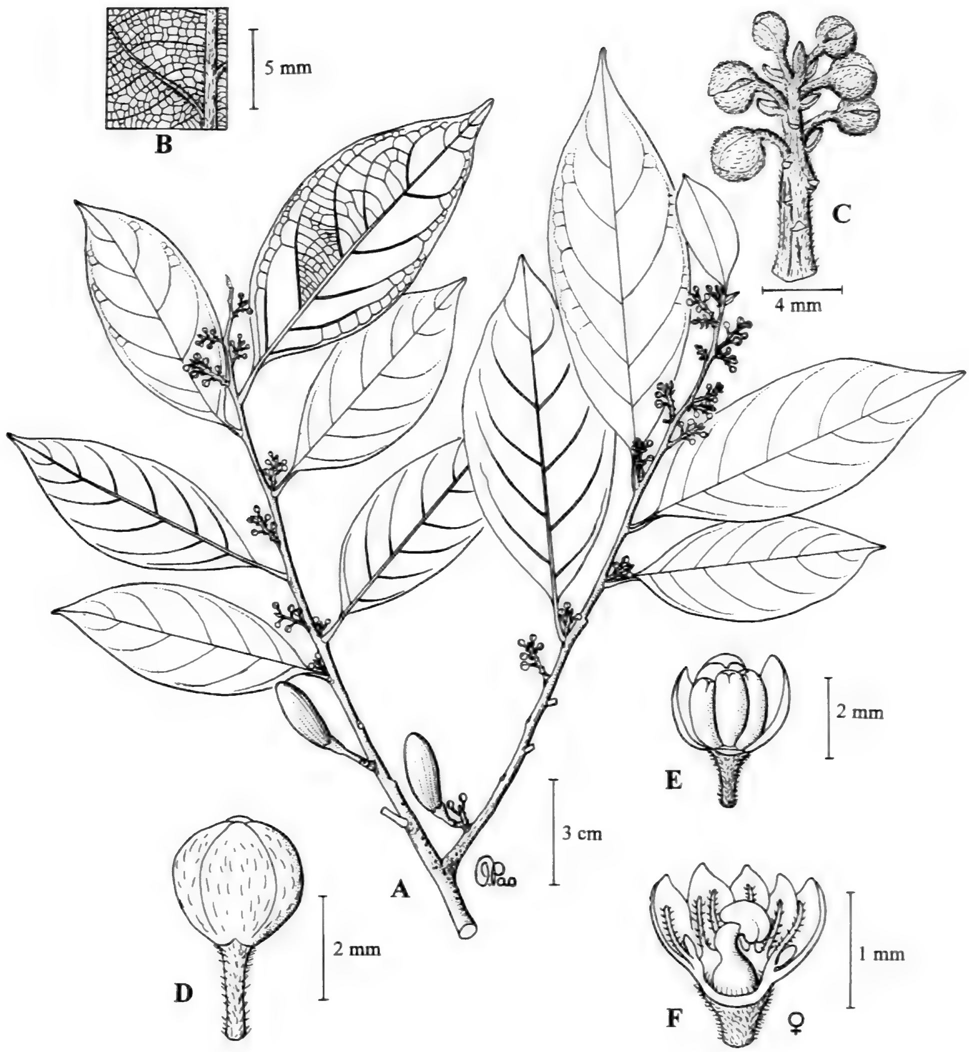

Figure 5. *Litsea jaswirii* Ng. A, flowering and fruiting leafy twig; B, detail of venation and indumentum on lower leaf surface; C, raceme of involucral buds; D, involucral bud; E, umbellule of florets within an involucral bud; F, female flower. (A–F from *SAN 28253*.)

BO, KEP, SAN, SAR).

16. **Litsea machilifolia** Gamble

Bull. Misc. Inform. Kew (1910) 320. **Type:** *Curtis 795*, Penang (lectotype, here designated, SING);

New synonyms:

Litsea teysmannii Gamble, Bull. Misc. Inform. Kew (1910) 319. **Type:** *Ridley 5845*, Malacca (lectotype, here designated, SING).

Litsea panamonja auct. non Hook. *f.*: Gamble, J. As. Soc. Beng. 75, 2 (1912) 172; Ridley, Flora Malay Pen. 3 (1924) 127; Kochummen, Tree Flora Malaya 4 (1989)162.

Litsea sp. '1' and *Litsea* sp. '2' in Kochummen, Tree Flora Malaya 4 (1989) 166.

Notes: This widespread and common species is easily distinguished by leaf morphology, relatively long racemes, and relatively large fruits. The cupule is a fleshy cup on a pedicel of variable length (0–3 cm long). This extreme variation in fruit pedicel length has been a source of great confusion. Gamble (1910) placed specimens with long pedicels in *L. machilifolia* and those without pedicels in *L. teysmannii*. Kochummen (1989) recognised *L. teysmannii* but associated it with swampy habitats. For the non-swamp specimens, he placed those with 2–3 cm-long pedicels in *L. machilifolia*; one specimen (*FRI 26004*) with a 0.7 cm-long pedicel into his *Litsea* sp. 2; and specimens without pedicels into *Litsea* sp. 1 (*FMS 6844*, *FRI 2045*, *FRI 3806*, *FRI 15688*, *FRI 19240*, *FRI 26003*, *KEP 110331* and *SFN 30880*). Non-fruiting specimens were placed arbitrarily. The impossibility of sorting out non-fruiting specimens indicates that the whole complex belongs to one species. In Borneo, the fruiting pedicel is similarly variable although not as extreme as in the Malay Peninsula.

Two Malayan specimens, from Perak (*Curtis 2694*) and Malacca (*Derry 2002*), had previously been determined by Gamble (1912) as *Litsea panamonja*, a species otherwise known only in India and Myanmar. I have redetermined these specimens as *Litsea machilifolia*, thereby excluding *Litsea panamonja* from the Malay Peninsula.

17. **Litsea magnifica** (Miq.) F.Villar

in Blanco, Fl. Filip. 3, Nov. App. (1880) 181. **Basionym**: *Lepidadenia magnifica* Miq. Fl. Ind. Bat. 1 (1858) 936. **Type:** *Teysmann HB 1011*, Sumatra, Batang Baroes (holo not seen; iso U *Acc. No. 38224*).

New synonym: *Litsea johorensis* Gamble, Bull. Misc. Inform. Kew (1910) 315. **Type:** *Ridley 13479*, Johore (lectotype, here designated, SING).

Notes: Litsea magnifica and *L. johorensis* are cauliflorous and similar in their large obovate leaves and small fruits, *c.* 1 x 0.7 cm. Kochummen (1989) separated them by the degree of swelling of the petiole base. There is also variation in the development of the cupule in fruit, but the number of herbarium collections is few and the evidence insufficient to support more than one species.

18. **Litsea sessiliflora** Hook.*f.*
Fl. Brit. Ind. 5 (1886) 160. **Type:** *Maingay, KD 1511*, Penang (holo K). This is one of the four species in which the number of anther locules may be 4 or 2. The variation is found within the new variety, var. *othmanii.*

i. Var. **sessiliflora**
New synonym: *Litsea sandakanensis* Merr., J. Str. Br. Roy. As. Soc. 85 (1922) 194. **Type:** *Ramos 1507*. Sabah (holo not seen; iso L *Acc. No. 923246540*).

Var. **othmanii** Ng, **var. nov.**
(Named for Haji Othman Ismawi, b. 1940, plant collector in the Sarawak Forest Department)

A varietate typica foliis glabris vel infra minute adpresse pubescentibus (*vs. tomentosorum*) *1.5–3*(*–4.5*) *cm latis* (*vs. 3–9.5 cm*) *differt.* **Typus:** *Othman S 57189*, Sarawak, Lundu, Gunung Putin (holo KEP; iso SAN, SAR).

Small tree. **Leaves** *opposite*, glabrous to finely appressed hairy below; blade *mostly narrow-elliptic* (rarely narrow-ovate or narrow-obovate), (6–)7–14.5 x 1.5–3 cm, *base cuneate*, apex acuminate; midrib sunken above; lateral veins 6–10 pairs; intercostal veins reticulate; petiole 0.3–0.8 cm long. Flowering on the twigs, raceme axis 0.1–0.5 cm long; **florets** 1–3 per umbellule; anther locules 2 (*Wong WKM 1252*) or 4 (*S 2992*, *S 44528*); peduncles 0.1–0.2 cm long. **Fruits** ellipsoid, *c.* 0.8 x 0.6 cm; cupule a small cup 0.3–0.4 cm wide, *c.* 0.2 cm deep, non-pedicellate.

Distribution: Endemic in Borneo: Sabah, Sarawak, Brunei and Kalimantan. Lowland to lower montane forests at 1500 m elevation.

Selected specimens examined: Sabah (*Chew RSNB 506*, *SAN 1156*, *SAN 29331*, *SAN 32930*, *SAN 46653*, *SAN 54383*, *SAN 78015*, *SAN 84387*, *SAN 91434* and *SAN 120142)*; Sarawak (*S 1145*, *S 13271*, *S 21517*, S 29992, *S 35172*, *S 41851*, S 44528, *S 51475 S 83468)*; Brunei (*BRUN 432*, *BRUN 1143*, *BRUN 15636, Wong WKM 785* and *WKM 1252*, Kalimantan *(Church*

582 and *Kostermans 21440)*.

Notes: The narrow, elliptic leaves resemble *Litsea subumbelliflora* (Blume) Ng which, however, has an attenuate leaf base. Also, the fruits of *L. subumbelliflora* have distinct peduncles (0.2–0.6 cm long) and pedicels (0.1–0.5 cm long).

When I first examined the specimen *Wong WKM 1252* and found uniflorous umbellules with 2-locular anthers, I thought I had a new species of *Iteadaphne* and a new generic record for Borneo. However, a single male specimen does not make a species. I eventually found the females in *Litsea* filed together with male specimens having 4-locular anthers and 2–3 florets per umbellule!

19. **Litsea suboppositifolia** Ng, **sp. nov.**
(Named for the subopposite leaves)

Folia subopposita coriacea ovata ad elliptico-oblonga plerumque plus quam 4 cm lata. **Typus:** *Sugau JBS 116*, Sabah, Tambunan (holo KEP; iso SAN). **Figure 6**

Small tree. **Leaves** subopposite, coriaceous, glabrous, slightly glaucous below; blade ovate to oblong-elliptic, 8.5–20 x 3.5–8 cm, but mostly broader than 4 cm, base cuneate, apex acute to acuminate; midrib broad and flat, impressed, or prominent above; lateral veins 6–12 pairs; intercostal veins reticulate to vaguely scalariform; petiole 1–2.5 cm long, 0.2–0.4 cm thick (relatively thick and stout). **Inflorescences** borne on the twigs; raceme axis 0.5–2.5 cm long; **florets** *c.* 3 per umbellule; peduncles 0.3–0.8 cm long. **Fruits** ellipsoid, to 2 x 1.5 cm; cupule forming a cup to 1.5 cm wide and 0.5–0.8 cm deep; pedicel short and fleshy, 0.2–0.3 cm long.

Distribution: Endemic in Borneo: Sabah and Sarawak. Lower and upper montane forest at 1100–3000 m elevation.

Selected specimens examined: Sabah (*SAN 29195*, *SAN 38327*, *SAN 38349*, *SAN 46569*, *SAN 95242*, *SAN 123342*, *SAN 123387*, *SAN 123532*, *Sugau JBS 116)*; Sarawak (*S 38135* and *S 50427)*.

20. **Litsea subumbelliflora** (Blume) Ng, **comb. nov.**
Basionym: *Laurus subumbelliflora* Blume, Bijdr. Fl. Ned. Ind. 11e (1826) 554. **Type:** *Blume s.n.*, Java (lectotype, here designated, L *Acc. No. 951212095*)

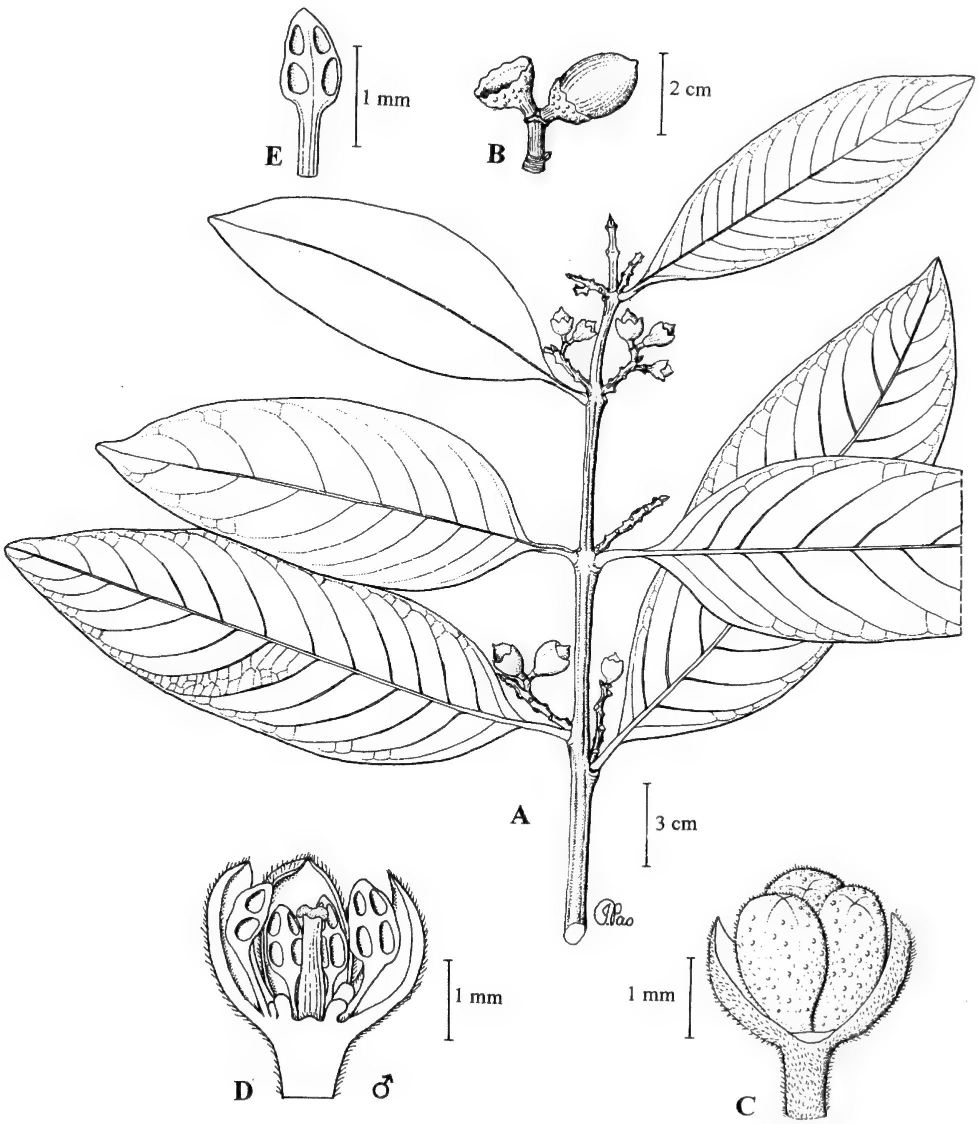

Figure 6. *Litsea suboppositifolia Ng*. A, fruiting (young) leafy twig; B, part of infructescence with an older fruit; C, umbellule of 3 fiorets (flowers) within an involucral bud; D, longitudinal section of flower; E, a stamen with 4-locular anther. (A from J.B. *Sugau JBS 116* from *Carr SFN 27101*, C–E from *Carr SFN 27724)*.

New synonyms:

Laurus pauciflora Blume, Fl. Ned. Ind. 11e (1826) 555. **Type:** *Blume s.n.*, Java (holo L *Acc. No. 905230213*).

Iteadaphne confusa Blume, Mus. Bot. Lugd. Bat. 1 (1851) 365, *nomen illeg.*

Lindera subumbelliflora (Blume) Kosterm., J. Sci. Res. Indon. 1 (1952) 127.

Litsea lanceolata (Blume) Kosterm., Reinwardtia 7 (1968) 348. **Basionym:** *Aperula lanceolata* Blume *l.c.* (1851) 367. **Type:** *Blume s.n.*, Java (holo not seen; iso U *Acc. No. 190430B*).

Notes: This is one of the four species in which male specimens with two anther locules were placed in *Lindera* or *Iteadaphne* and those with 4 anther locules in *Litsea.* In Borneo, both conditions occur, but in the Malay Peninsula only the 2-locular condition is found. The species includes *Laurus subumbelliflora* Blume and *Laurus pauciflora* Blume that Blume (1851) combined and renamed *Iteadaphne confusa* Blume when he created the genus *Iteadaphne*. This procedure is incorrect. The situation was rectified with the choice of the epithet *subumbelliflora* by Kostermans (1952) when he reduced *Iteadaphne confusa* Blume to *Lindera subumbelliflora* (Blume) Kosterm. With the merger of *Lindera subumbelliflora* with *Litsea lanceolata*, the species becomes *Litsea subumbelliflora*.

21. **Litsea umbellata** (Lour.) Merr.

Philip. J. Sc. Bot. 14 (1919) 242. **Basionym:** *Hexanthus umbellatus* Lour., Fl. Cochinch. (1790) 195. **Type:** not seen.

New synonym: *Litsea gracilis* Gamble, Bull. Misc. Inform. Kew. (1910) 317. **Type:** *Ridley 14603*, Perak, Temango (holo not seen; iso SING).

Notes: In his account in the Tree Flora of Malaya, Kochummen (1989) noted that he had not seen the rare species, *Litsea gracilis*, known only from the type. However, the isotype in SING bears a note by him reducing it to *Litsea umbellata*. I agree with this reduction.

22. **Litsea unita** (Blume) Boerl.

Handl. Fl. Ned. Ind. 3 (1900) 145. **Basionym:** *Cylicodaphne unita* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 387. **Type:** *s. coll.*, *s. n.*, Indonesia (holo L *Acc. No. 90523382*).

New synonyms:

Litsea pallidifolia Merr., Univ. California Publ. Bot. 5 (1929) 81. **Type:** *Elmer 20808*, Sabah, near Tawau (holo not seen; iso SING).

Litsea montis-dulit Airy Shaw, Bull. Misc. Inform. Kew (1939) 536. **Type:** *Synge 1649*, Sarawak, Dulit Ridge (holo K; iso BO, SING).

Notes: This species has pale-coloured leaves with few, widely spaced lateral veins. The isotype of *Litsea montis-dulit* in SING bears a note by Kostermans reducing it to *Litsea unita* but which reduction he did not publish.

Lindera Thunb.

23. **Lindera bibracteata** (Blume) Boerl.
Handl. Fl. Ned. Ind. 3 (1900) 146. **Basionym:** *Laurus bibracteata* Blume, Bijdr. Fl. Ned. Ind. (1825) 553. **Type:** *Blume s.n.*, Java, Mt Salak (holo L *Acc. No. 905230346*).
New synonyms:
Lindera rufa (Stapf) Gamble, J. As. Soc. Beng. 75, 2 (1912) 199. **Basionym:** *Lindera caesia* (Reinwardt *ex* Blume) VillarBoerl. var. *rufa* Stapf, Trans. Linn. Soc. Bot. 4 (1894) 220. **Type:** *Haviland 1106*, Borneo, Sabah (holo not seen; iso SING, SAR).
Lindera turfosa Kosterm., Reinwardtia 7 (1969) 497. **Type:** *Kostermans 8136*, Borneo, Kalimantan, Sampit district (holo BO; iso L).

Notes: This is a distinctive and common species with triveined, ovate leaves with a long-acuminate apex. There is variation in the degree of hairiness in the twigs and underside of the leaves, but the variation is continuous.

24. **Lindera lucida** (Blume) Boerl.
Handl. Fl. Ned. Ind. 3 (1900) 147. **Basionym:** *Litsea lucida* Blume, Bijdr. Fl. Ned. Ind. (1825) 562. **Type:** *Blume s.n.*, Java (holo L *Acc. No. 905230435*).
New synonym: *Lindera pedicellata* Kosterm., Reinwardtia 8 (1970) 83. **Type:** *Clemens 28522*, Borneo, Sabah, Gunung Kinabalu (holo BM)

Neolitsea Merr.

25 ***Neolitsea cassia*** (L.) Kosterm.
J. Sci. Res. Indon. 1 (1952) 152; Comm. For. Res. Inst. 57 (1957) 49 and 54. **Basionym**: *Laurus cassia* L., Sp. Pl. (1753) 369. **Type**: 'Fl. Zeylanica No 146' (BM)
Synonym: *Neolitzea zeylanica* (Nees) Merr., Philip. J. Sc. 1, Suppl. (1906) 57. **Basionym:** *Litsea zeylanica* Nees, Amoen. Bot. Bonn. 1 (1823) 58, *t*. 5. **Type:** Hermann's Herb: *Laurus zeylanica* in BM, not seen
New synonyms:
Neolitsea latifolia (Blume) S.Moore, J. Bot. 43, Suppl (1925) 89. **Basionym:** *Litsea latifolia* Blume, Mus. Bot. Lugd. Bat. 24 (1851) 394. **Type**: *s. coll., s.n.* Sumatra (not seen).

Neolitsea coccinea B.C.Stone. Malaysian Forester 43 (1980) 245. **Type:** *Kiew RK 732*, Gunung Ulu Kali (holo KEP).
Neolitsea sp. 1 in Kochummen. Tree Flora Malaya 4 (1989) 169.

Notes: Nees (1823), in publishing *Litsea zeylanica* Nees, listed *Litsea cassia* L. as a synonym. When Merrill (1906) established the genus *Neolitsea*, he transferred *Litsea zeylanica* (Nees) to *Neolitsea zeylanica* (Nees) Merr., and made it the type species of the new genus. Kostermans (1952) briefly discussed the history of *Neolitsea* and made the following comment about its type species: 'As *Neolitsea zeylanica* (Nees) Merr. is identical with *Laurus cassia* L. (p.p.), the type species was renamed in this paper: *Neolitsea cassia* (L.) Kosterm.'

Kostermans (1957) later restated the change in a more formal manner, but an explanation was only provided at the end of this paper, under the heading 'Additions to: A historical survey of Lauraceae'. The addendum says '*Laurus cassia* L. is based on no. 146 in his Flora zeylanica, which in turn is based on Hermann's specimens. In Hermann's Herbarium (British Museum) these represent a mixture of *Litsea zeylanica* Nees and the wild *Cinnamomum zeylanicum* (Trimen in J. Linn. Soc. Bot. 24: 140, 1887).'

Litsea latifolia Blume was described in 1851 with three varieties, var. *areolata*, var. *caesia* and var. *punctata* in addition to the typical variety. The species was reduced by Hooker *f.* (1886) to *Litsea zeylanica* Nees. I have seen a specimen labelled as *Litsea latifolia* Blume (BO *Acc. No.* 1278323), possibly the type of *L. latifolia* var. *caesia* Blume, and an image of another, *NY 355281*, possibly the type of *L. latifolia* var. *punctata* Blume (Herb. Meisner), from the NY website. Both specimens conform to *Litsea zeylanica*, now *Neolitsea cassia*, hence I concur with Hooker *f.*

Moore (1925) transferred *Litsea latifolia* Blume to *Neolitsea latifolia* (Blume) S.Moore apparently without realizing that Hooker *f.* had already reduced *Litsea latifolia* Blume to *Litsea zeylanica.*

Neolitsea zeylanica, now *Neolitsea cassia*, is variable in fruit shape (globose or ellipsoid), fruit size (0.5–1.5 cm diam.) leaf texture (chartaceous to coriaceous), and cupule development (distinct or indistinct). It covers a vast geographic range, from the Himalayas to Australia, and from sea coasts to high mountains. In the Malay Peninsula on Gunong Ulu Kali, there is a population with coriaceous leaves and small ellipsoid fruits that was described as *Neolitsea coccinea* B.C.Stone and which is identical to montane specimens of *N. cassia* in Borneo. Then there are montane specimens in the Malay Peninsula with ellipsoid fruits but leaves chartaceous to coriaceous, which Kochummen (1989) called *Neolitsea* sp 1, and which are also part of the *N. cassia* complex.

26. **Neolitsea villosa** (Blume) Merr.
Philip. J. Sc. Bot. 4 (1909) 261. **Basionym:** *Litsea villosa* Blume, Mus. Bot. Lugd. Bat. 1 (1851) 349. **Type:** *Zippelius s.n.*, Moluccas, Ambon (holo not seen; iso L *Acc. No. 905234108*).
New synonyms: *N. mollissima* (Gamble) Gamble, Bull. Misc. Inform. Kew (1911) 172. **Basionym:** *Tetradenia mollissima* Gamble, Bull. Misc.Inform. Kew (1910) 366. **Type:** *Wray 931*, Perak, Gunung Batu Putih (holo K).

Notes: This species differs from the more widespread *Neolitsea cassia* (L.) Kosterm. by its densely hairy twigs. I cannot see any difference between *N. mollissima* and *N. villosa*. Also, *N. kedahense* Gamble, existing as a single population on Gunong Jerai, Kedah, is probably no more than a local variant of *N. villosa*.

Excluded Species

Litsea casearioides Kosterm., Reinwardtia 7 (1968) 346. **Type**: *James Ah Wing SAN 19047* (holo L; iso SAN, SING, KEP).

This species has to be excluded from Lauraceae (J. Sugau and W.J.J.O. de Wilde, *pers. comm.*). Its status will be clarified in a paper being prepared by de Wilde.

Acknowledgements

I am grateful to the curators of the herbaria at BO, SAN, SAR and SING for the loan of specimens, to the curators at K and BM for photographs of type specimens, to Dr. J. F. Veldkamp for the botanical Latin, and to the Tree Flora of Sabah and Sarawak Project for funding the study. Special thanks are due to Prof. Jens Rohwer and Dr Henk van der Werff for kindly reviewing the manuscript and to Joseph Pao for preparing the botanical illustrations.

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An Unusual New Species of *Begonia* (Begoniaceae) from Vietnam

NGUYEN QUANG HIEU

New York Botanical Garden, Bronx, NY 10458 and
The Arboretum, University of California-Santa Cruz, Santa Crux, CA 96060, USA

AND

MARK C. TEBBITT

Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, NY 11225, USA

Abstract

An unusual new *Begonia* species, *Begonia cucphuongensis* H. Q. Nguyen & Tebbitt, is described from limestone ridges in northern Vietnam.

Introduction

In 2004, the first author discovered a very distinct species of *Begonia* in Vietnam's Cuc Phuong National Park, which is newly described and illustrated here.

This species has an unusual combination of morphological characters and cannot be classified within any of the 66 recognized sections of *Begonia* (Doorenbos *et al.*, 1998; Shui *et al.*, 2002; Forrest and Hollingsworth, 2003; de Wilde and Plana, 2003). In many respects the species is similar to *B. boisiana* Gagnep., which also has never been assigned to a section despite having been described as long ago as 1919. Both species share a combination of characters not otherwise found in the Begoniaceae – both are caulescent herbs with a distichous leaf arrangement, have palmate-pinnate leaf venation, lunate stigmas, and entire placentae and lack cystotyles. Both species are also restricted to shallow soils overlaying limestone in northern Vietnam. Given these similarities, the two species may well be closely related.

However, the two species differ considerably in several respects. Most notably *B. cucphuongensis* has a rhizome, while *B. boisiana* is non-rhizomatous, it also has protogynous rather than protandrous inflorescences, female flowers with three rather than five tepals and a markedly different fruit shape. Since many of the characters by which the two species differ are considered taxonomically important in the sectional classification of

Begonia, we refrain from classifying either species into an existing section or from creating any new sections to accommodate these species. This must await completion of an ongoing molecular phylogenetic analysis of these and other Indo-Chinese *Begonia*.

Begonia cucphuongensis H. Q. Nguyen & Tebbitt, ***sp. nov***.

Haec species *Begoniae boisianae* affinis, sed ab ea habitu rhizomatoso, in floribus femineis tepalis 3 et ovarii alis aequalibus distinguitur.**Typus:** Vietnam. Ninh Binh Province: Cuc Phuong National Park, 19 June 1999, shade on limestone-derived soil, forest dominated by *Streblus macrophyllus*, *M. A. Jaramillo et al. MAJ* 493 (holo HN; iso CPNP, F, MO).
Figure 1, Plate 1A

Monoecious, shortly rhizomatous, perennial herb, with an upright stem 30–40 cm tall. *Stems* few-branched, internodes 1.5–6 cm long, sparsely hairy. *Stipules* persistent, white, red or purple, elliptic to lanceolate, 1–1.5 x *c*. 0.3 cm, apex acute, ending in a short hair, margin entire. *Leaves* distichous; lamina asymmetric, ovate-lanceolate to oblong-lanceolate, 7–12.5 x 2–4.5 cm, above green, beneath paler green, often reddish tinged, both surfaces glabrous, apex acuminate, base oblique-cordate, margin with a few widely spaced short teeth-like multiseriate hairs where main veins terminate, teeth-like hairs 1–3 mm long, venation palmate-pinnate; petiole green, 1.5–4.5 cm long, with sparse microscopic uniseriate glandular hairs. *Inflorescences* axillary towards apex, cymose, 2–3-branched, 10- to 15-flowered, bisexual, protogynous; peduncle green, glabrous, 1–2 cm long; bracts persistent, pale purple or white, ovate or elliptic, 2–5 x 2–4 mm, margin dentate. *Flowers* white to pink. *Staminate flowers*: pedicel 0.8–1.7 cm long, glabrous; tepals 4, outer two ovate-cordate to cordate, 6–7 x 5–6 mm, margins entire; inner two oblong, *c*. 5 x 2 mm, glabrous, margin entire; androphore absent; stamens 15–40, yellow; anthers obovate, *c*. 1 mm long, apex truncate or rounded, connective not projecting, filament *c*. 1 mm long. *Pistillate flowers*: bracteoles absent; pedicel *c*. 1 cm long, glabrous; tepals 3, outer two obovate, *c*. 8 x 8 mm, margin entire, the inner one elliptic, 7–8 x 3–6 mm, margin entire. *Ovary* pink, 3-locular, elliptic, 1–1.2 x 0.6–0.7 cm long, glabrous, wings 3, equal, arcuate-deltoid, *c*. 8 mm tall, projecting past locules for *c*. 1 mm at apex and *c*. 2 mm at base; placentae axile, entire; styles 3, shortly fused at base, 2–3 mm long, yellow, unbranched, stigmas lunate. *Fruits* becoming dry and dehiscing via slits positioned next to the wings, *c*. 1.2 cm long.

Distribution: Vietnam, Ninh Binh province, Nho Quan District, Cuc Phuong

Figure 1. *Begonia cucphuongensis* H. Q. Nguyen & Tebbitt. (*P.K. Lok et al. P10408*).

National Park; Thanh Hoa Province, Ba Thuoc District, Pu Luong protected area.

Other specimens examined: Vietnam. Thanh Hoa Province, Ba Thuoc District, Pu Luong protected area, 500–700 m, 20°25'48"N, 105°14'13"E, 13 April 2001, *N. T. Hiep et al. HAL 937, 939* (CPNP, F, HN). Ninh Binh Province, Cuc Phuong National Park, Bong 20°21'04"N, 105°35'16" E, on limestone ridge, 500 m, 20 July 2000, *P. K. Loc et al. P10323, 10408* (CPNP, F, HN); 9 Dec 1999, *N. T. Hiep et al. NTH 4098* (HN); 18 Nov 1999, *N. T. Hiep & N. X. Tam 4093* (HN); 15 Mar 2000, *N. T. Hiep 4188* (HN); 15 Mar 2000, *N. T. Hiep 4189*; *D. D. Soejarto et al. 11080* (CPNP, F, HN).

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Plate 1. Innflorescences of A. *B. boisiana* Gagnep. (*NTH 3069*) and B. *Begonia cucphuongensis* H. Q. Nguyen & Tebbitt (*NTH 4098*). *Photographs H. Q. Nguyen.*

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Three New Species of *Scaphochlamys* (Zingiberaceae) from Peninsular Malaysia

Y.Y. SAM AND L.G. SAW

Forest Research Institute Malaysia,
52109 Kepong, Selangor, Malaysia

Abstract

Three new species of *Scaphochlamys* are described from Peninsular Malaysia: *S. abdullahii* Y.Y.Sam & Saw, *S. cordata* Y.Y.Sam & Saw and *S. laxa* Y.Y.Sam & Saw. All three are endemic to the eastern part of Peninsular Malaysia, with *S. abdullahii* and *S. cordata* confined to only one locality each in Terengganu.

Introduction

Scaphochlamys is a genus of small gingers only known from the West Malesian forest. Twenty six species are known so far and Peninsular Malaysia has the highest number of species; 19 species (Newman *et al.* 2004). In recent years, collections made from newly accessible forested area have revealed a number of new species. In this paper, we described three, *S. abdullahii*, *S. cordata* and *S. laxa*.

The description below is based on herbarium specimens and fresh material (especially important for floral parts) including plants in cultivation in the nursery of Forest Research Institute Malaysia. In most cases, the cultivated plants are similar in size to the wild population except for *S. cordata*, which tends to be smaller.

1. ***Scaphochlamys abdullahii*** Y.Y.Sam & Saw ***sp. nov.***
Scyphochlamide longifolia similis, foliis infra pilis dense appressis (nec costa pilosa solum) petiolo glabro (nec pilosus), bracteolis quam bracteis brevioribus (nec longiores), bracteis plus quam unifloris (nec uniflorae) differt. **Typus:** Peninsular Malaysia, Terengganu, Setiu, Ulu Setiu Forest Reserve, 17 January 2005. *Sam, Aidil & Arif FRI 49130* (holo KEP; iso SAN, SING).
Figure 1.

Ground herb to 55 cm tall, rhizome creeping underground, cut rhizome purple, 5–6 mm diam. Leafy shoots erect, close together, one leaf per shoot, rarely 2; bladeless sheaths 3, red to brownish red, ridged longitudinally, densely hairy especially when young, largest sheath 6–10.5 cm, drying during anthesis. *Leaf* sheath 1.5–3 cm, ligule bilobed, lobes small; petiole (5.5–)9–29 cm, round in cross section, channelled only in the terminal part, purplish brown at the base; lamina elliptic, 12–33 x 3.8–7.6 cm, unequal, apex narrowly acute, base narrowly rounded or decurrent, sometimes oblique, with densely appressed hairs on lower surface, red to purplish red when young. *Inflorescence*, 6.5–17 cm long, red when young; peduncle 4–13 cm long, covered entirely by the bladeless sheath when young; inflorescence head ovoid, 3–5.5 cm long. Bracts 8–25, spirally arranged, 19–25 x 13–20 mm, basal ones larger, spathulate, apex blunt, reflexed, margin thin and slightly wavy; rosy red when young, turning to reddish brown or green, imbricate and hiding the rachis entirely. Bracteoles shorter than the bracts, first bracteole largest, 10–16 x 5–7 mm, apex bilobed and hairy, tinged red. *Flowers* 5–6 per bract, white except for the calyx. Calyx tubular, 4–7 mm long, tinged red, apex blunt, split 2–3.5 mm on one side from apex. Corolla tube 17–25 mm. Dorsal corolla lobe lanceolate, 10–12 x 3–4 mm, apex hooded, tinged red distally. Lateral corolla lobes lanceolate, 7–10 x 2–4 mm, tip tinged pink to red. Staminodes oblong, 8.5–11 x 2–3 mm, apex blunt, slight yellowish. Labellum 13–14 x 9–11 mm, bilobed, recurved, *c.* 5 x 5 mm, median band yellow, both sides with purple streaks, sparsely papillose on the abaxial surface. Stamen flushed purple, covered with glandular hairs on the abaxial surface; filament *c.* 2 mm long; thecae 2.5–4 mm long, yellow; anther crest *c.* 1.5 x 2 mm, recurved. Epigynous glands 2, linear, *c.* 5 mm long, yellow. Ovary ellipsoid, trilocular. *Seed* ellipsoid, *c.* 8 x 3 mm, dark brown.

Distribution: Endemic to Peninsular Malaysia. Very rare, only recorded from Setiu District, Terengganu.

Habitat: Lowland forest, *c.* 41 m altitude. This species was found in forest fringes.

Notes: *Scaphochlamys abdullahii* belongs to the single-leaf group and is closest to *S. longifolia*, which has similar closely imbricating bracts and elliptic leaves. However, it differs from *S. longifolia* in having densely appressed hairs on the lower leaf surface, a glabrous petiole and it produces many flowers in the axil of each bract; *S. longifolia* has hairs on the midrib and petiole and single-flowered bracts (Holttum, 1950).

Ridley described *S. longifolia* in 1924 but its type was missing when Holttum (1950) revised the genus. The description given by Holttum was based on a specimen collected from the type locality that he thought was the same species. Although the details of the flower parts were not

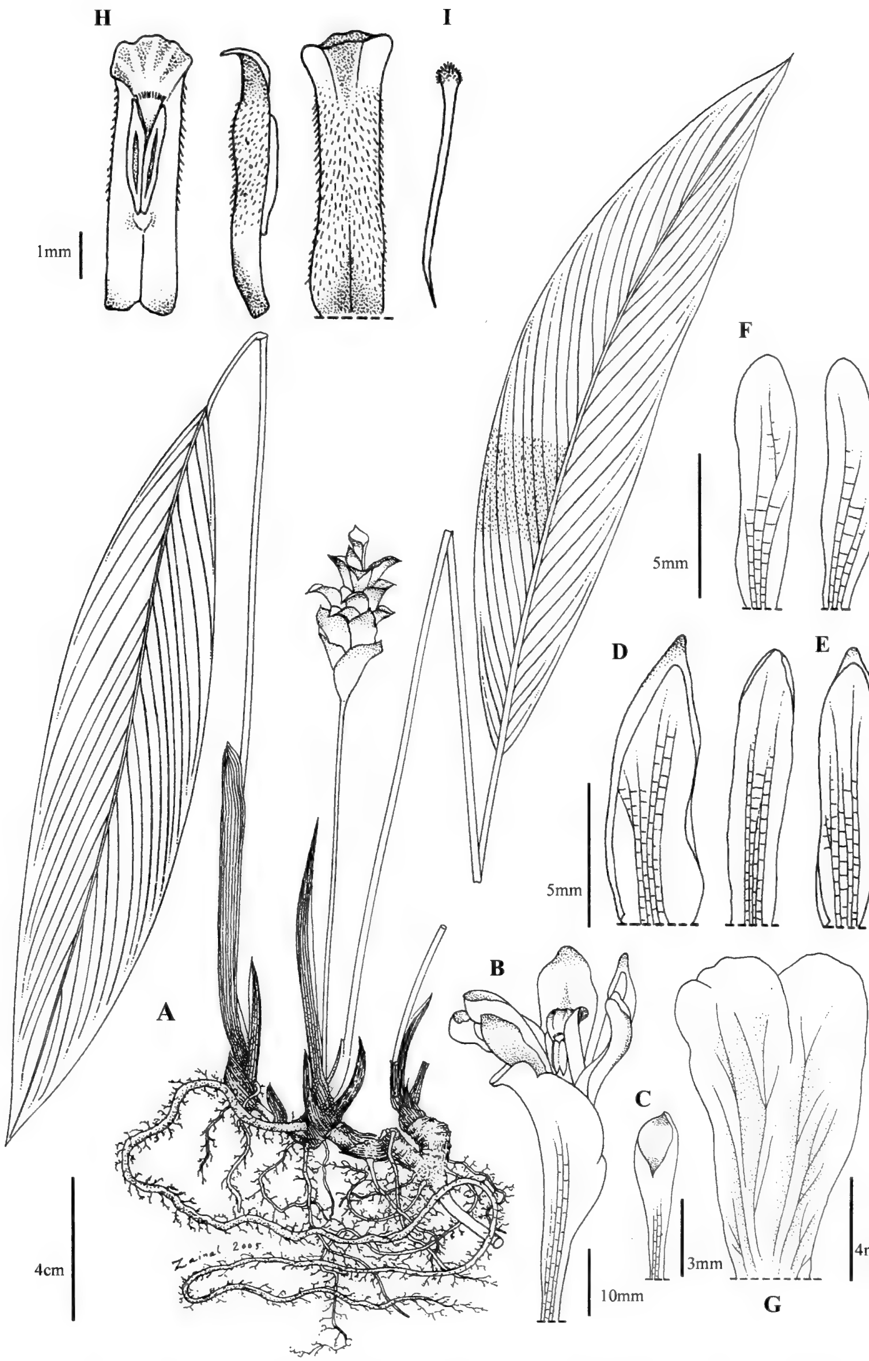

Figure 1. *Scaphochlamys abdullahii* Y.Y.Sam & Saw. A. habit; B. floral bract with flower; C. calyx; D. dorsal corolla lobe; E. lateral corolla lobes; F. staminodes; G. labellum; H. anther front, side and back view; I. stigma. (A. from type specimen; B, C, D, E, F, G, H, I from living collection of 2002–0072).

satisfactory, other characters, e.g. leaf, inflorescence structure and floral bracts, are sufficient to differentiate *S. abdullahii* from *S. longifolia*.

Scaphochlamys abdullahii has a bright rosy red colour in its young inflorescence. This is distinct from other *Scaphochlamys* species that usually have dull blood-red or brownish red in their young floral bracts.

Scaphochlamys abdullahii is named in honour of the Prime Minister of Malaysia, Datuk Seri Abdullah Ahmad Badawi, for his strong interest in nature conservation and protection of the environment.

Other specimens examined: TERENGGANU, Setiu, Kuala Sungai Bok via Kampung Seladang, 14 Mar 1975, *Mohd. Shah & Ahmad MS 3514* (SING); Ulu Setiu Forest Reserve, 16 Aug 2001, *Khaw KSH 743* (KEP); Cultivated material 14 July 2002 *Sam FRI 47053* (KEP).

2. ***Scaphochlamys cordata*** Y.Y.Sam & Saw ***sp. nov***.
Scaphochlamys atroviridi similissima, folii basi cordata (nec cuneata ad decurrenti), petiolo longiore (31–55.5 vs. 6–10 cm longus), inflorescentia longiore (21.5–25.3 vs. 5–10 cm longa) differt. Typus: Peninsular Malaysia, Terengganu, Dungun, Jengai Forest Reserve, 17 October 2002. *Sam & Mustapa FRI 47155* (holo KEP; iso E, SAN).
Figure 2.

Ground herb, rhizome creeping on ground surface. Leafy shoots ascending, close together, one leaf per shoot; bladeless sheaths 4, reddish brown, apex mucronulate, largest sheath 11–17 cm. *Leaf* sheath 1.5–2 cm long, ligule bilobed, lobes small, *c.* 1 mm; petiole slender, 31–55.5 cm long, round in cross section; lamina cordate, 15.5–28.5 x 8.2–14.7 cm, slightly asymmetric, apex acuminate, base strongly cordate, some with auricles overlapping; secondary veins 8–10 pairs, first 6 pairs always originate from the base, prominently raised on the upper leaf surface; leaf below densely hairy proximally, brownish red when young. *Inflorescence* slender, 21.5–25.3 cm long, red when young; peduncle 10–17.8 cm long, hidden within bladeless sheath when young; rachis 5.5–8.5 cm. Bracts spirally arranged, 4–10, lax, 1.5–2 cm apart, red when young, turning to green, spathulate, 15–22 x 5.5–12 mm when flattened, hairy towards the apex on both surfaces, distally reflexed. Bracteoles shorter than the bracts, narrowly lanceolate, 6–11 x 1–3 mm with inflexed margin, apex pointed, hairy throughout, first bracteole largest, enclosing subsequent bracteoles and flowers. *Flowers* more than 15 per bract, small, white except for the calyx. Calyx tubular, 7.5–9 x 1.5–2 mm, red, hairy, split 2.5–4 mm down on one side from apex. Corolla tube 11–14 mm. Dorsal corolla lobe lanceolate with strongly inflexed margin, 6–8.5 x 1.5–2 cm, apex hooded, pinkish distally, papillose on the abaxial

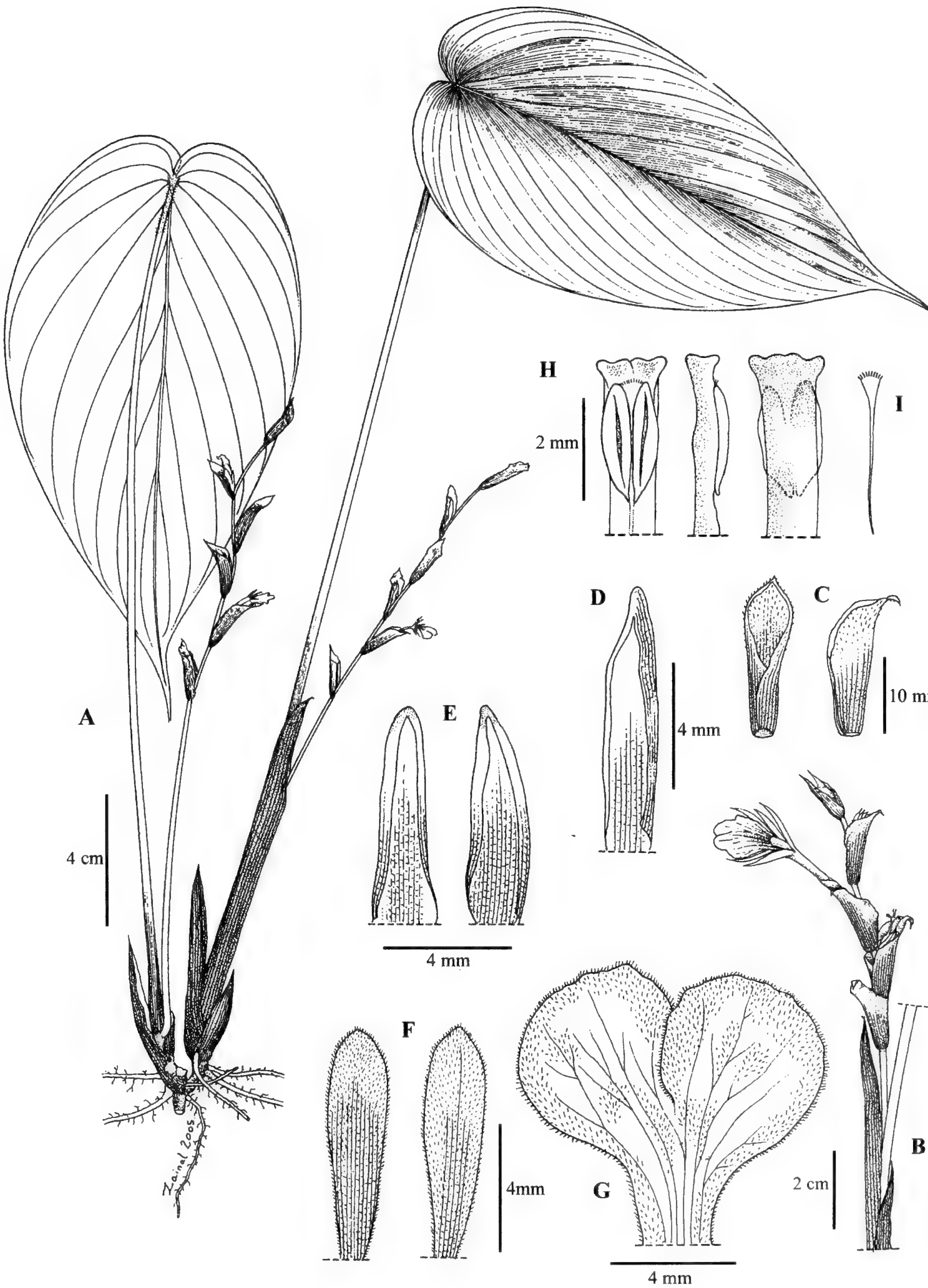

Figure 2. *Scaphochlamys cordata* Y.Y.Sam & Saw. A. habit; B. inflorescence; C. bract front and side view; D. dorsal corolla lobe; E. lateral corolla lobes; F. staminodes; G. labellum; H. anther front, side and back view; I. stigma. (A from type specimen; B, C from living material of 2004-0728; D, E, F G, H, I from FRI 49135).

surface; lateral corolla lobes lanceolate with strongly inflexed margin, 5–7 x 1–2 mm, pinkish distally, papillose on the abaxial surface. Staminodes oblong, 3–7.5 x 1–2 mm, apex rounded, papillose on the adaxial surface. Labellum 7–10 x 5–9.8 mm, bilobed, lobes overlapping, cleft *c.* 4 mm from distal end, median band faintly yellow, purple blotches at both sides. Stamen 3.5–4.5 mm, tinged purple; filament short, *c.* 1 mm long; thecae *c.* 2.5 mm long, anther crest short, less than 1 x 1.5 mm. Stigma small, cup-shaped, yellowish, papillose.

Distribution: Endemic to Peninsular Malaysia; only known from Jengai Forest Reserve in Terengganu.

Habitat: Lowland dipterocarp forest, at 80–140 m altitude. The species is observed to favour ridges.

Notes: Scaphochlamys cordata belongs to the single leaf group with very lax floral bracts in the inflorescence. This species is similar to S. atroviridis but differs in the leaf shape and apex, petiole and inflorescence length, size of floral bracts and labellum (Table 1).

Table 1. **Diagnostic characters to distinguish *Scaphochlamys cordata* and *S. atroviridis***

Characters	*S. cordata*	*S. atroviridis*
Leaf shape	cordate	elliptic with cuneate to decurrent base
Leaf apex	acuminate	rounded
Petiole length (cm)	31–55.5	6–10
Inflorescence length (cm)	21.5–25.3	5–10
Size of floral bracts (mm)	15–22 x 5.5–12	30–35 x 15
Size of labellum (mm)	7–10 x 5–9.8	18 x 15

This species is named for its distinctly cordate leaves.

Other specimens examined: TERENGGANU, Dungun, Jengai Forest Reserve, 9 Mar 2005, *Sam FRI 49135* (KEP). Cultivated material 23 Aug 2000 *Saw FRI 44306* (KEP).

3. ***Scaphochlamys laxa*** Y.Y.Sam & Saw ***sp. nov.***
Scyphochlamide cordata similis, petiolo longiore (31–36 vs. 13–29 cm

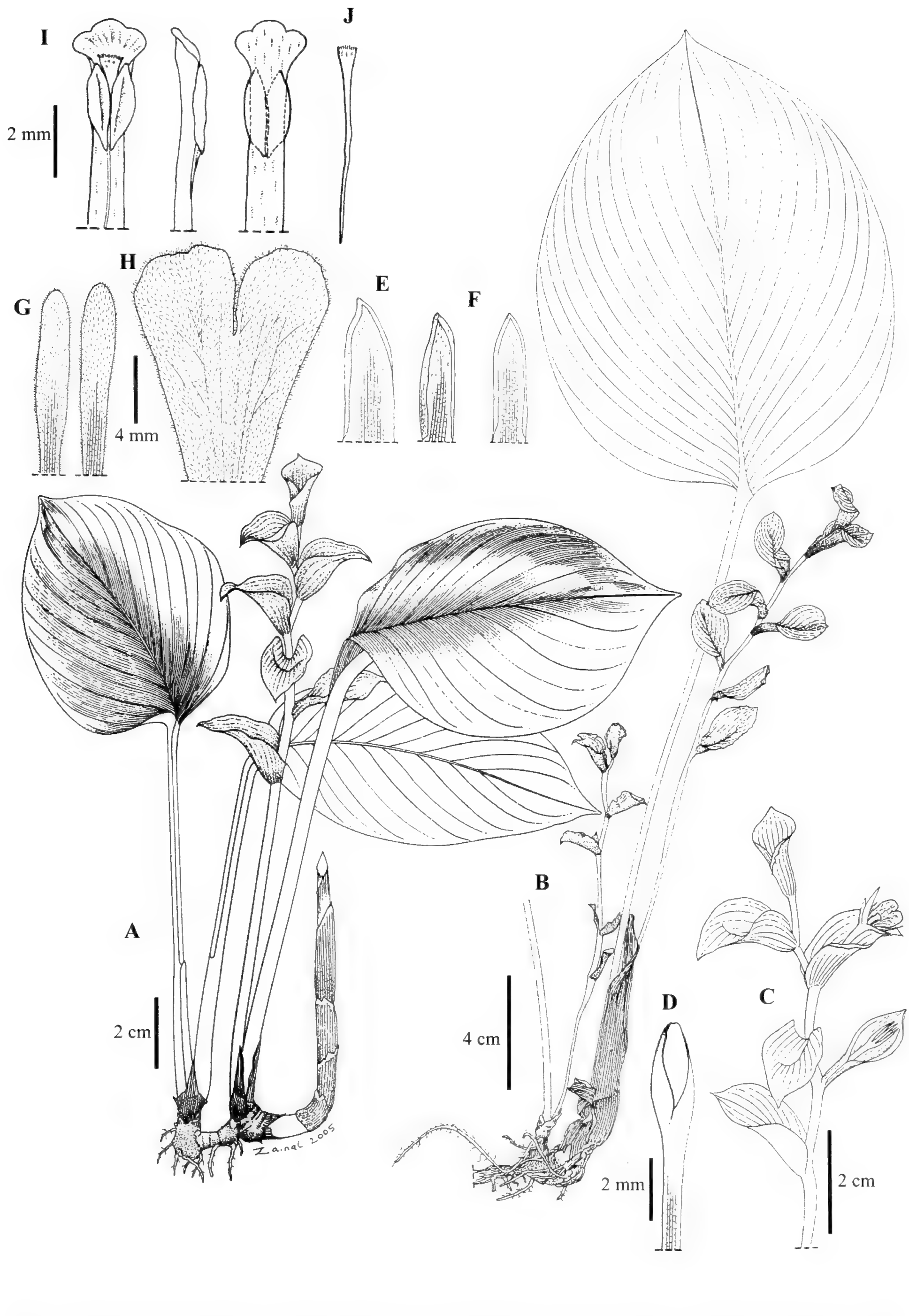

Figure 3. *Scaphochlamys laxa* Y.Y.Sam & Saw. A, B habit; C. inflorescence; D. calyx; E. dorsal corolla lobe; F. lateral corolla lobes; G. staminodes; H. labellum; I. anther front, side and back view; J. stigma. (A, C from living material of 2004-0718; B, D, E, F, G, H, I, J from type specimen).

longus), foliis late ellipticis vel ovatis (nec cordata), labello maiore (11.5–22 vs. 7–8 cm longum, 10–20 vs. 5–6 cm latum) distinguenda. **Typus:** Peninsular Malaysia, Terengganu, Dungun, Jengai Foest Reserve, 9 March 2005. *Sam & Apok FRI 49136* (holo KEP; iso SAN, SING).
Figure 3.

Rhizomatous herb; rhizome running horizontally on the ground, fleshy. Leafy shoots erect, 30–40 cm tall, red when young; one leaf per shoot, 1–3 cm apart (sometimes much closer and appearing as a two-leaved shoot when under stress or in cultivation); bladeless sheaths 3, red, ridged longitudinally, largest 7–13.5 cm. *Leaf* sheath 3.8–4.5 cm, ligule bilobed, lobes not obvious; petiole 13–36 cm long, grooved in cross section, red when young; lamina broadly elliptic or ovate, 13–22 x 10.5–14 cm, apex cuspidate, base slightly decurrent on the petiole, never cuneate, margin ciliate; secondary veins slightly raised on the upper surface, dark green, some with white bands in between midrib and leaf margin; leaf underneath pale green, red when young. *Inflorescence* 15–33 cm long; peduncle 9–12 cm, red when young; rachis 2.5–11 cm. Bracts spirally arranged, (2–4–)5–10, lax, 0.4–2 cm apart, dark green, spathulate, broadly elliptic when flattened, 1.7–2.5 x 0.8–1.6 cm, apex acute, distally reflexed, margin hairy when young. Bracteoles smaller than the bracts, 5–7 x 4.5–6 mm, hairy towards apex, first bracteole enclosing subsequent bracteoles and flowers. *Flowers* more than 20 per bract, white except for the calyx. Calyx tubular, 6–7 x *c.* 2 mm, apex bilobed, tinged red, split 3–4 mm down on one side from apex. Corolla tube 13–17 mm long. Dorsal corolla lobe lanceolate, 8–13 x 3–4 mm with inflexed margin, apex hooded and pointed, faintly yellow. Lateral lobes narrowly lanceolate with incurved margin, 7–11 x 2–3 mm, apex also hooded and pointed. Lateral staminodes oblong, apex blunt, 9–11.5 x 1–3 mm, papillose on the adaxial surface, faintly yellow towards the apex. Labellum hairy, 11.5–22 x 10–20 mm, bilobed, papillose on the upper surface, lobes 5.5–7 x 6–7 mm, cleft *c.* 6 mm from distal end, crisped, median band yellow with purple streaks at both sides. Filament 2.5–3 mm, some with purple blotches; thecae 2–2.5 mm long; anther crest 0.5–1 x 2.5–3 mm, apex trilobed, strongly recurved. Stigma *c.* 1 mm wide, cup-shaped, covered with brown papillae. Epigynous glands 2, linear, *c.* 4 mm, yellow. Ovary *c.* 2 mm long, trilocular.

Distribution: Endemic to Peninsular Malaysia. Found on the Timur Range of Pahang and Terengganu.

Habitat: The species is found on undulating land and slopes of lowland dipterocarp forest, from 65 to 130 m a.s.l., where it grows in abundance under heavy forest shade.

Notes: *Scaphochlamys laxa* is unique in having a very broadly elliptic or ovate lamina, unlike other *Scaphochlamys* species. *S. laxa* is similar to *S. cordata* but is distinguished by its shorter petiole (13–29 *vs*. 31–36 cm), grooved in cross section (round in *S. cordata*) and broadly elliptic or ovate leaves. The other differences include the larger flowers and the trilobed and reflexed anther crest of *S. laxa.*

The name '*laxa*' refers to the bracts that are very lax on the rachis.

Other specimens examined: TERENGGANU, Dungun, Jengai Forest Reserve, 17 Oct 2002, *Sam & Mustapa FRI 47152* (KEP); Pasir Raja Selatan Forest Reserve, 7 June 2004, *Markandan FRI 49179* (KEP). PAHANG, Jerantut, Gunung Aais Forest Reserve, Sungai Lurut, 5 Jul 2004, *Sam FRI 49057* (KEP).

Acknowledgements

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Malaxis inexpectata and *Habenaria paradiseoides* (Orchidaceae), New Records for Peninsular Malaysia

M. JUTTA[1]

AND

Q.Z. FARIDAH[1,2]

[1]Institute of Bioscience, Universiti Putra Malaysia (UPM), 43400 Serdang, Malaysia.

[2]Biology Department, Faculty of Science, Universiti Putra Malaysia (UPM), 43400 Serdang, Malaysia.

Abstract

Two new records, *Malaxis inexpectata* (J.J.Sm.) J.B.Comber and *Habenaria paradiseoides* J.J.Sm., are reported for the Orchidaceae of Peninsular Malaysia. Until now, both were known only from Sumatra, *M. inexpectata* with two, and *H. paradiseoides* with one collection.

Malaxis inexpectata

Malaxis inexpectata (J.J.Sm.) J.B.Comber, Orchids of Sumatra (2001) 172. syn. *Pseudoliparis inexpectata* (J.J.Sm.) Marg., Ann. Bot. Fennici. 40 (2003) 63. *Microstylis inexpectata* J.J.Sm., Bull. Jard. Bot. Buit. ser. 3, 10 (1928) 33.
Figure 1

Small herbs with closely spaced pseudobulbs, somewhat laterally compressed stems measuring 1.5 cm long by 0.6 cm wide. Leaves 4–5, the upper ones largest; lamina with three prominent veins, elliptic-ovate, apex acute-acuminate, margins undulate, 4.5 x 1.7 cm; petiole to 1 cm long, ending in a broad overlapping sheath. Inflorescence terminal; scape ~5 cm long; rachis bearing up to 20 flowers, opening 2–3 at a time; floral bracts narrowly lanceolate, acute, reflexed, 5 mm long. Flowers non-resupinate, orange. Median sepal ovate, obtuse, 4 x 2.2 mm; lateral sepals a little smaller, oblique; petals lanceolate, obtuse, 2.4 x 0.75 mm, recurved. Labellum including auricles about 3.4 mm long and 2.8 mm wide, not toothed; side lobes inconspicuous, midlobe curved up; fovea oblong with a distinct linear median depression and a small raised callus at the base; auricles not touching, apex rounded, 1.6 mm long. Column short, curved, winged, with a distinct, papillose horn-like projection at the back below the dorsally positioned anther; pollinia four, club-shaped.

Specimens examined: KEDAH: Langkawi, Gunung Machinchang 10 Jan 2004 *Mariam Jutta LCO/F-H 1* (UPM-IBS Herbarium; flower spirit specimen); *Mariam Jutta LCO/F 148* (live collection, Astaka Orkid UPM).

Notes: The species was collected as a tiny bulb on the lower peak of Gunung Machinchang and flowered in the live collection at Astaka Orkid, Universiti Putra Malaysia (UPM). It could not be confidently identified using the key in Seidenfaden & Wood (1992). Based on floral characteristics, it keys out closest to *Malaxis prasina* (Ridl.) Seidenf. & Smitinand, the only Peninsular Malaysian species with an untoothed apex of the labellum, but it is distinct from all M*alaxis* species reported from Peninsular Malaysia in having a 'horn' on the dorsal part of the column. The dorsal horn plus the orange flower colour in *M. inexpectata* are characteristic of Sect. *Pseudoliparis*, and make this collection the first record of this section for Peninsular Malaysia.

Our specimen matches the original description by Smith (1928) in most vegetative and floral aspects except: length of the lip 3.4 mm *vs*. Smith's 2.4 mm; apex of labellum entire *vs*. 'a little erose'; dorsal horn on column papillose *vs*. hairy (Fig. 1). However, after discussion with Peter O'Byrne, it was concluded that the Langkawi specimen merits inclusion in *M. inexpectata*.
This paper applies the name *Malaxis inexpectata* (J.J.Sm.) J.B.Comber as accepted by the World Checklist of Monocots (Govaerts, 2004). The name *Pseudoliparis inexpectata* Marg. (Margoňska, 2003) is treated as a synonym.

Habenaria paradiseoides

Habenaria paradiseoides J.J.Sm., Bull. Jard. Bot. Buit. ser. 3, 12 (1932) 105.
Figure 2

Small herb with closely spaced tufted stems, glabrous throughout. Stems short, each bearing about 8–10 linear, acute leaves, to 10 cm long by 0.5 cm wide. Stem above leaves 20–25 cm long, bearing a few leaf-like bracts, the lowest one up to 6 cm long; rachis to 10 cm long, with up to 20 white

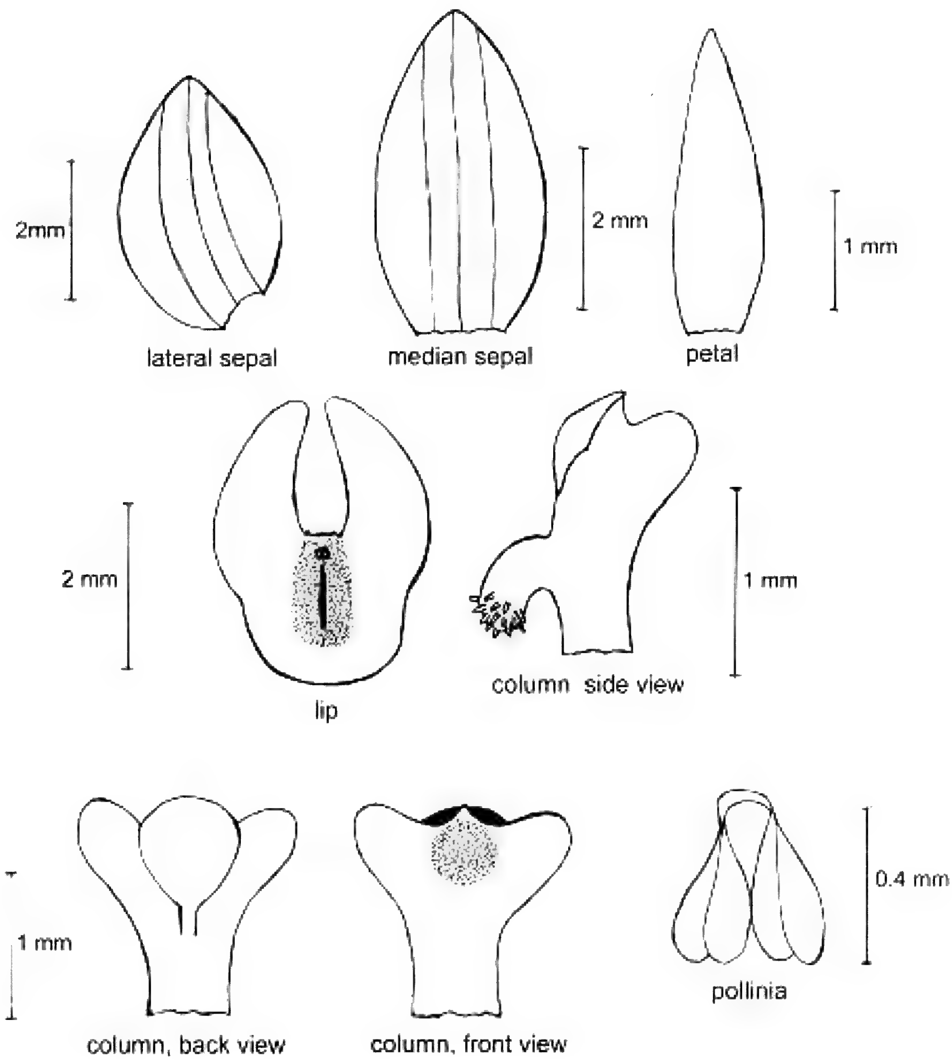

Figure 1. Flower parts of *Malaxis inexpectata* (J.J.Sm.) J.B.Comber.

flowers; floral bracts persistent, triangular acuminate, to 1.5 cm long. Flowers predominantly white. Median sepal about 3 mm long, broadly elliptic, white flushed with green at the back, and forming a hood with the obliquely lanceolate petals; lateral sepals of two unequal halves, oblique, 5.5 mm long, recurved, in-rolled. Labellum with conspicuous, winged, often laciniate side lobes measuring about 2 cm across; midlobe linear, obtuse, 7 mm long; spur 1.4 cm long, thickened towards the base, and curved forward. Column 2.0 mm long by 2.5 mm wide; anther canals compact, short, bent upwards.

Specimens examined: TERENGGANU: Pasir Raja Forest Reserve (FR) 8 June 2004 *Mariam Jutta LCO/F 150* (live collection Astaka Orkid UPM); 5 April 2005 *Mariam Jutta LCO/F-H 9* (UPM-IBS Herbarium); 11 April 2005 *Mariam Jutta LCO/F 544* (live collection, material passed to Singapore Botanical Garden June 05). PAHANG: Jerantut, Gunung Aais FR, *Markandan Moorthy FRI 49202* (KEP, SAN, SING).

Notes: *Habenaria paradiseoides* is considered as having no near allies within the genus (Smith, 1932). Its closest relatives among the Peninsular Malaysian species are *H. reflexa* Blume and *H. kingii* Hook.*f*., which have a similar habit, but differ in being limestone species opposed to *H. paradiseoides* that was found on granite. Flowers, though sharing some similar characteristics in the lateral sepals and spur, show distinct differences between *H. paradiseoides* and the other two species, especially in structure of the labellum and spur (both *H. kingii* and *H. reflexa*) and of the anther canals (*H. reflexa*).

This species was collected twice in Peninsular Malaysia from similar habitats (exposed locations in narrow gaps between rocks lining the banks of large rivers, often prone to strong currents) in Pahang and Terengganu. Both the description and habitat recorded by Smith (1932) match these specimens. Variations in the side lobes of the labellum are common, even on the same plant (Fig. 2), ranging from almost entire to deeply laciniate margins and either two- or three-sectioned lobes, the former being more common.

Acknowledgements

We acknowledge the help and advice of Jaap J. Vermeulen, Sam Yen Yen, Ahmad Ngah and Peter O'Byrne. Ruth Kiew assisted in the preparation of the manuscript.

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New *Tristaniopsis* Peter G.Wilson & J.T.Waterh. (Myrtaceae) From Borneo

P. S. ASHTON

Arnold Arboretum, Harvard University, 22 Divinity Avenue
Cambridge MA 02138, U.S.A.

and

Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, U.K.

Abstract

Three new species, *Tristaniopsis kinabaluensis* P.S.Ashton, *T. microcarpa* P.S.Ashton and *T. rubiginosa* S.Teo *ex* P.S.Ashton, and three new subspecies, *Tristaniopsis kinabaluensis* ssp. *silamensis* P.S.Ashton, *T. merguensis* ssp. *tavaiensis* P.S.Ashton and *T. whitiana* ssp. *monostemon* P.S.Aston, are described from northern Borneo, in preparation for a treatment of the Myrtaceae for the *Tree Flora of Sabah and Sarawak.*

Introduction

Species definition in *Tristaniopsis* Peter G.Wilson & J.T.Waterh. (formerly *Tristania* R. Br.) has proven to be even more difficult in Borneo than among the notorious and much larger myrtaceous genus *Syzygium* Gaertn. Leaf size and shape is variable. The number of stamens, which are clustered opposite the petals, is characteristic of each species but, although at most 10 per cluster, may vary in exceptional cases. Here, we adopt a conservative species concept, awaiting regional monographic and phylogenetic research. Eventually, and with further flowering collections, some at least of the infrapecific taxa described here may be raised to species rank.

All specimens examined have been at the Kew herbarium unless otherwise stated.

1. **Tristaniopsis kinabaluensis** P.S.Ashton, ***sp. nov.***

T. merguensis affinis, foliis minoribus basim versus subsessilibus attenuatis vel anguste obtusis haud auriculatis, subtus hebete glaucescentibus, staminibus 3(-5) in fasciculis, fructibus ad 5 x 4 mm minoribus facile distinguitur. **Typus:** *A. Gibot SAN 60705*, Sabah, Bukit Hampuan, Ranau, in flower (holo K; iso SAN).

Tree to 20(-35) m tall, to 30 cm diameter. Bark rust-brown, cracked and falling in small flakes; inner bark red-brown. Young parts densely yellowish silvery to pale brown downy, caducous. Twig *c*. 3 mm diameter, stout, eventually dark brown. Leaf subsessile, thickly leathery, dull, drying mauve to dark yellowish brown, generally pale mauve glaucous beneath, pits more or less apparent above, dots faint to obscure beneath; blade obovate-oblanceolate, 4–12 x 1.5–4.5 cm, base tapering or abruptly terminating at the *c*. 1 mm stout stalk, apex rounded or shortly broadly acuminate; venation hardly or not raised on either surface, main lateral veins *c*. 15 pairs, ascending. Cyme to 8 cm long, terminal or axillary, doubly branched, the branches and flowers clustered towards the end of the rachis. Flower bud to 4 x 3 mm, obconical, subsessile; sepal lobes to 1 x 1 mm, ovate acute; stamens 3(-5) per cluster. Capsule to 4 x 3 mm, ellipsoid or spherical.

Notes: As *Tristaniopsis merguensis* but leaf smaller, subsessile, base tapering or narrowly obtuse not auriculate even in juveniles, dull more or less mauve glaucous beneath; stamens 3(-5) per fascicle; capsule to 5 x 4 mm, smaller. The floral stamens are 3 in a fascicle as in *T. whitiana* (Griff.) Peter G.Wilson & J.T.Waterh. but the leaf is smaller, thickly leathery, and subsessile.

Subspecies ***kinabaluensis***

Subspecies tomento rufescente-brunneo, costis foliorum obscuris, fructu ad 5 x 4 mm lobis sepalorum ad 1 x 1 mm capsula amplexa valvis ad 4 x 2 mm ellipticis distinguitur.

Hairs dull rufous-brown; leaf venation obscure throughout; fruit to 5 x 4 mm, sepal lobes to 1 x 1 mm clasping base of to 4 x 2 mm elliptic capsule valves following dehiscence.

Distribution and ecology: Known only in and near Kinabalu National Park. Locally common in lower montane oak-laurel forest.

Other specimens examined: SABAH - *Mikil SAN 33924* (K), *Mikil SAN 33945* (K), *Madani SAN 36776* (K, SAN), road to Kamburangoh, Ranau; *Meijer SAN 37990* (K, SAN), above Tenompok; *Clemens 30242* (K), Tenompok; *Chew & Corner RSNB 4859* (K, SING); *RSNB 4148* (K, SAN, SING) Mesilau R.; *Chew & Corner RSNB 4458* (K, SAN, SING)

Bambangan R.; *Chew et al. 1862* (K, SAN, SING), *Beaman 10699* (K), Pinosuk Plateau; *Beaman 9381* (K), above bank of E. Mesilau R.

Notes: Several collections from Sarawak, in fruit or young bud, differ in their less coriaceous, dull but not glaucous leaf blade. These include *Chai S 30427* (K, SAN, SING), *Anderson S 4289* (K, SAN, SING), *Abg. Mochtar et al. S 30818* (K, SAN), Gunung Api, Mulu N.P.; *B. Lee S 38259* (K, SAN), Bukit Berar, Mulu N.P.; *Abg. Mochtar et al. S 49609* (K, SAN), Mulu N.P.; *Yii, P.C. S 41131* (K, SAN), Sabal F.R., Serian. They were collected from organic soils on limestone to 100 m altitude, and on sandstone. Good flowering material is needed to decide their identity.

Subspecies ***silamensis*** P.S.Ashton, ***ssp. nov.***

Subspecies tomento argento-luteo, costis foliorum patentibus costis lateralibus subtus elevatis, calyce in fructu tenue lobis ad 3 x 4 mm rotates, capsula ad 4 mm diam. globosa valvis ad 4 x 3 mm latioribus differt. **Typus:** *G. Shea SAN 75187*, Sabah, Gunung Silam, Lahad Datu, 800 m, in flower (holo K; iso SAN, SING).

Hairs yellowish silvery; leaf venation visible, the main lateral veins slender slightly raised beneath; fruit calyx to 8 mm diameter, shallowly cup-shaped, the lobes spreading, to 3 x 4 mm; capsule to 4 mm diameter, spherical, valves broadly elliptic, to 4 x 3 mm.

Distribution and ecology: Known only from Mt. Silam, coastal E. Sabah; on ultramafic substrate at 800-900 m in lower montane *kerangas.*

Other specimens examined: *Shea SAN 75180* (K), *Mujin SAN 37845* (K, SAN, SING), *Beaman 6991* (K), Mt. Silam.

2. **Tristaniopsis merguensis** (Griff.) Peter G.Wilson & J.T.Waterh.

Austr. J. Bot. 30 (1982) 430. **Basionym:** *Tristania merguensis* Griff., Pl. Cantor.(1857) 18. **Holotype:** *Griffith s.n.*, Mergui, peninsular Burma (holo K).

Synonyms:
Tristania maingayi Duthie, Fl. Brit. Ind. 2 (1878) 467; *T. subauriculata* King, J. As. Soc. Beng. 70, 2 (1901) 502.
New synonyms:
T. stellata Ridl., J. Bot. (1930) 38. **Type:** *Haviland 1983*, Sarawak, Kuching

(holo K); *T. grandifolia* Ridl., *loc.cit.*, *Tristaniopsis grandifolia* (Ridl.) Peter G.Wilson & J.T.Waterh., *loc. cit.* **Type:** *Beccari 2489*, loc. incert. (holo K).

Subspecies ***merguensis***

Canopy tree to 30 m high, to 40 cm diameter. Bark red-brown, becoming irregularly cracked and coarsely flaky in scroll-like pieces, fibrous; inner bark pale red brown, rather crumbly. Sapwood rich red-brown, hard. Inflorescence rachis persistently minutely yellow-brown pubescent, flower buds caducously so, parts otherwise hairless. Twigs 3–5 mm diam., round, glabrous, smooth soon thinly flaking. Leaf blade elliptic to obovate, (6–)10(–17) x (2–)4(–7) cm, leathery, glabrous; apex sharply to broadly acute, base without distinct stalk, distinctly auriculate in juvenile leaves but less distinctly so in mature leaves; main lateral veins shallowly furrowed to slightly raised above, raised below, (17–)28(–34) pairs, 2–8 mm apart, ascending; intramarginal vein *c.* 1 mm within margin. Cyme to 12 cm long, to 5-branched. Flower bud *c.* 3 x 2 mm; pedicel to 2.5 mm long; calyx lobes *c.* 1 x 1 mm; petals *c.* 1.5 mm long; stamens (3–)5–10 per cluster, filament 1–2 mm long; anther *c.* 0.1 mm. Capsule to 1 x 0.8 cm, ellipsoid-globose, pedicel 0.5–1 mm long; seeds *c.* 0.8 x 0.3 cm, relatively large, elliptic.

Distribution and ecology: East coast of Peninsular Malaysia (including Singapore) and throughout Borneo. In lowland mixed peat swamp forest over sandy alluvium, *kerangas* forest over ultramafic rock and rarely on limestone hill and organic soil on high ridge tops to 1000 m.

Specimens examined from Borneo: SABAH – *Ahmad Talip SAN 68396* (K, SAN, SING), Silam, Lahad Datu; *Joseph B. & Kuntul SAN 12085* (K), Mt Silam; *A. Gibot SAN 66926* (K, SAN), Lumut, Beaufort; *Saikeh SAN 73354* (K, SAN), Mesapol, Sipitang. SARAWAK – *Bujang Tajai S 1997* (K), *Smythies S 808* (K), Kayangeran F.R., Lawas; *Haviland & Hose 3187* (K), 'Baram'; *Anderson S 30830* (K, SING), Gunung Api, Mulu N.P.; *Brunig S 0970* (K), Merurong Plateau, Bintulu; *Othman & Abak S 8854* (K, SAN, SING), Bukit Urang, Bintulu; *Brain S 15947* (K, SING), Nyabau F.R., Bintulu; *A. Muas S 13356* (K, SAN), Balai Ringin P.F., Serian; *Hj. Bujang S. 13440* (K, SAN, SING), Gunung Selang, Kuching; *Yii, P.C. S 42956* (K, SAN), Telok Gador, Bako N.P., Kuching; *Haviland 1983* (K), near Kuching; *Beccari 3676* (K), *2489* (K), *loc. incert.* BRUNEI – *Ashton S 5898* (K, SING), Seria; *Ashton BRUN 808* (K), *Ashton 819* (K), Labu, Temburong. E. KALIMANTAN – *Kostermans 13137* (K, SING), Mt. Palimasan, W. Kutei.

Notes: We agree with the synonymy recommended by Kochummen (1978), but doubt whether *Tristaniopsis pontianensis* M.R. Henders. of southern Johor is distinct either. We here formally reduce *T. grandifolia* Ridl., in fruit, whose large leaves are typical of immature trees and *T. stellata* Ridl. in which the leaves are at the small end of the observed range.

Subspecies ***tavaiensis*** P.S.Ashton, ***ssp. nov.***

A species typico foliis ad 11 x 4 cm minoribus distincte petiolatis ad 5 mm late acuminates, cymis ad 8 cm longis brevioribus. **Typus:** *L. Madani SAN 81723*, Tavai Forest Reserve, Telupid, Sabah (holo K; iso KEP, SAN, SING).

Differing from the type subspecies as follows:
Leaf blade to 11 x 4 cm, smaller, with distinct 8–10 mm long stalk, to 5 mm long broadly acuminate apex; cyme to 8 cm long, shorter.

Distribution and ecology: Known only from Bukit Tavai F.R., S. Meliau, Karamuak, Telupid in forest overlying ultramafic rock.

Other specimens examined: SABAH – *Soepadmo et al. FRI 41309* (K, SING), *Zainudin 5029* (K, SAN), *Cheksum Tawan CST 285*, *Perumal & Sundaling SAN 135176* (K, SAN), all from the same locality of the type.

3. **Tristaniopsis microcarpa** P.S.Ashton, ***sp. nov.***

T. merguensis similis foliis maioribus haud auriculatis, floribus minoribus staminibus paucis fructibus minimis differt. **Typus:** H. S. Martyn *SAN 21623*, Look Mengulang, P. Sakar, in flower (holo K; iso KEP, SAN, SAR, SING).

Canopy tree to 30 m tall, to 80 cm diameter. Bark at first smooth greenish to yellow- or rust-brown, later exfoliating in large grey-brown scroll-like strips, eventually becoming shaggy towards base. Living parts shortly greyish puberulent, more or less persistent on cyme and exposed parts of flower and fruit, elsewhere early glabrescent. Twig *c.* 5 mm diam., round, stout, drying blackish at endings, becoming grey brown thinly peeling. Leaf blade (9–)13–27 x (3–)5–10 cm, oblanceolate, thinly leathery, minutely densely and larger sparsely dotted beneath, pitted above, drying dull olive-brown darker above; subsessile or occasionally tapering into *c.* 15 mm long stalk; apex shortly broadly acuminate or blunt; main lateral veins 25–30 pairs with variably distinct intermediates, dense, spreading, raised throughout more so beneath; tertiary veins lax distinct. Cyme to 15 cm long, to 3 mm diam. at base, elliptic in section, slender, to 4-branched, with to 8 cm long erect rachis. Flower to 3 x 3 mm, small; stamens 3(–4) in each cluster. Capsule to 6 x 4 mm, to 6 mm wide when open, 3-celled; seeds many, small.

Distribution and ecology: Known from Sabah where it is widespread, NE Sarawak to the Rejang valley, and E and C. Kalimantan to the Schwaner Range. Locally frequent in mixed dipterocarp forest to 1000 m, on clay and sandy clay soils over both sedimentary, and also ultramafic rocks where it is sometimes common.

Other specimens examined: SABAH – *Sigin & Rahim SAN 99694* (K, SAN, SING), Bukit Mensasau Beluran; *Madani SAN 130694* (K, SAN), Bidu-Bidu F.R., Beluran; *Amin G. et al. SAN 93896* (K, SAN, SING), Kiabau, Beluran; *Amin G. SAN 70315* (K, SAN), Telupid; *Davol, Pius et al. SAN 124652* (K, SAN), S. Kim, Tankulap, Telupid; *P.S. Shim SAN 134716* (K, SAN, SING), Bukit Tingka, Telupid; *Leopold & Taha SAN 83534* (K, SING), *Kodoh & Tarmijin SAN 83666* (K, SAN, SING), M.87 Telupid Rd., Sandakan; *Meijer SAN 53317* (K, SAN, SING), Sungai Meliau, Karamuak, Sandakan; *Madani SAN 81176* (K, SING), Bintang Mas logging area, Karamuak; *A. Gibot SAN 36069* (K, SAN), *Singh & Talip SAN 52602* (K, SAN, SING), *A. Gibot SAN 36025* (K, SAN), Pulau Sakar; *Muin Chai SAN 26995* (K, SAN, SING), *Muin Chai SAN 26655* (K, SAN, SING), *H.S. Martyn SAN 21613* (K), Look Mengulang, P. Sakar; *Joseph B. et al. SAN 120799* (K, SAN), Km 24 Taliwas, Lahad Datu. SARAWAK – *S. Tong S 32801* (K, SAN), Ulu Masia, Meligan range, Lawas; *Yahud et al. S 76338* (K, SAN), Sungai Kelepang, Remudu, Bario; *P.J. Martin S 38913* (K, SAN), Gunung Mulu N.P.; *Othman et al. S 41468* (K, SAN), Ulu Balleh; *Othman et al. S 62110* (K, SAN), Nanga Sebatu, Mengiong, Balleh, Kapit. C. and W. KALIMANTAN – *Argent & Wilkie 943* (K, SAN), Km 48 from Sangai, Sungai Mentoya, Kota Waringin Timor; *Jarvis & Ruskandi 6212* (K), Bukit Raka, Bukit Raya N. P.

Notes: This species is similar in leaf to *Tristaniopsis merguensis,* but the leaf is larger, never auriculate at base even in juveniles; the flowers are smaller with fewer stamens, and the fruit is much smaller.

4. **Tristaniopsis rubiginosa** S.Teo *ex* P.S.Ashton, ***sp. nov.***

Species praestans foliis magnis subtus prominenti fusco-brunneo puberulentibus staminibus 3–4 in fasculo facile distinguitur. **Typus:** *Purseglove 5053*, fruit, Telok Asam Bako N.P. (holo K; iso SAR, SING).

Small tree to 7 m tall, to 15 cm diam., with open prominently chocolate-brown-leaved crown. Bark pale grey and mauve peeling and scroll-marked; inner bark whitish. Sapwood dark tallow-brown. Young parts densely dark warm brown pubescent, caducous successively on leaf blade above, blade beneath, leaf stalk, twig, cyme and floral receptacle, more or less persisting into fruit. Twig *c.* 5 x 4 mm apically, somewhat flattened at first becoming round, smooth, blackish when dry, eventually thinly flaking. Leaf blade 10–17(–28) x 5–9 cm, broadly elliptic to obovate, thickly leathery, more or less persistently dark chocolate-brown pubescent beneath fading to mauve in fallen leaves, drying dull mauve-brown above, densely pitted above, dots obscure beneath; margin inrolled; base wedge-shaped narrowly tapering down sides of 10–17 mm long stout stalk; apex to 1 cm long broadly acuminate or blunt rounded; main veins *c.* 26 pairs with unequally dispersed more or less equal intermediate veins, spreading, slender but distinctly raised beneath, visible but hardly raised above; tertiary veins obscure, lax. Cyme to 12 cm long, terminal or subterminal-axillary, to 3-branched, drying flattened and ribbed. Flower bud to 5 x 3 mm, relatively large, ellipsoid, receptacle obconical; stamens 3–4 per cluster. Capsule to 5 x 4 mm, to 7 mm diam. following dehiscence; seeds many, small.

Distribution and ecology: Endemic to northern Borneo. Very local, but at Bako National Park abundant, on podsols in *kerangas* on sandstone plateaux and raised beaches, and in the open *'padang'* vegetation on the tableland, and on ultramafic substrate in Sabah, at low altitude.

Other specimens examined: SARAWAK – *Sipun Dominic & Dami S 81530* (K, SAN), *Chai & Ilias S 17868* (K, SAN, SING), *Corner & Brunig* S *10495* (K), *Brunig S 10408* (K), *Anderson & Ashton S 12341* (K, SING), *Sinclair & Kadim SFN 10315,* Bako N.P., Kuching. SABAH – *Saw L.G. FRI 36238* (K, SAN), Meliau Basin. BRUNEI – *Ashton BRUN 647* (K, SING), Bukit Puan.

5. **Tristaniopsis whitiana** Peter G.Wilson & J.T.Waterh.

Austr. J. Bot. 30 (1982) 440. **Basionym:** *Tristania whitiana* Griff., Pl. Cantor. (1837) 18. **Type:** *White s.n.*, Singapore (CAL?, not seen). **Synonym:** *Tristania sumatrana* Miq., Fl. Ind. Bat., Suppl. (1861) 308.

Subspecies ***whitiana***

Canopy, occasionally shortly emergent tree to 45 m high, to 1.5 m diam., with concave rounded buttresses. Bark at first white to light greenish grey with occasional hint of very pale orange, smooth, later peeling in scroll-like strips; older unpeeled bark evenly pale grey-dull light olive; peeled bark scrolls pale to dark grey with mauve-brown patches; inner bark whitish. Sapwood yellowish. Leaf beneath, rachis, flower bud, fruit sparsely or densely more or less persistently grey-brown puberulent, or sometimes glabrous. Twigs *c.* 2 mm thick apically, slender, round, glabrous, smooth eventually thinly peeling. Leaves shiny fresh green when alive, drying rich dark olive-brown glistening beneath, oblong to lanceolate, (7.3–)12.9(–26) x (2.5–)4(–5.5) cm, thinly leathery; base narrowly wedge-shaped, stalk distinct, (0.5–)0.8(–1.2) cm long, slender; apex sharply acute; main lateral veins subequal, (54–)68(–92) pairs, very many, dense, slender, slightly but distinctly raised above and below; intramarginal vein to 1 mm within margin. Cyme to 10 cm long, to 5-branched, with long slender rachis. Flower cream with yellow stamens; bud *c.* 1.5 x 1 mm; pedicel *c.* 1 mm long; calyx minutely warty, unribbed, lobes *c.* 0.5 x 1 mm; petals *c.* 1.5 mm long; stamens 3 per cluster opposite each petal, filament *c.* 1.5 mm long, anther *c.* 0.2 mm. Capsule *c.* 4 x 3.5 mm, ellipsoid; seeds many, *c.* 0.4 x 0.2 mm, elliptic.

Distribution and ecology: Sumatra, Peninsular Malaysia (including Singapore) and Borneo. More abundant in Sarawak and SW Sabah than elsewhere in Sabah. The paradigmatic late successional tree of landslips on the steep inland hills. Locally abundant also in secondary forest and river banks from the lowland to upper dipterocarp forest, to 1500 m on Mt. Kinabalu; generally in dipterocarp forests on mostly clay soils, but on sandy soils and the transition to *kerangas* in W. Sarawak.

Other Borneo specimens examined: SABAH – *Lowe s.n.* (K) 'Borneo'; *Woods 31* (K), *loc. incert.*; *Orolfo SAN 5488* (K, SING), Ulu Tawau; *Orolfo SAN 23* (K, SING), Silimpopon R., Sta. Lucia (= Tawau) For. Dist.; *Meijer SAN 19526* (K, SING), Serudong, Tawau; *Leopold & Taha SAN 83584* (K, SAN), M 87½ Telupid road, Sandakan; *Brand SAN 30876* (K, SAN, SING), Berambangan, Kudat; *A. Gibot SAN 79604* (K, SAN, SING), Kinabalu N.P.; *Saikeh SAN 72244* (K, SAN, SING), Beaufort; *Dewol & Karim SAN 77725* (K, SAN, SING), Lumaku F.R., Sipitang. SARAWAK – *Beccari 2773* (K), *2916* (K), *loc. incert.*, *Chai S 39731* (K, SAN), Sungai Mentawei Mulu N.P.; *Anderson S 4219* (K, SAN, SING), Melinau Paku path Gunung Mulu; *S. Tong S 34929* (K, SAN), Sungai Koyan Mengak, Belaga; *Richards 2459* (K), Long Kapa, Dulit, Tinjar; *Jacobs 5399* (K), Belaga, *Daud & Tachun SFN 35672* (K, SING), Nanga Pelagus, Kapit; *Ilias S 25783* (K, SING), Bukit Pantu, Kapit; *Othman Ismawi* S *40049* (K), Semengoh arboretum, Kuching; *Dg. Awa & Othman Ismawi S 47100* (K, SAN), Teluk

Bandung, Santubong; *Sinclair & Kadim SFN 10394* (K, SING), Sempadi F.R., Lundu. BRUNEI - *Ashton & Whitmore BRUN 485* (K, SING), Bangar; *Ashton BRUN 881* (K), Ulu Tutong at first rapid.

Subspecies ***monostemon*** P.S.Ashton, ***ssp. nov.***

A species typico floribus staminibus solo 5 differt. **Typus:** *Dan S 3033,* Lambir Hills, Sarawak (holo K; iso SAN, SING).

Differing from the type subspecies as follows: Tree at most 25 m tall, 30 cm diam.; bark brilliant coppery-brown; flower with a ring of 5 single stamens.

Distribution and ecology: Known from throughout Sarawak, Brunei, and W. and C. Kalimantan. Locally gregarious; on banks, usually on sandstone rocks, by white and black water rivers, in *kerangas* forest.

Other collections examined: SARAWAK – *B. Lee S 46502* (K, SAN); *Ilias S 15452* (K, SAN, SING), Sungai Sebiau, Bintulu; *Ashton S 16457* (K, SAN, SING), Sungai Jilai, Tatau; *Jugah S 15224* (K, SAN, SING), Sungai Sabal Tapang, Serian; *S. Teo S 75432* (K, SAN), Matang Wildlife Centre; *Jugah S 51588* (K, SAN), Sungai Raya, Division I; *Enjah et al. S 75426* (K, SAN), Pueh F.R. BRUNEI – *Niga et al. BRUN 15109* (K, SAN, SING), Sungai Lumut, Belait; *Coode 7102* (K, SAN, SING), Ulu Tutong; *Ashton BRUN 3303* (K, SING), Bukit Patoi. KALIMANTAN – *Awmack 19* (K), W. bank of R. Rekut, C. Kalimantan; *Church et al. 1745* (K, SAN), 8 m north of Desa Jelundung, Serawai, W. Kalimantan.

Notes: The single stamen opposite each petal is diagnostic. The tree is conspicuously different from the type on account of its vivid bark colour, but more collections in flower are needed to confirm whether bark and stamen characteristics are always correlated.

Acknowledgements

Stephen Teo, formerly of the Sarawak Forest Department Herbarium, early recognized many of the taxa, and prepared draft descriptions upon which the present descriptions are partially based. The work is otherwise based on collections at the Royal Botanic Gardens, Kew and Harvard University herbaria. Eve Lucas at Kew and Emily Wood at Harvard have been generous with their counsel. Staff at KEP, SAN, SAR and SING provided information on specimens in their care.

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Musa lokok (Musaceae), a New Species of Banana from Bario, Borneo

CONNIE GERI

AND

FRANCIS S. P. NG

Sarawak Biodiversity Centre,
KM 20, Jalan Borneo Height, Semenggoh,
Locked Bag 3032, 93990 Kuching Sarawak, Malaysia

Abstract

Musa lokok Geri & Ng, *sp. nov.* is described and illustrated. Locally, the young unfurled leaves have been used as cigarette wrappers.

Musa lokok

Musa lokok Geri & Ng, *sp. nov.*
Musa suratiorum similis sed folius subtus non glauco-ceraceus et fructis pendentis differt. **Typus**: Sarawak: Marudi District, Bario, Pa'Lungan *C. Geri & Pasen Paran TK1552*, 16 Aug 2005 (holo SAR, iso KEP, E, SBC). Plate 1

Clump forming herbaceous plant to c. 3 m tall to the tip of the leaves. *Suckers* emerging from below ground level from the corm with up to 6 rhizomes radiating horizontally, pseudostems spaced 10—30 cm apart, *mature pseudostem* 1.3–2 m tall, slender about 2.5 cm diam., gradually swollen to 4 cm diam. at the base, covered with brown fibrous persistent old leaf sheaths, emergent leaf sheaths yellowish green. *Sap* watery. Upper margin of sheaths (shoulder) smooth. *Fourth to last leaf:* petiole about 30 x 1 cm, yellowish green, petiole closed almost to the lamina, the channel about one third of the depth of the petiole, lamina 120–126 x 21–24 cm, narrowly elliptic, broadest about the middle, apex acute, base unequal, cuneate, not waxy underneath, light green above and paler underneath. *Inflorescence* hanging vertically downwards. Peduncle glabrous, smooth and without wax, at first white becoming black.†*Female buds c.* 37 x 3 cm, bracts bright purple outside, white inside, lifting to 90°, straight not curling back. First bract sterile, subsequent bracts with 1—3 flowers. *Female flowers c.* 10 cm long, ovary pale cream, the compound tepal deep green, *c.* 5 cm long, apically divided into 3 lobes *c.* 9 mm long, the free tepal *c.* 4 cm long, translucent white, wrinkled along the margin, staminodes 5, up to 1 cm long, style pale greenish cream, style and stigma *c.* 4 cm long, stigma glabrous, pure white. Fruit bunch hanging vertically down, the fruit at about 30° to the rachis, about 3 hands each with 1–3 bananas arranged in one row. *Fruits* ripening pale yellowish green, not splitting open, ovules in 2 rows per loculus. Pedicel *c.* 2.5 cm long, the fruit 6–8 cm long, 1.5–1.7 cm diam., straight, cylindrical, angled, contracted at the apex into a short 'beak'. *Seeds* black, barrel-shaped, *c.* 5 x 3 mm, at the inner end with a large circular white patch, rough with irregular very low tubercles. Male axis black, bract scars *c.* 1.5 cm apart on the same rank. *Male buds* slender, oblong-ovoid, *c.* 22 x 3.3 cm. Unopened bracts white beneath the flowers, rosy purple, slightly darker at the tip, straight, not curling back, glossy. *Male flowers c.* 4.3 cm long, compound tepal translucent pale yellowish green but white at the base, apically divided into 3 lobes *c.* 4 mm long, the middle lobe divided into 3 smaller lobes, free tepal *c.* 3 cm long, white and translucent, 3-pointed, stamens 5, pure white, *c.* 3 cm long, anther about 3/4 of the stamen length, style slender, white, style and stigma *c.* 3.5 cm long, longer than the stamens.

Other specimen: Sarawak: Marudi District, Bario, Pa'Lungan *C. Geri & Pasen Paran TK1553*, 16 Aug 2005. (SAR, SING, SAN, E).

Distribution: Endemic to Borneo, known only from Bario in the Marudi District.

Habitat: Swampy depressions in undisturbed forest at about 1167–1300 m altitude

Vernacular name: Lokok (Kelabit) and Sukar (Kelabit).
Local people informed us that the young unfurled leaves were formerly used as cigarette wrappers. The name 'lokok' appears to be a variation of 'rokok', the Malay word for cigarette. An elderly woman told us the original Kelabit name is 'sukar' because compared with other bananas, the leaves of this species are less liable to split and become tatty. Christensen (2002) refers to the cigarette-wrapper banana of the Kelabits as 'lukor'. We have sometimes heard 'lokok' pronounced as 'lukor'.

Notes: Musa lokok is unusual among Bornean bananas based on the combination of the following characters: it is a small slender banana with a narrowly elliptic leaf about 120–125 x 20–25 cm with an inflorescence hanging vertically down, the male bud is slender and spindle-shaped and

Plate 1: *Musa lokok* Geri & Ng a. Clump showing the pendent inflorescence, b. female inflorescence removed from the pseudostem, c. male flower, d. female flower, e. L.S. of fruit. *Photographs FSP Ng*

up to 3 cm in diameter, neither the male or female bracts curl back. Based on these characteristics, it resembles *Musa suratii* Argent from the Tenom District, Sabah, which was also recently discovered in Usun Apau, Baram District (S. Julia, *pers. comm.*). Like *M. lokok*, it is a highland species growing at about 1000 m altitude. However, it is distinct from *Musa suratii* in the characters noted in Table 1. Notable differences include the absence of wax from the lower surface of the leaf and the bananas pointing obliquely downwards.

Table 1. Morphological differences between *Musa suratii* and *M. lokok*

	Musa suratii	*M. lokok*
Petiole length (cm)	16—20	*c*. 30
Lower leaf surface	Thick white wax	No wax
Basal flowers	Hermaphrodite, with 5 stamens ranging from fully developed with apparently fertile pollen to tiny staminodes Female with 5 small staminodes	Female with 5 small staminodes
Fruit bunch	With 8—10 hands of fruits, bearing 8—10 bananas in two rows in the second hand, reflexed upwards	With 3—5 hands of fruits, bearing 1—7 bananas in each hand, pointing obliquely downwards
Fruit diameter (mm)	8—10	15—17
Seed (mm)	2.5 x 2	5 x 3
Male bract colour	Orange with green tip	Bright purple

The clump that *TK1553* was collected from was somewhat more variable, the leaves were 118–150 x 17–29 cm, the inflorescence had the first one or two bracts sterile and bearing up to 5 hands of bananas with 3–7 bananas per hand.

One population appeared to be a hybrid between *Musa lokok* and *M. textilis* Nees because the male bud was broader, more like that of *M. textilis*, and, in addition, it had a conspicuous green tip to the male bracts.

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Eileen Yen Ee Lee for her strong support in the project and Pasan Paren for his assistance and help in the collection of specimens. We should also like to thank Dr Ruth Kiew for her advice in describing this species.

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Dipterocarpus tempehes (Dipterocarpaceae) – A New Record for Singapore

S. LEE AND AIDI ABDUL GHANI

National Parks Board,
Singapore Botanic Gardens, Cluny Road,
Singapore 259569

The extreme dry weather conditions in the early part of this year triggered mast flowering of many trees in Singapore. Dipterocarps, many of which are known to flower heavily once in 5–10 years, produced flowers by the millions in many parts of Singapore. These particular trees were previously mistaken for *Dipterocarpus sublamellatus* Foxw. because of their similar leaves. When conducting regular surveys, in June 2005 the National Parks Board staff of the Central Catchment Nature Reserve, came across a strange and wingless dipterocarp fruit along MacRitchie Nature Trail.

On consulting the literature and the herbarium collection of the Singapore Herbarium (SING), these specimens (MacRitchie Nature Trail - *Aidi A.G. SING2005-246* 29 June 2005 (SING), *SING 2005-259* 11 July 2005 (SING); *Lua H.K. SING2005-290* 16 July 2005 (SING)) appeared to be identical with *Dipterocarpus tempehes* Sloot. P.S. Ashton (*pers. comm.*) confirmed its identity. However, according to Newman *et al.* (1995) and Symington (2004), this species has never been recorded from Singapore or Peninsular Malaysia, respectively.

Prior to this find, *Dipterocarpus tempehes* was known to be endemic only in Borneo (Ashton, 1982, 2004; Meijer and Wood, 1964; Newman *et al.*, 1998), where it is found in periodic swamps and along stream banks.

This is a new significant record for Singapore. In total, there are five mature trees towering above 35 m just off the nature trail. Similar in morphology to the Bornean ones, its habitat in Singapore is different. It is possible that the MacRitchie Nature Trail could have been swampy in the past, judging by the species composition of the primary forest patch near the streamlet. However, the area is now by and large moist and gently sloping, with no periodic inundations.

Acknowledgements

Chew P.T. and Lua H.K. are thanked for providing information on the ecology of the area, P.S. Ashton for promptly confirming its identity and J.J. Vermeulen for drawing the botanical illustration.

Figure 1. *Dipterocarpus tempehes* Sloot. a. fruit; b. leafy shoots with old infructescence. (from *Aidi SING2005-259*).

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Book Review: Christian Puff, Kongkanda Chayamarit and Voradol Chamchumroon. 2001. **Rubiaceae of Thailand. A Pictorial Guide to Indigenous and Cultivated Genera.** Forest Herbarium, National Parks, Wildlife & Plant Conservation Department, Bangkok, Thailand. viii + 245 pp. ISBN 974-463-142-2. Price: EURO 40 or USD 50 (inclusive of airmail).

The Rubiaceae comprise one of the largest families of flowering plants in the Southeast Asian tropics, and are therefore important in the Thai flora, including about 110 genera and some 600 species. There are few consistent workers in the family in Southeast Asia, because an introduction to such a diverse array of groups and form is not an easy thing to grasp or teach, so that collectors and botanists have had few guides to go by. The many taxa that are either rare or restricted in occurrence are frequently incompletely or little documented. Thus, the Rubiaceae, like other large and diverse families, have attracted few students so far, and have languished among the so-called "difficult and perhaps untidy families".

The appearance of this book gives hope that all this is about to change. With more than 20 years of experience in studying Thai and Southeast Asian Rubiaceae, Christian Puff, joined by co-workers Kongkanda Chayamarit and Voradol Chamchumroon who provide the Thai text to complement the main English text, now present a well organized account that is a truly effective guide to this family. As given in the subtitle, the book is meant to introduce the family botanically, in terms of its diversity of life form, vegetative and reproductive structure and biological attributes such as pollination biology and dispersal. This indispensable introduction is covered in the first two chapters of the book (General notes; Selected character states), which throughout is lavishly illustrated by colour photography and complemented by easy-to-understand diagrams.

The indigenous genera of Thailand are treated in the main part, forming Chapter 3, where the arrangement by life form (trees/treelets/shrubs; climbers; epiphytes and ant-plants; herbs) makes for a very user-friendly introduction. The photography is actually splendid, mouth-wateringly attractive in many cases. The last portion, Chapter 4, deals with the non-indigenous taxa, grouped as ornamentals and cash crops, again very informative. Most (more than 80) Thai genera are covered in this book, and there is nearly always a single page of text facing a plate of well-chosen illustrations of the genus concerned (exceptionally, genera such as *Psychotria*, *Morinda*, *Prismatomeris*, *Hydnophytum* or *Argostemma*, where variation in form and biology may be of particular interest, are given four full pages of treatment).

The account is more than just a potential novice's tool *par excellence*.

It also gives botanists specializing in other groups and other regions a highly accurate interpretation of the many forms expressing the fascinating diversity of plants encountered in the tropical forest in general. From the peculiar hooked branches of the climbing *Oxyceros*, the near-recumbent sprawling shrubby habit of *Gardenia saxatilis*, to the bizarre ant-inhabited stem-base tubers of *Hydnophytum* and *Myrmecodia* epiphytes, and herbaceous *Argostemma* species that have but a single conspicuous (in fact, somewhat oversized) leaf developed, the array represents an instructive panorama of plant form. Reproductive structure is equally varied and key types are often the basis of group recognition: syncarps formed by fruit fusion such as in *Morinda*, the peculiar cymes of *Mouretia* where scorpioid branches are broadly flattened and bear four rows of flowers fused together by their ovaries, and the show-calyces of *Mussaenda* and *Schizomussaenda*, are but some of the many interesting variations of infructescence and inflorescence form there can be in this large family.

The diversity of the Rubiaceae, as in any large and widely distributed family, is easy to appreciate in the context of radiation and adaptation in different directions, in response to climate, geography, soils or other ecological factors. Thailand covers an interesting range of climatic and floristic belts, from deciduous, seasonally dry forest in the north to wetter evergreen forest in the Thai peninsula, from the Myanmar and Indo-Chinese regions to the Malesian floristic region to its south, and includes influences from both temperate and tropical regions. Within, it has landform and vegetation from beaches to high mountains, and peatswamps to karst limestone.

This book is highly recommended to all interested in the tropical flora and represents an indispensable introduction for those wandering–by choice or chance–into the fold of the Rubiaceae.

K.M. Wong
Institute of Biological Sciences,
University of Malaya,
Kuala Lumpur

OBITUARY

Arthur George Alphonso

A deep love of plants led Arthur George Alphonso to pursue studies at the Serdang Agricultural College and thence to his appointment as Horticultural Assistant with the Singapore Botanic Gardens on 1 January 1940. In 1954, the Gardens sponsored him for a two-year training course at the Royal Botanic Gardens, Kews. He returned to assume the position of Gardens' Curator. George Alphonso developed a rewarding lifelong career with the Gardens, rising through the ranks to be its chief administrator before his retirement in 1976.

Upon his first appointment, he worked in the grounds, but during the WW II Japanese occupation of Singapore, was placed in charge of the potting yard. This was essentially the nursery and technical support area for the Gardens. Early experimental research and simple planting trials were carried out in the potting yard, with one of the mainstays being plant introduction. An estimated 80% of the plant species cultivated for roadside planting and in home gardens in the 1960s were introduced through the efforts of the Gardens. This was actively built up by George through an active plant exchange programme with other botanical institutions and personal contacts that he had established all over the world. Gardening enthusiasts, especially from the Australian, African and South American tropics, often stopped by the Gardens to share information and exciting new plant material they had discovered.

The Gardens' collections relied on and grew steadily with this goodwill exchange programme. There was scarce funding for things botanical and horticultural in those times, as the nation had more pressing issues to address. As the collections grew and were successfully propagated, the Gardens found itself with surplus plant material, which could be shared with the gardening community in Singapore, and a plant sales nursery was established for the public. Gardening advice was frequently sought from the Gardens' staff and as Curator, George was the main contact for the public. He was acknowledged as Singapore's expert in the field. When Singapore embarked on its enlightened greening programme and its Garden City Campaign, George Alphonso was among the pioneers instrumental in its successful implementation. Hundreds of thousands of planting material was produced by the Gardens and supplied *gratis* to government departments, schools, charitable institutions and other official organizations for Singapore's initial greening efforts.

Interest in gardening had always featured significantly among

George Alphonso with Queen Elizabeth II when she visited the Gardens in 1972. A VIP orchid, *Dendrobium* Elizabeth, a hybrid developed by the Singapore Botanic Gardens, was named in her honour.

Singaporeans. Those who could afford gardens were always keen to add new species or hybrids to their collection; others flocked to flower shows to admire the landscapes and prize blooms proudly displayed by the growers. Annual flower shows were eagerly anticipated, and the Singapore Botanic Gardens actively co-ordinated these shows, with George Alphonso taking on the role of Show Manager, and subsequently Judge, for many decades. The staging of the shows wrought a close bonding and camaraderie among the growers, hobbyists and professionals and inculcated an appreciation of plants in the visitors. George was active in the Singapore Gardening Society and the Malayan Orchid Society, Singapore Branch, where he served as both President and Editor of the *Malayan Orchid Review*. He was kept busy especially when there was both an Orchid and a Garden Show held in the same year.

George's professional interest in orchids grew progressively from the early fifties. Expeditions to the surrounding forests brought him into close proximity with this fascinating family of plants, and his interest could only grow as he gained more exposure to the range of forms and natural habitat of the plants. Orchid hybridisation was already an important aspect of research in the Gardens, with the precedence set by such eminent botanists as RE Holttum and GH Addison. George Alphonso sustained the Gardens' special interest and furthered its reputation as a world famous garden for the collection and conservation of orchid species and for producing many award winning hybrids. He forged close friendships with other orchid enthusiasts at local and international events and became much sought after as a judge at orchid shows as his name and reputation grew entwined with that of the Singapore orchid world. George's counsel was elicited when Singapore decided to have a national flower, and his advised choice of *Vanda* Miss Joaquim was accepted.

George Alphonso's long tenure with the Gardens will be fondly remembered by those who have worked with him. His was an era when the grounds were inspected on foot and hands-on advice was shared with the staff. His world was that of open skies and field, and he had little patience with air-conditioned meeting rooms. He felt that the world of plants and the solutions to their problems were best dealt with where they thrives – outdoors.

Geh Siew Yin,
Singapore

INSTRUCTIONS TO AUTHORS

The Gardens' Bulletin publishes original research findings and reviews of progress in the fields of plant taxonomy, horticulture and allied subjects. Contributions must be original and the material must not have been submitted for publication elsewhere.

Authors should look at the layout of articles recently published in the journal to ensure that submitted manuscripts conform as closely as possible to the accepted format. Particular care should be taken with the format of the references. Manuscripts may be submitted in electronic form (PC-compatible form) together with a hardcopy and original drawings and illustrations as appropriate.

Titles and authors: The title should give a concise description of the contents of the article. It should include the family name if a taxon name is included in the title. The names(s) and affiliation(s) of the author(s) must be given below the title. A short running title should also be provided. Lengthy papers must have contents listed at the beginning of the paper. Avoid footnotes.

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Scientific names: The complete scientific name – genus, species, authority with family in parenthesis – must be cited for every organism at the time of first mention.

Abbreviations: Standard abbreviations may be used in the text, but the full term should be given on the first mention. Dates should be cited as: 1 Jan 2000. Units of measurement should be spelled out except when preceded by a numeral where they should be abbreviated in standard form: g, ml, km, etc. and not followed by stops.

Tables: All tables should be numbered and carry a heading with their content. These should be comprehensive without reference to the text.

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For figures including photographs, type the captions in numerical order on a separate sheet.

Literature citation: Citation in the text should take the form: King and Gamble (1886). If several papers by the same author in the same year are cited, they should be lettered in sequence, 2000a, 2000b, etc. When papers are by three or more authors they should be cited as King *et al.* (1886) in the text, but with all the authors' names given in the reference section. All references must be placed in alphabetic order according to the family name of the first author. The journal title must be given in full, as in the following example:

Stone, B.C. 1994. Additional notes on the genus *Glycosmis* (Rutaceae). *Gardens' Bulletin Singapore*. **46**: 113-119.

References to books and monographs should be cited according to the following form:

Ridley, H.N. 1930. *The Dispersal of Plants Throughout the World.* L. Reeve, Ashford, U.K.

For literature citations in taxonomic papers, the following style is required:

Medinilla alternifolia Blume, Mus. Bot. Ludg.-Bat. I:1 (1849) 19.
Sterculia acuminatissima Merr., Philip. J. Sci. 21 (1922) 524.

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Field Guide to the Grasses of Singapore

(Excluding the Bamboos)

Helena Duistermaat

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Field Guide to the Grasses of Singapore

(Excluding the Bamboos)

HELENA DUISTERMAAT

The Herbarium, Singapore Botanic Gardens,
1 Cluny Road, Singapore 259569

Drawings by
Jaap J. Vermeulen

Sections

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Introduction

Grasses are generally neglected by the layman because they all look the same and do not have obvious flowers. However, the family of the grasses, Gramineae (also called Poaceae), is worthy of attention for a number of reasons. First, they are of huge economic importance. They are widely used for food (cereals, fodder), ornamentals (including lawns) and construction (bamboos), while other members of the family are known as the world's worst weeds. The second reason is that grasses are very abundant. Not only in species number is the grass family one of the largest of the world (with about 10,000 species); but they also cover a vast area, approximately 20% of the earth's land surface, ranging from tropical to arctic regions. They occupy a wide variety of habitats but they are most abundant in open habitats.

The original vegetation of Singapore consisted primarily of forests (mainly lowland dipterocarp forest) where only a few specialized forest-grass species in low densities occurred. In the permanently open habitats such as beaches, a few other grass species probably grew. (For a description of the original vegetation and the impact of human activities see Corlett 1992, 1993). Large-scale clearance of forest in Singapore started only after the British arrived in 1819. By the 1880s only 7% of the original primary forest was left. Today, 99.8% of the original forest cover has been cleared or severely disturbed. Rivers and even forest streamlets have been canalized or replaced by concrete drains and many of the original beaches have been replaced by reclaimed land.

A considerable number of the native grass species are now endangered or extinct. Ridley (1907) noticed that the majority of grass species of Malaya (Peninsular Malaysia and Singapore) either occurred on sandy spots by the sea or as weeds. At present, grasses are found mainly in unnatural open habitats, such as turf, roadsides and wastelands. Turfed areas (including more than 1000 ha of golf courses) alone occupy about 18% of Singapore's 574 km^2 of land surface (Corlett 1992: 415). From this it will be clear that grasses are indeed an important part of Singapore's present day flora.

Ridley (1907) provided the first account of the grass family for Malaya, followed much later by Gilliland (1971). Recently, Keng *et al.* (1998) summarised the family for Singapore. Recent new records are discussed in Duistermaat (2004). The keys provided in all works (in the latest flora treatment unfortunately not to the species level) are very technical. Also, some quite common species rarely seem to flower in Singapore and so cannot be identified with the available literature.

The present guide aims to provide all the necessary information with which anyone interested in grasses should be able to identify the species that occur in Singapore. All species that have been mentioned for the island state are included in this guide. The text is fully illustrated, a main key to the flowering grasses of Singapore is continued to the species level in the generic keys, and a key that uses only the vegetative characters is provided. The identification keys are designed to be user-friendly: the characters are easy-to-see (with the aid of a handlens with 10x magnification) and are explained in a section on Grass Morphology (p. 3) whereas descriptive terms are explained in the Glossary (p. 19). The Key to Sterile Grass Plants is a novelty for the region. In Europe, it has been proven possible to identify grasses on basis of vegetative parts alone (e.g. Van der Meijden 1983). It seemed useful to develop one for Singapore as a number of species rarely flower and roadsides and fields are mown frequently. Species that are thought to be extinct or found only in cultivation are, with a few exceptions, not included in this key. However, the majority of species can be identified with this key and only in a few cases groups of species remain (for the time being) unidentifiable when sterile. A shortened key to the turf grasses is also included (p. 16) to facilitate the identification of turf material. Bamboos were excluded from the present treatment, as the key in Keng *et al.* (1998) seems quite satisfactory. The characters that differentiate these from true grasses are shortly discussed. A separate section explains how to distinguish a grass from other groups of plants that look like grasses.

The species are arranged according to their scientific name, rather than by a common name as many do not have a common name. If an English and Malay name is known from the literature mentioned above or from Henderson (1954), they are included. In case more names are available priority has been given to one that was mentioned by Gilliland (1971) or Keng *et al.* (1998). English names have been checked in Mabberley (1997) to ensure they are not in use for another species. Only one species (*Pennisetum purpureum*) is known by two English names. The Malay names have been checked by staff of the Singapore Herbarium. Only *Padi Burung* and *Rumput Kumpai* each refer to two different species.

For reasons of convenience, the species descriptions are arranged alphabetically, rather than taxonomically. A modern classification of the grass family is found in Kellogg (2002). The descriptions are based on material present in the Singapore Herbarium (SING) and the herbarium of the University of Singapore (SINU). Almost all species descriptions are accompanied by an illustration of a (group of) spikelet(s). A selection of species is illustrated in colour.

The total number of accepted taxa (species, subspecies, varieties) is 134 (including 13 that have been found in cultivation only). Records are not included in the account if no material is extant in SING or SINU or if they have only been found cultivated in the Singapore Botanic Gardens. They are briefly discussed under the genus. Also excluded are *Eremochloa ciliaris* (Buitenhuis and Veldkamp 2001: 407; no material), *Miscanthus floridulus* and *M. sinensis* (only cultivated in the Singapore Botanic Gardens).

It is remarkable that in the tropics grasses are largely ruderal with many species being cosmopolitan. In relation to other plant families the grasses have a high (if not the highest) number of exotics: 31% of Singapore grasses are not native. Some of them have been introduced intentionally, in Singapore for instance as fodder for the horses of the British army or as a part of new seed mixes for turfs. Others where brought in unintentionally, e.g. with straw and hay for cattle, with sand for land reclamation or with potting mix. It is unlikely, however, that we have a complete record of all the species that have been introduced in Singapore. Some of the exotics will have lived here for too short a period to become noticed. If the climate is not (very) suitable for the introduced species it cannot establish a viable population and when the import of the fresh material ceases the species will (slowly) disappear. Other introductions, however, are very successful. Today, 28% of the most common species are not native whereas the commonest grass species of Singapore is probably the exotic *Axonopus compressus*. This shows that not only the number of exotic grass species is high, but that they do actually form an important part of the present day vegetation.

The introduction of new species is an ongoing process that is only to a certain level predictable, depending for instance on the geographical origin of the imported material. No attempt has been made to include species in the account that might be expected in the near future. If grasses collected in Singapore cannot be identified with the present Field Guide, there are several options. It could be that the plant under study is not actually a grass, or if it is indeed a grass its characters could have been misinterpreted or the species is more variable than described here or it might be a new record for Singapore. In the case of new introductions the following works are recommended: Gilliland (1971), Bor (1960) and the World Grass Species Database at the Kew website (http://www.rbgkew.org.uk/data/grasses/grasses.ink).

Grass morphology

Vegetative parts

Grasses do not have primary roots (as in carrots, *Daucus carota*), only a tuft of adventitious roots. In general grass roots are rather uninteresting except for the ones of *Lophatherum*, which form small edible tubers.

The stem of a grass is called a *culm*. It is jointed: divided into nodes and internodes (Fig. 1a,b). *Nodes* can be recognized as short, (slightly) thickened and solid parts of the culm between the much longer internodes. The nodes bear the leaves and, if present, roots and branches (in the leaf-axil). Before roots at the nodes start to grow they may be seen as tiny circular pits termed *root-eyes* (Plate 28, 29). Root-eyes are obvious in *Saccharum* species. The *internodes* are generally hollow, but are solid in a few grasses (e.g. *Saccharum* Sugar Cane and *Themeda* Tasselgrass). At the base of the culm they can be very short (about as long as the nodes) resulting in a concentration of leaves, which cover all the nodes. In the upper part of the culm the internodes are elongated.

The typical culm grows vertically: erect, or ascending from a geniculate base. Some culms, however, grow horizontally. Horizontal culms that lie on the soil surface are called *stolons*. They are generally green and the nodes root or not and bear well-developed leaves. Culms growing horizontally beneath the soil surface are called *rhizomes*. Rhizomes are generally whitish with rooting nodes and reduced, scale-like leaves. The presence of nodes and reduced leaves shows that rhizomes are not roots.

Branching of the culm always occurs at the nodes in a leaf axil between the culm and the basal part of the leaf (sheath, see below). The new shoot either grows upward to emerge at the sheath's tip (*intravaginal* branching, Fig. 2a) or else breaks through the base of the sheath and grows outward (*extravaginal* branching, Fig. 2b). Rhizomes and stolons are the result of extravaginal branching. Tufted plants, on the other hand, are the result of intravaginal branching at the base of the culm.

Grass leaves always arise from the node, in two alternate ('*distichous*') ranks along the culm (Fig. 3), but this is often obscured due to the twisting of the sheath or the culm inside the sheath. The leaves are composed of three parts: sheath, ligule, blade (Fig. 1c,d, 4).

The *sheath* is a tube around the culm with (slightly) overlapping margins (only in a few species non-Singaporean are the margins united). The sheath may be shorter to longer than the internode. The midrib may be raised or winged, and (minute) transverse veins may be present as well (best seen with back lighting). The *throat* (top of the sheath) or the base of the blade may have ear-shaped or triangular appendages, referred to as *auricles* (Fig. 4d). Auricles can be persistent or deciduous, glabrous or hairy.

The leaf *blade* arises on the top of the sheath. It is generally flat and elongated (much longer than wide) with more or less prominent longitudinal veins (*parallel-nerved*; only rarely, as in *Scrotochloa urceolata*, the blades are *pinninerved*: with veins arising from the midvein). Transverse veins are sometimes present as well. However, the presence of transverse veins in the blade does not predict their presence in the sheath, and vice versa. The midvein is prominent or not, is sometimes broad and white at the upperside of the blade

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Figure 1. The jointed culm (stalk) of a grass.
a. nodes, b. internodes, from the nodes arise c. the sheaths with d. their blades.

Figure 2. Branching of the culm.
a. intravaginal; b. extravaginal.

Figure 3. Grass leaves arranged in two ranks or distichous.

Figure 4. Grass leaf.
a. sheath, b. blade, c. ligule, d. auricle.

Figure 5. Blade base.
a. cuneate, b. rounded, c. cordate, d. amplexicaul.

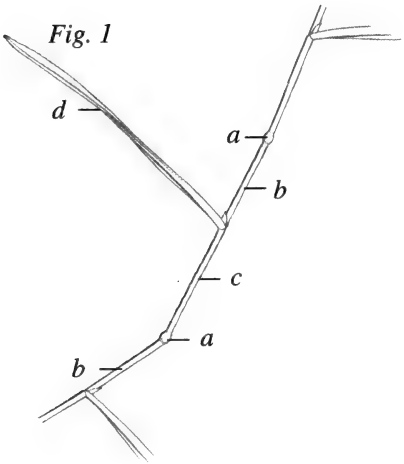


Fig. 1

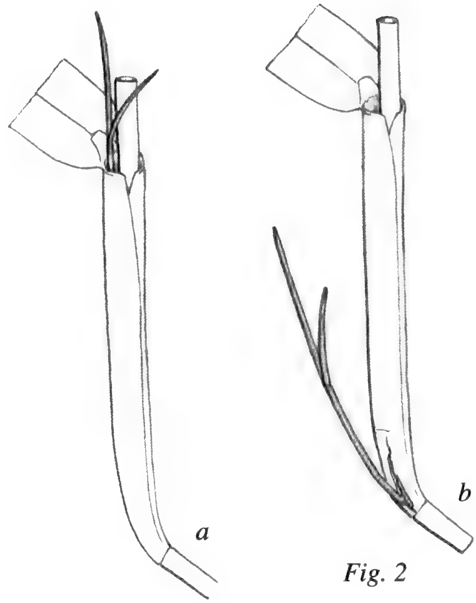


Fig. 2

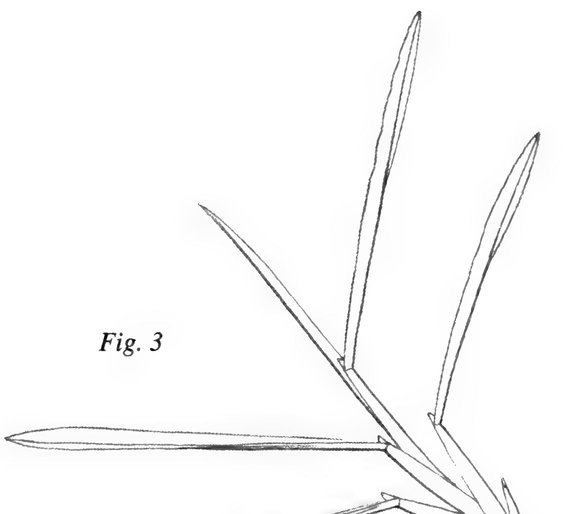


Fig. 3

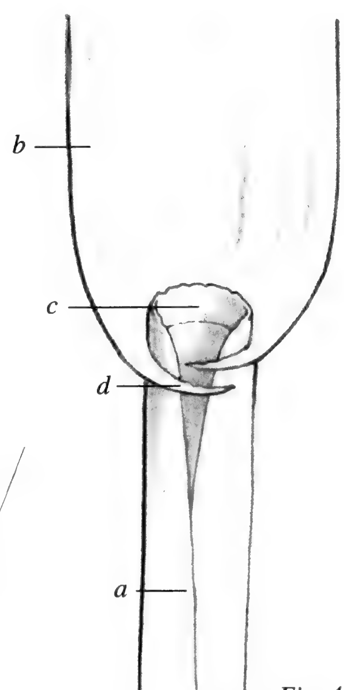
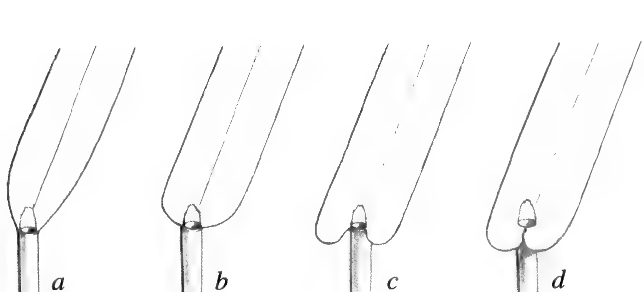


Fig. 4

Fig. 5



or distinctly winged underneath. The base can be cuneate, rounded, cordate or amplexicaul (Fig. 5). If the blade at the base is narrower than the sheath, the sheath is termed *shouldered* (Fig. 6a). Sometimes the blade is much narrowed at the base and appears stalked. It is then termed *pseudopetiolate* (Fig. 6b). (This is not a true petiole, which would be at the base of the sheath). The way the young blades emerge is constant within a species: either inrolled with one margin overlapping the other (Fig. 7a), or folded along the midrib with the margins meeting (Fig. 7b), or plicate (pleated; Fig. 7c).

The *ligule* is located at the junction of sheath and blade (Fig. 4c) on the side facing the culm (the *adaxial* side) and is either membranous and glabrous or hairy or is just a row of hairs. Only in a few species is the ligule absent (e.g. *Echinochloa colona*). A ligule even a few millimeters long is readily recognized. Shorter ligules, however, are more difficult to see. To examine it, pull the culm away from the blade and put your index finger on the underside of the blade's base while you prise open the sheath with your thumb. Pull back the blade with the middle finger of the same hand. With your free hand you can now hold the handlens to see the ligule (practice this first with one of the taller grasses).

Sometimes (as in bamboos) a *collar* is present. This is a band of hardened tissue on the *abaxial* side (this is the side furthest away from the culm) of the top of the sheath, indicating that the blade will eventually break off at that point (generally leaves have no callus, sheath and blade just wilt). An herbaceous rim or a row of hairs at this place is called an *external ligule* (e.g. bamboos, *Paspalum conjugatum*; Fig. 8).

The initial leaf (or leaves) of a culm or branch is (are) often different from the upper leaves in having no blades and ligules. The first leaves of young culms may be scale-like sheaths or *cataphylls* (Fig. 9). As growth proceeds, normal leaves are produced. When culms branch, the first leaf of the new shoot is produced from the adaxial side, between the new shoot and the main culm. This *prophyll* is an elongated and thin sheath-like scale with two keeled veins; its function is uncertain.

Various parts of the plant may be covered with hairs and these parts are then called *hairy*. If margins or ligules have a fringe of hairs they are described as *ciliolate* (with short hairs) or *ciliate* (with long hairs), but the difference is gradual.

Figure 6. Leaf blade narrowed at base.
a. sheath shouldered, b. blade pseudopetiolate.

Figure 7. Young leaf blades.
a. inrolled with one margin overlapping the other, b. folded along the midrib with the margins meeting, c. plicate (pleated).

Figure 8. External ligule, a herbaceous rim or a row of hairs at the abaxial side of the sheath's apex.

Figure 9. Cataphylls (sheathlike and bladeless bracts) at the base of the culm.

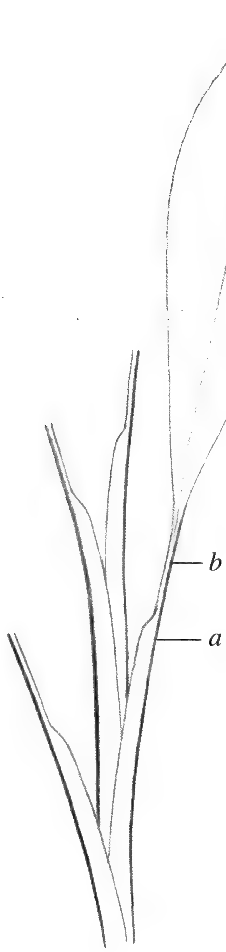


Fig. 6

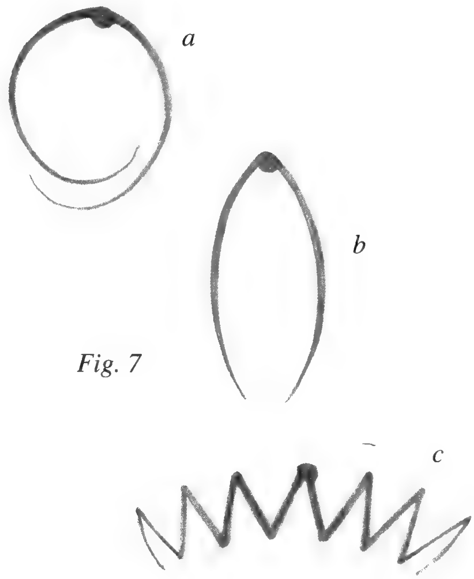


Fig. 7

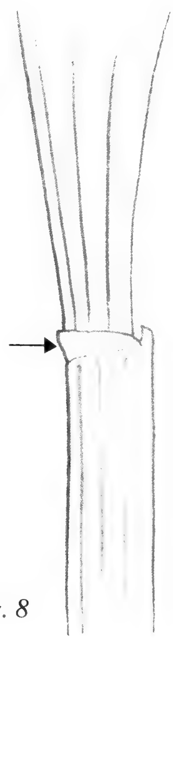


Fig. 8

Fig. 9

The inflorescence will generally develop from the terminal leaf (but see below), which is then also known as the *flag leaf*. It may differ from the leaves on sterile shoots in, for example, hairiness, size or ligule length.

Reproductive parts

Flowers

Grass *flowers* are highly reduced. They consist of only 1—6 stamens, a single ovary with 1—3 feathery stigmas, and/or 2—3 minute fleshy scales or *lodicules*. True sepals and petals are lacking (Fig. 10a—d). The lodicules are thought to be a reduced perianth and their function has still to be ascertained. The grass flower is protected by two straw-coloured to green bracts. The lower bract is called the *lemma* (Fig. 10e) and the upper is called the *palea* (Fig. 10f). The palea has two keeled veins. The lemma and palea together with its flower is called a *floret* (Fig. 10a—f). Florets are either *bisexual* (with stamens and ovary) or *unisexual* (*male* with stamens only or *female* with ovary only) or *sterile* (empty, both stamens and ovary are absent).

Bisexual florets may be *cleistogamous*, that is, they remain closed even at flowering time, which results in self pollination. They are recognized by the presence of anthers on the top of mature fruits in closed florets (e.g. *Eragrostis*, *Eriachne*).

Spikelets

Florets are arranged in two alternate ranks on a central axis, the *rachilla* (Fig. 10g). At the base of the rachilla, below the lowest floret, are two empty bracts: the *lower glume* (Fig. 10h) and the *upper glume* (Fig. 10i). The structure of two glumes and a rachilla with one to many florets is called a *spikelet* (Fig. 10a—i). The structure of a spikelet can be compared with a flowering branch (Fig. 11), with each flower in the axil of a leaf and accompanied by an extra leaf. However, it is still unclear if the lemma and the palea are homologous to (i.e. evolved from) these two leaves (Kellogg, 2002).

The spikelet is thus a miniature inflorescence. It is the basic unit in the description of the grass inflorescence. Tiny as it may be, the basic pattern of a spikelet is clear-cut. However, structures may be duplicated (as are the glumes in bamboos) or reduced or even absent. This hampers the interpretation of the structures and the determination of the number of florets in a spikelet (especially the distinction between 1- vs 2-flowered). Therefore, in the main key to the

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Figure 10. Grass flowers arranged in a spikelet (exploded view).
a. lodicule, b. anther, c. ovary, d. stigma, e. lemma, f. palea, g. rachilla, h. lower glume, i. upper glume.

Figure 11. Branch with flowers in the axils of bracts and pedicels each with a bracteole.

Figure 12. Cross-section of a spikelet.
a. not flattened, b. laterally flattened, c. dorsiventrally flattened.
• = rachilla.

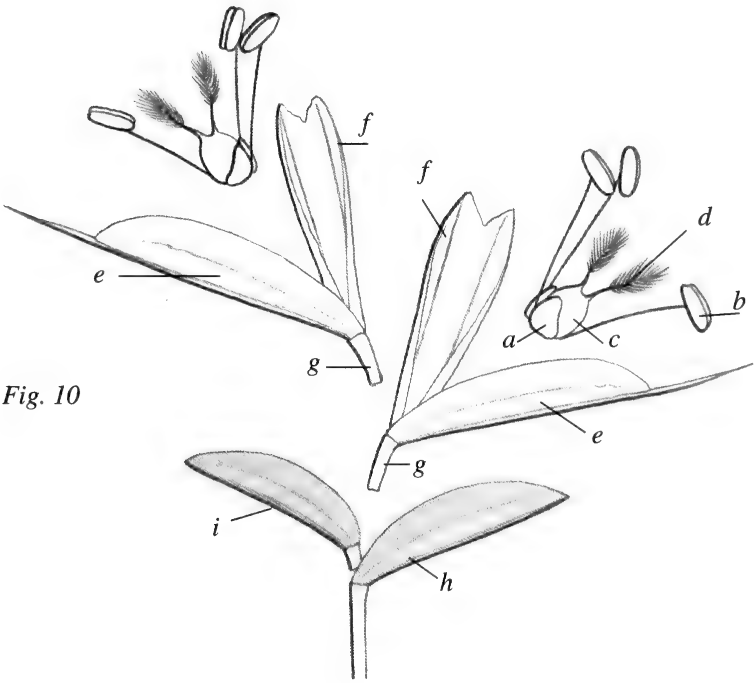

Fig. 10

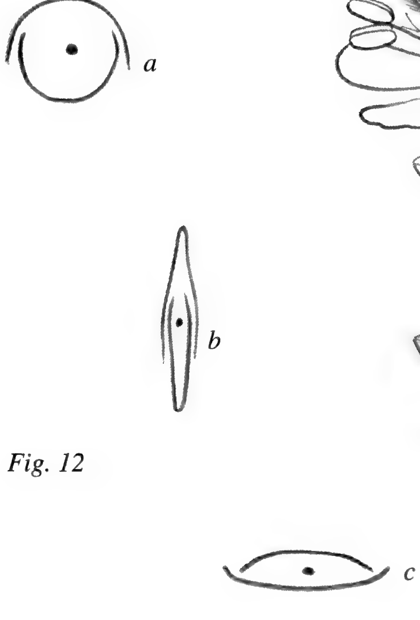

Fig. 12

Fig. 11

flowering grasses (p. 20) whenever possible the neutral term *bracts* is used instead of glumes, lemmas and paleas but in the generic keys these terms are used as the genus description has already clarified which structures are to be expected.

Spikelets may be sessile (not stalked) or stalked; the stalk is called the *pedicel*. Spikelets or groups of sessile spikelets may be surrounded by an *involucre*, which is formed of bristles or a single bract attached at the base of the spikelet(s) and at least half as long as the spikelet. The involucre together with the spikelet(s) it encloses is known as a *bur*. Generally, spikelets on the same plant are similar (or *homomorphous*), but sometimes they are *heteromorphous*, very different from each other (e.g. *Digitaria bicornis*, *Scrotochloa urceolata*, *Zea mays*). These different types of spikelets may be found within the same inflorescence or in separate inflorescences on one plant.

Apart from the size (length, width) of the spikelet, the shape of the spikelet is very important for the identification of the species. The outline of the spikelet varies from rounded (orbicular) to linear. Looking at the cross-section of the spikelet, it can either be *flattened* or *not flattened*. A spikelet is called *not flattened* if the cross-section is rounded: all axes are equally long (Fig. 12a) and the glumes and lemmas are generally distinctly rounded on the back. The spikelet is called *flattened* if its cross-section is elliptic with one axis distinctly longer than the other. *Laterally flattened* spikelets have boat-shaped glumes and lemmas and the rachilla is (nearly) visible (Fig. 12b). When all the glumes and lemmas are flattened to only slightly rounded on the back, the spikelet is called *dorsiventrally flattened* and the rachilla is hidden deeply inside the spikelet (Fig. 12c). Finally, the hunch-backed or distinctly lop-sided spikelet is called *gibbous* (e.g. *Cyrtococcum* species).

The number of florets per spikelet varies from one to a few tens depending on the species. For most species this number is fixed, e.g. spikelets strictly 1-flowered or (most commonly in Singapore) strictly 2-flowered (note that florets are referred to as flowers). However, spikelets with an additional floret may be found as abnormalities within the same inflorescence (e.g. *Isachne* species, *Panicum maximum*). It is therefore advisable to always check several spikelets within the same inflorescence. The number of florets is much less fixed in the species that have 3- or more-flowered spikelets (for example, *Eragrostis*). The lowest floret is referred to as the 1st floret (and 1st lemma, 1st palea), etc.

Awns are needle-like appendages or the much-narrowed continuations of the glumes, the lemmas or the paleas. They arise either from the tip (as in *Dactyloctenium aegyptium*) or in a sinus (referred to as the *notch*) between two lobes at the tip of the bract (as in *Chloris barbata*), or from its back. They vary in length and shape. In Singapore awns are always simple (unbranched), either straight or geniculate (then often with a twisted basal part and terminal bristle) and smooth or scaberulous. Bracts with very short awns (less than 0.5—1 mm long) are often called mucronate (if they are the continuation of the midvein only) or apiculate (if they are the continuation of midvein and a narrow part of the bract), but the difference between these and a true awn is gradual. The number of awns per spikelet varies from none to six.

Spikelets or parts of spikelets may be articulated, which means that they fall off or break up at maturity. A thickened structure (the *callus*) often indicates the place of articulation where either the entire inflorescence or a branch or entire spikelet or a part of the spikelet (with the rachilla articulating or not) breaks off.

Inflorescence

The inflorescence is the arrangement of the spikelets without any leafy bracts. It develops within the protection of a sheath, emerging only when it is almost ready for flowering. The main axis of the inflorescence is called the *rachis* (if unbranched) or *central rachis* (if branched). The part of the main axis below the first branch or spikelet is called the *peduncle*. The peduncle is generally long, with the inflorescence arising well above the flag leaf.

The spikelets are either arranged directly on the rachis, or on (primary, secondary or tertiary) branches. They are single or arranged in groups of 2—5 spikelets often with 1 sessile and 1 or more pedicelled. An unbranched inflorescence with only sessile spikelets is called a *spike* (Fig. 13a), or if all spikelets are pedicelled, it is called a *raceme* (Fig. 13b), and if the spikelets come in pairs of 1 sessile and 1 pedicelled spikelet it is called a *spike-like raceme* (Fig. 13c). The branched inflorescence is called a *panicle* and has branches either at intervals along the central rachis (Fig. 13d) or clustered at the tip of the peduncle (a central rachis is absent in this case, Fig. 13e). The (central) rachis and panicle branches can be rounded, triquetrous (triangular in cross-section) or flattened and the branches can be simple (unbranched) or branched further.

Generally, a single inflorescence arises from the terminal leaf of a culm or lateral branch. Sometimes, however, the terminal leaf has two or more inflorescences (Fig. 14) or the subterminal leaves have inflorescence(s) as well. The ultimate in this range is a *spatheate* inflorescence where much branched culms with *spathes* (sheath-like bracts or reduced leaves) all produce a separate inflorescence (Plate 36). The *final sheath* is any sheath from which axil arises an inflorescence without any leaves or spathes. It may be the sheath of the flag leaf or a subterminal leaf or a spathe.

Fruit

The ovary of a grass contains a single ovule that will mature into a single seed and the ovary wall into the fruit wall. The fruit is a grain or *caryopsis* with the fruit wall permanently fused to the seed coat (except in *Eleusine* and *Sporobolus*). Only grasses have this type of fruit. It is orbicular to linear-lanceolate in outline and flattened to round in cross-section. The *hilum*, the point of attachment of the grain, is facing the palea. The embryo is at the base and the starchy mass making up the rest of the fruit is the *endosperm* or foodstore for the germinating plant. This is the part we eat.

Diaspore

A grass *diaspore*, the part that is dispersed, may be the fruit alone (e.g. *Eragrostis*) or fruits together with a floret (e.g. *Centotheca*), a spikelet (e.g. *Lophatherum*), groups of spikelets (*Cenchrus*, *Pennisetum*) or even an entire inflorescence (*Scrotochloa*) depending on where disarticulation takes place.

The presence of hooks, hairs, awns and spines increases the chance of (long distance) animal or wind dispersal. The ability to float (as in *Mnesithea*, *Rottboellia*, *Thuarea*), will enhance dispersal by water. The diaspores of, for instance, *Rottboellia cochinchinensis* also seem to get carried away by ants that are attracted by elaisomes, structures that contain oily substances.

Life Forms

The absence of pronounced seasons in Singapore often makes it difficult to establish whether a plant is an annual or a perennial. However, if at flowering time all shoots of a plant show an inflorescence it is considered an *annual*. Some annuals have more than one generation a year. The presence of sterile shoots at flowering time, a rootstock and/or cataphylls indicates the plant is *perennial*.

Making a Reference Collection of Grasses

When studying grasses it is a good idea to build up a small reference collection or herbarium for personal use. This enables one to compare species seen at different times and places and makes it easier to remember their names. Collected plants should be dried and mounted on thick paper.

It is quite simple to make good collections of the smaller-sized grasses: just collect the whole plant, including the underground organs. A blunt knife, a small triangular trowel or a screwdriver is a useful tool to dig up the roots and/or rhizomes, especially when clayey soil has hardened after a long period of drought. Remove as much soil as is possible when still in the field. It is advised to gather several specimens ('duplicates') and to collect both flowering

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Figure 13. Type of inflorescence.
a. spike with spikelets single and sessile, b. raceme with spikelets single and pedicelled, c. spike-like raceme with spikelets in pairs of 1 single and 1 pedicelled, d. panicle with central rachis present, e. panicle without central rachis.

Figure 14. Terminal leaf with two panicles.

Figure 15. Two types of bamboo leaves.
a. culm leaves, b. foliage leaves.

Figure 16. Culm leaf of bamboo.
a. sheath, b. ligule, c. blade and d. auricles.

Figure 17. Tip of the leaf blade or bract.
a. bifid, b. emarginate, c. truncate, d. obtuse, e. acute, f. acuminate, g. mucronate.

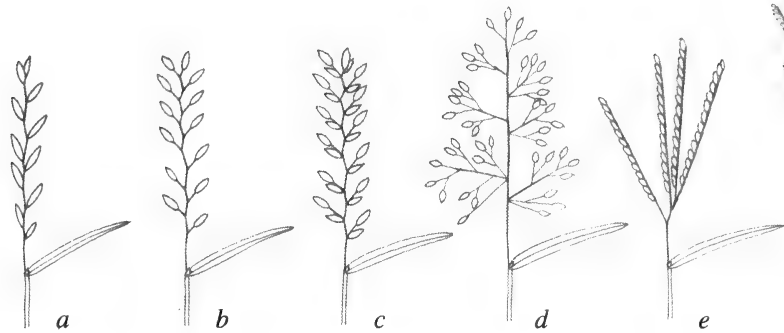

Fig. 13

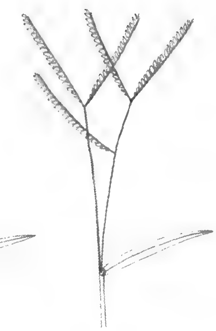

Fig. 14

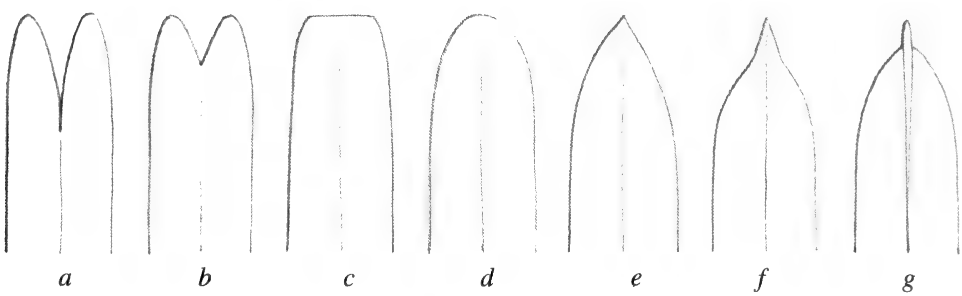

Fig. 17

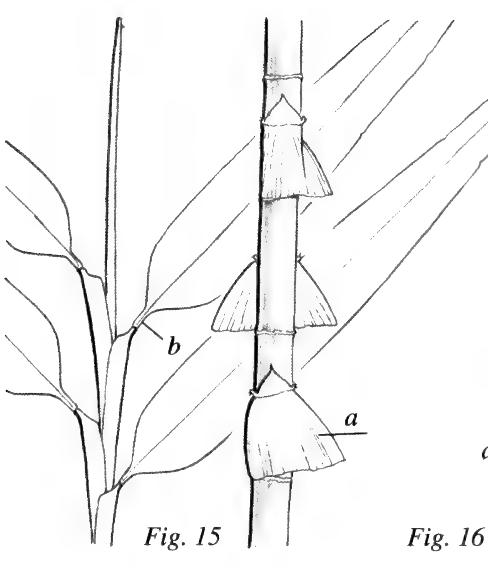

Fig. 15

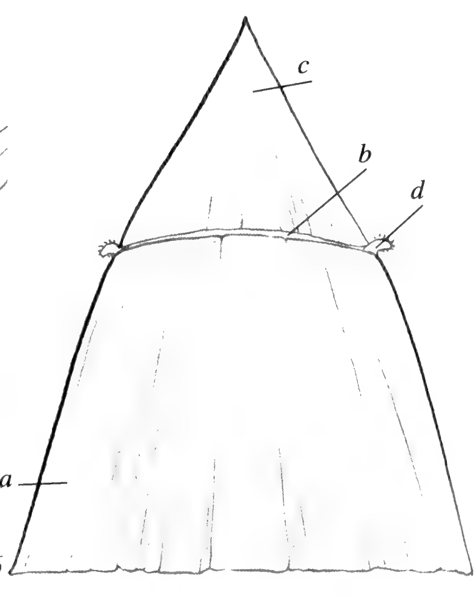

Fig. 16

and fruiting spikelets, so that both the different parts of the spikelet (including the anthers) as well as its disarticulation can be studied (essential in *Eragrostis*). A young, emerging blade should also be included, if present, especially when sterile material is collected. All this will increase the chance of finding the correct name.

If the plant is too big to collect whole (or if it is impossible to reach the lower parts), at least the inflorescence with the flag leaf and its node should be collected. Try also to get a piece of the culm with at least two leaves, for the flag leaf may differ considerably from the ones lower down. Be careful when handling the leaves, as some have very sharp edges that can make very nasty wounds.

For future reference number the collections in a notebook with a consecutive numbering, starting with 1. Attach small pieces of paper with that number to the plants. Date and place of collection should be recorded as well as fieldnotes, such as habitat and any features that will be lost in the drying process (e.g. coloration or three-dimensional shapes). At the same time, all other parts that could not be included in the collection should be described, such as whether the culm is single or tufted, erect or ascending, whether or not stolons or rhizomes are present and the total length of the culm. Features that can still be seen on the dried specimen (e.g. presence of hairs, veins etc.) need not be recorded. If, at a later moment, you think you have collected the same species again, do give it a new number, not the one you have employed before. Most likely it is from another locality and therefore a different gathering. Besides, it might even turn out to be a different species.

Collected specimens are easily dried when pressed between a single sheet of tabloid-size newspaper. Arrange the parts so that all details can be studied (avoid overlapping the leaves) and fold or cut the parts to fit the size of paper used for mounting (see below). Best results are obtained when dried for a few hours to a day in an oven at 60 ^{0}C (maximum). Without an oven, the drying process will take a few days and the newspaper needs to be changed every day to prevent mould from growing and to preserve some of the original colour.

After drying, the specimens are best mounted with narrow strips of glued paper on sheets of thick paper (A3 size) adding a label with the name and the field notes, as well as collector's name and place and date it was collected (Plate 1). Store them in boxes or plastic bags in a dark and dry place; either add mothballs or freeze them at regular intervals to prevent insects from foraging on the collection.

You might want to send (unmounted) duplicates with the labels to a scientific institute, like a local herbarium. They might want to keep them as scientific records and so your efforts could become part of the national and international heritage. The collector's name and numbers allow for quick and unequivocal reference to the individual collections.

Turf Grasses

A number of characteristics make grasses especially suitable for turf and lawns. First of all, in a number of perennial grasses the growing point of the non-flowering culm is close to the soil surface. When mown, these grasses can thus resprout more quickly than other plants. Furthemore, their linear leaf blades with long fibres are better able to resist being trodden on. Finally, the ability to form horizontal culms (rhizomes and stolons) enables grasses to form mats. The more frequently mown the grass is, the denser the mat becomes. When mown too low down, however, they cannot resprout and as a consequence the turf will be damaged.

From the above it will be clear that some grass species are more suitable for turf than others. Annual grasses, for instance, and grasses that form a single erect stem or that grow in tufts are of no use, as they will never form a dense mat. Only a few species, *Axonopus compressus*, *Cynodon dactylon* (including the cultivars Tifway, Tif dwarf and Tif-fine that are commonly used in the various parts of golf courses), *Digitaria didactyla* and *Zoysia matrella*, are commonly used for lawns and fields in Singapore and a few more are (or were) used infrequently. The fine-leaved grasses, such as *Cynodon dactylon*, *Digitaria didactyla* and *Zoysia matrella*, produce beautiful lawns but need a lot of maintainance. As it is difficult even for wiry weeds like *Desmodium triflorum* (Lesser Clover-leaved Desmodium) to grow between the densely arranged grass stems, they tend to cover the lawn and need to be weeded out by hand. Also, these fine lawns are not tolerant to shade and tend to be less resistant to intense use. Coarse turf with wide-leaved grass species, such as *Axonopus compressus* and *Stenotaphrum secundatum* does not need regular weeding as wiry weeds can grow underneath these grasses. Both grass species are strong and will give good general purpose lawns. They will also grow in light shade. It is impossible, however, to grow a lawn in deep shade. *Eremochloa ophiuroides* (Munro) Hack. (Centipede Grass, *Rumput Lipan, Rumput Centipede*) is also used for lawns in Peninsular Malaysia, but has not (yet) been found in Singapore. This slow-growing species gives a rather coarse, good lawn that is not very tolerant to wear.

The separate key to the species given here enables the user to quickly identify turf grasses. The various cultivars of these species are, however, not separated. As the lawn will normally be mown before the plants start flowering, only vegetative characters are used. For older turfs in which weedy grass species have invaded, The Key to Sterile Grass Plants of Singapore (p. 142) should be used. Descriptions of the species (except for *Eremochloa ophiuroides*) can be found in Descriptions and Generic Keys (from p. 31).

Key to the turf grasses

1a. Leaf blade 0.6—2.5(—3.0) mm wide. **2**
1b. Leaf blade 3—9 mm wide. **5**

2a. Ligule as a row of hairs, longest hairs at least 0.5 mm long. **3**
2b. Ligule membranous, glabrous or with hairs at the tip up to 0.1 mm long. **4**

3a. Sheath rounded, midrib not winged. Blade at base cuneate. **Bermuda Grass, *Cynodon dactylon***
3b. Sheath flattened, midrib winged, wing 0.5 mm wide. Blade at base rounded. **Centipede Grass, *Eremochloa ophiuroides***

4a. Ligule (0.5—)1.5—2.2(—2.5) mm long, glabrous. **Serangoon Grass, *Digitaria didactyla***
4b. Ligule 0.2 mm long, ciliolate. **Siglap Grass, *Zoysia matrella***

5a. Young leaf blade folded along the midrib. **6**
5b. Young leaf blade inrolled. **8**

6a. Ligule as a row of hairs, 0.5—0.7 mm long. **Centipede Grass, *Eremochloa ophiuroides***
6b. Ligule membranous, with hairs at the tip up to 0.1 mm long. **7**

7a. Leaves glossy and (dark) green; sheath with margins in upper half glabrous or glabrescent; blade hardly wider than sheath. ***Axonopus fissifolius***
7b. Leaves glaucous; sheath with margins densely hairy in upper half; blade distinctly wider than sheath. **St. Augustine Grass, *Stenotaphrum secundatum***

8a. External ligule present as a short-hairy fringe. **9**
8b. External ligule absent. **10**

9a. Nodes hairy. Ligule densely fringed. **Carpet Grass, *Axonopus compressus***
9b. Nodes glabrous. Ligule glabrous. **Buffalo Grass, *Paspalum conjugatum***

10a. Sheath 1—2.5 cm long, without transverse veins. Ligule 0.05—0.1 mm long. **Love Grass, *Chrysopogon aciculatus***

10b. Sheath 4—8.5 cm long, with transverse veins. Ligule 0.5—0.8 mm long.
Creeping Panic Grass, *Panicum repens*

Bamboos and Grasses

Bamboos, which belong to the Bambuseae tribe in the Gramineae, are actually grasses and not palms. Unlike palms but like the true grasses, they have jointed culms with solid nodes and hollow internodes. Kellogg (2002) discusses their relationship within the grass family.

Bamboos are recognized by a number of characters. First of all, they have woody culms. Secondly, bamboos have leaves of two types (Fig. 15). The young culm shoot is the part of the bamboo that we eat. It is covered with scale-like leaves, which are brownish and rather rigid structures with the blade absent or much shorter than the sheath and often triangular in shape (Fig. 15a and 16). These *culm-leaves* are shed entirely when the culm hardens during growth. The *foliage leaves*, on the other hand, are found on the branches higher along the main culm (Fig. 15b). They have persistent sheaths with the blades deciduous above the collar. The blades are green, elongate and pseudopetiolate. Finally, the spikelets of bamboos are arranged in dense nodal clusters on a leafless axis (Plate 2). The spikelet often has more than two glumes. However, flowering of bamboos is rare, and therefore in their taxonomy much emphasis is laid on the vegetative parts. If you see any flowering specimens it might be wise to make a collection, for some flower only once in a human life time. Be sure to collect the culm leaves, noting in your data the presence and direction of the remnant of the blade (pointing up, down or horizontal). The hairs on the sheath, if present, may stick to your hands. To remove the hairs, gently rub your hands through your own hair.

The bamboos are excluded here because Keng *et al.* (1998) provided a useful key to all 19 species of bamboo known from Singapore, including those only known from cultivation. Further information can also be found in Wong (1995a,b) and Ohrnberger (1999).

Grasses and Grass Look-alikes

The grass family, Gramineae, can be confused with a number of other groups. For Singapore, the sedge family, Cyperaceae, is the most relevant one. Both have strap-shaped leaves that are differentiated into sheath and blade and the flowers are arranged in spikelets without true sepals and petals. There are a number of differences between the two families, but most do not hold for all members, certainly not worldwide (Table 1).

Table 1. Differences between grasses and sedges in Singapore.

	Grasses	Sedges
Culm	Rounded to flattened, never triangular in cross-section	Triangular in cross-section or rounded to flattened
Leaves	In two ranks (may be obscure)	In three ranks, rarely in two
Sheath margins	Overlapping, not fused (in Singapore)	Fused
Ligule	Generally present and short to long, sometimes absent	Absent or present (in Singapore always less than 1 mm long)
Flower	Each generally subtended by two bracts	Each always subtended by only one bract (and a number of perianth-bristles or scales can be present as well)
Florets	Arranged in two ranks	Spirally arranged or in two ranks
Fruit	Fruit wall generally fused to seed coat	Fruit wall free from the seed coat

Species from other families that could also be mistaken for grasses because of their grass-like leaves include *Blyxa alternifolia* and *B. auberti* (Hydrocharitaceae), *Eriocaulon longifolium* and *E. truncatum* (Eriocaulaceae), *Murdannia nudiflora* and *M. vaginata* (and perhaps other Commelinaceae), *Philydrum lanuginosum* (Philydraceae), *Xyris complanata* and *X. pauciflora* (Xyridaceae). Most of them differ from grasses in that they have three sepals and three colourful petals, but their petals tend to fall after flowering, and some do have a lesser number or scale-like perianth parts. However, all these non-sedge grass look-alikes have fruits that are different from the grasses: namely a dehiscent capsule containing two to many seeds that are free from the fruit wall as compared with always one seed per flower in grasses and sedges.

If plants are not flowering or fruiting it, might be difficult to establish beyond doubt whether they are grasses. If the sheath has free margins *and* a ligule is present then the plant is a grass. On the other hand, if the sheath is closed (the margins are fused) or a ligule is absent, and/or the distinction between sheath and blade is unclear then it is probably not a grass.

Glossary

Technical terms have been avoided as much as was possible. The use of some general descriptive terms, however, could not be avoided. They follow in alphabetical order. For the names of the different parts of a grass plant see the section on Grass Morphology (p. 3).

acuminate Tapering to a point (Fig. 17f).
acute Sharply pointed (Fig. 17e).
amplexicaul Clasping the stem and the two lobes not fused (Fig. 5d).
annular Like a ring.
antrorse Pointing forwards or upwards.
ascending Gradually curving upward.
bifid Divided in two parts (Fig. 17a).
bristles Long stiff hairs (longer than 1 mm).
caducous Falling off (eventualy).
cartilaginous Hard and tough.
ciliate Fringed with long hairs.
ciliolate Fringed with short hairs.
collar-shaped The outline a band much wider than long (Fig. 18a).
cordate Heart-shaped (Fig. 5c).
cuneate Wedge-shaped (Fig. 5a).
decumbent Horizontal and only the tip curving upward.
ellipsoid Three-dimensional body with elliptic outline.
elliptic The outline of a flattened circle, length-width ratio *c.* 1.5 and largest width in the middle.
emarginate With V-shaped indentation at the top (Fig. 17b).
erect Upright.
fusiform Cigar-shaped and length-width ratio more than 2.
geniculate Abruptly bent upward, knee-like.
glabrescent Becoming glabrous.
glabrous Hairless.
glaucous With a waxy layer and a bluish glow.
globose Globe-shaped.
granulate Covered with small grains.
herbaceous Soft, coloured and not transparent.
heteromorphous Of dissimilar forms.
homomorphous Of similar forms.
hyaline Thin, colourless and transparent.
indument The covering of hairs.
indurated Hardened.
keeled With a ridge.
lanceolate Length-width ratio 3—5.

linear Length-width ratio 10 or more and parallel sides.
membranous Thin and semi-transparent.
mucronate Ending abruptly in a sharp point that is the continuation of the midvein only (Fig. 17g).
nodular With small rounded lumps.
nodule Small rounded lump.
oblong Length-width ratio c. 2.5 and largest width in the middle.
obtuse Blunt (Fig. 17d).
orbicular The outline circular, length-width ratio 1.
ovate The outline egg-shaped, length-width ratio *c.* 1.5 and largest width below the middle (Fig. 18b).
ovoid Egg-shaped.
patent Spreading.
pectinate Margin with a row of relatively long hairs, comb-like.
punctate Covered with small dots.
reticulate Covered with intersecting lines forming the shape of a network.
rugose With irregular ridges as if wrinkled.
rugosity Irregular ridge like a wrinkle.
rugulose With irregular minute ridges as if finely wrinkled.
scaberulous With a slightly rough surface.
scabrous With a rough surface.
scrambling Climbing by sprawling over other plants or fences.
serrate Margin saw-toothed.
serrulate Margin minutely saw-toothed.
setaceous Bristle-like.
setae Short stiff hairs (up to 1 mm long).
setulose With short stiff hairs.
smooth Surface even, free from roughness, lumps, wrinkles etc.
striate Covered with narrow lines, ridges or furrows.
subglobose Almost globe-shaped.
terete Rounded in cross section.
triquetrous Triangular in cross-section.
truncate Appearing as if cut off (Fig. 17c).
undulate Wavy, going up and down.
winged With a flat elongation.

Key to the Flowering Grasses of Singapore

Transverse veinlets are best seen with back lighting (be sure not to look into the sun or a lamp when using a hand lens). The terms leaves, sheaths and blades do not include cataphylls, prophylls and spathes. Pedicel length is to be measured on any spikelet except the uppermost of a branch where it may be much longer than usual. Unless stated otherwise, the size of spikelets excludes awns if present. The *adaxial* side of a structure is the side closest to the axis, the *abaxial* side is the side furthest away from the axis; for leaves this axis is the culm, for inflorescence branches it is the central axis and for spikelets it is the rachis or the branch of the inflorescence they are directly attached to.

To facilitate back tracking of the followed path in the key, the couplet number of origin is repeated in bold print at the beginning of the couplet it referred to if it is more than 3 couplets away.

A. Plant woody. Internodes hollow. Culm-leaf sheaths deciduous, blade absent to shortly triangular, shorter than the sheath. Foliage leaves with sheath persistent; blade deciduous from sheath, linear to lanceolate, pseudopetiolate (Fig. 6). Inflorescence with spikelets arranged in dense nodal clusters without subtending bracts (Plate 2).
Bamboos (see Keng *et al.* 1998)

B. Plant herbaceous to semi-woody. Internodes hollow or solid. Culm-leaves as foliage leaves, basal ones with sheath deciduous or not; blade persistent, generally longer than sheath, ovate to linear, pseudopetiolate or not. Inflorescence with spikelets single or in small groups and not densely clustered, or spatheate and with clusters of spikelets in subtending bracts. **1**
(if not flowering see p. 142)

1a. Inflorescence(s) from final sheath *either* an unbranched spike or (spike-like) raceme (Fig. 13a—c), *or* branched with the longest branch up to 5 mm long and spikelet unawned. Ligule always present. **2**

1b. Inflorescence(s) from final sheath branched (Fig. 13d,e), a panicle with branches at least 10 mm long (sometimes with only 2 branches closely together, as in Plate 13, 15); *if* panicle branches shorter *then either* ligule absent *or* spikelet with 1—6 awns of at least 2 mm long. **24**

2a. Spikelets (in groups) all surrounded by involucre of bristles or indurated bract at least half as long as spikelet, and falling off together with them. **3**

2b. Spikelets not or not all surrounded by an involucre, bristles when present *either* less then half as long as spikelet *or* persistent on pedicel after spikelet has fallen off (see *Setaria parviflora*). **4**

3a. Involucre a dentate and indurated bract with bristles in lower half. ***Cenchrus***

3b. Involucre of many bristles only. ***Pennisetum***

4a. Inflorescence at base with a hard bead-like involucre enclosing 1 female and 2 sterile spikelets; rachis continuing through pore at tip of involucre, with 2 pairs of male spikelets. Culm internodes solid. ***Coix lacryma-jobi***
4b. Inflorescence at base with spikelets exposed, *either* involucre absent *or* consisting of sterile herbaceous spikelets. Culm internodes solid or hollow. **5**

5a. Spikelets all *either* unawned, *or* awned with awn up to 1 mm long *and* spikelet including awn shorter than 4 mm. **6**
5b. Spikelets, at least part of them, awned, *either* awn at least 2 mm long *or* spikelet including awn at least 9 mm long. **16**

6a. Leaf blade 56—75 mm wide. All spikelets unisexual or sterile but never bisexual, heteromorphous, 8—8.5 mm long. ***Tripsacum dactyloides***
6b. Leaf blade 1—24 mm wide. At least lowest spikelet bisexual. Spikelets homomorphous or heteromorphous, 1—6 mm long. **7**

7a. Lowest bract of spikelet 0.9—1 times as long as spikelet. **8**
7b. Lowest bract of spikelet 0.05—0.65 times as long as spikelet. **12**

8a. Inflorescence rachis transversely articulating, base of joints with a central knob. Spikelets paired. Lowest bract of sessile spikelet dorsiventrally flattened, indurated. **9**
8b. Inflorescence rachis not articulating. Spikelets single. Lowest bract of spikelet *either* boat-shaped, *or* flattened *and* herbaceous. **11**

9a. Young leaf blade folded along midrib. Sessile spikelet orbicular, *c.* 1 mm long. Lower glume with squarish depressions. ***Mnesithea granularis***
9b. Young leaf blade inrolled. Sessile spikelet ovate to elliptic, 3.9—5 mm long. Lower glume *either* granulate *or* marginal keels at base with gland-like warts. **10**

10a. Lower glume smooth, marginal keels at base with glandlike warts, glabrous or hairy. 1st floret of sessile spikelet sterile. ***Mnesithea glandulosa***
10b. Lower glume minutely granular, marginal keels smooth. 1st floret of sessile spikelet male. ***Rottboellia cochinchinensis***

11a. Nodes hairy. Rachis longitudinally folded (U-shaped), 3.6 mm wide with 1 bisexual spikelet at base and 4 or 5 male spikelets above. Inflorescence disarticulating as a single unit. ***Thuarea involuta***
11b. Nodes glabrous. Rachis rounded, *c.* 0.2 mm diameter with many bisexual spikelets, not articulating. ***Zoysia matrella***

12a. **(7)** Young leaf blade folded along midrib. Spikelets 3.8—6 mm long. **13**
12b. Young leaf blade inrolled. Spikelets 1.7—3.4 mm long. **14**

13a. Stolons absent. Branchlets absent. Rachis c. 1 mm wide. Spikelets 3—6-flowered. ***Eleusine indica***
13b. Stolons present. Branchlets each with 3 spikelets. Central rachis 3—4 mm wide. Spikelets 2-flowered. ***Stenotaphrum secundatum***

14a. Pedicels (or at least half of them) with bristles 3—11 mm long. ***Setaria***
14b. Pedicels all glabrous. **15**

15a. Inflorescence a spike-like panicle; branches many, up to 5 mm long. Spikelet not flattened, gibbous, 2-flowered. ***Sacciolepis***
15b. Inflorescence a raceme; branches absent. Spikelets laterally flattened, not gibbous, 1-flowered. ***Zoysia matrella***

16a. **(5)** Culm with more than 20 inflorescences, forming a spatheate inflorescence. Each inflorescence at base with an involucre of 2 pairs of sterile or male, unawned spikelets, followed by 1 or 2 fertile awned spikelets (and more sterile spikelets). ***Themeda***
16b. Culm with 1—10 inflorescences, spatheate or not. Each inflorescence *either* with fertile spikelets only, *or* if spikelets paired the pedicelled ones may be sterile. **17**

17a. Spikelets single, lowest bract with awn at least 2 mm long (a basal 0.3 mm-long bract at adaxial side should be ignored if present: see *Lepturus*). **18**
17b. Spikelets in pairs or threes, lowest bract *either* unawned *or* awn up to 0.5 mm long. **20**

18a. Rachis 1.5—2 mm wide, with cavities holding the spikelets, breaking up at maturity. Lowest (abaxial) bract of spikelet flat, indurated. ***Lepturus repens* var. *repens***
18b. Rachis 0.1—0.4 mm wide, without cavities holding the spikelets, persistent. Lowest bract of spikelet boat-shaped, hyaline to thinly herbaceous. **19**

19a. Nodes hairy. Spikelet 2-flowered, lowest bract (excluding awn) 0.6—0.7 times as long as spikelet. ***Oplismenus burmanni***
19b. Nodes glabrous. Spikelet 1-flowered, lowest bract (excluding awn) as long as spikelet. ***Perotis indica***

20a. Young leaf blade inrolled. **21**

20b. Young leaf blade folded along midrib. **23**

21a. Spikelets in threes, the middle pedicelled and the 2 lateral sessile. ***Polytrias indica***
21b. Spikelets in pairs of 1 sessile and 1 pedicelled. **22**

22a. Sessile spikelet 3.5—5 mm long, dorsiventrally flattened, with 1 awn. ***Dichanthium***
22b. Sessile spikelet 1.5—2 mm long, laterally flattened, with 2 awns. ***Pogonatherum crinitum***

23a. Blade at least at base with up to 7 mm-long hairs. Inflorescence 1 and at tip of culm. Pedicel glabrous. Spikelets of lower 8 or 9 pairs all unawned, followed by 5—8 pairs of 1 sessile awned spikelet and 1 pedicelled unawned spikelet. ***Heteropogon contortus***
23b. Blade glabrous. Inflorescences 2—10 scattered along culm. Pedicel hairy on one margin. Spikelets all in pairs of 1 sessile awned and 1 pedicelled unawned. ***Schizachyrium sanguineum***

24a. **(1)** Culm internodes solid. Spikelets unisexual with male and female spikelets in separate inflorescences on the same plant. Male inflorescence a panicle from terminal sheath, female inflorescence (cob) in the axils of lower leaves, completely enclosed in large bracts, with a stout central axis and numerous fruits in rows. ***Zea mays***
24b. Culm internodes hollow or solid. Spikelets *either* bisexual *or* unisexual with male and female spikelets in the same inflorescence. **25**

25a. Leaf blade with transverse veins present. Stolons absent. Blades 8.5—60 mm wide. **26**
25b. Leaf blade without transverse veins. Stolons absent or present. Blades 0.5—50 mm wide. **30**

26a. Spikelets heteromorphous, unisexual. **27**
26b. Spikelets homomorphous, bisexual. **28**

27a. Leaf blade 40—62 mm wide, pinninerved. Spikelets unawned; female spikelet 6—7.5 mm long, not flattened, globose-obovoid; male spikelet 4—6 mm long, more or less laterally flattened, elliptic-ovate. ***Scrotochloa urceolata***
27b. Leaf blade up to 30 mm wide, parallel-nerved. Spikelets awned; female spikelet *c*. 50 mm long (including awn), more or less laterally flattened, lanceolate to linear; male spikelet *c*. 16 mm long (including awn), similar in shape. ***Zizania latifolia***

28a. Spikelets 4—12-flowered, awned with awn at least 1 mm long. ***Lophatherum gracile***
28b. Spikelets 2- or 3-flowered, unawned or mucronate with mucro up to 0.3 mm long. **29**

29a. Plant 20—80 cm tall. Inflorescence up to 20 cm long. Longest branch 6—10 cm long, straight. Spikelets 4—5.5 mm long. ***Centotheca lappacea***
29b. Plant (40—)200—300 cm tall. Inflorescence at least (20—)50 cm long. Longest branch at least 20 cm long, wavy. Spikelets (1.6—)2—2.1 mm long. ***Thysanolaena latifolia***

30a. **(25)** Ligule at least 6 mm long, membranous, glabrous. Inflorescence with central rachis present. ***Oryza***
30b. Ligule *either* absent or 0.05—4 mm long, *if* longer than 4 mm *then* ligule hairy or inflorescence without central rachis. **31**

31a. Inflorescence from final sheath with simple branches only. **32**
31b. Inflorescence from final sheath with at least longest branch further branched. **60**

32a. Spikelet 3—many-flowered. **33**
32b. Spikelet 1- or 2-flowered. **36**

33a. Spikelet unawned. **34**
33b. Spikelet awned. **35**

34a. Young leaf blade folded along midrib. Inflorescence with up to 11 branches, at least half the number at the tip. ***Eleusine***
34b. Young leaf blade inrolled. Inflorescence a panicle with more than 20 branches scattered along central rachis, often in whorls of 2—4. ***Leptochloa chinensis***

35a. Stolons absent. Inflorescence branches with spikelets up to the tip. Spikelet not flattened; awns 3—5 mm long. ***Chloris barbata***
35b. Stolons present. Inflorescence branches without spikelets in the uppermost 1—2.5 mm (Plate 30). Spikelet laterally flattened; awns 1.5—2 mm long. ***Dactyloctenium aegyptium***

36a. **(32)** Ligule at least 0.5 mm long, *either* a row of hairs *or* basal part membranous with hairs at tip as long as or longer than the membrane. **37**

36b. Ligule *either* absent or up to 0.1 mm long *or* up to 7.5 mm long and membranous with hairs at tip absent or shorter than the membrane. **44**

37a. Spikelet *either* unawned or with a mucro up to 0.3 mm long, *or* awn concealed and not exserted beyond the spikelet bracts. **38**
37b. Spikelet awned, awn obvious and not concealed. **41**

38a. Culms 1—20(—40) cm long. Spikelet 1—2.5 mm long, *either* 1-flowered *or* 2nd floret abortive and hyaline or herbaceous. **39**
38b. Culms 30—500 cm long. Spikelet 3—4.3 mm long, 2-flowered, 2nd floret indurated. **40**

39a. Leaf blade 1.5—2.5 mm wide, cuneate at base. Inflorescence with branches coming from one point, central rachis absent. Spikelets in two rows, 2.4—2.5 mm long. ***Cynodon dactylon***
39b. Leaf blade 4—9 mm wide. Inflorescence with branches scattered along central rachis. Spikelets not in rows, *c.* 1 mm long. ***Sphaerocaryum malaccense***

40a. Culm erect to ascending, stolons absent. Spikelet at base with a cup-shaped callus, 0.2—0.7 mm long, often red-coloured. ***Eriochloa***
40b. Culm geniculate to decumbent or creeping to scrambling, stolons absent or present. Spikelet at base without a cup-shaped callus. ***Urochloa***

41a. **(37)** Lowest bract of spikelet awned with awn at least 2 mm long. ***Oplismenus***
41b. Lowest bract of spikelet unawned or with mucro up to 0.5 mm long. **42**

42a. Leaf blade setaceous, *c.* 0.5 mm wide. Spikelet with 2 or 6 awns, the two lowest bracts as long as spikelet (excluding awns). ***Eriachne***
42b. Leaf blade flat, 3—12 mm wide. Spikelet with 1 awn, lowest bract distinctly shorter than spikelet. **43**

43a. Panicle without central rachis. Spikelet 3—3.5 mm long. (Very dry places). ***Alloteropsis cimicina***
43b. Panicle with central rachis. Spikelet *c.* 4.7 mm long. (Marshy places). ***Echinochloa picta***

44a. **(36)** Culm with more than 20 inflorescences, spatheate. Inflorescence without central rachis, branches 2. ***Cymbopogon***
44b. Culm with 1(—10) inflorescences, not spatheate. Inflorescence with central rachis absent or present, branches 2—many. **45**

45a. Spikelets in pairs, heteromorphous; sessile spikelet (4—)5—7.5 mm long. Pedicel 0.7—2 mm wide, as wide as or wider than rachis. ***Ischaemum***
45b. Spikelets in groups of 1—3(—5), homo- or heteromorphous, sessile and/or pedicelled, 1.2—4.4 mm long. Pedicel 0.1—0.4 mm wide, narrower than or as wide as rachis. **46**

46a. Ligule absent. ***Echinochloa***
46b. Ligule present, although sometimes a minute rim. **47**

47a. Spikelets not flattened or laterally flattened. **48**
47b. Spikelets dorsiventrally flattened. **55**

48a. Inflorescence without central rachis, branches 2—4. **49**
48b. Inflorescence with central rachis, branches 3—many. **50**

49a. Young leaf blade inrolled. Spikelet 2.3—2.8 mm long, *either* unawned *or* awn 5.5—8.5 mm long. ***Dimeria ornithopoda***
49b. Young leaf blade folded along midrib. Spikelet *c*. 1.2 mm long, awn minute and mucronate. ***Eustachys tenera***

50a. Spikelets with lowest bract 0.9—1 times as long as spikelet. **51**
50b. Spikelets with lowest bract 0.15—0.7 times as long as spikelet. **52**

51a. Ligule 0.05—0.1 mm long. Spikelets in threes (or the lower in pairs), 2-flowered, callus needle-shaped, awn *c*. 4 mm long; the two lowest bracts herbaceous. ***Chrysopogon aciculatus***
51b. Ligule 2 mm long. Spikelets single, 1-flowered, callus more or less obtuse, unawned (acuminate); both bracts indurated. ***Leersia hexandra***

52a. Ligule 1.5 mm long. Spikelets gibbous. ***Cyrtococcum accrescens***
52b. Ligule 0.2—0.7 mm long. Spikelets not gibbous. **53**

53a. Spikelets with 2nd lowest bract 0.4—0.5 times as long as spikelet. ***Ottochloa nodosa***
53b. Spikelets with 2nd lowest bract (almost) as long as spikelet. **54**

54a. Blade at base cordate. Spikelets *c*. 4.3 mm long; lowest bract 0.7 times as long as spikelet. Glumes and lemmas at their tips laterally flattened, as if pinched. ***Acroceras munroanum***
54b. Blade at base cuneate to rounded. Spikelets 2.1—2.4 mm long; lowest bract 0.15—0.2 times as long as spikelet. Glumes and lemmas at their tips not laterally flattened. ***Panicum trichocladum***

55a. **(47)** Spikelet awned, awn 13—23 mm long. **56**
55b. Spikelet unawned. **57**

56a. Inflorescence with 13—21 branches. Rachis of branches and pedicels more or less flattened and furrowed. ***Bothriochloa bladhii***
56b. Inflorescence with 2—5 branches. Rachis of branches rounded, pedicels somewhat flattened, both not furrowed. ***Dichanthium annulatum***

57a. Spikelets 1.1—1.6 times as long as wide. ***Paspalum***
57b. Spikelets 2.2—3.3 times as long as wide. **58**

58a. Spikelets in groups of 2 or 3(—5). ***Digitaria***
58b. Spikelets single. **59**

59a. Ligule 0.4 mm long, densely fringed. Inflorescences usually several from the upper leaf. Spikelets 2—2.4 mm long. ***Axonopus***
59b. Ligule 1 mm long, glabrous. Inflorescence 1 from the upper leaf. Spikelets 2.7—4.4 mm long. ***Paspalum vaginatum***

60a. **(31)** Spikelets 3—many-flowered. **61**
60b. Spikelets 1- or 2-flowered, rarely and then only a few 3-flowered. **64**

61a. Culm 12—100(—160) cm long. Blades 0.5—7 mm wide. Spikelet glabrous, or with hairs up to 0.6 mm long; 1st lemma 0.7—2 mm long. ***Eragrostis***
61b. Culm (80—)150—300 cm long. Blades 7—40 mm wide. Spikelet with silky hairs 2—5 mm long; 1st lemma 3.5—12 mm long. **62**

62a. Ligule of flag leaf 0.4—0.7 mm long (excluding hairs on blade just behind ligule). Rachilla internodes between the lemmas with long hairs. Lemmas glabrous. ***Phragmites vallatoria***
62b. Ligule of flag leaf 1.5—5 mm long. Rachilla internodes between the lemmas glabrous or with short hairs at its tip only. Lemmas (except first) with long hairs. **63**

63a. Culm internodes hollow. Ligule 1.5—2 mm long, membraneous, tip ciliolate. Leaf blade 15—40 mm wide. The two lowest bracts of spikelet *c.* 0.8 times as long as spikelet (including awns). 1st lemma hairy. ***Arundo donax***
63b. Culm internodes solid. Ligule 3—5 mm-long row of hairs. Leaf blade 7—20 mm wide. The two lowest bracts of spikelet 0.2—0.3 times as long as spikelet (including awns). 1st lemma glabrous. ***Neyraudia arundinacea* var. *zollingeri***

64a. **(60)** Ligule absent. ***Echinochloa***
64b. Ligule present, sometimes just a minute rim. **65**

65a. *Either* lowest two bracts of spikelet indurated (in lower half) and as long as spikelet (excluding awn when present), *or* each spikelet with 2 bracts only and these indurated. **66**
65b. Lowest two bracts of spikelet hyaline to herbaceous, shorter than or as long as spikelet; each spikelet with 3 or more bracts. **67**

66a. Leaf blade 3—7 mm wide, margins serrulate. Spikelets single, laterally flattened, with 2 bracts (1 lemma and 1 palea), unawned. (Ponds and marshes). ***Leersia hexandra***
66b. Leaf blade 21—42 mm wide, margins smooth. Spikelets paired; sessile spikelet dorsiventrally flattened to subterete, with 5 bracts (2 glumes, 2 lemmas and 1 palea), awned or unawned; pedicelled spikelets variously reduced, dorsiventrally flattened. (Dry places). ***Sorghum bicolor***

67a. Spikelets awned, awn exserted beyond spikelet bracts and (0.6—)1—14 mm long; *if* awn 0.6—1 mm long *then* upper glume and 1st lemma densely hairy, hairs 2—6.5 mm long and pinkish. **68**
67b. Spikelets *either* unawned *or* awn not exserted beyond spikelet bracts and up to 0.6 mm long *and* upper glume and 1st lemma glabrous or with hairs up to 0.5 mm long and whitish or yellowish. **74**

68a. Ligule *either* 0.05—0.1 mm long and densely fringed *or* membranous with hairs at tip absent to shorter than membranous part. **69**
68b. Ligule *either* a row of hairs *or* membranous with hairs at tip longer than membranous part. **70**

69a. Culms 40—110 cm long. Nodes hairy. Inflorescence with longest branches 4—7 cm long. Spikelets in pairs, the terminal in threes. Callus obtuse. Awn 13—14 mm long. ***Bothriochloa bladhii***
69b. Culms 15—35 cm long. Nodes glabrous. Inflorescence with longest branches 1.5—3 cm long. Spikelets in threes, the lower sometimes in pairs. Callus needle-shaped. Awn up to 4 mm long. ***Chrysopogon aciculatus***

70a. Ligule in basal third *either* membranous *or* of fused hairs. **71**
70b. Ligule a row of free hairs. **72**

71a. Inflorescence with central rachis absent or shortly developed, branches (almost) in a single whorl. Lowest bract of spikelet unawned. ***Alloteropsis cimicina***

71b. Inflorescence with central rachis well developed, branches scattered. Lowest bract of spikelet awned, awn at least 2 mm long. ***Oplismenus compositus***

72a. Spikelets densely hairy; hairs pink to red turning silvery at maturity, patent, at least a few longer than 4(—6.5) mm; awn up to 2 mm long. ***Melinis repens***
72b. Spikelets (sparsely) hairy; hairs yellowish white, appressed to erecto-patent, up to 1 mm long; awn at least 3 mm long. **73**

73a. Leaf blade flat, *c*. 12 mm wide. Spikelet with 1 exserted awn, lowest bract about half as long as spikelet, second as long as spikelet (excluding awns). ***Echinochloa picta***
73b. Leaf blade setaceous, *c*. 0.5 mm wide. Spikelet with 2 exserted awns, the two lowest bracts as long as spikelet (excluding awns). ***Eriachne pallescens***

74a. **(67)** Spikelet at base with a cup-shaped, 0.2—0.7 mm long, often red-coloured callus. ***Eriochloa***
74b. Spikelet without a cup-shaped callus at the base. **75**

75a. Lowest bract of spikelet 0.1—0.7 times as long as spikelet. **76**
75b. Lowest bract of spikelet (0.8—)0.9—1 times as long as spikelet. **82**

76a. Pedicels usually with 1—9 bristles longer than the spikelet and not falling off with the spikelets. ***Setaria***
76b. Pedicels without bristles, *if* hairs present *then* shorter than spikelet. **77**

77a. Spikelets gibbous. ***Cyrtococcum***
77b. Spikelets not gibbous. **78**

78a. Spikelet *either* 1-flowered *or* 2-flowered with 2nd floret hyaline and thinner than 1st floret. **79**
78b. Spikelet 2-flowered, 2nd floret (more or less) indurated and thicker than 1st floret. **80**

79a. Sheath with (few) transverse veins present. Spikelet (3—)3.9—4.9 mm long, 2-flowered. (Semi-, aquatic). ***Hymenachne amplexicaule***
79b. Sheath without transverse veins. Spikelet 1.1—2.3 mm long, 1-flowered. (Terrestrial). ***Sporobolus***

80a. Second lowest bract of spikelet (= upper glume) 0.4—0.5 times as long as spikelet. ***Ottochloa nodosa***

80b. Second lowest bract of spikelet (= upper glume) 0.9—1 times as long as spikelet. **81**

81a. Inflorescence branches rounded to triquetrous, 0.1—0.7 mm wide, *if* patent *then* with spikelets well-spaced. Spikelets abaxial, single or paired. ***Panicum***
81b. Inflorescence branches more or less flattened, 0.8—1.2 mm wide, patent, with spikelets densely crowded. Spikelets adaxial, at least in middle of branch paired or in threes. ***Urochloa mutica***

82a. **(75)** Pedicels and/or spikelets with long silky hairs, hairs 2—12 mm long. **83**
82b. Pedicel and spikelet *either* glabrous *or* with hairs up to 0.5 mm long. **84**

83a. Leaves before flowering clustered at the base of the culm. Inflorescence branches not articulated, not breaking up at maturity. Both spikelets of a pair pedicelled, shortest pedicel at least 1 mm long. ***Imperata***
83b. Leaves before flowering scattered along elongated culm. Inflorescence branches articulated, breaking up at maturity. One spikelet of a pair sessile, the other pedicelled. ***Saccharum***

84a. Spikelet 3.5—5.2 mm long. Sheath at least 4 cm long. **85**
84b. Spikelet 1.3—2.5(—3.3) mm long, *if* longer than 3 mm *then* sheath not longer than 2 cm. **86**

85a. Culm 120—250 cm long. Spikelets in pairs or threes of 1 sessile and 1 or 2 pedicelled, the pedicelled narrower and less hairy than the sessile spikelet. Lower glume with many appressed hairs, acute. ***Sorghum propinquum***
85b. Culm 25—40 cm long. Spikelets in pairs, both pedicelled, similar. Lower glume glabrous, apiculate. ***Urochloa glumaris***

86a. Ligule row of hairs, 1—4 mm long. Leaf blade 2.5—9 mm wide, base rounded. ***Isachne***
86b. Ligule membraneous, 0.5 mm long, tip ciliolate. Leaf blade 15—20 mm wide, base cordate. ***Panicum brevifolium***

Descriptions and Generic Keys

Descriptions are kept short. If not mentioned otherwise, the following applies to all species: **internodes less than 3 mm diameter, transverse veins absent, pseudopetiole absent, leaf blades parallel-nerved and not distinctly ribbed, spikelets homomorphous and length measured excludes awns.**

A key to the species is given if a genus (i.e. the first part of the scientific name) is represented by two or more species. Characters that are shared by all the species of this genus are included in the generic description. There is no generic description if only one species is present.

Beside the common names, synonyms used in the earlier literature (as cited in the Introduction) are mentioned. The figures depict the spikelets, unless mentioned otherwise. The glumes (if present) are always grey and the bar indicates 1 mm. The species description is followed by information on whether it is native in Singapore or not, its global distribution, its first record for Singapore (as present in the Singapore Herbarium (abbreviated as SING) and the herbarium of the National University of Singapore (SINU)) and its present day abundance (and date of last record if now extinct in Singapore). Botanic Gardens refers to the Singapore Botanic Gardens. In a separate line the ecology is given. The term Malesia is used for the biogeographical region ranging from the Isthmus of Kra in Thailand to Bougainville Island in the Solomon Islands and including Malaysia, Brunei, Indonesia, Timor Leste, Philippines and Papua New Guinea, but excluding Australia. Finally, any other information of relevance, including differences with species it has been or might be confused with is given in notes. Herbarium material is cited as the collector's name in italic print followed by the collection number and/or year of collection.

Acroceras Stapf

Acroceras tonkinense (Balansa) C.E.Hubb. was mentioned for the Botanic Gardens (Ridley 1907, as *Panicum oryzoides* Sw.; Ridley 1925, as *A. sparsum* Ridl. ex Stapf) but no herbarium or living material has been found. It differs from *A. munroanum* in having hairy nodes, blades with midvein distinct and margins thickened, and spikelets with only the 2nd lemma pinched at its tip.

Acroceras munroanum (Balansa) Henrard – Fig. 19.

Gilliland 1971: 165. Keng *et al.* 1998: 154.

A. ridleyi (Hack.) Stapf ex Ridl. 1925: 229.

Culms stoloniferous, up to 55 cm long; nodes glabrous. Sheath rounded, glabrous, margin hairy. Ligule membranous, 0.2—0.3 mm long, entire or ciliolate. Young leaf blade inrolled. Blade 3.5—7 cm long, 6—9 mm wide, glabrous, scabrous, base cordate. Inflorescence panicle, central rachis 3—5 cm long, branches 3—5; longest branch 1.5—2.5 cm long, *c.* 0.5 mm wide, simple. Pedicel *c.* 0.7 mm long. Spikelets in pairs and similar (or single), *c.* 4.3 mm long, 1.8—2.5 mm wide, not flattened, 2-flowered, unawned; lowest bract *c.* 0.7 times as long as and 2nd as long as spikelet; glumes and lemmas at tip laterally flattened, glumes and 1st floret herbaceous; lower glume *c.* 3.1 mm long, glabrous; upper glume *c.* 3.8 mm long, glabrous; 1st lemma and palea present, glabrous; 2nd lemma and palea glabrous, indurated.

Figure 18. Lower glume of spikelets of *Panicum*.
a. collar-shaped, b. ovate.

Figure 19. *Acroceras munroanum* (Balansa) Henrard.

Figure 20. *Alloteropsis cimicina* (L.) Stapf.

Figure 21. *Arundo donax* L.

Fig. 18

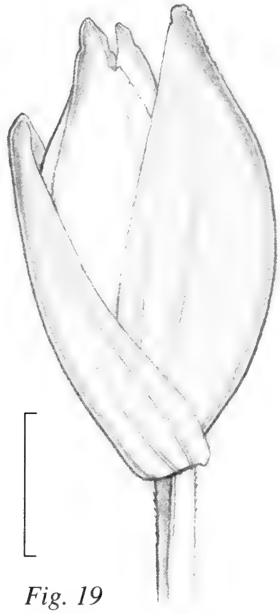

Fig. 19

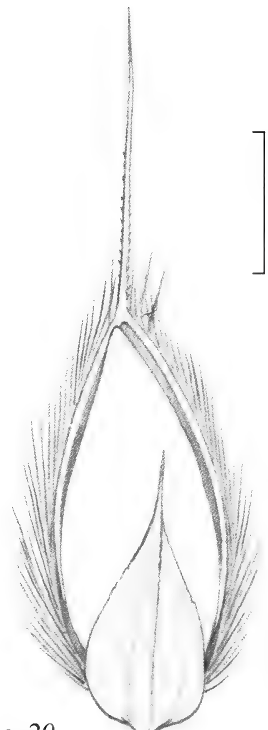

Fig. 20

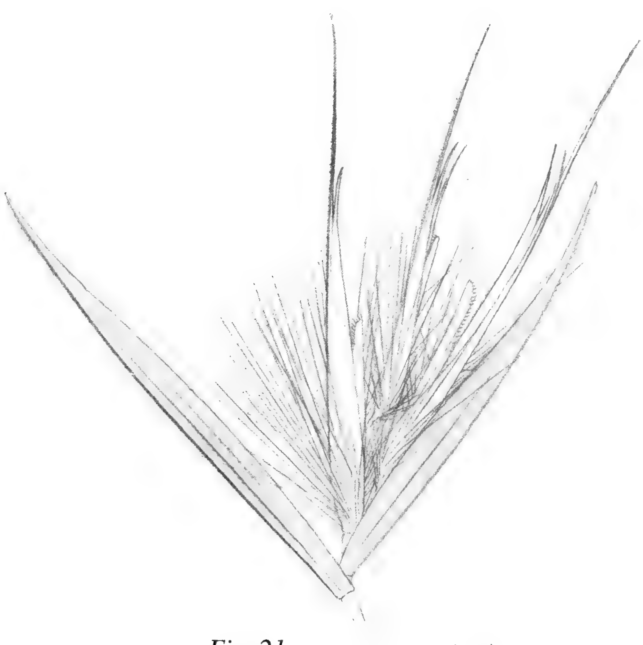

Fig. 21

Not native; India and Myanmar to Malesia. First record 1899; extinct (1961).

It is probably adventive as it was only found in the Botanic Gardens; however, Ridley (*Ridley s.n.*, 1899, SING) reports it as wild.

Alloteropsis J.Presl

Alloteropsis cimicina (L.) Stapf – Fig. 20.

Ridley 1925: 223. Gilliland 1971: 198. Keng *et al.* 1998: 154.

Axonopus cimicinus (L.) P.Beauv.: Ridley 1907: 144.

Culms tufted, 40—60 cm long; nodes glabrous or hairy. Sheath rounded, glabrous to hairy, external ligule hairy. Ligule membranous with hairs at tip, basal part 0.6 mm long, hairs 1 mm long. Young leaf blade inrolled. Blade 3—7 cm long, 7—11.5 mm wide, glabrous, base cordate. Inflorescence panicle, central rachis absent or shortly developed; branches 4—5, (almost) in a single whorl, 8—14 cm long, *c.* 0.6 mm wide, lowest 3—7 cm naked, simple (or branched). Pedicel 1—5 mm long. Spikelets in groups of 2—4, similar but unequally pedicelled, 3—3.5 mm long, 1.2—1.8 mm wide, dorsiventrally flattened, 2-flowered, awned; lowest bract 0.5—0.7 times as long as and 2nd as long as spikelet; glumes and 1st lemma thin herbaceous; lower glume 1.6—2 mm long, glabrous, acute to acuminate; upper glume 2.9—3.4 mm long, margin densely hairy, hairs up to 1.2 mm long; 1st lemma 2—2.5 mm long, glabrous; 1st palea absent; 2nd lemma and palea glabrous, indurated; 2nd lemma awn 1—2.7 mm long, scabrous.

Native; Paleotropics. First record 1890. Rare.

Waste places, usually on damp soil.

Arundo L.

Arundo donax L. – Fig. 21.

Gilliland 1971: 51. Keng *et al.* 1998: 154.

Culms loosely tufted, erect, 150—300 cm long; internodes hollow; nodes glabrous. Sheath rounded, glabrous. Ligule membranous, 2 mm long (1.5 mm in non-flowering shoot), ciliolate. Young leaf blade inrolled. Blade *c.* 40 cm long, 15—40 mm wide, glabrous, sometimes with white stripes (cv *versicolor*), base rounded. Inflorescence panicle, central rachis 35—60 cm long, branches many (in whorls); longest branch 20—30 cm long, *c.* 0.7 mm wide, branched. Pedicel 3—8 mm long. Spikelets single, *c.* 13 mm long (including awn), *c.* 5 mm wide, laterally flattened, 3- or 4-flowered (falling off at maturity), awned; rachilla internodes with short hairs at tip, between the glumes 0.8 mm long, between the florets 1.7 mm long and articulated; the two lowest bracts *c.* 0.8 times as long as spikelet; glumes and lemmas herbaceous, paleas hyaline; lower glume *c.* 10.3 mm long, enveloping, glabrous; upper glume *c.* 10 mm long, glabrous, midvein 0.5—0.8 mm-long protruding; 1st lemma *c.* 11.3 mm long, basal half densely covered with up to 5 mm-long hairs, midvein protruding in *c.* 3 mm long awn; 1st palea *c.* 5 mm long; 2nd—4th florets as 1st, gradually decreasing in size.

Not native; S. Europe, Asia, now worldwide. First record 1877. Cultivated.

Axonopus P.Beauv.

Culms with stolons, erect part 10—40 cm long. Sheath more or less flattened, midrib raised, glabrous, margin hairy. Ligule membranous, 0.4 mm long, densely fringed. Inflorescence panicle, 1—4 per sheath, central rachis absent or present, at least 2 branches at tip; longest branch 4—8 cm long, 0.8—0.9 mm wide, simple. Pedicel absent. Spikelets single,

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Figure 22. *Axonopus compressus* (Sw.) P.Beauv.

a. facing the 1st lemma, b. facing the upper glume.

Figure 23. *Axonopus fissifolius* (Raddi) Kuhlm.

Figure 24. *Bothriochloa bladhii* (Retz.) S.T.Blake, pair of spikelets.

Fig. 24

Fig. 23

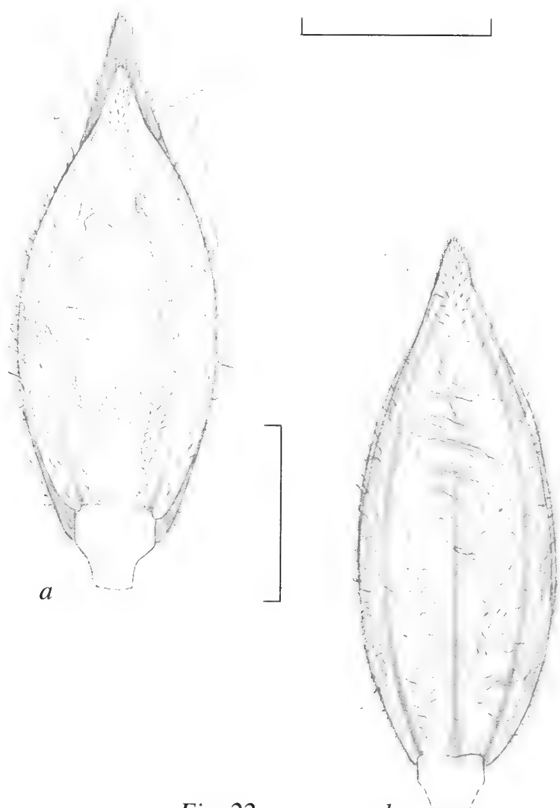


Fig. 22

dorsiventrally flattened, 2-flowered, unawned; the two lowest bracts as long as spikelet; lower glume absent; upper glume and 1st lemma herbaceous, (slightly) hairy; 1st palea absent; 2nd lemma and palea indurated.

1a. Nodes hairy. Young leaf blade inrolled. Blade flat, (sparsely) hairy, margin undulate, with numerous long hairs. ***A. compressus***

1b. Nodes glabrous or sparsely appressed-hairy. Young leaf blade folded along midrib. Blade folded, glabrous, margin smooth, glabrous or with a few hairs at the base. ***A. fissifolius***

Axonopus compressus (Sw.) P.Beauv. – Fig. 22, Plate 4.

Carpet Grass, *Rumput Tikar*

Ridley 1925: 216. Gilliland 1971: 187. Keng *et al.* 1998: 154. Veldkamp 1997b: 511.

Paspalum platicaulon Poir.: Ridley 1907: 125.

Nodes hairy. External ligule a sparse row of short hairs. Young leaf blade inrolled. Blade 5—15 cm long, 4—9 mm wide, flat, (sparsely) hairy, margin undulate, base rounded and with many up to 2 mm-long hairs. Central rachis 1—2 cm long, lower branches 1 or 2. Spikelet 2.3—2.4 mm long, *c.* 1 mm wide; upper glume 5 veins, midvein present (sometimes obscure).

Not native; Neotropics, introduced in Africa and Asia. First record 1918 (Botanic Gardens), in the wild 1955. Common.

In open to partly shaded places.

Introduced between 1895 and 1900 (*Purseglove* P4073, 1955, SING), but spread rapidly only after it was used for edging beds in the Botanic Gardens (Ridley 1925: 216). It is now probably the most common grass species in Singapore, widely used for lawns (including golf courses). It is less usually called Cow Grass.

For differences with *Chrysopogon aciculatus* and *Paspalum conjugatum* see notes under the respective species.

Axonopus fissifolius (Raddi) Kuhlm. – Fig. 23.

Keng *et al.* 1998: 154. Veldkamp 1997b: 511.

A. affinis Chase: Gilliland 1971: 189.

Nodes glabrous or sparsely appressed-hairy. External ligule absent. Young leaf blade folded along midrib. Blade 7.5—18 cm long, 3—5 mm wide, glossy green, folded, glabrous, margin smooth and glabrous or sparsely hairy at base, base cuneate to slightly rounded. Central rachis absent to 1 cm long, lower branches 0 or 1. Spikelet *c.* 2 mm long, 0.6—0.9 mm wide; upper glume 4 (or 5) veins, midvein absent or obscure.

Not native; Neotropics, introduced in Africa and Australasia. First record 1955. Rare.

In open to partly shaded and moist places, apparently associated with seepage.

Its blades are generally narrower and darker green than those of *A. compressus*. Veldkamp (1997b) mentions that the nodes are glabrous.

Bothriochloa Kuntze

Bothriochloa bladhii (Retz.) S.T.Blake – Fig. 24.

Long-leaved Beard Grass

Keng *et al.* 1998: 157.

Amphilophis glabra (Roxb.) Stapf: Ridley 1925: 209 (excluding Singapore).

Andropogon intermedius R.Br.: Ridley 1907: 166 (excluding Singapore).

B. intermedia (R.Br.) A.Camus: De Wet and Harlan 1970: 339—340. Gilliland 1971: 281.

Culms tufted, erect to geniculate, 40—110 cm long; nodes hairy, lower glabrescent. Sheath rounded, midrib slightly raised, glabrous. Ligule membranous, 1—1.3 mm long, hairy at abaxial side, ciliolate. Young leaf blade inrolled. Blade 15—21 cm long, 6—8 mm wide, sparsely hairy with up to 5 mm-long hairs, base cuneate. Inflorescence panicle, central rachis 2.5—8.5 cm long; branches 13—21, 4—7 cm long, *c.* 0.3 mm wide, more or less flattened, furrowed (at least in upper part of branch), margins hairy, empty at basal 1 cm, simple or the lowest sometimes branched. Spikelets in pairs of 1 sessile and 1 pedicelled, the upper in threes. Sessile spikelet 3.5—3.8 mm long, *c.* 1 mm wide, dorsiventrally flattened, 2-flowered, awned; callus obtuse, hairy; the two lowest bracts as long as spikelet; lower glume 3.7 mm long, basal half and margin upper half hairy; upper glume *c.* 3.5 mm long, glabrous; 1st lemma *c.* 2.4 mm long, hyaline, sterile; 1st palea absent; 2nd lemma 1.4—1.6 mm long, hyaline, with 13—14 mm long awn from tip; 2nd palea absent. Pedicel 2—2.5 mm long, furrowed, margins hairy. Pedicelled spikelet reduced to 2 glumes, unawned.

Native; Paleotropics. First record 1955. Rare.

Weed of open habitats.

It can be mistaken for *Dichanthium annulatum*, which differs as follows: branches and pedicels solid, central rachis 0.5—1.5 cm long and inflorescence with 2—5 branches. Hybrids with *Dichanthium annulatum* are known (de Wet and Harlan 1970), but have not (yet) been found in Singapore.

Cenchrus L.

Weston 1974: 375—380. Doust and Kellogg 2002: 1203—1222.

Culms tufted, erect to geniculate, 20—60 cm long; nodes glabrous. Sheath more or less flattened, midrib (slightly) raised, glabrous or hairy in upper half marginal area. Ligule either membranous with hairs at tip or a row of hairs, basal part 0—0.2 mm long, hairs 0.5—0.8 mm long. Young leaf blade inrolled. Blade 7—26 cm long, 6—7 mm wide, base rounded. Inflorescence spike-like raceme of subsessile burs, 2.5—7 cm long, 1.3—1.5 cm wide. Bur deciduous; involucre indurated, at base covered with bristles, tip 8-lobed, spikelets 2—4. Pedicel absent. Spikelets not flattened, 2-flowered, unawned; upper glume and 1st lemma thin herbaceous; 2nd lemma and palea herbaceous, glabrous, palea slightly shorter than lemma.

It is most closely related to *Pennisetum*, which has an involucre of bristles fused only at base. Future research might show they are in fact one genus (Doust and Kellogg, 2002). In Singapore *Setaria* differs from both *Cenchrus* and *Pennisetum* in that the bristles do not fall off together with the spikelet.

1a. Burs 1—2 mm apart; basal bristles 0.1—0.2 mm wide, erect, longest up to 7 mm long; lobes at margin with hairs up to 0.5 mm long. Spikelet 4—5 mm long. ***C. brownii***

1b. Burs 1.5—4 mm apart; basal bristles 0.3—0.5 mm wide, recurved, longest up to 4 mm long; lobes at margin with at least a few hairs 1—1.5 mm long. Spikelet 5—6.2 mm long. ***C. echinatus***

Cenchrus brownii Roem. & Schult. – Fig. 25.

Weston 1974: 376. Keng *et al.* 1998: 157 (incl. *C. echinatus*). Duistermaat 2004: 30.

Inflorescence in middle dense, burs 1—2 mm apart. Involucre 4—5 mm wide (excluding spines), 5—6 mm long, lobes at margin with hairs up to 0.5 mm long, bristles up to 7 mm long, 0.1—0.2 mm wide, erect. Spikelet 4—5 mm long, 1 mm wide; lowest bract *c.* 0.75 and 2nd 0.9—1 times as long as spikelet; lower glume absent; upper glume *c.* 3 mm long, glabrous; 1st lemma *c.* 3.5 mm long; 1st palea absent; 2nd lemma *c.* 3.5 mm long.

Not native; Neotropics, introduced in Africa and tropical (Austral)Asia. First record 1950. Rare.

Weed of waste places.

Cenchrus echinatus L. – Fig. 26, Plate 3.

Weston 1974: 378. Veldkamp 1999b: 232. Duistermaat 2004: 30.

Inflorescence in middle more or less open, burs 1.5—4 mm apart. Involucre 4—6 mm wide (excluding spines), 6—8 mm long, lobes at margin with at least few hairs 1—1.5 mm long, bristles up to 4 mm long, 0.3—0.5 mm wide, recurved. Spikelet 5—6.2 mm long, 2 mm wide; either lowest bract *c.* 0.85 and 2nd 0.9—1 times as long as spikelet, or lowest *c.* 0.45 and 2nd 0.9—1 times as long as spikelet; lower glume absent or *c.* 2.8 mm long, hyaline; upper glume 5—5.2 mm long, glabrous to minutely hairy at base; 1st lemma 5.3—5.8 mm long; 1st palea 5.3 mm long, thin herbaceous; 2nd lemma *c.* 6 mm long.

Not native; Neotropics, introduced in Africa, Asia and Australia. First record 1994. Rather rare.

Weed of waste places.

Centotheca Desv.

Monod de Froideville 1971: 57—60.

Centotheca longilamina Ohwi was mentioned for Singapore by Gilliland (1971: 54), but no herbarium or living material has been found. It differs from *C. lappacea* as follows: blades at least 6.3 times as long as wide and gradually narrowed into symmetric base, spikelets 1—3-flowered, and the 1st lemma bristled (Monod de Froideville 1971).

Centotheca lappacea (L.) Desv. – Fig. 27, Plate 5.

Barbed Grass, *Rumput Darah*

Ridley 1907: 181; 1925: 253. Gilliland 1971: 53. Keng *et al.* 1998: 158.

Centotheca latifolia Trin.: Monod de Froideville 1971: 59.

Culms tufted, erect, 20—80 cm long; internodes (partially) filled with spongy pith, up to 2.5 mm diameter; nodes glabrous. Sheath rounded, glabrous to sparsely hairy at tip, basal sheaths reduced. Ligule membranous, 1—1.5 mm long. Young leaf blade inrolled. Blade 3.5—11 cm long, 13—28 mm wide, transverse veins present, underside glabrous to hairy, upperside appressed-hairy, margins often transversely wrinkled, base abruptly and asymmetrically narrowed, pseudopetiole 0.5—0.7 mm long. Inflorescence panicle, central rachis 11—20 cm long, branches many; longest branch 6—10 cm long, *c.* 0.2 mm wide, rounded, scaberulous, simple or branched. Pedicel 2—4 mm long. Spikelets single, 4—5.5 mm long, 1.4—1.9 mm wide, not to slightly laterally flattened, herbaceous, 2- or 3-flowered, unawned; rachilla articulate between the florets, 0.7 mm long between 1st and 2nd floret, extension above last floret 1.8 mm long; the two lowest bracts 0.6—0.8 times as long as spikelet; lower glume *c.* 2.5 mm long, enveloping, glabrous; upper glume 2.7—3 mm long, glabrous; 1st lemma 3.4—3.5 mm long, glabrous, mucro 0.2 mm long; 1st palea 2.2—2.3 mm long; 2nd and 3rd lemma 2.5—3.5 mm long, uppermost marginal area at maturity with up to 10 retrorse bristles of up to 0.8 mm long, mucro 0.3 mm long; 2nd and 3rd palea 1.8—2.7 mm long.

Native; Paleotropics. First record 1894. Rather rare.

Figure 25. *Cenchrus brownii* Roem. & Schult., bur with an involucre and several spikelets.
Figure 26. *Cenchrus echinatus* L., bur with an involucre and several spikelets.
Figure 27. *Centotheca lappacea* (L.) Desv.
Figure 28. *Chloris barbata* Sw.

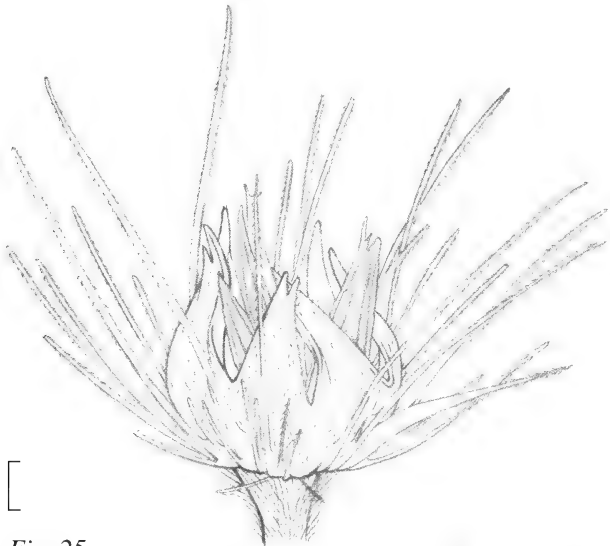


Fig. 25

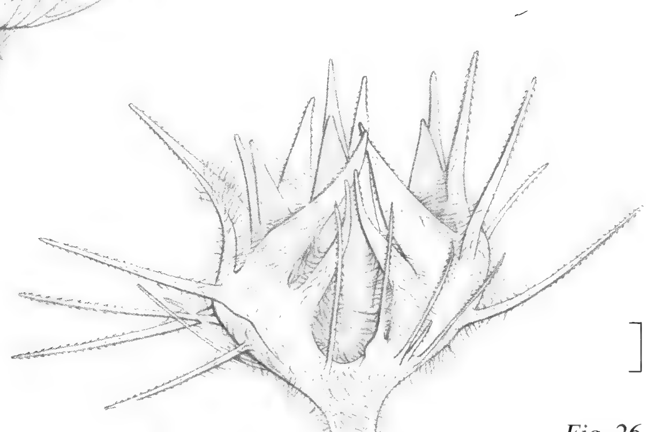


Fig. 26

Fig. 27

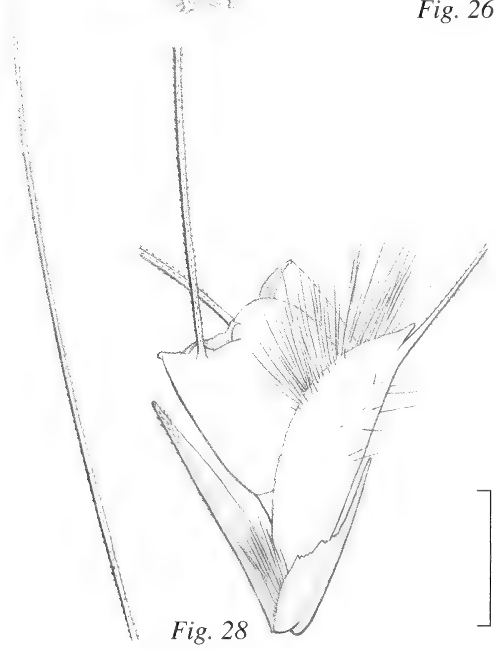


Fig. 28

In forests, partly shaded areas, on moist (to wet) soil.

Non-flowering plants of *Lophatherum gracile* differ in having blades that are not wrinkled, pseudopetioles that are much longer (7—20 mm long) and roots with tubers.

Chloris Sw.

Chloris barbata Sw. – Fig. 28, Plate 6.

Plush Grass

Ridley 1907: 173; 1925: 250. Gilliland 1971: 86. Keng *et al.* 1998: 158.

Culms tufted, erect to geniculate, stolons absent, 35—70 cm long; internodes of non-flowering plants very short; nodes glabrous. Leaves of non-flowering plants all basal and distinctly distichous, shoot fan-shaped. Sheath 2.5—7.5 cm long, flattened, midrib winged, tip with few hairs. Ligule membranous, c. 0.5 mm long, hairy at abaxial side, ciliolate. Young leaf blade inrolled. Blade 1.5—13 cm long, 1—6 mm wide, in basal half with few up to 3 mm-long hairs, midvein winged underneath, base cuneate. Inflorescence panicle, central rachis absent; branches 7—14, 4—7.5 cm long, 0.1—0.2 mm wide, rounded, scaberulous, simple. Pedicel *c.* 0.4 mm long, rounded, scaberulous. Spikelets single, in 2 rows, *c.* 2.3 mm long, 1—1.2 mm wide, not flattened, often tinged purple, 3-flowered with 1st floret bisexual and 2nd and 3rd sterile, awned; rachilla between glumes and 1st lemma hairy; lowest bract 0.6—0.7 and 2nd 0.8—1 times as long as spikelet; lower glume 1.4—1.6 mm long, glabrous, hyaline; upper glume as lower, 1.7—2.5 mm long; 1st lemma 1.7—2.2 mm long, thick herbaceous, along midvein and upper half marginal veins with up to 1 mm long hairs, truncate, awned just below tip, awn 3—5 mm long and scaberulous; 1st palea 1.9—2 mm long; 2nd and 3rd lemma 0.9—1.1 mm long, (thin) herbaceous, truncate, awn 3—5 mm long, scaberulous; 2nd and 3rd palea absent.

Not native; Neotropics, introduced in Africa, Asia and Australia. First record 1892. Common.

Weed of waste places on well-drained soil, including reclaimed land, roadsides, etc.

Ridley (1925) already reported it as well established.

For differences with *Eustachys tenera* see note under that species.

Chrysopogon Trin.

Veldkamp 1999a: 503—533.

Vetiveria Bory

Sheath glabrous, at least one margin hairy. Young leaf blade inrolled. Inflorescence panicle, central rachis present. Sessile spikelet 2-flowered; 1st palea absent.

Veldkamp (1999a) argues that *Vetiveria* and *Chrysopogon* are best united. Although the two species present in Singapore look very different, intermediate characters of a number of African and Australian species seriously blur the generic delimitation.

1a. Culms 15—35 cm long, with short stolons. Blade 1.5—9 cm long. ***C. aciculatus***

1b. Culms 150—250 cm long, with short rhizomes. Blade 25—120 cm long. ***C. zizanioides***

Figure 29. *Chrysopogon aciculatus* (Retz.) Trin., group of three spikelets, one sessile and two pedicelled.

Figure 30. *Coix lacryma-jobi* L., inflorescence.
a. involucre with exserting stigma, b. male spikelets.

Figure 31. *Cymbopogon martini* (Roxb.) Will.Watson.
a. sessile spikelet, b. pedicelled spikelet.

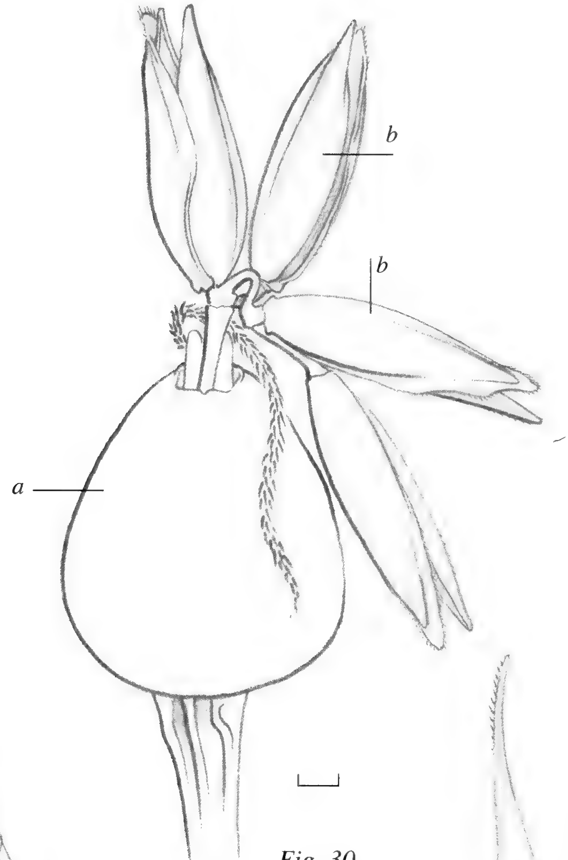
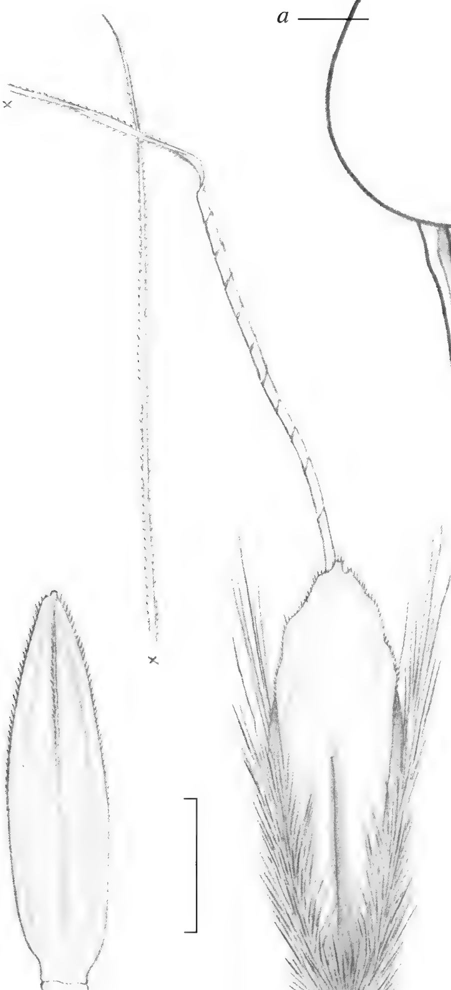


Fig. 30



b *Fig. 31* a

Fig. 29

Chrysopogon aciculatus (Retz.) Trin. – Fig. 29, Plate 17.
Love Grass, *Kemucut*

Ridley 1925: 207. Gilliland 1971: 236. Keng *et al.* 1998: 158. Veldkamp 1999a: 509.
Andropogon aciculatus Retz.: Ridley 1907: 166.
Culms with short and densely leaved stolons, erect part 15—35 cm long; nodes glabrous. Sheath 1—2.5 cm long, rounded. Ligule 0.05—0.1 mm long, densely fringed. Blade linear-lanceolate to linear, 1.5—9 cm long, 4—6 mm wide, glabrous, base cuneate to rounded with margins (sparsely) hairy. Inflorescence with central rachis 6—9 cm long, branches in whorls of 2—8; longest branch 1.5—3 cm long, *c.* 0.2 mm wide, rounded, simple or branched. Spikelets in threes of 1 sessile and 2 pedicelled, lower sometimes in pairs. Sessile spikelet 3.8—4 mm long, 0.5 mm wide, not flattened, awned; callus needle-shaped, 3.6—6.4 mm long, short-hairy; the two lowest bracts 0.9—1 times as long as spikelet; lower glume *c.* 3.5 mm long, herbaceous, hairy on midvein and margins, tip bifid; upper glume as lower, *c.* 4 mm long, tip acuminate, mucro *c.* 0.6 mm long; 1st lemma 2.5 mm long, sparsely hairy, hyaline; 2nd lemma *c.* 2.2 mm long, glabrous, hyaline, awn *c.* 3.8 mm long, scaberulous; 2nd palea *c.* 0.4 mm long. Pedicel *c.* 3 mm long, flattened, hairy. Pedicelled spikelet male, unawned.

Native; S. and E. Asia to Australia. First record 1880s. Common.

In open places, lawns, roadsides, etc.

Non-flowering plants of *Axonopus compressus* differ in the hairy nodes, the presence of a hairy external ligule, the longer ligule, and the generally longer blades that are (sparsely) hairy on both sides.

Chrysopogon zizanioides (L.) Roberty
Vetiver, *Rumput Wangi*

Veldkamp 1999a: 522.
Vetiveria odorata Virey: Ridley 1925: 208.
V. zizanioides (L.) Nash: Gilliland 1971: 232. Keng *et al.* 1998: 187. Ng 1999: 288.
Culms with short and scented rhizomes, internodes of non-flowering plants very short; nodes unknown. Leaves of non-flowering plants all basal. Sheath *c.* 12 cm long, keeled, transverse veinlets present. Ligule of basal leaves 2 mm long and lacerate, of higher leaves 0.2 mm long and densely fringed. Blade very long-linear, 25—120 cm long, 4—5 mm wide, glabrous, with strong and white midrib, transverse veins present, margins serrate, base cuneate and glabrous to densely hairy.

Not native; Africa to Indochina, introduced in America. First record 1929. Cultivated.

It is only known from the Botanic Gardens (at present in the Evolution Garden) where it has never flowered. I have not seen the culms but according to Veldkamp (1999a) they are 150—250 cm long and with glabrous nodes.

This species is cultivated for the rhizomes that contain a fragrant oil, used in perfumes and in curries. Because of its soil-binding capacity it has been planted along the new highways in Malaysia (Ng 1999).

Coix L.

Coix lacryma-jobi L. – Fig. 30.
Job's Tears, *Jelai*

Ridley 1907: 151; 1925: 191. Gilliland 1971: 304. Keng *et al.* 1998: 159.
Culms single or tufted, erect, 60—200 cm long; internodes solid; nodes glabrous. Sheath rounded, somewhat inflated, glabrous. Ligule membranous, *c.* 0.5 mm long, ciliolate. Young leaf blade inrolled. Blade 17—42 cm long, 24—40 mm wide, glabrous, margin with minute hairs, base rounded. Inflorescence 1 per sheath, many per culm, spike-like raceme, rachis 3.5—6 cm long. Spikelets unisexual, unawned, basal group enclosed in involucre, upper group

free. Involucre of basal group much indurated bead-like sheath, *c.* 10 mm long, to 6.5 mm wide, shiny grey, enclosing 1 female and 2 sterile spikelets. Rachis continuing through pore at tip of involucre. Pedicel upper spikelets *c.* 3.5 mm long, glabrous, flattened. Upper spikelets in 2 pairs of 1 sessile and 1 pedicelled, otherwise similar, 10.5—11 mm long, 3—3.5 mm wide, dorsiventrally flattened, 2-flowered, male, unawned; the two lowest bracts (almost) as long as spikelet; lower glume 10—10.5 mm long, herbaceous, glabrous, submarginally winged, wings up to 1 mm wide and widest at tip; upper glume 8.5—9.7 mm long, herbaceous, narrowly winged on midvein, upper half of wing with short hairs; 1st lemma 8.2—9.5 mm long, glabrous, hyaline, tip bifid; 1st palea 7.5—8.8 mm long; 2nd lemma and palea as 1st, slightly shorter.

Not native; tropical Asia, now worldwide. First record 1889. Rare.

On roadsides, waste places, in secondary vegetation.

According to Ridley (1925) it is not wild. Cultivated as a cereal and escaping. Involucres of lower spikelets are used as beads.

Cymbopogon Spreng.

Gilliland 1971: 294—299. Soenarko 1977: 225—375.

Culms tufted, erect, when flowering up to 300 cm long; nodes at base densely crowded and covered by sheaths. Sheaths of non-flowering culms overlapping, rounded, swollen at base, glabrous. Ligule membranous, 1.5—2.5(—5) mm long. Young leaf blade inrolled. Blade up to 100 cm long, 8—20 mm wide, glabrous except for few hairs behind ligule, margins sharply serrate, base cuneate (cordate in *C. martini*). Spatheate inflorescence up to 50 cm long, much branched with branches up to 20 cm long, final sheaths (spathes) up to 2.5 cm long. Inflorescence panicle, central rachis absent; branches 2, up to 2 cm long, *c.* 0.2 mm wide, simple. Spikelets in pairs of 1 sessile and 1 pedicelled. Sessile spikelet not to slightly dorsiventrally flattened, 2-flowered, awned or unawned; the two lowest bracts as long as spikelet; lower glume flat, with 2 narrow submarginal keels; upper glume boat-shaped, midvein keeled. Pedicel 2.5—3 mm long, flattened, hairy. Pedicelled spikelet somewhat smaller, unawned.

Not native; Paleotropics. Cultivated.

Several species are cultivated for aromatic essential oils. In Singapore they are rarely seen flowering and only known from gardens. As plants might survive for a long time in abandoned plots, an annotated key to the species is provided.

1a. Leaf blade at base cordate. Lower glume of sessile spikelet with deep longitudinal furrow in its lower half. (India, two forms cultivated in the tropics). Grown for palmarosa oil and ginger oil. Ginger Grass. ***C. martini*** (Roxb.) Will.Watson – Fig. 31.

1b. Leaf blade at base cuneate. Lower glume of sessile spikelet without such a furrow, but sometimes broadly hollow near the base. **2**

2a. Sessile spikelet unawned or awn reduced to a bristle and not visible from outside spikelet. **3**

2b. Sessile spikelet awned, awn visible from outside spikelet. **4**

3a. Lower glume of sessile spikelet 6 mm long, very narrow, without distinct veins between the keels, basal part depressed. Basal sheaths whitish green, persistent. (Origin unknown, cultivated throughout the tropics). Used for flavouring food. Lemon Grass, *Serai*. ***C. citratus*** (DC.) Stapf

3b. Lower glume of sessile spikelet 4—5 mm long, with distinct veins between the keels, basal part not depressed. Basal sheaths purple, caducous. (India and Ceylon, introduced elsewhere in the tropics). Grown for citronella oil. Citronella Grass, *Serai Wangi*.
C. nardus (L.) Rendle **var. nardus** – Fig. 32.

4a. Lower glume of pedicelled spikelet 7(—9)-veined, upper glume 3(or more)-veined. Basal sheaths yellowish. (Malay Peninsula, Thailand, on limestone). Unscented. **C. calcicola** C.E.Hubb. – Fig. 33.
4b. Lower glume of pedicelled spikelet 1—3-veined, upper glume 1-veined. Basal sheaths green. (India, naturalized in Indonesia, cultivated in the tropics). Malabar Grass.
C. flexuosus (Nees ex Steud.) Will.Watson – Fig. 34.

Cynodon Pers.

Nowack 1992: 477—478.

Gilliland (1971) mentioned *Cynodon arcuatus* J.Presl (a later synonym for *C. radiatus* Roth in Roem. & Schult.) in the synonymy of *C. dactylon*, but according to Nowack (1992) they are different:

1a. Rhizomes present. Culms 0.1—0.2 m long. Blades 1.5—2.5 mm wide. Spikes 3—6, 1—6 cm by 1.2—2 mm, not wavy. Anthers 0.8—1.5 mm long. **C. dactylon**
1b. Rhizomes absent. Culms 0.2—0.4 m long. Blades 4—7 mm wide. Spikes 5—8, 6—12 cm by 0.6—1.5 mm, wavy. Anthers 0.5—0.7 mm long. (Not yet known from Singapore.) **C. radiatus**

Cynodon dactylon (L.) Pers. – Fig. 35, Plate 7.

Bermuda Grass, *Rumput Bermuda*

Ridley 1907: 173, p.p.; 1925: 249, p.p. Gilliland 1971: 90. Keng *et al.* 1998: 160.
Culms with long rhizomes or stolons, rarely tufted without stolons, erect part 10—25 cm long; nodes glabrous. Sheath rounded, glabrous or throat with few hairs. Ligule row of hairs of unequal length, 0.2—1 mm long with longest hairs at least 0.5 mm long. Young leaf blade inrolled to seemingly folded along midrib. Blade 0.5—4.5 cm long, 1.5—2.5 mm wide, glabrous or underside in middle short-hairy, base cuneate. Inflorescence panicle, central rachis absent; branches 2—5, 1.5—5 cm long, *c.* 0.5 mm wide (0.8—1.7 including spikelets), flattened to V-shaped, shortly winged, hairy at base, simple. Pedicel absent. Spikelets single, alternate on branch, 2.4—2.5 mm long, 1.3—1.9 mm wide, laterally flattened, yawning or not, 1(—2)-flowered, unawned; the two lowest bracts 0.6—0.7 times as long as spikelet; lower and upper glume 1.4—1.7 mm long, often erecto-patent, herbaceous, sparsely hairy, acute; 1st lemma 2.1—2.4 mm long, thin herbaceous, hairy on midvein and margins; palea 2—2.2 mm long; 2nd floret absent or much reduced, on elongated rachilla. Anthers (0.5—) 0.8—1.3 mm long.

Native; tropical and temperate regions of the world. First record 1894. Common.

In lawns, open grasslands, on seashores and sandy soil.

Figure 32. *Cymbopogon nardus* (L.) Rendle var. *nardus*, pair of spikelets.
Figure 33. *Cymbopogon calcicola* C.E.Hubb, pair of spikelets.
Figure 34. *Cymbopogon flexuosus* (Nees ex Steud.) Will.Watson, pair of spikelets.

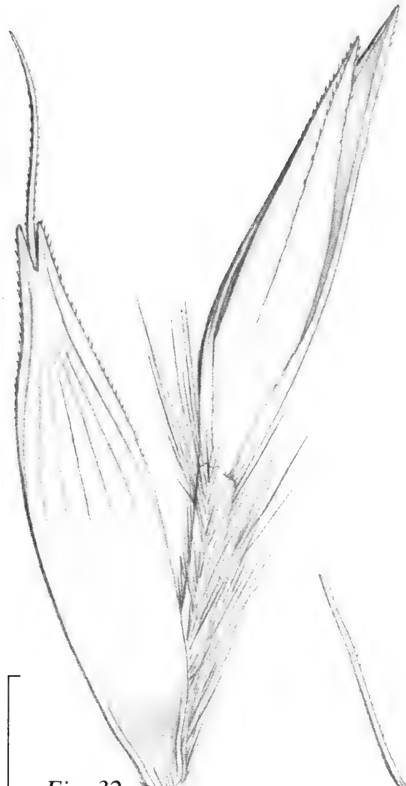


Fig. 32

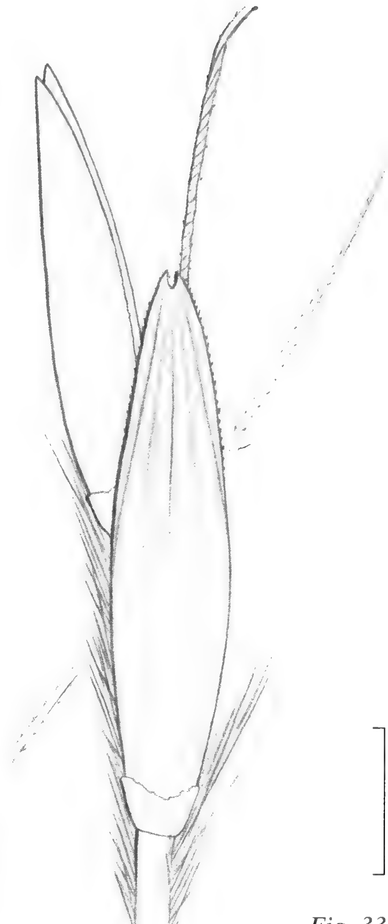


Fig. 33

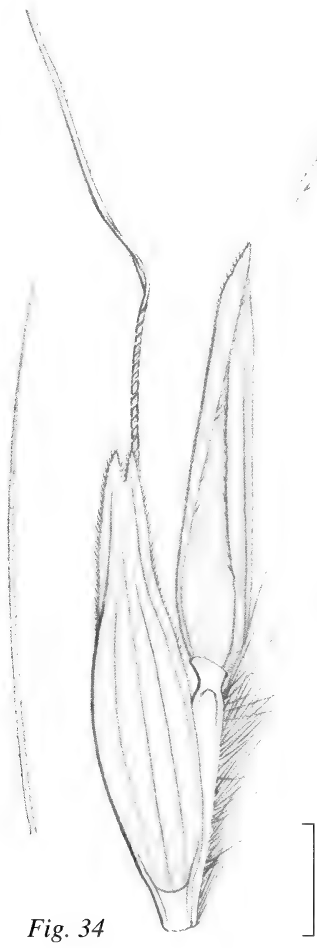


Fig. 34

The branches of the inflorescence are generally much narrower than Nowack (1992) reports. Plants that share with *C. radiatus* a tufted habit and anthers of 0.5—0.7 mm long but are otherwise as *C. dactylon* are here included in *C. dactylon*.

Differences with *Zoysia matrella* are mentioned there.

Cyrtococcum Stapf

Culms with stolons, lower nodes rooting. Sheath rounded, not shouldered. Ligule membraneous, glabrous. Young leaf blade inrolled. Blade (sparsely) hairy, base cuneate (to rounded), margins with long hairs. Inflorescence a panicle, central rachis present; branches 0.1—0.4 mm wide. Pedicel glabrous, rounded. Spikelets in pairs with pedicels of unequal length, more or less laterally flattened, gibbous, 2-flowered with 1st floret sterile and 2nd bisexual, unawned; lowest bracts 0.5—0.7 and 2nd lowest 0.6—0.8 times as long as spikelet; both glumes thin herbaceous; 1st lemma (thin) herbaceous; 1st palea absent; 2nd floret thick herbaceous.

Differences with *Isachne* are mentioned there. The spikelets of *Panicum* are not gibbous, and its upper glumes are at least 0.9 times the length of the spikelet.

Cyrtococcum oxyphyllum, earlier mentioned for Singapore (Ridley 1925: 233, Gilliland 1971: 148, Keng *et al.* 1998: 161) has not been found. Differences with both *C. accrescens* and *C. patens* include a contracted inflorescence and that the longest pedicel of the pair is shorter than the spikelet.

Veldkamp (*pers. comm.*) provided the key to the species. However, intermediates occur (Duistermaat 2004: 31).

1a. Erect part of culms 30—100 cm long. Sheath usually hairy all over. Panicle 20—50 by 6—30 cm. Spikelets usually 1.35—1.5 mm long. ***C. accrescens***

1b. Erect part of culms 10—30 cm long. Sheath usually hairy along margins only. Panicle 3—18 by 0.8—2.3 cm. Spikelets usually 1.5—1.8 mm long. ***C. patens***

Cyrtococcum accrescens (Trin.) Stapf – Fig. 36.

Diffuse Panic Grass, *Rumput Telur Ikan*

Ridley 1925: 234. Gilliland 1971: 149. Keng *et al.* 1998: 160.

Panicum patens auct., non L.: Ridley 1907: 142.

Culms erect part 30—100 cm long; nodes glabrous. Sheath 3—5.5 cm long, sparsely hairy all over. Ligule 1.5 mm long. Blade 7—14 cm long, 10—14 mm wide. Inflorescence 20—35 cm long, 8—17 cm wide; longest branches 11—18 cm long, simple or branched. Longest pedicel of the pair 5.5—7.5 mm long. Spikelet 1.3—1.5 mm long, 0.7—1 mm wide.

Native; S. and E. Asia. First record 1885. Rare.

In shaded places on damp soil.

Figure 35. *Cynodon dactylon* (L.) Pers.

Figure 36. *Cyrtococcum accrescens* (Trin.) Stapf.
a. pair of spikelets, b. spikelet.

Figure 37. *Cyrtococcum patens* (L.) A.Camus.
a. pair of spikelets, b. spikelet.

Figure 38. *Dactyloctenium aegyptium* (L.) Willd.

Fig. 35

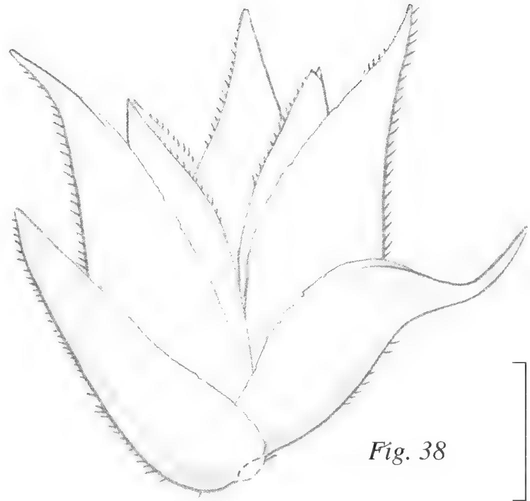
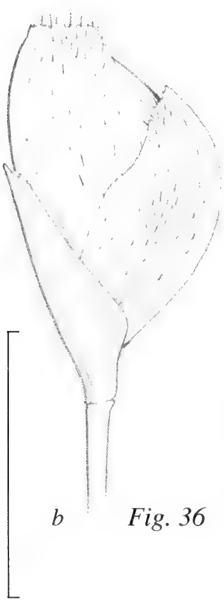


Fig. 38



b

a

Fig. 36

a

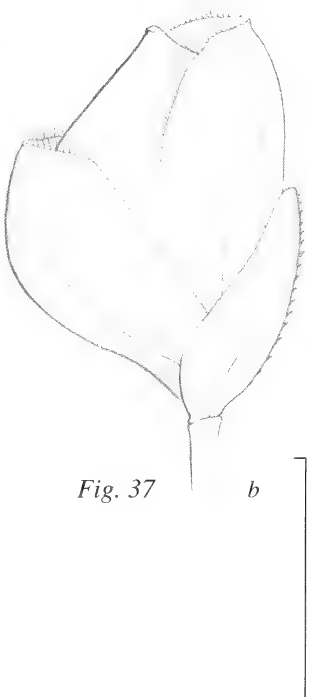


Fig. 37 b

Cyrtococcum patens (L.) A.Camus – Fig. 37.

Gilliland 1971: 148. Duistermaat 2004: 31.

C. carinatum Stapf ex Ridl. 1925: 233 (excluding Singapore).

Culms erect part 10—30 cm long; nodes hairy at one side. Sheath 1.5—2 cm long, with hairy margins only. Ligule 0.4—0.8 mm long. Blade 4—7 cm long, 5—8 mm wide. Inflorescence 4—9 cm long, 1—2.3 cm wide; longest branch 3—5 cm long, branched. Longest pedicel of the pair 2.5—4 mm long. Spikelet 1.5—1.8 mm long, 0.9—1 mm wide.

Native; S.E. Asia. First record 1993. Rare.

In secondary or primary forest on damp soil.

Although it was found only rather recently, it is probably native.

Dactyloctenium Willd.

Dactyloctenium aegyptium (L.) Willd. – Fig. 38, Plate 30.

Egyptian Finger Grass

Ridley 1925: 251. Gilliland 1971: 81. Keng *et al.* 1998: 161.

Eleusine aegyptia (L.) Desf.: Ridley 1907: 174 (as *E. aegyptiaca*).

Culms with stolons, erect part 20—30 cm long; nodes glabrous. Sheath rounded, sparsely hairy, margins hyaline and at throat with few long hairs. Ligule membranous, 0.6—0.8 mm long (including hairs at tip), hairs at tip 0.2—0.3 mm long. Young leaf blade inrolled. Blade 5—15 cm long, 5—6 mm wide, (sparsely) hairy, base rounded and hairy at margin. Inflorescence panicle, central rachis absent; branches 3—5, 1.5—4.5 cm long, 0.9 mm wide (including spikelets 5—7 mm wide), sparsely hairy, naked at uppermost 1—2.5 mm, simple. Pedicel absent. Spikelets single, alternately in 2 dense rows, the uppermost in 1 row, 3.5—4 mm long, 3—3.5 mm wide, laterally flattened, (thin) herbaceous, 3- or 4-flowered, awned; the two lowest bracts 0.7—0.75 times as long as spikelet; lower glume 2.5—2.8 mm long, midvein keeled in lower half, sparsely hairy, tip truncate; upper glume 1.8—2 mm long, glabrous, truncate, midvein scaberulous and protruding into 1.5—2 mm long awn; 1st lemma 3.1—3.4 mm long, glabrous, vein 1 and keeled in upper half, acuminate; 1st palea 2—2.3 mm long; 2$^{nd—4th}$ lemma and palea as 1st, but gradually smaller.

Native; Paleotropics. First record 1893. Common.

Weed on well-drained soil on roadsides, beaches, in lawns, waste places.

Dichanthium Willemet

Sheath glabrous. Ligule membranous, hairy at abaxial side. Young leaf blade inrolled (unknown for *D. mucronulatum*). Spikelets in pairs of 1 sessile and 1 pedicelled. Sessile spikelet dorsiventrally flattened, 2-flowered, awned; callus short-hairy; the two lowest bracts as long as spikelet; glumes (thin) herbaceous, lower flattened and submarginally keeled to winged in upper half, upper boat-shaped; lemmas hyaline, glabrous; 2nd lemma awned from tip, awn scaberulous and twisted; paleas absent. Pedicel (somewhat) flattened, hairy on one or both margins. Pedicelled spikelet slightly smaller than sessile, 2 glumes (and hyaline lemmas) present, unawned.

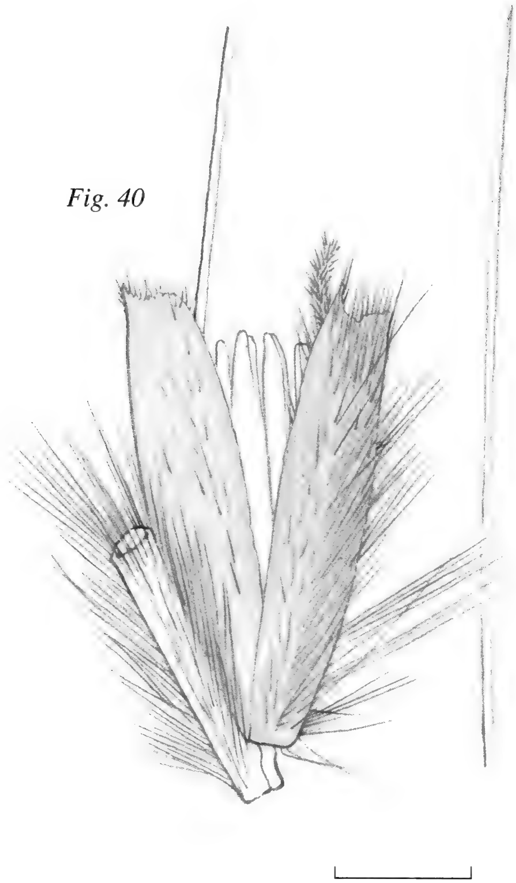
1a. Nodes (densely) hairy. Inflorescence a panicle, branches 2—5. ***D. annulatum***

1b. Nodes glabrous to sparsely hairy. Inflorescence spike-like raceme, simple. **2**

Figure 39. *Dichanthium annulatum* (Forssk.) Stapf, pair of spikelets.

Figure 40. *Dichanthium caricosum* (L.) A.Camus, pair of spikelets.

Fig. 40



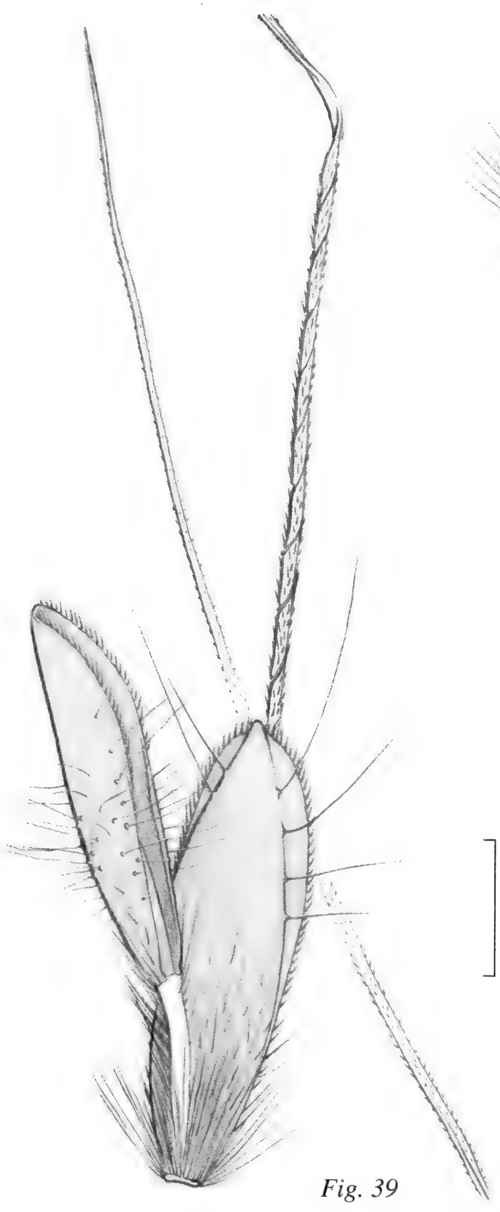


Fig. 39

2a. Upper blades hairy, base rounded. Lower glume of sessile spikelet truncate and marginal veins protruding. ***D. caricosum***

2b. Upper blades glabrous, base long cuneate. Lower glume of sessile spikelet with 3-pointed tip. ***D. mucronulatum***

Dichanthium annulatum (Forssk.) Stapf – Fig. 39.

Gilliland 1971: 284. Duistermaat 2004: 32.

Culms tufted, geniculate to decumbent, 50—200 cm long; nodes (densely) hairy. Sheath 3—7 cm long, more or less rounded, midrib not to slightly raised. Ligule 1.5 mm long. Blade 7—17 cm long, 3—6 mm wide, at least upperside (sparsely) hairy, base rounded. Inflorescence panicle, central rachis 0.5—1.5 cm long; branches 2—5, 3.5—7 cm long, 0.4 mm wide, rounded, axils hairy, simple. Sessile spikelet 3.5—3.9 mm long, 1—1.2 mm wide; lower glume 3.4—3.8 mm long, margin and lower half hairy, with 9 veins, truncate; upper glume 3.5—4 mm long, margin and marginal veins sparsely hairy, acute; 1st lemma 3 mm long; 2nd lemma 1.6 mm long, 0.1 mm wide, awn 21—23 mm long. Pedicel 1.8—2 mm long.

Native; tropical Africa and South East Asia. First record 1932. Rare.

Weed in lawns, on roadsides, brick walls.

Gilliland (1971) reported that it grows on limestone, probably because he included *Ischaemum beccarii* (see *D. mucronulatum*) in the synonymy.

Differences with *Bothriochloa bladhii* are mentioned there.

Dichanthium caricosum (L.) A.Camus – Fig. 40.

Ridley 1925: 210 (excluding Singapore). Gilliland 1971: 284. Keng *et al.* 1998: 162.

Culms geniculate, up to 35 cm long; nodes sparsely hairy. Sheath 2 cm long, rounded and keeled at tip. Ligule 0.5 mm long. Blade 2.5—4 cm long, 2—3 mm wide, (sparsely) hairy, base rounded and with prominent midvein. Inflorescence spike-like raceme, 2.5—3 cm long. Sessile spikelet 3.5 mm long, 0.8 mm wide; lower glume 3.5 mm long, hairy on lower $\frac{2}{3}$rd, with 5 veins, truncate and marginal veins protruding; upper glume 3 mm long, hairy, with 3 veins, emarginate; 1st lemma 1.8 mm long; 2nd lemma 1.3 mm long, awn 6.5—8 mm long. Pedicel 2 mm long.

Not native; Paleotropics, Pacific Islands to Fiji. Single record 1932 from Newton. Extinct (1932).

It is probably not native, as it prefers a pronounced dry season (Gilliland 1971).

Dichanthium mucronulatum Jansen

Gilliland 1971: 283. Keng *et al.* 1998: 161.

Ischaemum beccarii auct., non Hack.: Ridley 1907: 160; 1925: 204.

Nodes glabrous. Ligule 1—1.5 mm long. Blade 8—17 cm long, 4—5 mm wide, glabrous, base long cuneate. Inflorescence spike-like raceme, 4—5 cm long. Sessile spikelet 4.5—5 mm long; lower glume indurated, with few short appressed hairs in upper $\frac{1}{4}$, tip bifid, mucronate; 2nd lemma awn *c.* 3 cm long. Pedicel 1.3 mm long.

Not native; Malaysia: Langkawi, on limestone. Single record 1897 from the Botanic Gardens. Extinct (1897).

Weed.

Digitaria Haller

Veldkamp 1973: 1—80.

Sheath (more or less) rounded, midrib raised or not, submarginally hyaline, margin glabrous. Ligule membranous, glabrous, erose. Young leaf blade inrolled. Blade midvein inconspicuous or at upperside white and/or at underside raised. Inflorescence panicle, central rachis absent or present with at least 2 branches from tip of peduncle or central rachis; branches winged, simple. Pedicel glabrous. Spikelets in groups of 2—3(—5) on one side of branch, at least 1 pedicelled, more or less dorsiventrally flattened, 2-flowered with 1st floret sterile and 2nd bisexual, unawned; lower glume absent or glabrous; upper glume and 1st lemma (thin) herbaceous; 1st palea absent; 2nd lemma and palea indurated, glabrous.

Because the lowest spikelet of a group is sometimes aborted, it is important to check the number of spikelets in several groups throughout inflorescence. The rachis is considered distinctly serrate if the spicules are visible with 10x magnification.

1a. Spikelets 2—3.5 mm long, all in pairs. Abscission of pedicels truncate. **2**
1b. Spikelets 1.3—2 mm long, at least in the middle of the branches in groups of 3(—5), sometimes apparently in pairs, then pedicel of third spikelets adnate to the rhachis and this spikelet apparently solitary, or pedicels with an abortive spikelet at base. Abscission of pedicels discoid to cup-shaped. **10**

2a. Lower glume absent to very small, up to 0.25 mm long (see note *D. ciliaris*). **3**
2b. Lower glume distinct, at least 0.25 mm long. **7**

3a. Margins of rhachis smooth to serrulate, teeth up to 0.03 mm long. ***D. radicosa***
3b. Margins of rhachis distinctly serrate, teeth at least 0.05 mm long. **4**

4a. Spikelets either homomorphous and all 1st lemmas in the second interspace with yellowish bristles (appressed at flowering time!), or at least upper pair of branch heteromorphous, i.e. 1st lemma of the sessile spikelet *either* glabrous and veins equidistant *or* slightly pubescent and veins not equidistant, that of the pedicelled spikelet always more pubescent to bristled, veins not equidistant. (The basal spikelets may be homomorphous, then completely glabrous!). **5**
4b. All spikelets homomorphous, with a hairy fringe, but never bristled. **6**

5a. Upper glume 1—2.75 mm long, 0.35—0.8 times as long as the spikelet. Bristles of the 1st lemma absent or obscured by the other pubescence, especially during flowering time. ***D. bicornis***
5b. Upper glume 0.3—1 mm long, 0.15—0.3 times as long as the spikelet. Bristles of the 1st lemma present, at most with only a few hairs between them. ***D. setigera* var. *calliblepharata***

6a. Spikelet 2—2.5 mm long. Upper glume 0.4—0.8 times as long as the spikelet, 1—1.5 mm long. Anthers 0.3—0.6 mm long. ***D. nuda***

6b. Spikelet (2—)2.8—3.1 mm long. Upper glume 0.2—0.25(—0.4) times as long as the spikelet, usually much less, 0.25—1.25 mm long. Anthers 0.65—1.25 mm long. ***D. setigera* var. *setigera***

7a. **(2)** Blades up to 2 mm wide. Spicules of pedicels often more or less hair-like. ***D. didactyla***

7b. Blades 2—9 mm wide. Spicules of pedicels absent to triangular. **8**

8a. Spikelets either homomorphous and bristled, or at least upper pair of branch heteromorphous: i.e. 1st lemma of the sessile spikelet *either* glabrous and veins equidistant *or* slightly pubescent and veins not equidistant, that of the pedicelled spikelet always more pubescent to bristled, veins not equidistant. ***D. bicornis***

8b. Spikelets homomorphous, never bristled. **9**

9a. Rhachis distinctly serrate, spicules at least 0.05 mm long. ***D. ciliaris***

9b. Rhachis smooth to serrulate, spicules up to 0.03 mm long. ***D. radicosa***

10a. **(1)** Spikelets glabrous. 2nd lemma protruding (at maturity), pale yellow to yellow-brown in fruit, often with a bluish tip. ***D. fuscescens***

10b. Spikelets puberulous to pubescent, (appressed) hairs present at least along the margins of the upper glume and 1st lemma. 2nd lemma not protruding, pale yellow to dark brown in fruit. **11**

11a. Plant tufted, culms erect to geniculate, not stoloniferous. Inflorescence with 2—10(—14) branches, central rachis usually well-developed, 0.3—3 cm long. Pedicels sparsely to densely serrate. 2nd lemma dark brown to black in fruit. ***D. violascens***

11b. Plant stoloniferous. Inflorescence with 2—4 branches, central rachis only rarely developed, then up to 1.5 cm long. Pedicels smooth to sparsely serrate. 2nd lemma pale yellow to dark yellow-brown in fruit. **12**

12a. Spikelets 1.3—1.7(—1.9) mm long. Upper glume as long as the spikelet.

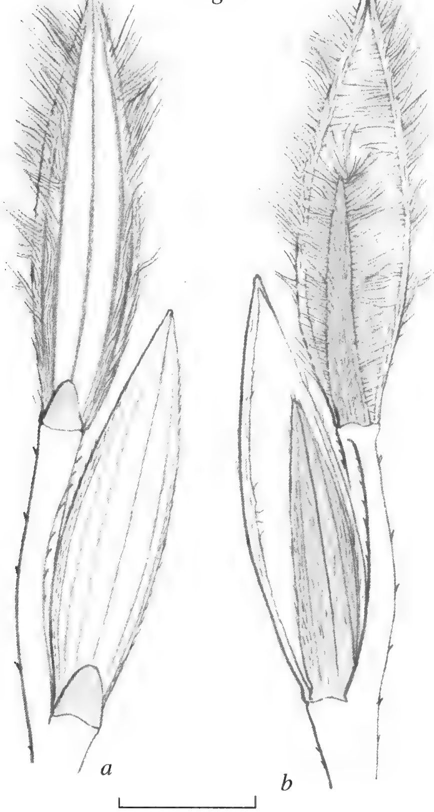
Figure 41. *Digitaria bicornis* (Lam.) Roem. & Schult., pair of heteromorphous spikelets.
a. facing lower glume, b. facing upper glume.

Figure 42. *Digitaria ciliaris* (Retz.) Koeler.
a. facing upper glume, b. facing lower glume.

Figure 43. *Digitaria didactyla* Willd.
a. facing lower glume, b. facing upper glume.

Figure 44. *Digitaria fuscescens* (J.Presl) Henrard.
a. facing 1st lemma, b. facing upper glume.

Fig. 41



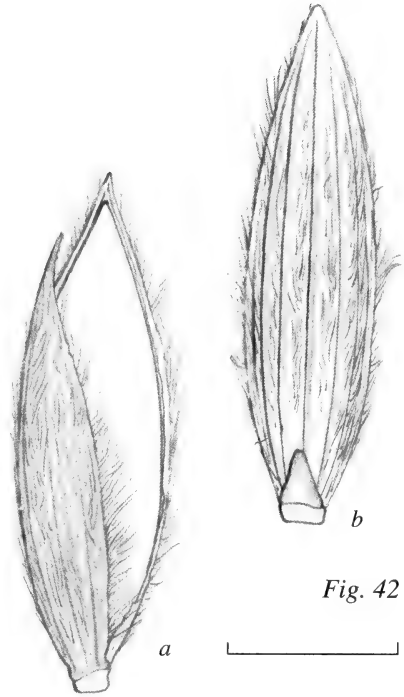


Fig. 42

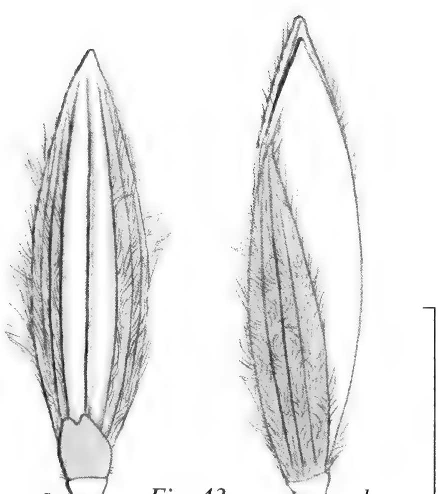


Fig. 43

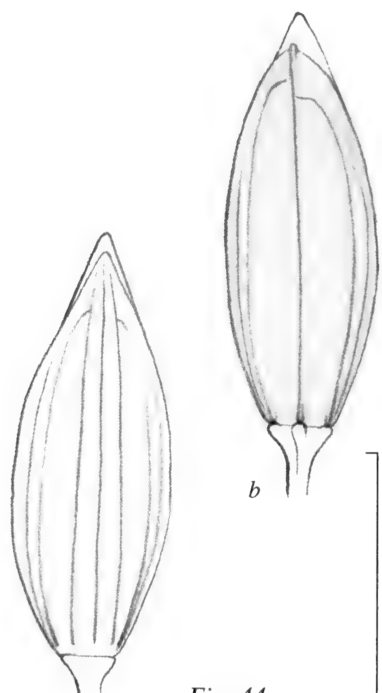


Fig. 44

1st lemma with 5—7 more or less inequidistant veins, obtuse. ***D. longiflora***

12b. Spikelets 1.8—2 mm long. Upper glume 0.7—1 times as long as the spikelet. 1st lemma with 7 equidistant veins. ***D. mollicoma***

Digitaria bicornis (Lam.) Roem. & Schult. – Fig. 41.

Veldkamp 1973: 30. Duistermaat 2004: 32.

Paspalum sanguinale (L.) Lam. var. *ciliare* auct., non Hook.f.: Ridley 1907: 125 (excluding Singapore).

Culms tufted, erect to ascending, 30—60 cm long; nodes sparsely hairy. Sheath 4—9 cm long, glabrous to hairy. Ligule 2 mm long. Blade 4—14 cm long, 2—9 mm wide, glabrous or hairy at upperside, base rounded. Inflorescence with central rachis 0—5 cm long; branches 2—5, 7—11 cm long, 0.9 mm wide, glabrous, serrate. Pedicel 2 mm long, serrate. Spikelets in pairs, homomorphous in lower part, heteromorphous in upper 1/2—1/3 of rachis. Sessile spikelet 2.7—3.5 mm long; lowest bract 0.03—0.15 and 2nd lowest 0.35—0.7 times as long as spikelet; lower glume 0.1—0.4 mm long; upper glume 1—2.5 mm long (excluding overtopping hairs), with up to 1 mm long silky hairs; 1st lemma 2.8—3 mm long, either glabrous and equidistantly 7-veined, or slightly pubescent and inequidistantly veined (pedicelled spikelet then always pectinate), acute; 2nd lemma 2.6—2.7 mm long, acuminate, yellowish in fruit. Pedicelled spikelet with 1st lemma inequidistantly veined, pectinate, hairs 0.5—1 mm long, bristles absent or 1.5—2 mm long.

Native; (sub-)tropics. First record 1890. Rare.

In waste places, often on sand, also along the shore.

It is readily recognized when the upper pedicelled spikelets, which fall off early, are still present; otherwise it closely resembles *D. nuda* (lower glume generally absent) and *D. ciliaris* (anthers 0.6—1 mm long vs 0.5—0.6 mm in *D. bicornis*).

Digitaria ciliaris (Retz.) Koeler – Fig. 42.

Common Crab Grass

Gilliland 1971: 196. Veldkamp 1973: 32. Keng *et al.* 1998: 162.

D. marginata Link: Ridley 1925: 213.

D. marginata Link var. *ciliaris* Hook.f. ex Ridl. 1925: 214, p.p.

Paspalum sanguinale auct., non Lam. (incl. var. *commutatum* auct., non Hook.f.): Ridley 1907: 125, p.p.

Culms tufted, erect to ascending, 30—65 cm long; nodes glabrous. Sheath 7—11 cm long, glabrous or the lower at base patent hairy. Ligule 1—3 mm long. Blade 3—15 cm long, 3—7(—10) mm wide, glabrous to hairy, base cuneate to rounded and with up to 5 mm long hairs. Inflorescence with central rachis 0.6—4 cm long; branches 2—6, 5—15 cm long, 0.8 mm wide, serrate. Pedicel 0.8—3 mm long, serrate. Spikelets in pairs, homomorphous, 2.5—3.5 mm long, 0.6 mm wide; lowest bract 0.1—0.2 and 2nd 0.5—0.8 times as long as spikelet; lower glume (0.15—)0.25—0.5 mm long (see note); upper glume 1—2.4 mm long, 3 veins, sparsely hairy at margin, acute; 1st lemma 2.5—2.7 mm long, inequidistantly 7-veined, sparsely hairy, acute; 2nd lemma 2.5 mm long, acute, yellowish in fruit.

Native; tropics. First record 1880s. Common.

Weed of lawns and open places.

The length of the lower glume varies within a branch, but at least a few are 0.25 mm long or longer. Apart from the absence of the lower glume, *D. nuda* is different in that the 1st lemma is (almost) equidistantly veined. For difference with *D. bicornis* see there.

Digitaria didactyla Willd. – Fig. 43.

Serangoon Grass, *Rumput Serangoon*

Gilliland 1971: 195. Veldkamp 1973: 44. Keng *et al.* 1998: 162.

D. marginata Link var. *debilis* auct., non Ridl.: Hook.f. ex Ridley 1925: 214, p.p.

Paspalum sanguinale Lam. var. *debile* auct., non Hook.f.: Ridley: 1907: 125, p.p.

Culms densely tufted and with stolons, 20—40 cm long; nodes glabrous. Sheath 4—5 cm long, lower at least at base (densely) hairy and upper glabrous. Ligule (0.5—)1.5—2.2(—2.5) mm long. Blade (0.6—)3—8 cm long, 0.6—1.7(—2) mm wide, glabrous or upperside short-hairy, base cuneate to rounded and short-hairy. Inflorescence with central rachis 0—1 cm long; branches 2—4, (1—)4—6 cm long, 0.5 mm wide, glabrous, at base smooth and upwards serrate with hairlike spicules. Pedicel up to 1.5 mm long, serrate. Spikelets in pairs, homomorphous, 2—2.5 mm long, 0.6 mm wide; lowest bract 0.1—0.2 and 2nd 0.5—0.7 times as long as spikelet; lower glume 0.2—0.5 mm long; upper glume 1—2 mm long, hairy, 3 veins, acute; 1st lemma 2.4—2.5 mm long, hairy, more or less inequidistantly 7-veined, acute; 2nd lemma 2.1—2.3 mm long, acute, yellowish to greyish in fruit.

Not native; Africa, elsewhere cultivated and naturalized. First record 1892 from the Botanic Gardens, 1932 in the wild. Rather rare.

In lawns, on roadsides.

Introduced and used as a lawn grass. Elsewhere known as Blue Couch.

Digitaria fuscescens (J.Presl) Henrard – Fig. 44.

Gilliland 1971: 193. Veldkamp 1973: 61. Keng *et al.* 1998: 162.

Paspalum longiflorum auct., non Retz.: Ridley 1907: 126 p.p. — *D. longiflora* auct., non Pers.: Ridley 1925: 214, p.p.

Culms with long stolons, erect part 15—40 cm long; nodes hairy. Sheath 1.1—1.7 cm long, glabrous or with few hairs at tip. Ligule 0.5—2 mm long. Blade 1—5 cm long, 2—5 mm wide, glabrous to sparsely hairy, base rounded and at margin with few hairs. Inflorescence with central rachis rarely developed (up to 0.5 cm long); branches 2 or 3, 3—5 cm long, 0.5—0.8 mm wide, glabrous, minutely serrate. Pedicel 0.5—1.5 mm long, smooth. Spikelets in threes, homomorphous, 1.3—1.6 mm long, 0.5 mm wide, glabrous; the two lowest bracts 0.9—0.95 times as long as spikelet; lower glume absent (rarely up to 0.1 mm long); upper glume 1.1—1.5 mm long, 3—5 veins, acute; 1st lemma 1.1—1.5 mm long, in- or equidistantly 7-veined, acute; 2nd lemma protruding (at maturity), 1.5 mm long, acute, pale yellow to yellow-brown with bluish to purplish tip in fruit.

Native; Paleotropics. First record 1890. Rare.

Pioneer on damp sandy to rocky soil in disturbed places, on beaches, roadsides, etc.

Digitaria longiflora (Retz.) Pers. – Fig. 45.

Lesser Crab Grass

Ridley 1925: 214, p.p. Gilliland 1971: 192. Veldkamp 1973: 66. Keng *et al.* 1998: 162.

D. pertenuis Buse: Ridley 1925: 214, p.p. Gilliland 1971: 192, p.p.

Paspalum longiflorum Retz.: Ridley 1907: 126, p.p.

Culms tufted and with long stolons, erect part 10—50 cm long; nodes glabrous or hairy. Sheath 0.7—4.5 cm long, sparsely to densely hairy. Ligule 1—2 mm long. Blade 1—5 cm long, 2—5 mm wide, glabrous or hairy, base rounded. Inflorescence with central rachis rarely developed (up to 0.2 cm long); branches 2—4, 2—5 cm long, 0.5 mm wide, glabrous, serrate. Pedicel up to 1.5 mm long, smooth. Spikelets in threes, homomorphous, 1.3—1.7(—1.9) mm long, 0.5—0.6 mm wide; either lowest bract *c.* 0.1 and 2nd 0.9—1 times as long as spikelet, or the two lowest bracts 0.9—1 times as long as spikelet; lower glume absent or up to 0.15

mm long; upper glume 1.3—1.7 mm long, hairy at least at margins, 5 veins, acute; 1st lemma 1.3—1.9 mm long, hairy, more or less inequidistantly 5—7-veined, obtuse to acute; 2nd lemma 1.5—1.8 mm long, acute, (pale) yellow to yellow-brown in fruit.

Native; Paleotropics. First record 1894. Rare.

Pioneer on moist sandy to rocky soil, in open grasslands, forest margins, on roadsides.

A collection earlier than that mentioned in Duistermaat (2004: 33) was found among material at SING that was included in *D. violascens* (see note there).

It closely resembles *D. mollicoma*, which generally has longer spikelets and acute to acuminate 1st lemmas.

Digitaria mollicoma (Kunth) Henrard – Fig. 46.

Veldkamp 1973: 69. Duistermaat 2004: 33.

D. pertenuis Buse: Ridley 1925: 214, p.p. Gilliland 1971: 192, p.p.

Paspalum longiflorum auct., non Retz.: Ridley 1907: 126, p.p. — *D. longiflora* auct., non Pers.: Ridley 1925: 214, p.p.

Culms with stolons, 45—50 cm long; nodes (sparsely) hairy. Sheath 1.5—8 cm long, (sparsely) hairy. Ligule 1—2 mm long, erose. Blade (1—)2—6 cm long, 2—5.5 mm wide, glabrous to hairy, base rounded. Inflorescence with central rachis rarely developed (up to 1.5 cm long); branches 2—4, 4—7 cm long, 1—1.1 mm wide, glabrous, serrate. Pedicel 0.5—2.5 mm long, smooth or sparsely serrate. Spikelets in threes or fours, homomorphous, 1.8—2 mm long (excluding hairs), 0.6—0.7 mm wide; lowest bract *c.* 0.9 times as long as and 2nd bract as long as spikelet; lower glume absent; upper glume 1.6—1.7 mm long (excluding hairs), with 3 veins, hairy between veins and at margin, overtopping at tip; 1st lemma 1.7—1.8 mm long, more or less equidistantly 7-veined, hairy, acute to acuminate; 2nd lemma 1.8—1.9 mm long, acute, (pale) yellow to dark yellow-brown in fruit.

Native; Penisular Malaysia to New Guinea, and Taiwan. First record 1890. Rather rare.

On open damp, sandy to rocky soil, (shaded) roadsides.

Earlier collections than that mentioned in Duistermaat (2004) were found among material at SING that was included in *D. violascens* (see note there).

Digitaria nuda Schumach. – Fig. 47.

Veldkamp 1973: 41. Tan 1995: 139.

Culms tufted, erect to decumbent, 30—60 cm long; nodes glabrous to sparsely hairy. Sheath 3—8 cm long, glabrous to hairy. Ligule 1—1.5 mm long. Blade 1.5—7 cm long, 2.5—5 mm wide, glabrous, base cuneate to rounded and with few hairs. Inflorescence with central rachis rarely developed, up to 1 cm long; branches 2—4(—8), 5—8 cm long, 0.4—0.5 mm wide, glabrous or sparsely hairy with hairs up to 5 mm long, serrate, rarely with setae in lower part. Pedicel 0.5—2.5 mm long, serrate. Spikelets in pairs, homomorphous, 2—2.5 mm long, 0.5—0.7 mm wide; either lowest bract less than 0.1 and 2nd 0.5—0.6 times as long as spikelet, or lowest bract 0.5—0.6 times as long as and 2nd as long as spikelet; lower glume absent or

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Figure 45. *Digitaria longiflora* (Retz.) Pers.
a. facing upper glume, b. facing 1st lemma.

Figure 46. *Digitaria mollicoma* (Kunth) Henrard.
a. facing 1st lemma, b. facing upper glume.

Figure 47. *Digitaria nuda* Schumach.
a. facing 1st lemma, b. facing upper glume.

Figure 48. *Digitaria radicosa* (J.Presl) Miq.
a. facing lower glume, b. facing upper glume.

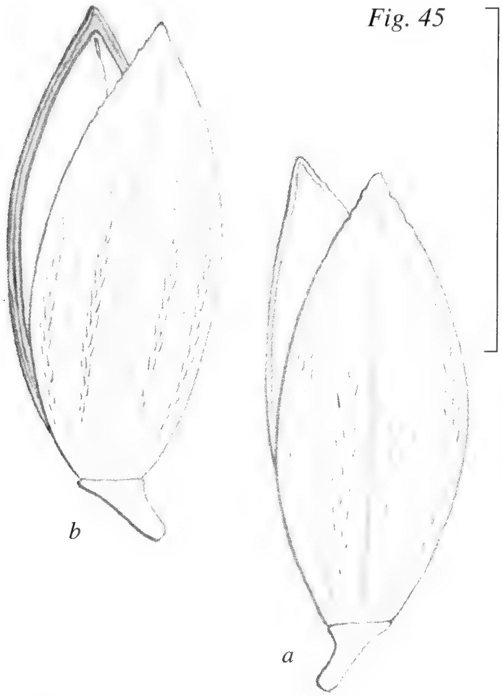


Fig. 45

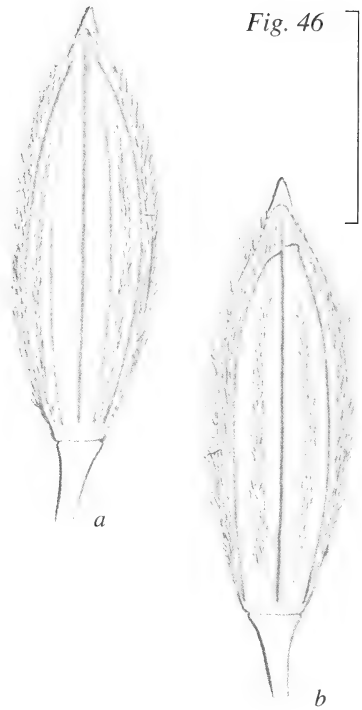


Fig. 46

Fig. 47

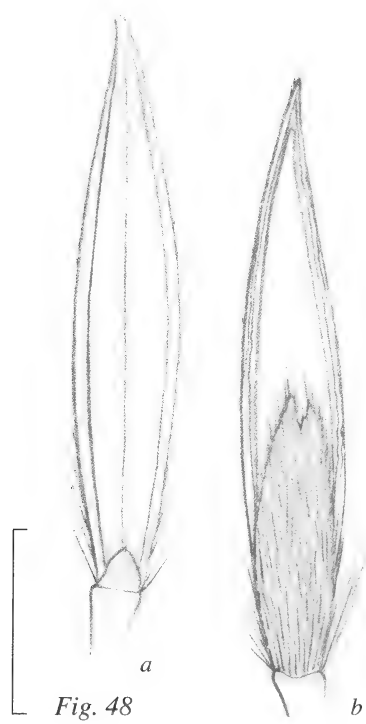


Fig. 48

rarely up to 0.15 mm long; upper glume 1.2—1.4 mm long (excluding overtopping hairs), hairy, 3 veins; 1st lemma 2.2—2.5 mm long, (almost) equidistantly 7-veined, sparsely hairy, acute; 2nd lemma 2—2.4 mm long, acute, yellowish to brownish greyish in fruit.

Native; tropics. First record 1955. Rare.

Waste places, preferring sandy soil.

It is not mentioned in Keng *et al.* (1998), but is included in Tan (1995: 139). Differences with *D. ciliaris* are mentioned there.

Digitaria radicosa (J.Presl) Miq. – Fig. 48, Plate 8.

Veldkamp 1971: 35. Keng *et al.* 1998: 163.

D. marginata Link var. *debilis* auct., non Ridl.: Hook.f. ex Ridl. 1925: 214, p.p.

D. timorensis (Kunth) Balansa: Gilliland 1971: 198.

Paspalum sanguinale Lam. var. *debile* auct., non Hook.f.: Ridley 1907: 125, p.p.

Culms with (short) stolons, erect part 20—60 cm long; nodes glabrous to sparsely short-hairy. Sheath 2—6 cm long, glabrous or hairy. Ligule 1—2 mm long. Blade 3—5 cm long, 2—5 mm wide, glabrous or hairy, base (slightly) rounded and hairy. Inflorescence without central rachis; branches 2 or 3 (or 4), 3—7 cm long, 0.5—0.6 mm wide, glabrous, smooth (at 10x magnification). Pedicel 0.5—3 mm long, more or less smooth. Spikelets in pairs, homomorphous, 2.5—3.5 mm long, 0.5—0.7 mm wide; either lowest bract 0.03—0.1 and 2nd 0.3—0.5 times as long as spikelet, or lowest 0.3—0.5 times as long as and 2nd as long as spikelet; lower glume absent or 0.1—0.4 mm long; upper glume 1.2—1.6 mm long, 3 veins, hairy at least at margin, obtuse or bifid; 1st lemma 2.7—3.5 mm long, 3—5 veins (if 5 these inequidistant), hairy especially at margin, acute; 2nd lemma 2.4—2.7 mm long, acute, yellowish in fruit.

Native; Paleotropics. First record 1892. Rather common.

In open places, lawns, on roadsides.

Digitaria setigera Roem. & Schult.

Veldkamp 1973: 37. Keng *et al.* 1998: 163.

D. marginata Link var. *commutata* auct., non Ridl. and var. *pruriens* (Fisch. ex Trin.) Hook.f. ex Ridl. 1925: 214.

D. microbachne (J.Presl) Henrard: Gilliland 1971: 194.

D. microstachya Henrard: Gilliland 1971: 195.

Paspalum sanguinale Lam. var. *extensum* Hook.f. and var. *pruriens* (Fisch. ex Trin.) Hook.f. and var. *commutatum* auct., non Hook.f. p.p.: Ridley 1907: 125.

Culms tufted and erect to decumbent or with stolons, (20—)40—100 cm long. Sheath 4—10 cm long. Ligule 1.5—3.5 mm long. Blade 3—17 cm long, 4—9 mm wide, glabrous, base cuneate to rounded and hairy. Inflorescence branches serrate. Pedicel 0.5—3 mm long. Spikelets in pairs, homomorphous; upper glume hairy at least at margin, obtuse or bifid; 1st lemma inequidistantly 5- or 7-veined, acute; 2nd lemma acute, yellowish to brownish in fruit.

This is the most robust of the *Digitaria* species.

Figure 49. *Digitaria setigera* Roem. & Schult. var. *calliblepharata* (Henrard) Veldk.
a. facing 1st lemma, b. facing upper glume.

Figure 50. *Digitaria setigera* Roem. & Schult. var. *setigera*.
a. facing 1st lemma, b. facing upper glume.

Figure 51. *Digitaria violascens* Link.
a. facing lower glume, b. facing upper glume.

Figure 52. *Dimeria ornithopoda* Trin.

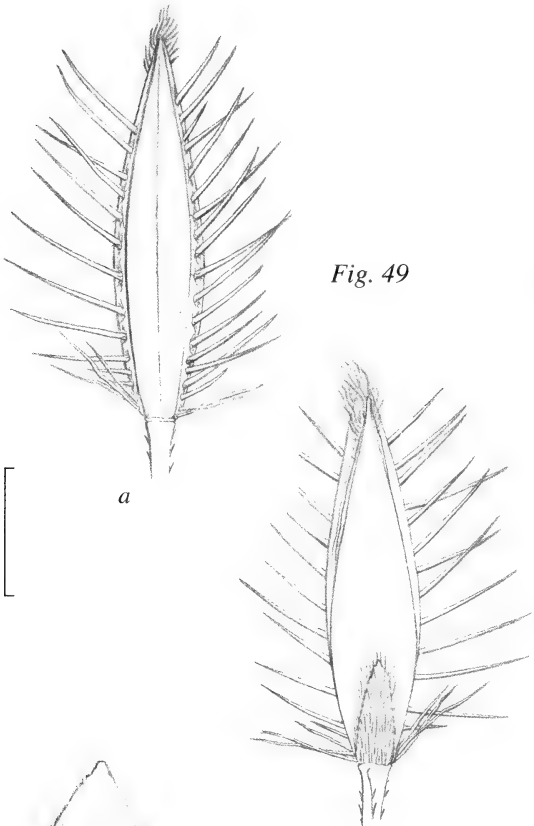

a *b*

Fig. 49

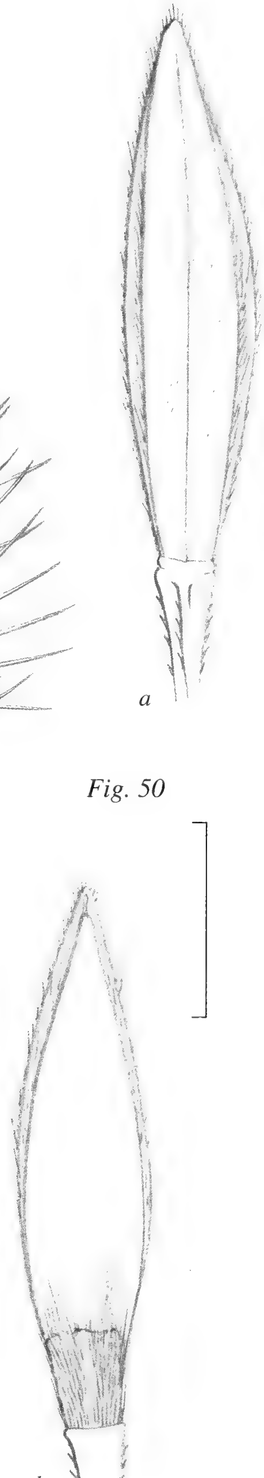

a *b*

Fig. 50

Fig. 52

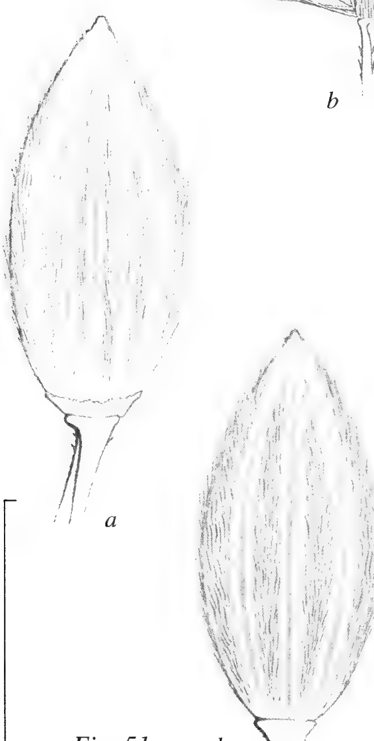

a *b*

Fig. 51

1a. Spikelets 3—3.2 mm long; 1st lemma with 1.5 mm-long bristles, otherwise glabrous; 2nd lemma 2.8—3 mm long. ***D. setigera* var. *calliblepharata***
1b. Spikelets 2.8—3.1 mm long; 1st lemma hairy, bristles absent; 2nd lemma 2.5—2.8 mm long. ***D. setigera* var. *setigera***

Digitaria setigera Roem. & Schult. **var. *calliblepharata*** (Henrard) Veldk. – Fig. 49.
Veldkamp 1973: 40. Keng *et al.* 1998: 163.
D. marginata Link var. *ciliaris* auct., non Ridl.: Ridley 1925: 214, p.p. — *Paspalum sanguinale* Lam. var. *ciliare* auct., non Hook.f.: Ridley 1907: 125.
D. microbachne subsp. *calliblepharata* Henrard: Gilliland 1971: 194.
Nodes glabrous. Sheath glabrous to sparsely hairy. Inflorescence with central rachis 1.5—2 cm long; branches 5—8, 8—10 cm long, 0.5—0.7 mm wide. Spikelets 3—3.2 mm long, 0.7—0.8 mm wide (excluding bristles); lowest bract 0.15—0.2 and 2nd as long as spikelet; lower glume absent; upper glume 0.5—0.7 mm long (excluding hairs); 1st lemma 3—3.2 mm long, inequidistantly 7-veined, with up to 1.5 mm long bristles in 2nd intervenium, otherwise glabrous; 2nd lemma 2.8—3 mm long.
Native; tropical Asia. First record 1904. Extinct (1959).
Open places.

Digitaria setigera Roem. & Schult. **var. *setigera*** – Fig. 50.
Nodes glabrous to sparsely hairy. Sheath at least lowest (sparsely) hairy with up to 4 mm-long patent hairs. Inflorescence with central rachis 0—4 cm long; branches (3—)5—11, 6—16 cm long, 0.6—0.7 mm wide, glabrous. Spikelets 2.8—3.1 mm long, 0.7—0.9 mm wide; either lowest bract 0.03 and 2nd 0.2—0.25 times as long as spikelet, or lowest bract 0.2—0.25 times as long as and 2nd as long as spikelet; lower glume absent to 0.2 mm long; upper glume 0.6—0.7 mm long (excluding hairs); 1st lemma 2.8—3.1 mm long, sparsely hairy, inequidistantly 7-veined; 2nd lemma 2.5—2.8 mm long.
Native; tropical Asia. First record late 19th century. Common.
Weed in waste places.

Digitaria violascens Link – Fig. 51.
Gilliland 1971: 191. Veldkamp 1973: 63. Keng *et al.* 1998: 63.
D. caespitosa Ridl. 1925: 215.
D. chinensis (Nees) A.Camus, non Hornem.: Ridley 1925: 215.
D. pertenuis Buse: Gilliland 1971: 192 (excluding Colour pl.17).
Paspalum longiflorum auct., non Retz.: Ridley 1907: 126, p.p. — *D. longiflora* auct., non Pers.: Ridley 1925: 214, p.p.
Culms tufted, erect to ascending, stolons absent, 25—70 cm long; nodes glabrous or sparsely hairy. Sheath 2—14 cm long, hairy at least in lower half. Ligule 1—2 mm long. Blade (1.5—)5—13 cm long, (1.5—)2—6 mm wide, glabrous or hairy, base rounded. Inflorescence with central rachis 0.3—2 cm long; branches 2—6, 4—11 cm long, 0.6—0.8 mm wide, glabrous, serrate. Pedicel 0.5—3.5 mm long, sparsely to densely serrate. Spikelets in threes (fours or fives), homomorphous, 1.3—1.9 mm long, 0.5—0.7 mm wide; either lowest bract 0.03 and 2nd 0.9—1 times as long as spikelet, or lowest bract 0.9—1 times as long as and 2nd as long as spikelet; lower glume absent or 0.1 mm long; upper glume 1.2—1.9 mm long, hairy, 3 veins, truncate to acute; 1st lemma 1.3—1.9 mm long, (sparsely) hairy, inequidistantly 7-veined (or midvein lacking), obtuse to acute; 2nd lemma 1.2—1.7 mm long, acute, dark brown to black in fruit.
Native; tropics. First record 1889. Common.
Weed in waste places, on roadsides etc.

Contrary to Veldkamp (1973), plants with stolons are excluded from *D. violascens*. These stoloniferous plants differ from *D. violascens* in having glabrous to sparsely serrate pedicels and (dark) yellow-brown 2nd lemmas when fruiting. Part of the stoloniferous material is included in *D. longiflora* and part in *D. mollicoma*.

Dimeria R.Br.

Dimeria ornithopoda Trin. – Fig. 52.

Bird's Foot Grass

Ridley 1907: 151; 1925: 192. Keng *et al.* 1998: 163. – var. *ornithopoda*: Gilliland 1971: 214.

Dimeria glabra Ridl. 1925: 192. — *D. ornithopoda* Trin. var. *glabra* (Ridl.) Jansen: Gilliland 1971: 216. Keng *et al.* 1998: 163.

Culms tufted, erect to decumbent, stolons absent, 12—80 cm long; nodes hairy. Sheath 0.7—2(—4) cm long, rounded, midrib distinctly raised, glabrous or (sparsely) hairy, margins glabrous. Ligule membranous, 0.4—0.7 mm long, ciliolate. Young leaf blade inrolled. Blade 1—7 cm long, 1—2 mm wide, midvein at upperside prominent and white and at underside raised, glabrous or hairy, base rounded and glabrous. Inflorescence panicle, central rachis absent; branches 2 or 3, 2.5—6 cm long, 0.8 mm wide, glabrous, triquetrous (to narrowly winged), naked at lower 1.2—3 mm, simple. Pedicel 0.1 mm long. Spikelets single, alternate, 2.3—2.8 mm long, 0.5 mm wide, laterally flattened, 2-flowered, awned or unawned; callus with few hairs; lowest bract 0.8 times as long as and 2nd as long as spikelet; lower glume 1.9—2.5 mm long, herbaceous, 1 vein, sparsely hairy at least on vein, acute; upper glume 2.2—2.7 mm long, herbaceous, 3 veins, keeled and sparsely hairy on midvein, truncate with minutely protruding midvein; 1st lemma 0.6—0.9 mm long, hyaline; 1st palea absent; 2nd lemma 1.8—2 mm long, hyaline, bifid, unawned or awn arising just below tip and 5.5—8.5 mm long; 2nd palea absent.

Native; tropical Asia and Australia. First record 1889. Rare.

In (partly) shaded and (periodically) wet grasslands, marshes; usually on poor soil, sometimes ephemeral.

The infraspecific taxa are not maintained because they seem to be the extremes of a range.

Echinochloa P.Beauv.

Sheath rounded, glabrous. Young leaf blade inrolled. Blade glabrous to sparsely hairy at upper side, base rounded (to cuneate in *E. picta*). Inflorescence panicle, central rachis present; branches simple or branched, setulose and/or hairy. Spikelets single, not to slightly dorsiventrally flattened, 2-flowered; lowest bract about half as long as spikelet, 2nd (excluding awn) as long as spikelet; glumes and 1st lemma (thin) herbaceous; lower glume enveloping; 1st palea hyaline; 2nd lemma and palea indurated, glabrous (to sparsely hairy at tip in *E. picta*).

1a. Ligule row of hairs, 1.5—2.5 mm long. ***E. picta***
1b. Ligule absent. **2**

2a. Inflorescence branches all simple or rarely with the lowermost with an up to 0.8 cm-long secondary branch. Spikelets more or less clearly arranged in four rows. 1st lemma acuminate to mucronate, never awned. Anthers purple or yellow. Stigmas blackish-purple. ***E. colona***

2b. Inflorescence branches with the lower ones usually shortly branched at base. Spikelets usually not clearly arranged in four rows. 1st lemma acuminate, usually at least a few awned. Anthers yellow. Stigmas white or red. ***E. crus-galli***

Echinochloa colona (L.) Link – Fig. 53, Plate 9.

Jungle Rice, *Padi Burung*

Ridley 1925: 222. Gilliland 1971: 167. Keng *et al.* 1998: 164.

Panicum colonum L.: Ridley 1907: 132.

Culms single or tufted, erect to ascending, 25—100 cm long; nodes glabrous to sparsely hairy. Sheath 3—6 cm long. Ligule absent. Blade 6—28 cm long, 4—8 mm wide, glabrous to sparsely hairy. Inflorescence 6—22 cm long; branches 6—30, 0.6—6.5 cm long, 0.4 mm wide. Pedicel up to 0.7 mm long, sparsely hairy. Spikelets more or less arranged in 4 rows, 2.3—3.7 mm long, 0.8 mm wide, unawned; lower glume 0.9—1.6 mm long, hairy in marginal area, 3 veins, 0.2 mm-long mucronate; upper glume 2.2—3.5 mm long, hairy on veins and margin, 5 veins, 0.3 mm-long mucronate; 1st lemma 2.1—3.2 mm long, hairy at least on veins, 5 veins, acuminate; 1st palea 1.5—2.5 mm long; 2nd lemma 1.8—2.9 mm long, acute.

Native; Paleotropics. First record 1880s. Rather common.

In waste places, often periodically wet places.

Echinochloa crus-galli (L.) P.Beauv. – Fig. 54.

Barnyard Millet, *Padi Burung*

Ridley 1925: 222. Gilliland 1971: 168. Keng *et al.* 1998: 164.

Panicum crus-galli L.: Ridley 1907: 132.

Culms erect to ascending, 50—100 cm long; nodes glabrous. Sheath *c.* 15 cm long. Ligule absent. Blade 25 cm long, 7 mm wide, glabrous. Inflorescence 14—24 cm long; branches 11—18, longest 3—8 cm long, 0.5 mm wide. Pedicel up to 0.5 mm long, sparsely hairy. Spikelets not arranged in 4 rows, 2.8—3.1 mm long, 1.3 mm wide, mucronate to awned; lower glume 1—1.2 mm long, hairy, 3 veins, 0.2 mm-long mucronate; upper glume 2.6—3 mm long, veins and marginal area hairy, 5 veins, 0.3—0.4 mm-long mucronate; 1st lemma 2 mm long, hairy on veins, 5 veins, awn 0.5—4(—20) mm long with the longest at tip of branch(let); 1st palea 1.4—1.5 mm long; 2nd lemma 2—2.1 mm long, acute to acuminate.

Native; Paleo(-sub)tropics, serious weed in temperate regions. First record 1932. Rare.

In waterlogged waste places, roadsides.

This species is also known as Cockspur.

Echinochloa picta (J.König) P.W.Michael – Fig. 55.

Clayton 1989: 57.

E. stagnina auct., non (Retz.) P.Beauv.: Bor 1960: 311; Gilliland 1971: 166; Keng *et al.* 1998: 164.

Culms rhizomatous, creeping or floating, up to 200 cm long; nodes unknown. Ligule 1.5—2.5 mm-long hairs. Blade 26 cm long, 12 mm wide, glabrous, base cuneate to rounded.

Figure 53. *Echinochloa colona* (L.) Link.
a. facing upper glume, b. facing lower glume.

Figure 54. *Echinochloa crus-galli* (L.) P.Beauv.
a. facing upper glume, b. facing lower glume.

Figure 55. *Echinochloa picta* (J.König) P.W.Michael.
a. facing upper glume, b. facing lower glume.

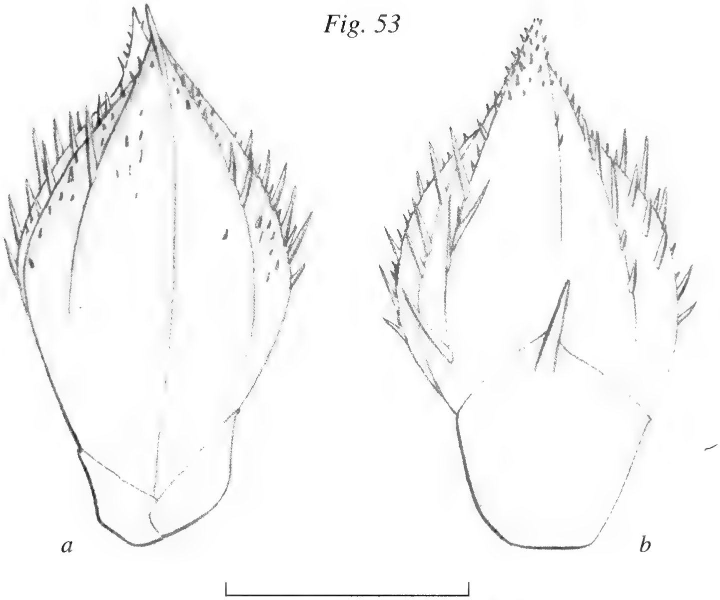


Fig. 53

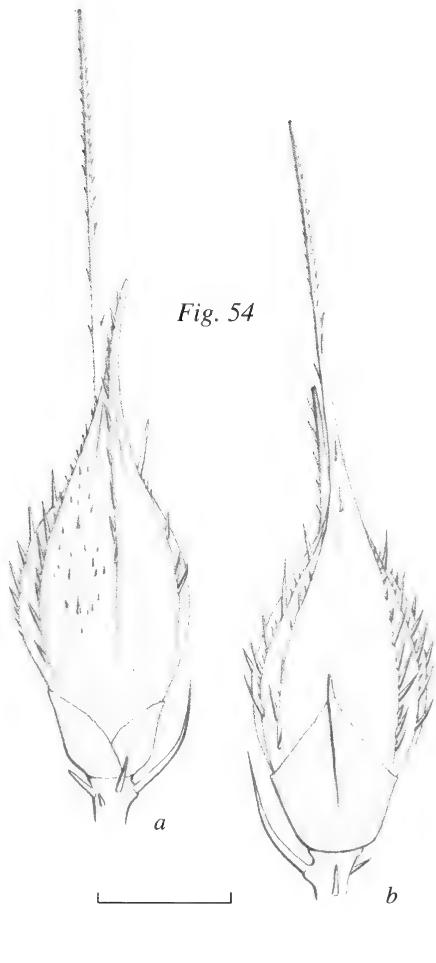


Fig. 54

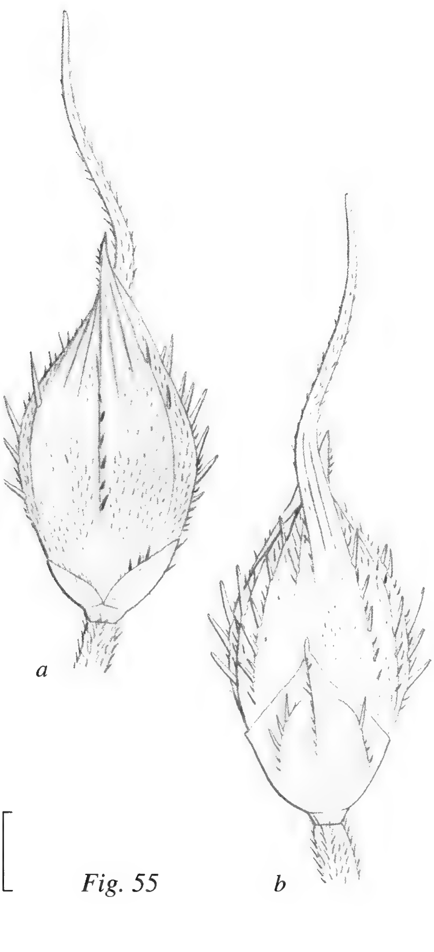


Fig. 55

Inflorescence 18 cm long; branches 8, longest *c.* 3 cm long, 0.7 mm wide. Pedicel up to 1.5 mm long, setulose. Spikelets not arranged in 4 rows, 4.7 mm long, 2.1 mm wide, awned; lower glume 2.1 mm long, sparsely hairy, 5 veins, acuminate to mucronulate; upper glume 4.7 mm long, sparsely hairy, at base with 7—9 veins, acute to obtuse; 1st lemma 4.5 mm long, sparsely hairy, 7 veins, awn from tip and 3.5 mm long; 1st palea 3.4 mm long; 2nd lemma 4 mm long, acuminate.

Native; India and SE Asia. Single record 1883, locality unknown. Extinct (1883).

Streamsides, pond margins, growing in water, sometimes floating.

It was formerly known as *E. stagnina*, which is an African species with less plump spikelets (Clayton 1989).

The culm nodes are not represented on the Singapore Herbarium material. Gilliland (1971) mentioned that the nodes are 'with a few scattered short hairs', whereas Veldkamp (*pers. comm.*) has seen some glabrous nodes as well.

Eleusine Gaertn.

Culms tufted, erect to geniculate, stolons absent; nodes glabrous. Sheath glabrous, margin hairy at least at throat. Young leaf blade folded along midrib. Blade underside glabrous, upperside sparsely hairy, base rounded. Inflorescence panicle (rarely spike); branches at least half the number at tip, simple. Pedicel absent. Spikelets single, alternate on abaxial side of branch, laterally flattened, 3—6-flowered, unawned; the two lowest bracts 0.45—0.65 times as long as spikelet; glumes and lemmas herbaceous, with keeled midvein, hairy; lemmas obtuse; paleas hyaline, 2 keeled veins, hairy; 2nd and following florets as 1st, gradually smaller.

1a. Leaves overtopping the inflorescence. Lower glume 2.4 mm long, truncate; upper glume 3 mm long, obtuse. ***E. coracana***

1b. Leaves shorter than to overtopping the inflorescence. Lower glume 1.8—2 mm long, obtuse to acute; upper glume 2.4—2.6 mm long, acute. ***E. indica***

Eleusine coracana (L.) Gaertn. – Fig. 56.

African Millet

Gilliland 1971: 80. Keng *et al.* 1998: 164.

E. indica (L.) Gaertn. var. *coracana* Gaertn.: Ridley 1907: 174; 1925: 250.

Culms *c.* 60 cm long. Leaves overtopping inflorescence. Sheath 10—14 cm long, rounded. Ligule either membranous and ciliolate, or row of hairs, 2 mm long. Blade 53 cm long, 13 mm wide, base at margin glabrous. Inflorescence central rachis rarely developed (up to 1 cm long); branches 7—9, 6—8 cm long, 2.5 mm wide, margins hairy. Spikelet 5 mm long, 3.8 mm wide, 4-flowered; lower glume 2.4 mm long, 3 veins, truncate; upper glume 3 mm long, 5 veins, obtuse; 1st lemma 3 mm long, 7 veins.

Not native; Africa, cultivated in tropical regions. First record 1880s. Cultivated (last record 1963).

Eleusine indica (L.) Gaertn. – Fig. 57.

Goose Grass, *Rumput Sambau*

Ridley 1907: 174; 1925: 250. Gilliland 1971: 78. Keng *et al.* 1998: 165.

Culms 25—45 cm long. Leaves shorter than to overtopping the inflorescence. Sheath 5—10 cm long, more or less flattened, midrib raised. Ligule membranous, 0.5—1 mm long, glabrous or with few hairs at tip. Blade 4.5—16(—40) cm long, 3—4.5 mm wide, base at margin sparsely hairy. Inflorescence central rachis 0—7 cm long; branches 1—11, 5—15 cm long, 1 mm wide, only at axils hairy. Spikelet 3.8—6 mm long, 1.7—4 mm wide, 3—6-flowered; lower glume 1.8—2 mm long, 1 or 3 veins, obtuse to acute; upper glume 2.4—2.5 mm long, 5—7 veins, acute; 1st lemma 2.7—3 mm long, 3 veins.

Native; worldwide in (sub-)tropical regions. First record 1880s. Common.

Weed of waste places, often after disturbance, on moist (not wet) soil.

Eragrostis Wolf

Lazarides 1997: 77—187. Veldkamp 2002: 157—204.

Culms single or tufted, erect to decumbent; nodes glabrous. Sheath rounded, external ligule short-hairy. Young leaf blade inrolled. Inflorescence panicle, central rachis present; branches 0.3—0.5 mm wide, at least longest branched. Spikelets single, laterally flattened, 3—many-flowered, unawned; the two lowest bracts 0.05—0.5 times as long as spikelet; palea 2 keeled veins; 2nd and following florets as 1st, but gradually smaller.

Eragrostis elongata (Willd.) J.Jacq., actually the correct name for the Papuasian *E. diandra* (R.Br.) Steud. (Veldkamp 2002), has been so widely misapplied to species of the *E. brownii* complex, e.g. *E. atrovirens* and *E. brownii* (in the wider sense), that Veldkamp (2002: 160) has regarded it as a confusing name to be disregarded.

The inclusion in Keng *et al.* (1998: 166) of *Eragrostis nutans* (Retz.) Steud., described as 'palea falling together with the lemma', is probably a misidentification; the name refers to an Indian species with persistent paleas (Veldkamp 2002: 175).

1a. Palea keels setose. ***E. amabilis***
1b. Palea keels glabrous to ciliolate. **2**

2a. Paleas falling off early (Fig. 66b). **3**
2b. Paleas longer persistent (Fig. 63). **6**

3a. Culm (60—)80—160 cm long. Spikelet rachilla with 7 or 8 nodes per 3 mm length. Anthers 0.6—1 mm long. Fruit fusiform, terete, fruit wall finely striate. ***E. atrovirens***
3b. Culm 10—55(—80) cm long,—*if* longer than 55 cm *then* spikelet rachilla with 13—16 nodes per 3 mm length. Anthers 0.1—0.5 mm long. Fruit ellipsoid, laterally somewhat flattened, fruit wall smooth or finely reticulate. **4**

4a. Perennials. Culms rooting at lower nodes. Ligule a ciliolate rim. Spikelet rachilla with 13—16 nodes per 3 mm length. Keels of palea ciliolate. ***E. unioloides***
4b. Annuals. Culms not rooting at lower nodes. Ligule a ciliolate rim or a row of hairs. Spikelet rachilla with 7—10 nodes per 3 mm length. Keels of palea scaberulous to ciliolate. **5**

5a. Ligule a ciliolate rim. Glumes subequal, lower glume 1-veined. Anthers 2. Fruit wall finely reticulate. ***E. gangetica***
5b. Ligule a row of hairs. Glumes unequal, lower glume without veins. Anthers 3. Fruit wall smooth. ***E. pilosa***

6a. **(2)** Sheaths and blades glandular. ***E. cilianensis***
6b. Sheaths and blades without glands. **7**

7a. Rachilla articulated, ultimately breaking up from above downward (Fig. 58a). ***E. brownii***
7b. Rachilla persistent, not articulated (Fig. 58b). ***E. montana***

Eragrostis amabilis (L.) Wight & Arn. ex Nees – Fig. 59, Plate 10.

Feathery Eragrostis, *Rumput Telur Kutu*

Ridley 1907: 178, p.p.; 1925: 246, p.p. Keng *et al.* 1998: 165. Veldkamp 2002: 164.

E. tenella (L.) P.Beauv. ex Roem. & Schult.: Gilliland 1971: 71.

E. viscosa (Retz.) Trin.: Ridley 1907: 177; 1925: 246. Gilliland 1971: 71. Keng *et al.* 1998: 167.

Culms geniculate to prostrate, not rooting at the lower nodes, 15—40 cm long, green. Sheath 1—3.2 cm long, glabrous to sparsely hairy, margin glabrous or throat with up to 4 mm long hairs. Ligule 0.3—0.4 mm long hairs, free or fused at basal 0.1—0.2 mm. Blade 1—9 cm long, *c.* 2.5 mm wide, glabrous, base rounded and with 2—3 mm long hairs. Inflorescence 3—16 cm long; longest branches 1.5—3 cm long, scaberulous, with tuft of hairs in axils. Pedicel 1—3 mm long, scaberulous. Spikelet 1.5—1.9 mm long, 0.9 mm wide, hyaline, 3—6-flowered, palea and rachilla disarticulating from top to bottom; lower glume 0.4—0.7 mm long, glabrous, 1 vein; upper glume 0.6—0.8 mm long, as lower; 1^{st} lemma 0.7—0.9 mm long, glabrous, 3 veins, truncate; 1^{st} palea 0.7—0.9 mm long, glabrous, keels with 0.3—0.4(—0.6) mm long setae. Anthers 3, 0.2 mm long.

Native; Paleotropics. First record 1893. Common.

Weed on roadsides, in waste places, etc.

Glandular and sticky plants (in the literature known as *E. viscosa*) have not been found in Singapore.

Differences with *Sporobolus tenuissimus* are mentioned there.

Eragrostis atrovirens (Desf.) Trin. ex Steud. – Fig. 60.

Gilliland 1971: 68. Lazarides 1997: 97. Keng *et al.* 1998: 165. Veldkamp 2002: 167.

E. elegantula auct., non Steud.: Ridley 1907: 179; 1925: 248, p.p.

E. elongata auct., non (Willd.) J.Jacq.: Ridley 1907: 179; 1925: 248. Keng *et al.* 1998: 166, p.p.

Culms erect or geniculate, sometimes rooting at the lower nodes, (60—)80—160 cm long, glaucous. Sheath 7—12 cm, glabrous. Ligule 0.2—0.3 mm long, ciliolate. Blade 10—17 cm long, 2—5 mm wide, glabrous or upperside sparsely long-hairy, base cuneate. Inflorescence 13—25 cm long; longest branches 8—20 cm long, smooth, glabrous. Pedicel 1—4 mm long, scaberulous. Spikelet 3.5—20 mm long, 1.3—2.2 mm wide, herbaceous, 4—38-flowered; rachilla with 7 or 8 nodes per 3 mm, persistent; lemmas and paleas disarticulating simultaneously from bottom to top; lower glume 1—1.5 mm long, glabrous, 1 vein; upper glume 1.5—2 mm long, as lower; 1^{st} lemma 1.7—2 mm long, punctate, 3 veins, acute; 1^{st}

Figure 56. *Eleusine coracana* (L.) Gaertn.
Figure 57. *Eleusine indica* (L.) Gaertn.
Figure 58. *Eragrostis* rachilla.
a. articulated, b. not articulated.
Figure 59. *Eragrostis amabilis* (L.) Wight & Arn. ex Nees.

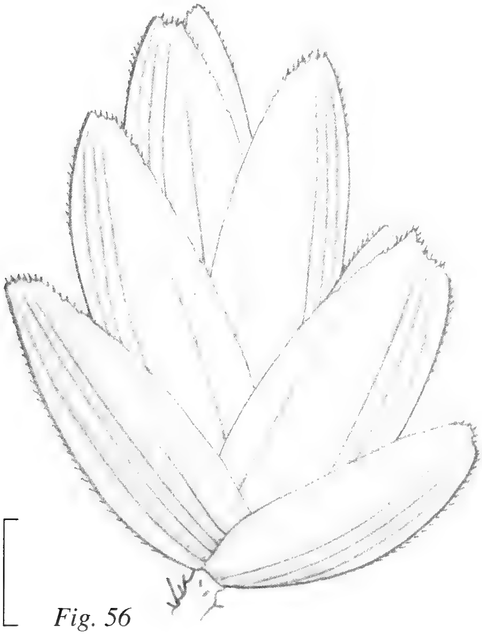
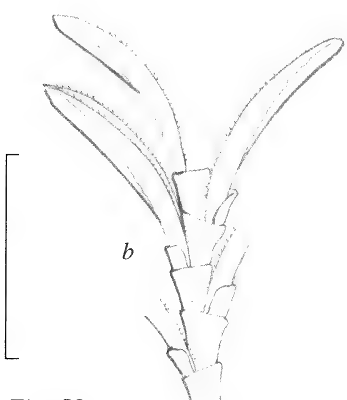
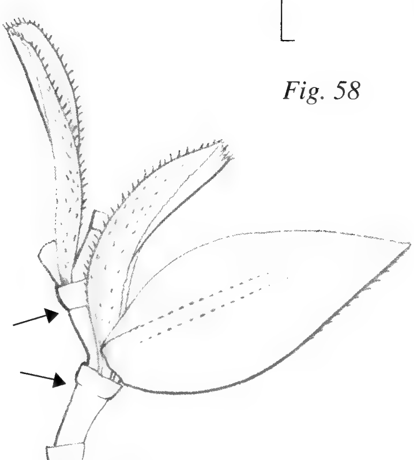


Fig. 56

Fig. 57



b



a

Fig. 58

Fig. 59

palea 1.5—1.8 mm long, glabrous, keels scaberulous to ciliolate. Anthers 3, 0.6—0.7 mm long.

Native; Paleotropics. First record 1906. Rather common.

On moist to wet soil, usually unshaded.

Its tall size and bluish colour are very distinctive.

Eragrostis brownii (Kunth) Nees – Fig. 61, Plate 11.

Lazarides 1997: 101. Veldkamp 2002: 169. Duistermaat 2004: 34.

Eragrostis cumingii Steud.: Gilliland 1971: 65. Lazarides 1997: 109. – var. *cumingii*: Veldkamp 2002: 172.

E. elegantula auct., non Steud.: Ridley 1907: 179; 1925: 248, p.p.

E. elongata auct., non (Willd.) J.Jacq.: Ridley 1907: 179; 1925: 248. Keng *et al.* 1998: 166, p.p.

Culms geniculate, not rooting at the lower nodes, 18—50 cm long, green to glaucous. Sheath 1.5—6 cm long, at throat with up to 4 mm-long hairs. Ligule 0.2—0.3 mm long, ciliolate. Blade 4—8(—24) cm long, 1—3 mm wide, glabrous, base rounded, with few up to 4 mm-long hairs. Inflorescence 5.5—18 cm long; longest branches 1.5—5 cm long, scaberulous to setulose, with few hairs in axils. Pedicel 0.5—1.7 mm long, scaberulous to setulose. Spikelet 2.5—20 mm long, 1.2—2.2 mm wide, (thin) herbaceous, (3—)4—50-flowered; rachilla with 9—11 nodes per 3 mm, articulated, (ultimately) breaking up from above, lemmas disarticulating from below and paleas more or less persistent; lower glume 1.1—1.5 mm long, glabrous, 1 vein; upper glume 1.5—1.7 mm long, as lower; 1st lemma 1.5—1.7 mm long, glabrous or somewhat punctate, 3 veins, along marginal veins minute glands (25x magnification!), obtuse to acute; 1st palea 1.2—1.6 mm long, glabrous, keels scaberulous. Anthers 3, 0.15—0.4 mm long.

Native; Tropical Asia and Australia. First record 1889. Common.

Open to slightly shaded places, roadsides, lawns, often on sandy soil.

Eragrostis brownii is treated in the wider sense, including *E. cumingii* var. *cumingii* (Duistermaat 2004).

Eragrostis cilianensis (Bellardi) Vignolo ex Janch. – Fig. 62.

Lazarides 1997: 105. Veldkamp 2002: 171. Duistermaat 2004: 34.

Culms erect or geniculate, sometimes rooting at the lower nodes, 55 cm long. Sheath 3—5 cm long, with translucent glands on veins in upper half, collar in marginal area with up to 2.5 mm-long hairs. Ligule row of hairs, 0.5—0.7 mm long. Young leaf blade unknown. Blade 12—14 cm long, 3.5—4.5 mm wide, glabrous, base cuneate to rounded, margin in basal half with sessile glands. Inflorescence 12—15 cm long; longest branch 3—6 cm long, glabrous or with few scattered glands. Pedicel 1.5—2 mm long, scaberulous. Spikelet 5—9.5 mm long, 2.1—2.7 mm wide, herbaceous, 9—20-flowered; rachilla with 8 or 9 nodes per 3 mm, persistent, lemmas disarticulating from below and paleas long persistent; lower glume 1.5 mm long, glabrous, 1 vein; upper glume 2 mm long, glabrous, 3 veins; 1st lemma 2 mm long, glabrous, marginal and uppermost area minutely punctate, 3 veins, midvein protruding; 1st palea 1.7 mm long, glabrous, keels ciliolate. Anthers 3, 0.25—0.35 mm long.

Probably not native; Paleo(sub)tropics, especially in regions with a distinct dry season. Single record 1941 from Yio Chu Kang. Extinct (1941).

Figure 60. *Eragrostis atrovirens* (Desf.) Trin. ex Steud.

Figure 61. *Eragrostis brownii* (Kunth) Nees.

Figure 62. *Eragrostis cilianensis* (Bellardi) Vignolo ex Janch.

Figure 63. *Eragrostis gangetica* (Roxb.) Steud.

Figure 64. *Eragrostis montana* Balansa.

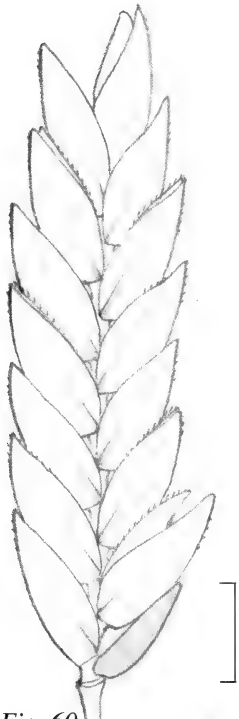
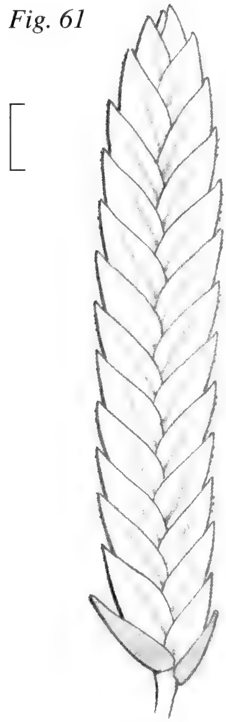


Fig. 60

Fig. 61



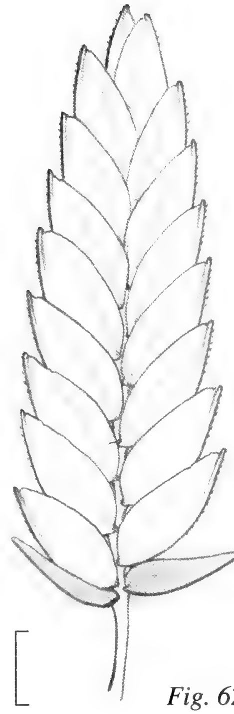


Fig. 62

Fig. 63

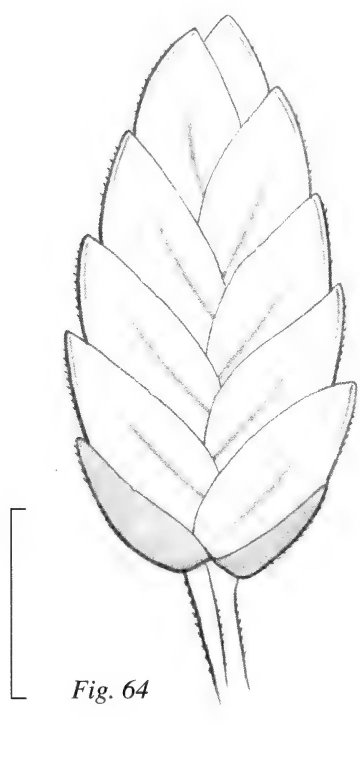


Fig. 64

Eragrostis gangetica (Roxb.) Steud. – Fig. 63.

Gilliland 1971: 68. Keng *et al.* 1998: 166. Veldkamp 2002: 175.

Culms erect, not rooting at the lower nodes, *c.* 40 cm long. Sheath 3—6 cm long, margin at tip with a few hairs. Ligule 0.1—0.2 mm long, ciliolate. Blade 6—14 cm long, 2—4 mm wide, underside glabrous, upperside with up to 1.5 mm long hairs, base cuneate. Inflorescence 14—15 cm long; longest branches *c.* 5 cm long, glabrous. Pedicel 2—5 mm long, scaberulous. Spikelet 4.5—5.5 mm long, 1.5 mm wide, herbaceous, 9—13-flowered; rachilla with 9 or 10 nodes per 3 mm, persistent, lemmas and paleas disarticulating from below upward; lower glume unknown; upper glume 1 mm long, glabrous, 1 vein; 1st lemma 1.5 mm long, glabrous, smooth or minutely punctate, 3 veins, obtuse; 1st palea 1.1 mm long, glabrous, keels scaberulous. Anthers 2, 0.3 mm long.

Probably not native; tropical Africa to N Vietnam. Single record 1951 from Seletar Reservoir. Extinct (1951).

In disturbed places.

According to Veldkamp (2002), the lemmas are acuminate.

Eragrostis montana Balansa – Fig. 64.

Keng *et al.* 1998: 166. Veldkamp 2002: 180.

E. malayana Stapf: Ridley 1907: 178; 1925: 247. Gilliland 1971: 65.

Culms erect or geniculate, not rooting at the lower nodes, 20—35 cm long. Sheath 1.8—3.2 cm long, glabrous. Ligule row of hairs, 0.2—0.3 mm long. Blade 4—6 cm long, 0.5—1.3 mm wide, underside glabrous, upperside sparsely hairy with hairs up to 2 mm long, base rounded. Inflorescence 5—10 cm long; longest branch 1—2.5 cm long, scaberulous, axils glabrous or with 1 long hair. Pedicel 1—3 mm long, glabrous. Spikelet 2—4 mm long, 1.2—2.1 mm wide, (thin) herbaceous, 3—18-flowered; rachilla with 13 nodes per 3 mm, persistent, lemmas disarticulating from below and paleas long persistent; lower glume 0.6—0.7 mm long, glabrous, 1 vein; upper glume 0.9—1 mm long, as lower; 1st lemma 1.1—1.2 mm long, glabrous, 3 veins, acute; 1st palea 1 mm long, glabrous, keels scaberulous. Anthers 3, 0.2 mm long.

Native; Myanmar to western Malesia. First record 1889. Extinct (1963).

On water-logged, stony or sandy soil in open forest, along roads, ditches, banks.

Eragrostis pilosa (L.) P.Beauv. – Fig. 65.

Indian Love Grass

Ridley 1907: 179; 1925: 247. Gilliland 1971: 69. Keng *et al.* 1998: 167. Lazarides 1997: 142. Veldkamp 2002: 183.

Culms erect or geniculate, not rooting at the lower nodes, 14—45 cm long. Sheath 3.5—9 cm long, glabrous, sometimes glandular, throat at margin with up to 3 mm long caducous hairs. Ligule row of hairs, 0.3—0.4 mm long. Blade 10—13 cm long, 2 mm wide, glabrous or sometimes glandular, base rounded, with a few hairs. Inflorescence 9—17 cm long; longest branch 3—8 cm long, glabrous, lowest axils with up to 3 mm long hairs (or rarely glabrous). Pedicel 2—5 mm long, glabrous. Spikelet 3.3—5.5 mm long, 0.8—1.2 mm wide, hyaline to thin herbaceous, 4—13-flowered; rachilla with 7—9 nodes per 3 mm, persistent, lemmas disarticulating from below and paleas slightly longer persistent; lower glume 0.5 mm long, glabrous, unveined; upper glume 1 mm long, glabrous, 1 vein; 1st lemma 1—1.5 mm long, with scattered minute glands, otherwise glabrous, 3 veins, obtuse; 1st palea 0.9—1.1 mm long, glabrous, keels scaberulous. Anthers 3, 0.2 mm long.

Native; temperate to tropical regions of the Old World. First record 1904. Rather rare.

Drought-resistant weed, in open places like roadsides, flowerbeds etc.

Eragrostis unioloides (Retz.) Nees ex Steud. – Fig. 66.
Pink Eragrostis, *Rumput Kolam Padang*

Gilliland 1971: 66. Keng *et al.* 1998: 167. Lazarides 1997: 163. Veldkamp 2002: 187. *Eragrostis amabilis* auct., non Wight & Arn. ex Nees: Ridley 1907: 178, p.p.; 1925: 246, p.p.
Culms geniculate to decumbent, rooting at the lower nodes, 12—50(—80) cm long. Sheath 2—4 cm long, glabrous, throat at margin with a tuft of up to 2 mm long hairs. Ligule 0.2 mm long, ciliolate. Blade 1.5—14 cm long, 2—7 mm wide, glabrous or with long hairs on upperside only, base rounded, collar with up to 3 mm long hairs. Inflorescence 5—17 cm long; longest branch 1.5—6 cm long, glabrous. Pedicel 2—9 mm long, scaberulous. Spikelet 3.5—7.8 mm long, 2.5—3.2 mm wide, herbaceous, 7—34-flowered (less in juvenile spikelet), whitish and often tinged pinkish; rachilla with 13—16 nodes per 3 mm, persistent, lemmas and paleas disarticulating simultaneously from below; lower glume 1—1.2 mm long, 1 vein (not in middle); upper glume 1.5—1.7 mm long, glabrous, 1 vein; 1st lemma 1.4—1.5 mm long, glabrous, punctate, 3 veins, acute; 1st palea 1.2 mm long, glabrous, keels ciliolate. Anthers 2, 0.2—0.4 mm long.

Native; SE Asia. First record 1888. Common.

Open, unshaded to shaded places on moist to waterlogged soil, e.g. roadsides, fields, swamps etc.

Eriachne R.Br.

Van Eck-Borsboom 1980: 127—138.
Culms tufted, erect; nodes glabrous. Sheath rounded. Ligule row of hairs. Young leaf blade setaceous. Blade *c.* 0.5 mm wide, setaceous. Inflorescence panicle, central rachis present; branches 0.2 mm wide, with few spikelets. Pedicel scaberulous. Spikelets single, more or less laterally flattened, 2-flowered, florets articulating, awned; the two lowest bracts as long as spikelet (excluding awns); glumes herbaceous; callus below each floret hairy; lemmas and paleas hairy, 1st identical to 2nd.

According to van Eck-Borsboom (1980), most Malaysian and Singapore specimens are cleistogamous.

1a. Each spikelet with 2 awns, points of the palea not extended into awns. ***E. pallescens***

1b. Each spikelet with 6 awns, points of the palea extended into awns. ***E. triseta***

Eriachne pallescens R.Br. – Fig. 67.
Slender Eriachne

Ridley 1907: 172; 1925: 240. Gilliland 1971: 94. Van Eck-Borsboom 1980: 133. Keng *et al.* 1998: 167.
Culms 20—60 cm long. Sheath 2—3.5 cm long, glabrous or margin sparsely hairy. Ligule 0.5 mm long. Blade 2—6 cm long, hairy, or underside glabrous, base somewhat rounded, collar at margin with few up to 3 mm long hairs. Inflorescence 2—7 cm long, branches 2—4; longest 3—5 cm long, scaberulous, with 2—4 spikelets, simple or branched. Pedicel 5—25 mm long. Spikelet 4—4.4 mm long, 1.1—2 mm wide, with 2 awns; lower glume 3.9—4.2 mm long, not enveloping base, glabrous or with few hairs on midvein, 9 veins; upper glume as lower, 3.5—3.9 mm long, 9—11 veins; 1st lemma 3—3.2 mm long, herbaceous, 5 veins, awn from tip and 3.5—3.7 mm long; 1st palea 3—3.4 mm long, bifid, unawned.

Native; tropical Australasia. First record 1889. Rather rare.

Dry, rocky or clayey soil, unshaded.

Eriachne triseta Nees ex Steud. – Fig. 68.

Ridley 1907: 172 1925: 240 (both excluding Singapore). Van Eck-Borsboom 1980: 136. Keng *et al.* 1998: 168.

Massia triseta Balansa in Morot: Gilliland 1971: 94.

Culms *c.* 40 cm long. Sheath 2—4(—6.5: flag) cm long, sparsely short-hairy. Ligule 0.4 mm long. Blade 7—11 cm long, sparsely hairy at both sides, base cuneate. Inflorescence 5—9 cm long; branches 2, *c.* 1.5 cm long, axil with up to 1 mm long hairs, with 2 spikelets, simple. Pedicel 2—8 mm long. Spikelet 9.8 mm long, 1.8 mm wide, with 6 awns; lower glume 9 mm long, almost entirely enveloping base, glabrous, 11 veins; upper glume as lower; 1st lemma 18.3 mm long including the not clearly demarcated awn, indurated, 5 veins; 1st palea 17 mm long including the two awns, indurated, 2 veins graduating into awns.

Probably not native; tropical Australasia. Single record 1983 near the National Parks Pasir Panjang Nursery. Rare.

Partly shaded, open waste ground.

Eriochloa *Kunth*

Davidse 1987: 143—155. Thompson *et al.* 1990: 1463—1468.

Stolons absent. Nodes hairy. Sheath rounded. Ligule row of hairs. Young leaf blade inrolled. Blade at underside sparsely hairy, base rounded. Inflorescence panicle, central rachis present, branches simple or branched. Spikelets in pairs (sometimes obscurely so) with pedicels of unequal length, not to slightly dorsiventrally flattened, 2-flowered, unawned or if awned awn not exserted; callus cup-shaped, 0.2—0.7 mm long, often red-coloured; the two lowest bracts as long as spikelet; lower glume absent; upper glume and 1st lemma herbaceous, with 5 veins, transverse veinlets very obscure or absent; 2nd lemma and palea indurated, glabrous.

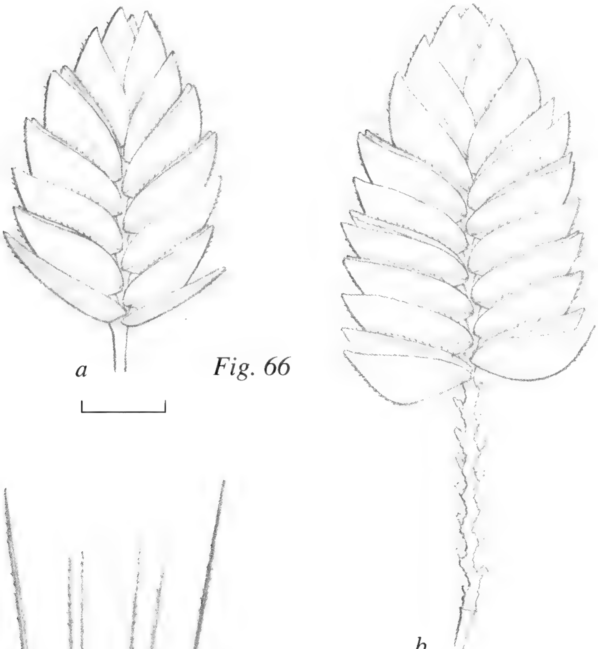
Thompson *et al.* (1990) showed that the callus is not a rudimentary lower glume. Davidse (1987) suggested it might contain lipids to attract ants, but further research is needed to verify this.

Eriochloa villosa (Thunb. in Murray) Kunth, reported by Keng *et al.* (1998), is excluded because information on the herbarium labels of d'Alleizette on which this record was based is unreliable (Veldkamp *pers. comm.*).

1a. Pedicel scaberulous. Upper glume glabrous or sparsely hairy at base and margin, obtuse to acute; 1st palea 2.5—2.8 mm long; 2nd lemma 0.1 mm apiculate. ***E. meyerana***

1b. Pedicel scaberulous or with a few up to 2 mm-long hairs at tip. Upper glume (sparsely) hairy, 0.1—0.3 mm-long mucronate; 1st palea absent; 2nd lemma with 0.4—0.6 mm-long awn, awn not exserted. ***E. procera***

Figure 65. *Eragrostis pilosa* (L.) P.Beauv.
Figure 66. *Eragrostis unioloides* (Retz.) Nees ex Steud.
a. young spikelet, b. maturing spikelet.
Figure 67. *Eriachne pallescens* R.Br.
Figure 68. *Eriachne triseta* Nees ex Steud.
Figure 69. *Eustachys tenera* (J.Presl) C.E.Hubb.



a

b

Fig. 66

Fig. 67

Fig. 68

Fig. 65

Fig. 69

Eriochloa meyerana (Nees) Pilg. – Fig. 70.

Keng *et al.* 1998: 168. Veldkamp 1999b: 233.

Culms single, erect, *c.* 55 cm long. Sheath 5—12 cm long, glabrous to sparsely hairy at base, margin in basal half with up to 1 mm-long hairs. Ligule 0.7—0.8 mm long. Blade 4—11 cm long, 4—5.5 mm wide. Inflorescence 11—14 cm long, branches 5—9; longest branch 6—8 cm long, 0.6 mm wide, scaberulous. Longer pedicel of the pair 1.5—2 mm long, scaberulous. Spikelet 3.2—3.6 mm long, 1.1—1.3 mm wide; upper glume 2.8—2.9 mm long, glabrous or sparsely hairy at base and marginal area, obtuse to acute; 1st lemma 2.7—2.8 mm long, sparsely hairy, acute; 1st palea 2.5—2.8 mm long; 2nd lemma 2—2.3 mm long, smooth, 0.1 mm-long apiculate.

Not native; (sub-)tropical Africa, introduced elsewhere. First record 1948 in Kew Herbarium (not seen). Extinct (1966).

On bank of canal, University campus (the university campus adjacent to the Botanic Gardens and the Bukit Timah Road).

Eriochloa procera (Retz.) C.E.Hubb. – Fig. 71, Plate 12.

Gilliland 1971: 202. Keng *et al.* 1998: 168.

E. annulata (Flüggé) Kunth: Ridley 1925: 223 (excluding Singapore).

E. polystachya auct., non Humb., Bonpl. & Kunth: Ridley 1907: 127 (excluding Singapore).

Culms single or tufted, erect or outer culms ascending, 50—120 cm long. Sheath 6—14 cm long, glabrous. Ligule 0.7 mm long. Blade 5—20 cm long, 4.5—10 mm wide. Inflorescence 17—18 cm long, branches 9—14; longest 3.5—7 cm long, 0.4 mm wide, short hairy especially in axil. Longer pedicel of the pair 2—3 mm long, at tip with up to 2 mm long hairs or rarely scaberulous. Spikelet 3—3.5 mm long, 1 mm wide; upper glume 2.7—3.1 mm long, (sparsely) hairy, 0.1—0.3 mm-long mucronate; 1st lemma 2.5—2.9 mm long, hairy; 1st palea absent to 0.5 mm long; 2nd lemma 1.8—2 mm long, rugulose, awn from tip 0.4—0.6 mm long and not exserted.

Native; Paleotropics. First record 1928. Rather common.

Wet to moist waste places in coastal areas and more inland.

The cup-shaped callus distinguishes this species from *Panicum repens*, *Urochloa subquadripara* and *U. piligera*. Also, *P. repens* has a lowest bract that is *c.* 0.2 times as long as spikelet, whereas both *Urochloa* species have glumes and 1st lemmas with transverse veins.

Eustachys Desf.

Eustachys tenera (J.Presl) C.E.Hubb. – Fig. 69.

Gilliland 1971: 88. Keng *et al.* 1998: 168.

Cynodon dactylon auct., non (L.) Pers.: Ridley 1907: 173, p.p.; 1925: 249, p.p.

Culms tufted, geniculate and with short stolons, 20—40 cm long; nodes glabrous. Sheath 4—5 cm long, glabrous, broadly winged. Ligule 0.1 mm-long hairs. Young leaf blade folded along midrib. Blade up to 9 cm long, 2—3.5 mm wide, glabrous, base cuneate. Inflorescence panicle, central rachis absent; branches 2—4, longest 4—5 cm long, 0.4 mm wide, scaberulous,

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Figure 70. *Eriochloa meyerana* (Nees) Pilg.

a. facing 1st lemma, b. lateral view, c. pair of pedicels.

Figure 71. *Eriochloa procera* (Retz.) C.E.Hubb.

a. facing 1st lemma, b. pedicel.

Figure 72. *Heteropogon contortus* (L.) P.Beauv.

a. male spikelet, b. female spikelet.

Figure 73. *Hymenachne amplexicaulis* (Rudge) Nees.

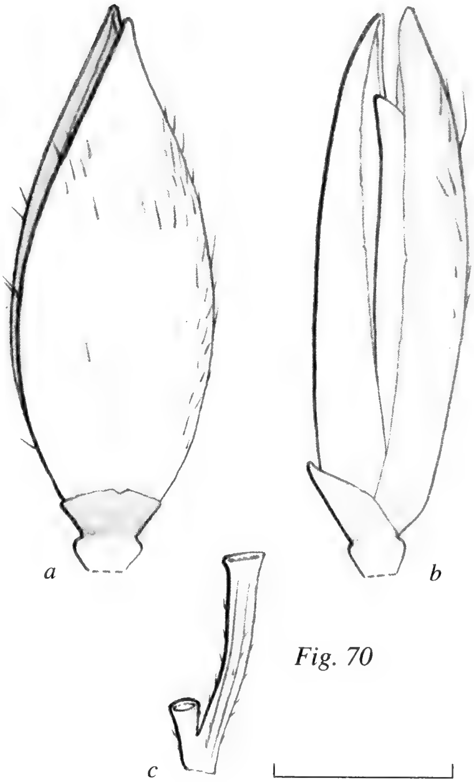


Fig. 70

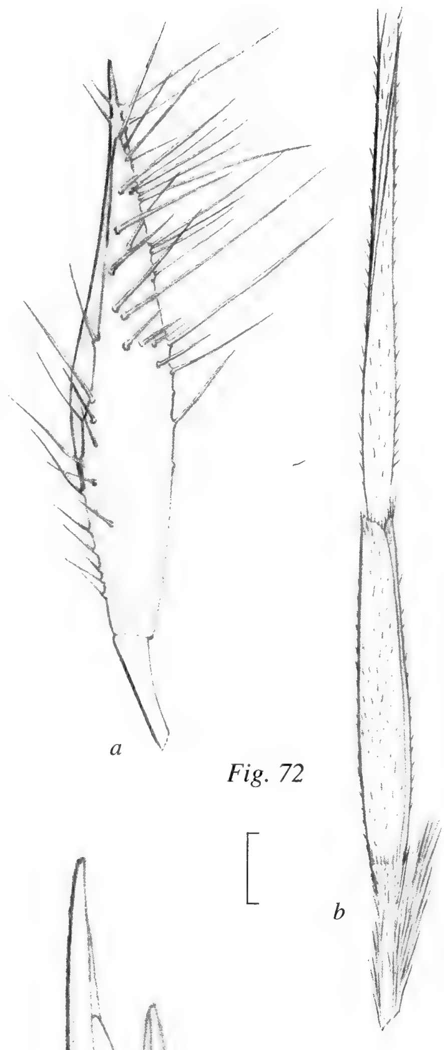


Fig. 72

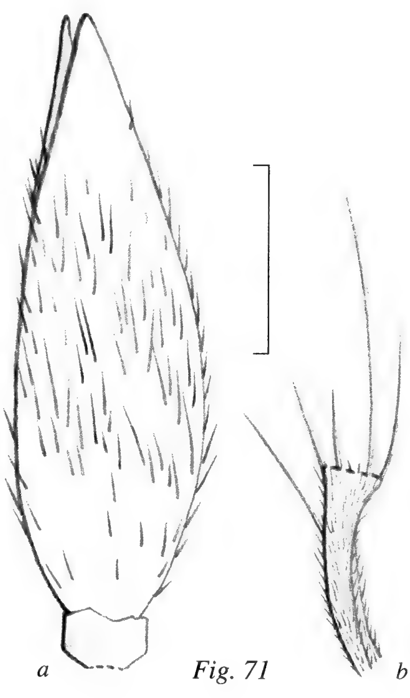


Fig. 71

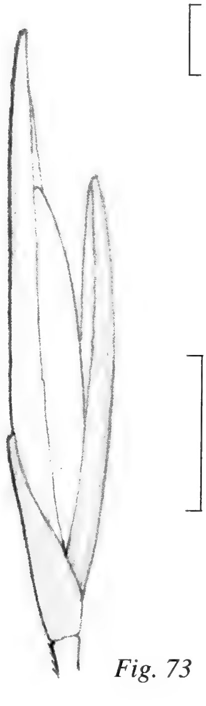


Fig. 73

simple. Pedicel absent. Spikelets single, alternate on one side of branch, *c.* 1.2 mm long, 1.3 mm wide, somewhat laterally flattened, 2-flowered, mucronate; lowest bract as long as and 2nd (excluding mucro) 0.9 times as long as spikelet; lower glume 1 mm long, hyaline to thin herbaceous, glabrous, 1 vein; upper glume 1.1 mm long, herbaceous, scaberulous, 1 vein, 0.5 mm mucronate; 1st lemma 1.1 mm long, herbaceous, 3 veins with 0.5 mm long hairs; 1st palea 0.9 mm long; 2nd lemma 0.6 mm long, hyaline, glabrous; 2nd palea absent.

Native; Indochina to Malesia. First record 1898. Extinct (1964).

Sandy soil.

It has been confused with *Cynodon dactylon*, but the latter has unwinged sheaths, longer ligules, hairy blades and acute upper glumes that are not mucronate. *Chloris barbata* differs in generally being a taller plant, and in having inrolled young leaf blades and distinctly awned and 3-flowered spikelets.

Heteropogon Pers.

Heteropogon contortus (L.) P.Beauv. – Fig. 72.

Tangle-head

Ridley 1925: 213 (excluding Singapore). Gilliland 1971: 292. Keng *et al.* 1998: 169.

Andropogon contortus L.: Ridley 1907: 167 (excluding Singapore).

Culms tufted, erect, *c.* 60 cm long; nodes glabrous. Sheath 4—7 cm long, rounded, with up to 1.5 mm-long bulbous-based hairs, margin hairy. Ligule 1 mm long, basal part membranous and 0.5 mm long, hairs at tip 0.5 mm long. Young leaf blade folded along midrib. Blade 10—20 cm long, 2—7 mm wide, sparsely hairy to glabrescent, base cuneate and hairy. Inflorescence spike-like raceme, 4—5 cm long. Pedicel 0.9 mm long, glabrous. Spikelets in pairs of 1 sessile and 1 pedicelled, 2-flowered, unisexual, first 8 or 9 pairs male and unawned spikelets followed by 5—8 pairs of 1 sessile female (or rarely bisexual) awned and 1 pedicelled male unawned spikelet; the two lowest bracts as long as spikelet; both paleas absent. Male spikelet 6—7 mm long, 1 mm wide; lower glume 5.8 mm long, herbaceous, almost glabrous at base, upwards with hairs increasing in length up to 1.5 mm long, 13 veins; upper glume 6—7 mm long, herbaceous, sparsely hairy on midvein and margins only, 3 veins; 1st lemma 4.5 mm long, hyaline; 2nd lemma as 1st, 4 mm long. Female spikelet 5 mm long, falling off with 2.5 mm long sharply pointed and short-hairy part of rachis; lower glume 5 mm long, slightly indurated, with 0.2 mm long stiff hairs, 9 veins; upper glume as lower, 5 mm long, 3 veins; 1st lemma 2.2 mm long, hyaline; 2nd lemma 4.5 mm long, basal part very narrow and hyaline, upward widening and somewhat indurated, awn from tip and 8.5 cm long.

Native; tropical America, Africa, India to S. China, Japan, Marianas Isl., Australia, widespread in Malesia. First record 1936. Extinct (1957).

On open sandy soil, beach.

The long awns tend to become entangled, hence the name Tangle-head.

Hymenachne P.Beauv.

Pohl and Lersten 1975: 223—227.

Hymenachne and *Sacciolepis* are separated by the presence of culms filled with spongy pith in the former, and gibbous upper glumes in the latter (Pohl and Lersten 1975).

Hymenachne amplexicaulis (Rudge) Nees – Fig. 73.

Swamp Panic Grass, *Rumput Kumpai*

Keng *et al.* 1998: 170.

H. acutigluma (Steud.) Gilliland: Gilliland 1971: 155.

H. myuros auct., non Humb., Bonpl. & Kunth: Ridley 1925: 230.

Panicum myurus auct., non Humb., Bonpl. & Kunth: Ridley 1907: 135 (excluding Singapore).
Culms erect to ascending, stolons absent, *c.* 90 cm long; internodes *c.* 3 mm diameter, (partially) filled with open-spongy pith; nodes glabrous. Sheath 8—11 cm long, rounded, with (few) transverse veins present (only visible from inside), glabrous, margin hairy. Ligule membranous, 2 mm long. Young leaf blade inrolled. Blade 10—22 cm long, 6—11 mm wide, underside glabrous, upperside sparsely hairy, base rounded to somewhat cordate. Inflorescence spike-like panicle, central rachis 10—23 cm long, branches erect; longest branch up to 6 cm long, 0.6 mm wide, branched, 1st branchlets very short and flattened with hairlike spicules on margin. Pedicel 0.2—0.5 mm long, with hairlike spicules. Spikelets single, (3—)3.9—4.9 mm long, 0.6 mm wide, not flattened, 2-flowered, unawned; lowest bract *c.* 0.25 and 2nd 0.7—0.9 times as long as spikelet; glumes herbaceous, midvein more or less keeled and scaberulous and up to 0.4 mm protruding; lower glume 1—1.3 mm long, enveloping, glabrous, 1—3 veins; upper glume 2.5—3.2 mm long, glabrous, 5 veins; 1st lemma 3.4—4.4 mm long, (thin) herbaceous, glabrous, 5 veins, (long-)acuminate; 1st palea absent; 2nd lemma 2.4—2.7 mm long, hyaline; 2nd palea 2.4 mm long.

Native; India, Myanmar, Thailand, Peninsular Malaysia, Singapore, Borneo. First record 1904. Rare.

In open swamps and riversides, on muddy soil.

Also called Wick Grass, as the pith of the culm was used as a wick for oil lamps.

The length of the spikelets is more variable than mentioned by Gilliland (1971: 4.6 mm long).

Differences with *Panicum auritum* are mentioned there. *Sacciolepis indica* has gibbous spikelets of up to 3.4 mm long, shorter panicle branches (up to 0.5 cm long), culms without pith and sheaths without transverse veins.

Imperata Cirillo

Ng 1999: 288.

Culms single or tufted, with short rhizomes, erect, internodes of non-flowering plants very short. Leaves of non-flowering plants all basal. Sheath rounded. Ligule membranous, dorsal side hairy. Young leaf blade inrolled. Blade base cuneate, those of flag leaves 0.6—0.8 cm long. Inflorescence panicle, silky hairy, central rachis present; branches numerous, scaberulous, persistent, branched. Spikelets in pairs with pedicels of unequal length, not flattened, 2-flowered, unawned; callus densely silky-hairy, hairs 6—10 mm long; the two lowest bracts as long as spikelet; both glumes thin herbaceous, hairy; both lemmas and 2nd palea hyaline; 1st palea absent.

Some *Miscanthus* species (not recorded from Singapore, but used as ornamentals), *Neyraudia*, *Phragmites* and *Saccharum* also have silky-hairy inflorescences. However, all these have non-flowering culms with much longer internodes and with all leaves scattered along the culm. Also, in *Saccharum* species the inflorescence branches break up at maturity, whereas the spikelets of *Miscanthus* species are distinctly awned. The spikelets of both *Neyraudia* and *Phragmites* have 4 or more florets.

Recent (as yet unpublished) research has indicated that the two taxa generally accepted cannot be distinguished. The anthers often seem to have 2 locules at the base and 4 at the tip (study by Ms Delia Co; Veldkamp *pers. comm.*). For now the two species are maintained.

1a. Flowering culm glabrous just below the nodes. Peduncle hollow. Panicle 28—52 cm long, more or less lax; longest branch 7.5—15 cm long, drooping, without spikelets in lower 0.3—0.4 part. Anther 1.
I. conferta

1b. Flowering culm with long bulbous-based hairs just below the nodes. Peduncle more or less solid. Panicle 4—20 cm long, more or less contracted; longest branch 1.2—4 cm long, erect, with spikelets from the base. Anthers 2. ***I. cylindrica* var. *major***

Imperata conferta (J.Presl) Ohwi – Fig. 74.

Gilliland 1971: 222. Keng *et al.* 1998: 170.

I. contracta Hitchc.: Burkill 1935: 1228.

I. exaltata auct., non Brongn.: Ridley 1907: 152; 1925: 193.

Culms 50—150 cm long; flowering culm glabrous just below the nodes. Sheath glabrous. Ligule 0.7—2.5 mm long. Blade 65—110 cm long, 10—22 mm wide, glabrous. Peduncle hollow. Inflorescence 28—52 cm long, 5—8 cm wide; longest branch 7.5—15 cm long, drooping, naked in lower 0.3—0.4 part. Pedicel short 1.3—1.5 mm, long 2—3.5 mm long, scaberulous. Spikelet 3—3.2 mm long; lower glume 3—3.5 mm long, hairs 3.5—5 mm long, 3 veins; upper glume as lower, 2.8—3.2 mm long; 1st lemma 2—2.1 mm long; 2nd lemma 1.9 mm long; 2nd palea 1 mm long. Anther 1, 1.6—1.8 mm long.

Native; SE Asia. First record 1889. Rare.

Open sandy places, unshaded to partly shaded dry laterite soil, on roadsides.

The only recent location where *I. conferta* and *I. cylindrica* grew together yielded an intermediate form with characters of both species. Most likely it is a hybrid between the two species.

Imperata cylindrica (L.) P.Beauv. – Fig. 75.

Lalang, *Lalang*

Clayton and Renvoize 1982: 702.

I. cylindrica var. *maior* (Nees) C.E.Hubb. ex C.E.Hubb. & Vaughan: Gilliland 1971: 220. Keng *et al.* 1998: 170.

I. arundinacea Cirillo: Ridley, 1907: 152; 1925: 193.

Culms 65—75 cm long; flowering culm with bulbous-based hairs just below the nodes. Sheath glabrous or hairy. Ligule (0.5—)2 mm long, tip ciliolate. Blade 40—60 cm long, 6—14 mm wide, base with up to 3 mm long hairs. Inflorescence 4—20 cm long, 0.6—2 cm wide; longest branch 1.2—4 cm long, erect, with spikelets from the base. Pedicel short 1.3 mm, long 2.5 mm long, at base with up to 3 mm long hairs. Spikelet 3—4.5 mm long; lower glume 2.7—4.5 mm long, hairs 8—10 mm long, 1 vein; upper glume as lower, 2.7—4.2 mm long, 3 or 5 veins; 1st lemma 2.4—3 mm long; 2nd lemma 1.4—1.9 mm long; 2nd palea 1.1—1.2 mm long. Anthers 2, 2—3 mm long.

Native; tropical Asia. First record 1880s. Common.

Unshaded to slightly shaded fields, roadsides etc.

Clayton and Renvoize (1982) argued that all varieties should be ignored. Although there is geographical variation, the variants cannot be separated perfectly.

Lalang is one of the world's worst weeds. Fields that have been burnt repeatedly are dominated by it to such an extent that all other species are outcompeted. The rhizomes of this fire climax species survive fire and immediately start new growth whereas other species are often killed. When frequently mown, however, plants get smaller and produce smaller inflorescences or stop flowering altogether. Eventually, this process kills them. For intermediates, see note under *I. conferta*.

Figure 74. *Imperata conferta* (J.Presl) Ohwi.

Figure 75. *Imperata cylindrica* (L.) P.Beauv.

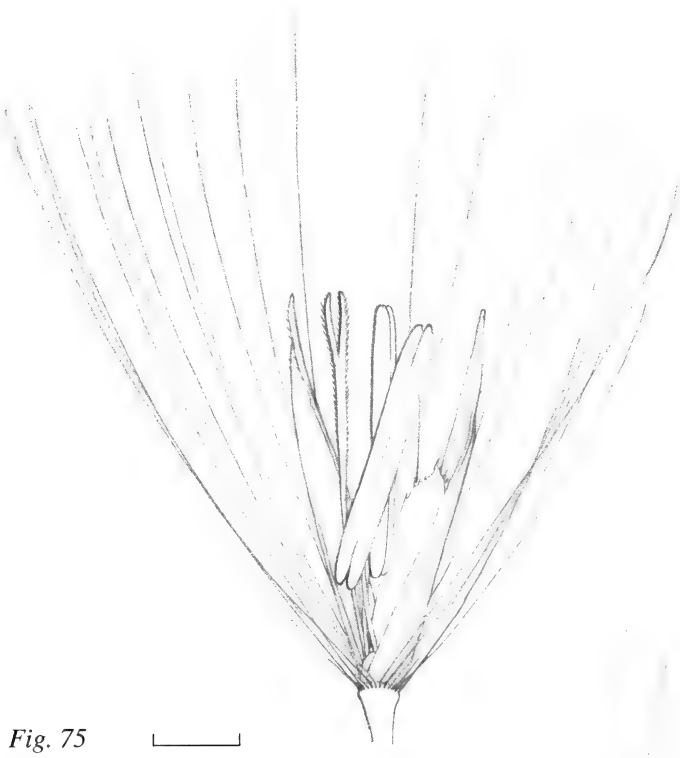


Fig. 75

Fig. 74

Isachne R.Br.

Iskandar and Veldkamp 2004: 159—179.

Culms with stolons or tufted and geniculate. Sheath rounded, midrib not raised, glabrous, margins hairy. Ligule row of hairs. Young leaf blade inrolled. Blade sparsely hairy at both sides, at base at underside with prominent veins, base rounded. Inflorescence panicle, central rachis present; branches glabrous, axils of the lowest with a gland, at least longest branched. Pedicels present. Spikelets single, not flattened, 2(—3)-flowered, unawned; glumes (thin) herbaceous; both paleas slightly shorter than lemmas, glabrous, texture as lemma.

Spikelets with 3 florets are very rare and in Singapore are known only from one collection (see *I. pulchella*). The hairy ligule and the relatively long glumes distinguish the species of *Isachne* readily from *Cyrtococcum* species.

The key follows Iskandar and Veldkamp (2004).

1a. Glumes longer than florets. Lower floret bisexual. Both lemmas hairy, similarly indurated and convex. ***I. kunthiana***

1b. Glumes shorter than or as long as florets. Lower floret male. Both lemmas glabrous to hairy, the 1st lemma thinner and usually larger and flatter than the 2nd. **2**

2a. Culm with annular gland below the node. ***I. pulchella***

2b. Culm without annular gland below the node. **3**

3a. Nodes glabrous. Ligule (1.4—)2—4 mm long. Blade underside at base 7—9-veined, margins white cartilaginous or not. 2nd lemma indurated. ***I. globosa***

3b. Nodes (sparsely) hairy. Ligule 1—1.6 mm long. Blade underside at base 3—5-veined, margins not white cartilaginous. 2nd lemma herbaceous. ***I. minutula***

Isachne globosa (Thunb.) Kuntze – Fig. 76.

Rounded Isachne, *Rumput Minyak*

Gilliland 1971: 123. Keng *et al.* 1998: 170. Iskandar and Veldkamp 2004: 165.

I. australis R.Br.: Ridley 1907: 129; 1925: 239.

Culms erect part 30—60 cm long; nodes glabrous, annular ring below them absent. Sheath 1.8—6.5 cm long, marginal hairs 2—3 mm long. Ligule 2—4 mm long. Blade 4—7.8 cm long, 3.5—7 mm wide, prominent veins 7—9; margin white cartilaginous or not, scaberulous, glabrous or hairy. Inflorescence 5—14 cm long, longest branch 2.5—6 cm long. Pedicel 0.5—1.7 mm long, glabrous. Spikelet 1.8—2.5 mm long, 1.2—1.4 mm wide, not yawning; the two lowest bracts 0.9—1 times as long as spikelet, not longer than the florets; lower glume 1.7—2.4 mm long, sparsely hairy, 7 veins; upper glume 1.6—2.2 mm long, sparsely hairy, 9 veins; 1st lemma 1.8—2.2 mm long, glabrous, slightly indurated, dorsally convex or grooved; 2nd lemma 1.2—1.6 mm long, glabrous, indurated.

Native; India to China, south to Malesia, Solomon Islands, New Caledonia, Australia, New Zealand. First record 1889. Rare.

In wet and open places.

Figure 76. *Isachne globosa* (Thunb.) Kuntze.

Figure 77. *Isachne kunthiana* (Wight & Arn. ex Steud.) Miq.

Figure 78. *Isachne minutula* (Gaudich.) Kunth.

Figure 79. *Isachne pulchella* Roth in Roem. & Schult.

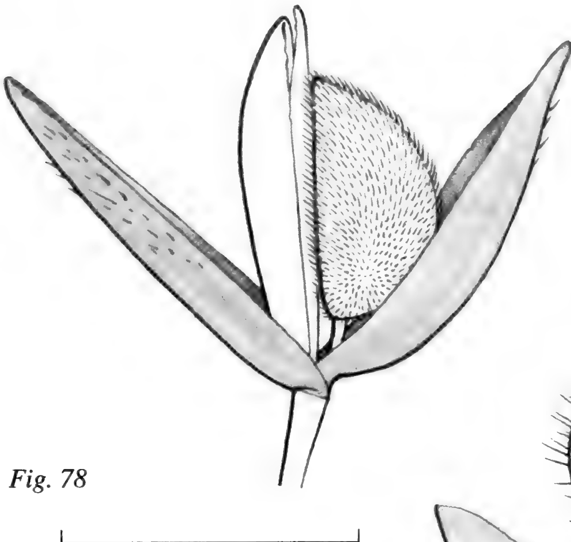


Fig. 78

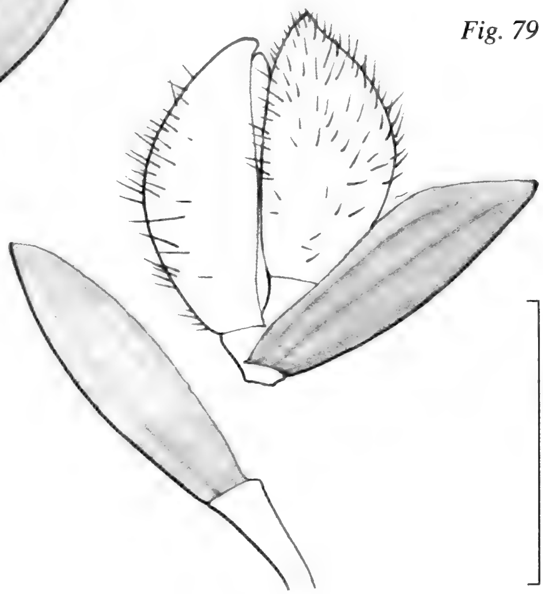


Fig. 79

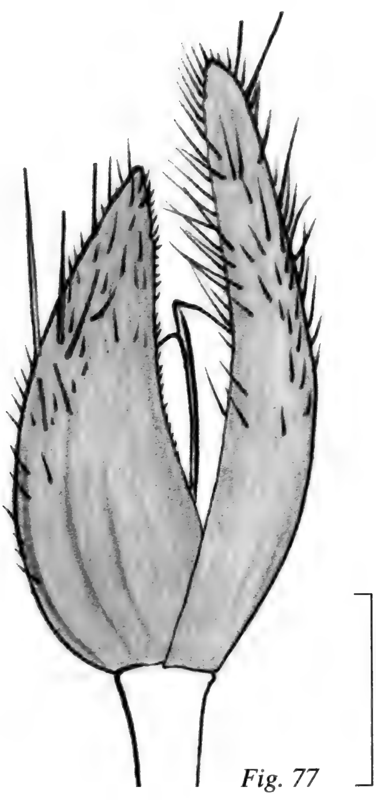


Fig. 77

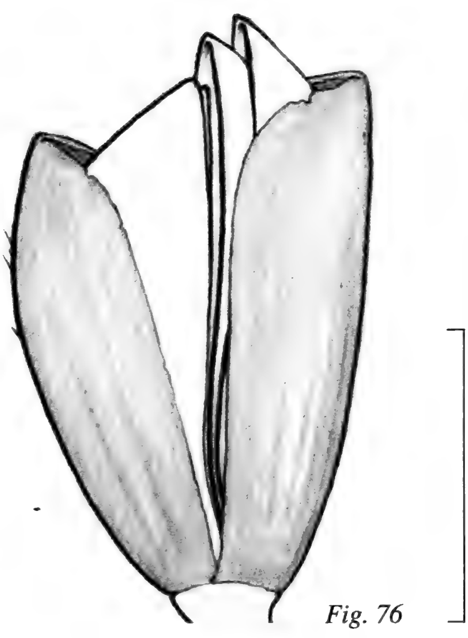


Fig. 76

Isachne kunthiana (Wight & Arn. ex Steud.) Miq. – Fig. 77.

Ridley 1907: 128. Gilliland 1971: 122. Keng *et al.* 1998: 171.

I. semitalis Ridl. 1925: 237.

Culms erect part 7—30 cm long; nodes short appressed hairy, annular ring below them absent. Sheath 1.2—2 cm long, marginal hairs up to 2 mm long. Ligule 1—1.6 mm long. Blade 2—5 cm long, 6.5—9 mm wide, prominent veins 5—7; margin white cartilaginous, scaberulous, glabrous. Inflorescence 2—4 cm long, longest branch 2 cm long. Pedicel 1.2—1.5 mm long, glabrous or with a single hair. Spikelet 2—3.3 mm long, yawning at maturity; the two lowest bracts as long as spikelet, longer than the florets; lower glume 2.2—3 mm long, hairy, 7 or 9 veins; upper glume 1.9—2.9 mm long, hairy, 9 or 11 veins; 1st lemma 1.5—1.8 mm long, hairy, indurated, convex; 2nd lemma as 1st.

Native; India to Japan, China, Malesia southward to Solomon Islands, New Caledonia, Australia, New Zealand. First record 1892. Rare.

Damp open forest sites.

Isachne minutula (Gaudich.) Kunth – Fig. 78.

Iskandar and Veldkamp 2004: 167.

I. miliacea auct., non Roth: Ridley 1907: 129; 1925: 239.

I. pulchella auct., non Roth: Gilliland 1971: 120. Keng *et al.* 1998: 171.

Culms erect part *c.* 10 cm long; nodes (sparsely) hairy at least below the margins of the sheaths, annular ring below them absent. Sheath 0.6—2.2 cm long, marginal hairs up to 1 mm long. Ligule 1—1.6 mm long. Blade 1.6—3.3 cm long, 2.5—6 mm wide, prominent veins 3—5; margins not white cartilaginous, scaberulous, glabrous. Inflorescence 2—4.5 cm long, longest branch 0.6—2 cm long. Pedicel 0.5—1.3 mm long, glabrous. Spikelet 1.4—1.8 mm long, 1.2 mm wide, not yawning; the two lowest bracts 0.9—1 times as long as spikelet, not longer than the florets; lower glume 1.3—1.7 mm long, sparsely hairy, 7 veins; upper glume as lower, 1.2—1.7 mm long; 1st lemma 1.2—1.7 mm long, glabrous, thin herbaceous, dorsally grooved; 2nd lemma 0.8—1.2 mm long, densely covered with 0.15 mm long, patent hairs, slightly indurated.

Native; India to Vietnam, Sumatra, Java, Borneo, Philippines, Celebes, Lesser Sunda Islands, Moluccas, Australia. First record 1892. Extinct in the wild (1905).

Damp places in forest.

Recently only found in the Botanic Gardens at several different places where it seems to grow abundantly as a weed in damp to wet places.

This species was previously known as *I. pulchella* (Gilliland 1971, Keng *et al.* 1998), but that species has an annular gland below each node.

Isachne pulchella Roth in Roem. & Schult. – Fig. 79.

Iskandar and Veldkamp 2004: 168.

Culm erect part 20—35 cm long; nodes hairy to glabrescent, annular ring below them present. Sheath 1—2.5 cm long, marginal hairs up to 0.5 mm long. Ligule *c.* 1 mm long. Blade 1—2.5 cm long, 3—5 mm wide, prominent veins 7; margins white cartilaginous, scaberulous, at base hairy. Inflorescence 3—4.5 cm long, longest branch 0.8—1.5 cm long. Pedicel 0.3—0.7 mm long, glabrous. Spikelet *c.* 1.4 mm long, *c.* 1 mm wide, yawning at maturity; the two lowest bracts 0.8—0.9 times as long as spikelet, not longer than the florets; lower glume 1.3 mm long, glabrous, 5 veins; upper glume as lower, 1.1—1.2 mm long; 1st lemma 1.2 mm long, glabrous to sparsely short-hairy at tip, thin herbaceous, flattened, not dorsally grooved; 2nd lemma 1 mm long, densely short-hairy, indurated.

Native; India to SW China, Sumatra, Java, Borneo, Philippines, Celebes. First record 1905. Rare.

On clayey soil in a ditch with slow flowing clear water.

This is the first time this species is recorded for Singapore (see the note under *I. minutula*). The first record is from Bukit Timah, the second from the Western Catchment area where it was found in 2004. Both the remoteness of the recent locality and the habitat indicate that it is native. Some of the spikelets were 3-flowered with an additional floret above the 2nd.

Ischaemum L.

Auricles triangular, fused with ligule, glabrous. Ligule membranous, tip entire or ciliolate. Young leaf blade inrolled. Inflorescence panicle, central rachis absent (or up to 0.8 cm long); branches 2(—4), one with spikelets from the base upward, the other with the basal 0.6 cm naked, margins hairy (or glabrous in *I. magnum*), simple. Spikelets in pairs of 1 sessile and 1 pedicelled on one side of rachis, heteromorphous, not flattened, 2-flowered; callus with thin part that is concave after flowering; the two lowest bracts as long as spikelet; lemmas and paleas thinner than glumes; both paleas slightly shorter to slightly longer than the lemmas. Sessile spikelet with lower glume flattened, basal 0.5—0.7 part indurated, upper 0.3—0.5 part herbaceous and submarginally keeled to winged; upper glume boat-shaped, midvein more or less keeled. Pedicelled spikelet (slightly) smaller than sessile; lower glume boat-shaped, smooth (or minutely rugulose), winged at one margin; 2nd lemma unawned (or awn shorter than in sessile spikelet).

Inflorescences with 3 or 4 branches occur rarely in *I. ciliare*, *I. muticum* and *I. timorense*.

Material of *Ischaemum barbatum* Retz., earlier mentioned as a weed in the Botanic Gardens (Ridley 1925, Keng *et al.* 1998), has not been re-found. It differs from *I. magnum* in having a geniculate awn.

The key follows Gilliland (1971).

1a. Lower glume of sessile spikelet entire at the tip; upper glume unawned. **2**
1b. Lower glume of sessile spikelet bifid at the tip; upper glume awned, awn 0.5—2 mm long. **4**

2a. Lower glume of sessile spikelet not transversely rugose or nodular. Pedicel and joint of rachis subequal to rachis below. ***I. muticum***
2b. Lower glume of sessile spikelet transversely rugose or nodular at the margins. Pedicel and joint of rachis inflated compared to rachis below. **3**

3a. Lower glume with up to 4 transverse rugosities or marginal nodules. Perennial. ***I. magnum***
3b. Lower glume with about 6 transverse rugosities. Short-lived 'annual'. ***I. rugosum***

4a. Lower glume obovate, wings 0.4—1 mm wide. ***I. ciliare***
4b. Lower glume ovate-lanceolate, wings 0—0.4 mm wide. ***I. timorense***

Ischaemum ciliare Retz. – Fig. 80, Plate 13.
Smut Grass

Ridley 1907: 160. Veldkamp 1991: 180. Keng *et al.* 1998: 171.
I. aristatum auct., non L.: Ridley 1925: 203.
I. indicum auct., non (Houtt.) Merr.: Gilliland 1971: 263.

Culms with stolons or straggling, 20—90 cm long; nodes hairy. Sheath 2—10 cm long, rounded at base and more or less flattened in upper part, with prominent midrib, at least the lower hairy, margins glabrous. Ligule 1—2 mm long, hairy at abaxial side, tip ciliolate. Blade (2—) 4—7(—11) cm long, 4—8 mm wide, both sides hairy, base cuneate, pseudopetiole absent. Peduncles 1 per sheath and from upper sheath. Inflorescence branches 3—12 cm long, divergent. Sessile spikelet (4—)4.5—5.5(—7.5) mm long, 1.5—2 mm wide, awned; lower glume 3.4—5.5 mm long, obovate, basal part smooth and glabrous, upper part 7—13 veins and sparsely hairy, wings 0.4—1 mm wide, tip bifid; upper glume (4—)5.5—6 mm long, 5 veins, margins hairy, awn 0.9—1.5 mm long; 1st lemma 3.8—4.5 mm long; 2nd lemma 3—4 mm long, upper half bifid, awned from notch, awn 6—16 mm long, geniculate. Pedicel *c.* 2.5 mm long, as thick as rachis, margins hairy.

Native; India to Japan, south to Malesia, Australia. First record 1890. Common.

Lawns, roadsides, open places.

Plants infected by smut fungus occur frequently, hence the English name. Their inflorescences do not develop completely and often do not completely exert from their sheaths.

It is very similar to *I. timorense* with which it might be conspecific. In addition to characters already mentioned in the key, *I. ciliare* is generally (but not always) a smaller plant with shorter leaf blades.

Ischaemum magnum Rendle – Fig. 81, Plate 14.

Ridley 1907: 158; 1925: 200. Gilliland 1971: 261. Keng *et al.* 1998: 171.

I. laeve Ridl.: Ridley 1907: 158; 1925: 201.

Culms single or tufted, erect or geniculate, 110—200 cm long; nodes glabrous. Sheath 10—17 cm long, rounded, glabrous or hairy, margin glabrous or hairy. Ligule 2—7.5 mm long, glabrous or hairy at abaxial side, tip entire. Blade 10—35 cm long, 10—16 mm wide, glabrous, base long cuneate, pseudopetiole 1—4 mm long and hairy. Peduncles 1—3 per sheath and from upper and 1 or more lower sheaths. Inflorescence branches 6.5—14 cm long, closely appressed or divergent. Sessile spikelet 5—6.5 mm long, 1.5—1.8 mm wide, (minutely) awned; lower glume 5—6.5 mm long, oblong, glabrous, basal part with 4 (or 5) transverse rugosities or (rudimentary) marginal nodules, upper part 0 or 1 vein, wings 0—0.4 mm wide, tip entire (and mucro up to 0.1 mm long); upper glume 5—6.3 mm long, glabrous or margins hairy, 3—5 veins, unawned; 1st lemma 4.5—5.5 mm long; 2nd lemma 2.5—5.1 mm long, upper half bifid, awned from notch, awn 0.4—12 mm long, straight. Pedicel 1.5 mm long, as thick as rachis, margins glabrous or one hairy.

Native; Myanmar to Borneo. First record 1878. Rather rare.

Margin of rivers, canals and lakes; in places with seepage; on beach.

Ischaemum muticum L. – Fig. 82, Plate 15.

Seashore Centipede Grass, *Rumput Tembaga Jantan*

Ridley 1907: 159; 1925: 201. Gilliland 1971: 255. Keng *et al.* 1998: 172.

Culms with stolons or straggling, 30—200 cm long; nodes glabrous. Sheath 2.5—4 cm long, more or less flattened, midrib raised, glabrous or hairy at tip, at least one margin hairy. Ligule 0.5 mm long, glabrous, tip entire or ciliolate. Blade 3—12 cm long, 5—13 mm wide, glabrous or underside sparsely hairy, base rounded, pseudopetiole 1—2 mm long. Peduncles 1 per sheath and from upper sheath. Inflorescence branches 1.5—5 cm long, closely appressed. Sessile spikelet 6.7—7.5 mm long, 2.2—2.3 mm wide, minutely awned, awn not protruding;

Figure 80. *Ischaemum ciliare* Retz., pair of spikelets.

Figure 81. *Ischaemum magnum* Rendle, pair of spikelets.

Figure 82. *Ischaemum muticum* L., pair of spikelets.

Fig. 80

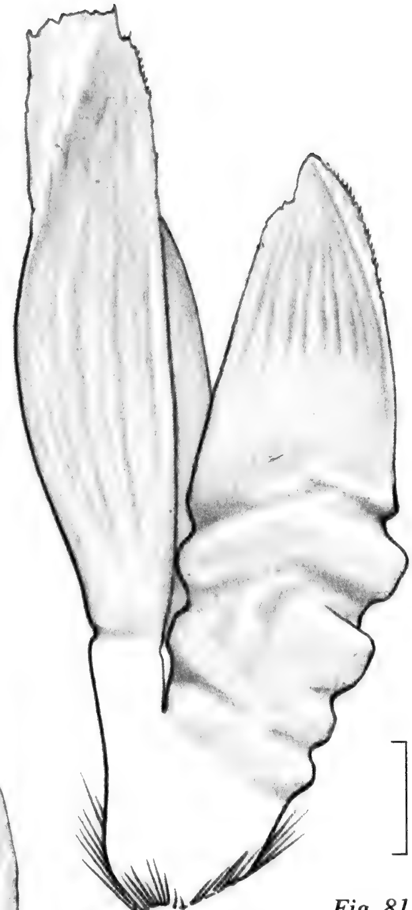


Fig. 81

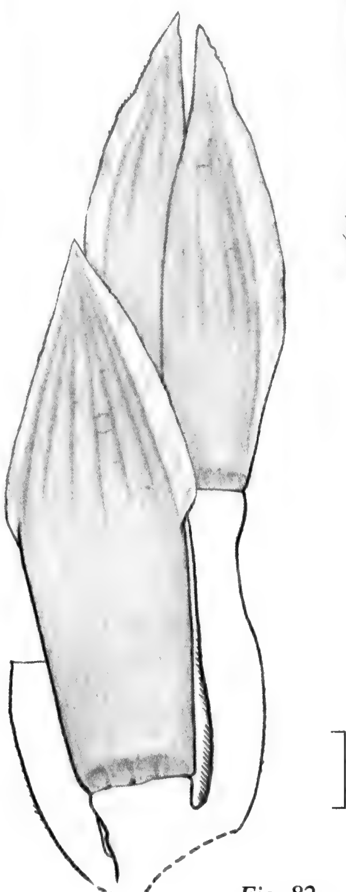


Fig. 82

lower glume 6.7—7.5 mm long, oblong, glabrous, basal part smooth, upper part with 7—9 veins and transverse veins, wings *c.* 0.4 mm wide, tip entire; upper glume 6.7—7.5 mm long, 3 veins, glabrous, unawned; 1st lemma 5.5—6.5 mm long; 2nd lemma 4.5—6.6 mm long, tip acute, awn 1.2—1.5 mm long, straight. Pedicel 5.3 mm long, as thick as rachis, margins hairy.

Native; India to E. Asia, south to Malesia and Polynesia. First record 1888. Common.

In lawns, open places, scrub, also near the sea (mangroves and beaches above high tide mark).

It is readily distinguished from the other species of *Ischaemum* by the pale yellow inflorescence with white stigmas sticking out laterally.

Ischaemum rugosum Salisb. – Fig. 83.

Wrinkled Centipede Grass, *Rumput Ekor Cawi*

Ridley 1907: 157; 1925: 200. Gilliland 1971: 259. Keng *et al.* 1998: 172.

Culms erect, *c.* 50 cm long; nodes hairy. Sheath 8—10 cm long, rounded, sparsely hairy at tip, margins glabrous. Ligule 3 mm long, glabrous, tip entire. Blade (3—)15—17 cm long, (2—) 10 mm wide, (sparsely) hairy on both sides, base rounded, densely hairy behind ligule, pseudopetiole absent. Peduncles 1 per sheath, from upper and up to 2 lower sheaths. Inflorescence branches 5—7 cm long, divergent. Sessile spikelet 5 mm long, 1.7 mm wide, awned; lower glume 5 mm long, ovate, glabrous, basal part with 6 or 7 transverse rugosities or (rudimentary) marginal nodules, upper part 9 veins, wings 0.2 mm wide, tip entire; upper glume 5 mm long, 3 veins, glabrous, unawned; 1st lemma 4.8 mm long; 2nd lemma 4 mm long, upper half bifid, awned from notch, awn *c.* 17 mm long, geniculate. Pedicel *c.* 2 mm long, as thick as rachis, one margin hairy.

Native; India to east Asia, south to Malesia. Single record 1898 from 'Galang' (Kallang). Extinct (1898).

According to (Ridley 1925), it grew in waste ground or in places where the ground was not too dry (Gilliland 1971).

Ischaemum timorense Kunth – Fig. 84.

Common Centipede Grass

Ridley 1907: 160; 1925: 203. Gilliland 1971: 264. Keng *et al.* 1998: 172.

I. macrurum Stapf ex Ridl. 1925: 203.

Culms with short stolons, 60—120 cm long; nodes hairy. Sheath 4—7 cm long, rounded at base and more or less flattened in upper part, hairy at least at base and tip, margins glabrous or hairy. Ligule 2—4 mm long, hairy at back, tip ciliolate. Blade (2—)4—26 cm long, 4—11 mm wide, glabrous or hairy, base rounded and hairy, pseudopetiole absent. Peduncles 1 and from upper sheath. Inflorescence branches 2—10 cm long, divergent. Sessile spikelet 4.5—6.8 mm long, 1.3—1.4 mm wide, elliptic, awned; lower glume 3.5—6 mm long, ovate, basal part smooth and glabrous, upper part 6 or 7 veins and glabrous or hairy, wings 0—0.4 mm wide, tip bifid; upper glume 4.5—6 mm long, 7 veins, glabrous, awn 0.5—2 mm long; 1st lemma 3—4.8 mm long; 2nd lemma 2.6—4.3 mm long, upper half bifid, awned from notch, awn 5.5—17 mm long, geniculate or straight. Pedicel 2.8—3.3 mm long, as thick as rachis, hairy on margins.

Native; India to east Asia, Malesia and Polynesia. First record 1889. Rather common.

Figure 83. *Ischaemum rugosum* Salisb., pair of spikelets.
Figure 84. *Ischaemum timorense* Kunth, pair of spikelets.
Figure 85. *Leersia hexandra* Sw.
Figure 86. *Leptochloa chinensis* (L.) Nees.

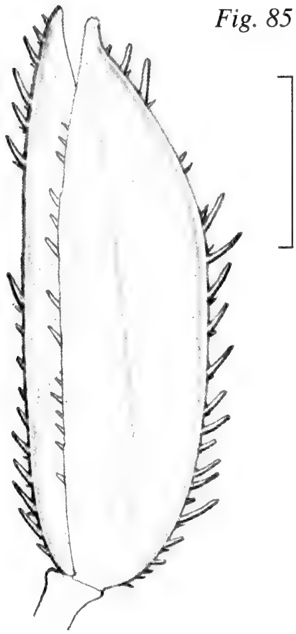


Fig. 85

Fig. 84

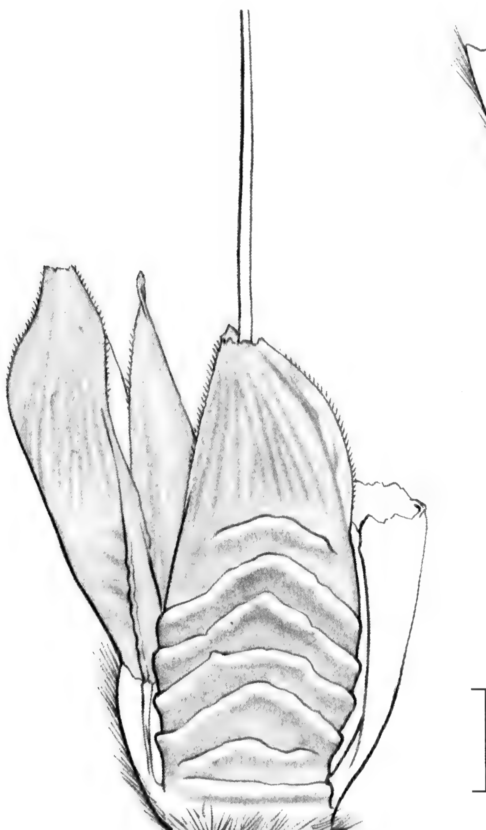


Fig. 83

Fig. 86

In open places, on forest margins or in scrub.
Differences with *I. ciliare* are mentioned there.

Leersia Sw.

Leersia hexandra Sw. – Fig. 85.

Rice Grass

Ridley 1907: 148; 1925: 253. Gilliland 1971: 97. Keng *et al.* 1998: 173.

Culms single or tufted, geniculate, 50—100 cm long; nodes hairy, hairs deflexed. Sheath 4—9.5 cm long, rounded, midrib (slightly) raised, glabrous, scaberulous at base, margins glabrous. Auricles fused with ligule, triangular, glabrous. Ligule membranous, 2 mm long, glabrous, truncate or emarginate. Young leaf blade inrolled. Blade (3.5—)11—14 cm long, 3—7 mm wide, sparsely hairy, margin serrulate, base cuneate. Inflorescence panicle, central rachis 4.5—9.5 cm long, branches 5—14; longest branch 1.7—5 cm long, basal 1/3—2/5 part without spikelets, simple or branched. Pedicel *c.* 0.5 mm long, scaberulous, tip cup-shaped. Spikelets single, 3.3—3.9 mm long, *c.* 1.3 mm wide, laterally flattened, 1-flowered, unawned; callus more or less obtuse; only 2 bracts present, almost equally long, indurated; glumes absent; lemma 3.3—3.9 mm long, veins 5 and with stiff hairs most prominent on midvein, acuminate; palea 3.2—3.7 mm long, 3 veins, acute.

Native; pantropical. First record 1889. Rare.

In wet or swampy areas.

The two glumes are reduced to minute auricles forming a cup-shape at the tip of the pedicel.

Leptochloa P.Beauv.

Lazarides 1980: 247—269.

Leptochloa chinensis (L.) Nees – Fig. 86.

Ridley 1907: 175 (excluding Singapore); 1925: 249. Gilliland 1971: 73. Lazarides 1980: 258. Keng *et al.* 1998: 173.

Culms single or tufted, erect to geniculate or with stolons, 30—120 cm long; nodes glabrous or hairy. Sheath 5.5—10 cm long, keeled, glabrous, margins glabrous. Ligule membranous (i.e. fused hairs), 1—1.3 mm long, hairy at abaxial side. Young leaf blade inrolled. Blade 8.5—19 cm long, 6—13 mm wide, midvein winged underneath, glabrous or upperside sparsely hairy, base cuneate. Inflorescence panicle, central rachis 10—45 cm long, branches at least 25 and often in whorls of 2—4; longest branch 3—14 cm long, with spikelets from the base, simple. Pedicel 0.5 mm long, scaberulous. Spikelets single, 2.1—4.3 mm long, 0.7—1.3 mm wide, more or less laterally flattened, 3—7-flowered, unawned; the two lowest bracts 0.5—0.6 times as long as spikelet; glumes and lemmas herbaceous; lower glume 0.7—2 mm long, 1 vein, glabrous, acute; upper glume 1.1—2.3 mm long, 1 vein, glabrous, acute to acuminate; 1st lemma 1.4—1.7 mm long, 3 veins, hairy at least near the veins, truncate to obtuse; 1st palea *c.* 1.4 mm long, hyaline; upper florets as 1st but gradually smaller, last floret sometimes much reduced.

Native; S and E Asia, Australia. First record 1906. Rather rare.

Waste areas on sand or clay, dry to waterlogged soil, or in water.

Lepturus R.Br.

Nowack and Veldkamp 2002: 385—389.

Lepturus repens (G.Forst.) R.Br. **var. *repens*** – Fig. 87, Plate 16.

Nowack and Veldkamp 2002: 388. — *L. repens* (G.Forst.) R.Br.: Ridley 1907: 182; 1925: 254 (both excluding Singapore). Gilliland 1971: 83. Keng *et al.* 1998: 173.

Culms erect or with stolons, 20—30 cm long; nodes glabrous. Sheath 4—6.5 cm long, rounded, glabrous, margin glabrous. Ligule membranous, 0.5—1 mm long, tip ciliolate. Young leaf blade inrolled. Blade 2.5—9 cm long, 2—4.5 mm wide, underside glabrous, upperside distinctly ribbed, ribs flat and scaberulous, margins in upper half scaberulous, base cuneate and glabrous or sparsely hairy. Inflorescence spike, rachis 7—17 cm long, 1.5—2 mm wide. Pedicel absent. Spikelets single, alternately in rachis cavities, 9—14 mm long (including awn), dorsiventrally flattened, 2-flowered, awned; lowest bract (including awn) as long as and 2nd *c.* 0.5 times as long as spikelet (rudimentary lower glume ignored: see note); upper glume (including awn) 9—14 mm long, indurated, 7 veins, glabrous, at tip gradually tapering into scaberulous awn; both lemmas 4.5—4.8 mm long, thin herbaceous; both paleas 4.7 mm long, thin herbaceous.

Native; East Africa, South and East Asia, Australia, Polynesia and Hawaii. First record 1941. Rather common.

Sandy beaches above high tide mark, preferring coral sands.

The lower glumes are easily overlooked. They are about 0.3 mm long and hidden between the rest of the spikelet and the rachis (adaxial).

Lophatherum Brongn.

Lophatherum gracile Brongn. – Fig. 88, Plate 19.

Crested Grass, *Rumput Jarang*

Ridley 1907: 181; 1925: 253. Gilliland 1971: 55. Keng *et al.* 1998: 173.

Culms single or loosely tufted, erect to geniculate, 40—60 cm long; some roots partly thickened, up to 3 mm diameter; nodes glabrous. Sheath 3.5—10 cm long, somewhat keeled, glabrous to sparsely hairy, with transverse veins, one margin hairy. Ligule membranous, 0.7 mm long, tip ciliolate. Young leaf blade inrolled. Blade 5—16 cm long, 8.5—22 mm wide, with transverse veins present, glabrous to sparsely hairy, pseudopetiole 7—20 mm long and densely short-hairy. Inflorescence panicle, central rachis 15—32 cm long, branches 6—14 in whorls of 1—4; longest branches 7—12 cm long, simple or branched. Pedicel 0—0.2 mm long, scaberulous to sparsely hairy at tip. Spikelets single, 5.7—8 mm long, 1.4—1.6 mm wide, somewhat laterally flattened, 4—12-flowered with 1st floret bisexual and 2nd—12th sterile, awned; the two lowest bracts 0.3—0.5 times as long as spikelet; rachilla not articulate, between 1st and 2nd lemma 1—3.7 mm long and glabrous, extension beyond last lemma 1.5 mm long and scaberulous; glumes and lemmas herbaceous; lower glume 2.9—3.2 mm long, slightly enveloping, 3 or 5 veins, hairy at least at tip, truncate to obtuse; upper glume *c.* 4 mm long, slightly enveloping, 5 veins, sparsely hairy, acuminate; 1st lemma 4.7—5.5 mm long, 9—11 veins, glabrous, tip bifid and ciliolate, awn from notch 1.2 mm long and scaberulous; 1st palea 2—4.3 mm long, hyaline; 2nd—12th lemmas as first but gradually smaller, not visible in young spikelets before flowering time; 2nd—12th paleas absent.

Native; S and SE Asia and Australia. First record 1880s. Rare.

Open spots on moist soil in primary and older secondary forests.

For the difference in its vegetative parts with *Centotheca lappacea* see there.

Melinis P.Beauv.

Melinis repens (Willd.) Zizka – Fig. 89, Plate 20.

Natal Grass

Keng *et al.* 1998: 173.

Rhynchelytrum repens (Willd.) C.E.Hubb.: Gilliland 1971: 150.

Culms tufted, erect to somewhat geniculate, 55—80 cm long; nodes (upper distinctly) hairy. Sheath 7—17 cm long, rounded, lower ones densely hairy, upper glabrescent, margins glabrous. Ligule row of hairs, 0.7—1 mm long. Young leaf blade inrolled. Blade (4—)9—14 cm long, (1.5—)4 mm wide, sparsely hairy in basal half at underside, base rounded and sparsely hairy. Inflorescence panicle, central rachis 10—17 cm long, branches 8—12; longest branch 3—7 cm long, scaberulous to sparsely hairy at base, branched. Pedicel 1—3.5 mm long, thinner than branch, purplish, sparsely hairy near tip. Spikelets single, 3.5—4.2 mm long, 2 mm wide, yawning, somewhat laterally flattened, 2-flowered with 1st floret male and 2nd bisexual, awned; lowest bract 0.2 times as long as and 2nd as long as spikelet; lower glume 0.9—1.2 mm long, herbaceous, 1 vein, densely hairy, hairs up to 1.5 mm long and reddish, emarginate; upper glume 3.2—3.6 mm long, herbaceous, 5 veins, densely hairy, hairs up to 6.5 mm long and red, truncate to obtuse, awn from tip and 0.6—2 mm long; 1st lemma as upper glume, 3.1—3.5 mm long, awn 0.5—1.5 mm long; 1st palea 2.7—3 mm long, hyaline; 2nd lemma 1.8—2 mm long, thin herbaceous, 5 veins, emarginate; 2nd palea 1.7—2 mm long, thin herbaceous.

Not native; Africa, introduced in Asia, Australia and America. First record 1896 from the Botanic Gardens, 1939 in the wild. Rather rare.

Open spaces on dry sandy soil.

Mnesithea Kunth

Veldkamp *et al.* 1986: 281—307.

Culms erect. Inflorescence spike-like raceme, rachis articulated, joints at articulation with a central knob. Spikelets in pairs of 1 sessile and 1 pedicelled. Sessile spikelet more or less dorsiventrally flattened, 2-flowered with 1st floret sterile and 2nd bisexual, unawned; lowest bract as long as spikelet, 2nd slightly shorter but longer than the florets; lower glume flattened, submarginally keeled, indurated; upper glume (thick) herbaceous; lemmas and paleas hyaline (or 2nd palea absent).

The internodes of the inflorescence are corky, allowing them to float on water after articulation. The central knob (or elaiosome) in *M. laevis* (and *Rottboellia cochinchinensis* as well) is reported to contain an oily substance that attracts ants (Veldkamp *et al.* 1986: 295). This still needs to be confirmed for the two species included below.

Rottboellia differs from this genus in having a male 1st floret (Veldkamp *et al.* 1986).

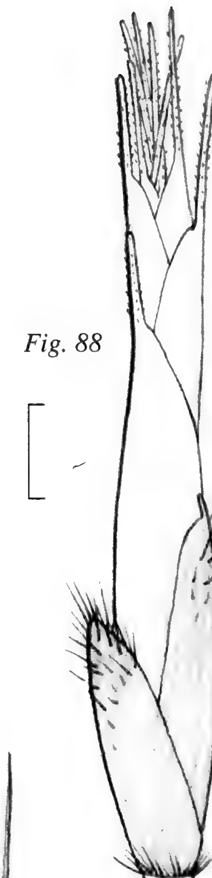
1a. Culms 90—210 cm long. Sessile spikelet 3.9—4.8 mm long. Lower glume lanceolate, veins not thickened and raised, keels at base with 2—7 gland-like warts, in upper half winged. ***M. glandulosa***

1b. Culms *c.* 40 cm long. Sessile spikelet *c.* 1 mm long. Lower glume orbicular, veins and transverse veins thickened and raised, making squarish depressions, keels thickened and raised and without warts. ***M. granularis***

Figure 87. *Lepturus repens* (G.Forst.) R.Br. var. *repens*.
a. spikelet, b. rachis, c. exploded view of spikelet.
Figure 88. *Lophatherum gracile* Brongn.
Figure 89. *Melinis repens* (Willd.) Zizka.
Figure 90. *Neyraudia arundinacea* (L.) Henrard var. *zollingeri* (Büse) Henrard.

Fig. 89

Fig. 88



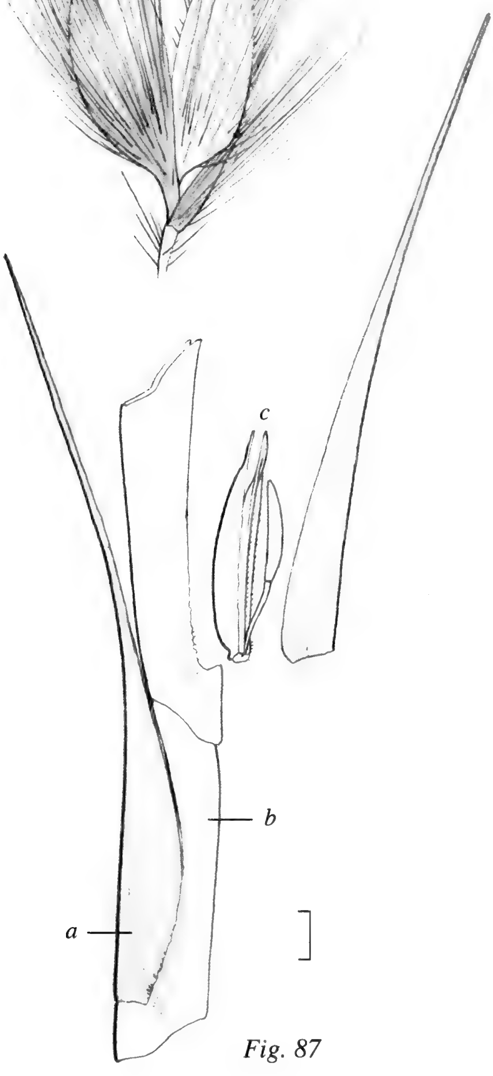


Fig. 87

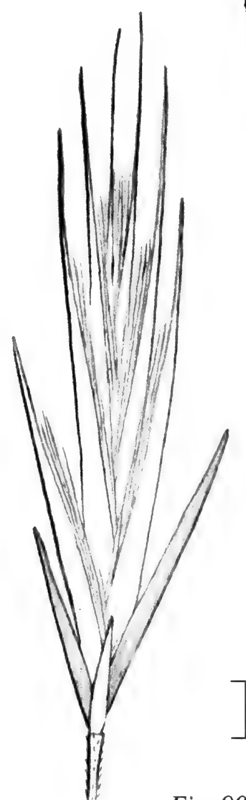


Fig. 90

Mnesithea glandulosa (Trin.) De Koning & Sosef – Fig. 91.

Mat Grass

Veldkamp *et al.* 1986: 288. Keng *et al.* 1998: 174.

Coelorachis glandulosa (Trin.) Stapf ex Ridl. 1925: 204. Gilliland 1971: 270.

Rottboellia glandulosa Trin.: Ridley 1907: 161.

Culms single or tufted, 90—210 cm long; internodes hollow, 4—10 mm diameter; nodes glabrous. Sheath 10—17 cm long, rounded, glabrous. Auricles triangular, hairy. Ligule membranous, 1—1.5 mm long, ciliolate. Young leaf blade inrolled. Blade 29—45 cm long, 13—24 mm wide, glabrous, base cuneate to somewhat rounded and hairy. Peduncles 1—5 per sheath from upper and lower sheaths. Inflorescence 7—14 cm long. Pedicel 4.5—5 mm long, not fused to rachis. Sessile spikelet 3.9—4.8 mm long, 1.4—1.6 mm wide; lower glume 3.9—4.8 mm long, 7 veins, glabrous or hairy, keels at base with 2—7 glandlike warts and in upper half winged, wings 0.5—0.9 mm wide; upper glume 3.6—4.5 mm long, boat-shaped, 3 veins, midvein keeled and ciliolate; 1st lemma 2.6—3.2 mm long; 1st palea 1.7—2 mm long; 2nd lemma 2.6—2.8 mm long; 2nd palea *c.* 2.5 mm long. Pedicelled spikelet reduced, lower glume winged on one side only, lemmas and paleas absent.

Native; Thailand, Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, Philippines. First record 1887. Rather rare.

Coast-near woodlands (abandoned plantations, forests etc.), on dry to moist soil.

Ridley (1907, 1925) mentioned it grew on riverbanks.

Rottboellia cochinchinensis is different in having hairy sheaths and upper surfaces of blades; other differences are mentioned in note under *Mnesithea* and in the key to flowering grasses (p. 22, lead 10).

Mnesithea granularis (L.) De Koning & Sosef – Fig. 92.

Veldkamp *et al.* 1986: 294. Keng *et al.* 1998: 174.

Hackelochloa granularis (L.) Kuntze: Gilliland 1971: 277.

Manisuris granularis L.f.: Ridley 1907: 163; 1925: 205 (both excluding Singapore).

Culms single, *c.* 40 cm long; basal internodes *c.* 3 mm diameter; nodes hairy. Sheath *c.* 2.5 cm long, rounded, densely hairy, margin densely hairy, auricles absent. Ligule membranous, 1—1.5 mm long, hairy. Young leaf blade folded along midrib. Blade 7—9 cm long, 6—8 mm wide, hairy, base rounded to cordate and pectinate. Peduncles 1 per sheath, from 1—3 sheaths. Inflorescence 1—2 cm long. Pedicel *c.* 0.8 mm long, furrowed, fused to rachis to form cavity that holds sessile spikelet. Sessile spikelet *c.* 1 mm long, *c.* 1 mm wide; lower glume *c.* 1 mm long, veins and transverse veins thickened and raised to make squarish depressions, glabrous, wings absent; upper glume *c.* 1 mm long, more or less flattened, veins not obvious; 1st lemma *c.* 0.8 mm long; 1st palea absent; 2nd lemma as 1st; 2nd palea absent (see note). Pedicelled spikelet lower glume *c.* 1.2 mm long, winged on one side only, acute; upper glume *c.* 1.2 mm long, boat-shaped, keel winged, acute.

Doubtfully native; pantropical. Single record 1949 from Kampung Kelapa at Pulau Ayer Merbau, now part of Jurong Island. Extinct (1949).

According to Gilliland (1971) the 2nd palea is 0.6 mm long.

In Peninsular Malaysia, it was also found only once. In Java it grows much bigger (Gilliland 1971), suggesting that it might not be native in Singapore.

Figure 91. *Mnesithea glandulosa* (Trin.) De Koning & Sosef, pair of spikelets.

Figure 92. *Mnesithea granularis* (L.) De Koning & Sosef.
a. sessile spikelet, b. pedicelled spikelet.

Figure 93. *Oryza sativa* L.

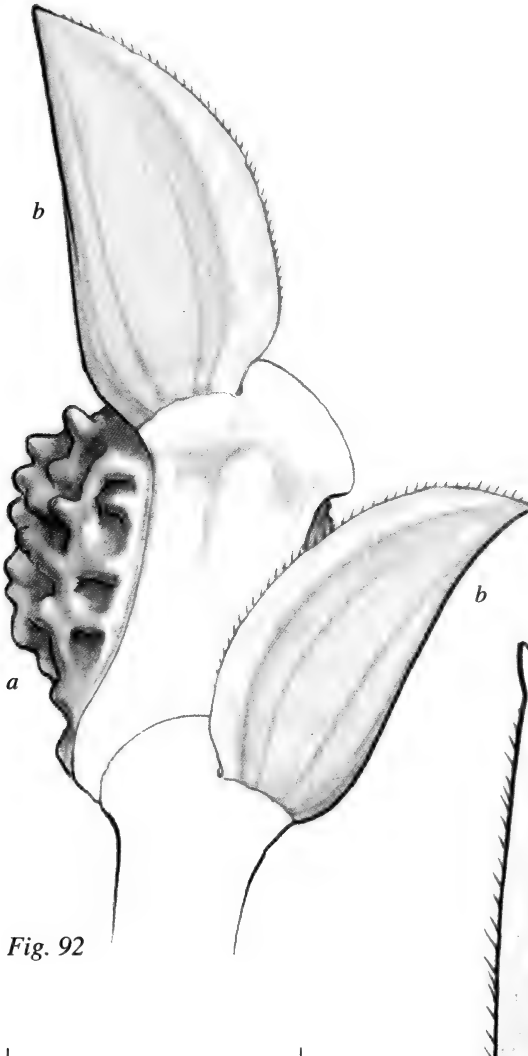


Fig. 92

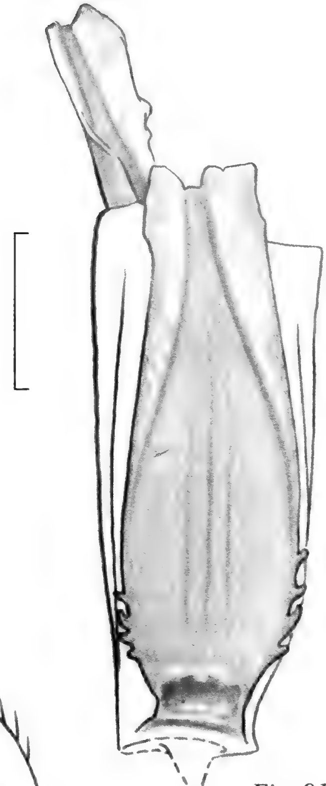


Fig. 91

Fig. 93

Neyraudia Hook.f.

Neyraudia arundinacea (L.) Henrard **var.** ***zollingeri*** (Büse) Henrard – Fig. 90.

Veldkamp 1999b: 234. Duistermaat 2004: 42.

Neyraudia madagascariensis Hook.f. var. *zollingeri* Hook.f.: Ridley 1907: 176 (excluding Singapore).

Triraphis madagascariensis sensu Ridl., 1925: 251 (excluding Singapore).

Neyraudia reynaudiana (Kunth) Keng ex Hitchc.: Gilliland 1971: 61.

Culms up to 3 m long; internodes solid; nodes glabrous. Sheath 9—16 cm long, rounded, hairy at tip, margins glabrous. Ligule row of hairs, 3—5 mm long. Young leaf blade inrolled. Blade *c.* 40 cm long, 7—20 mm wide, glabrous, base rounded and with short hairs. Inflorescence panicle, silky hairy, central rachis *c.* 65 cm long, branches many and in groups of 1—4; longest branch *c.* 18 cm long, glabrous, branched. Pedicel 3—4 mm long, scaberulous. Spikelets single, *c.* 10.5 mm long (including awns), more or less laterally flattened, herbaceous, 7-flowered with 1st floret sterile and 2nd—7th bisexual, awned; rachilla articulated between 1st and 2nd floret; the two lowest bracts 0.2—0.3 times as long as spikelet; lower glume 2.5 mm long, at base almost enveloping, 3 veins, glabrous, acute; upper glume 2.7 mm long, 3 veins, midvein somewhat keeled and ciliolate, acute; 1st lemma 3.9 mm long, 3 or 5 veins, glabrous, acute; 1st palea absent; 2nd lemma 3.5 mm long, margin with *c.* 2 mm-long silky hairs, midvein protruding into *c.* 0.8 mm-long awn; 2nd palea 2.3 mm long; 3rd—7th florets as 2nd with lemmas up to 5 mm long and awns up to 2 mm long.

Doubtfully native; India to SW China, Peninsular Malaysia, Singapore, Sumatra, Java, Lesser Sunda Islands; naturalized in North America and Caribbean. Single record 1959 from Bartley Road. Extinct in the wild (1959).

It was reported as growing on infertile soil, in thickets and unshaded places (Veldkamp 1999). In Peninsular Malaysia it is more common in the north and grows in less wet places than *Phragmites* (Gilliland 1971). It is not known whether in Singapore it was native. Today, it is only known planted in the Botanic Gardens.

It is different from *Phragmites* in the solid culm internodes and hairy lemmas (hollow respectively glabrous in *Phragmites*). Differences with other species with silky-hairy panicles are mentioned in a note under *Imperata*.

Oplismenus P.Beauv.

Scholz 1981: 1—213. Veldkamp 1999b: 234.

Culms stoloniferous, 25—60 cm long; nodes (sparsely) hairy. Sheath rounded, hairy, margins hairy. Auricles triangular, hairy. Ligule row of hairs, fused in basal part. Young leaf blade inrolled. Blade hairy, base rounded. Inflorescence panicle, central rachis flattened to somewhat triquetrous and hairy; branches 3—5, more or less flattened to triquetrous, 0.4 mm wide. Pedicel rounded, hairy. Spikelets single, not to laterally flattened, 2-flowered with 1st floret sterile and 2nd bisexual, awned; the two lowest bracts (excluding awns) 0.6—0.8 times as long as spikelet; glumes and 1st lemma (thin) herbaceous; lower glume not enveloping, 5 veins, awned; upper glume shorter awned; 2nd floret leathery, glabrous.

1a. Awns antrorsely scaberulous, filiform, dull.	***O. burmanni***
1b. Awns smooth, rather thick, viscid, shiny.	***O. compositus***

Oplismenus burmanni (Retz.) P.Beauv. – Fig. 94.

Ridley 1907: 145; 1925: 221 (both excluding Singapore). Gilliland 1971: 172 (excluding Singapore). Scholz 1981: 57. Veldkamp 1999b: 234. Duistermaat 2004: 42.

Sheath 0.7—1.9 cm long. Ligule 0.8—1 mm long, basal part 0.3—0.4 mm long, free hairs 0.5—0.6 mm long. Blade 2.5—3.5 cm long, 5—9 mm wide. Inflorescence 2.5—5 cm long; longest branch 0.5—1.2 cm long, simple. Spikelet 2.3—3.2 mm long, 1 mm wide; lower glume 1.7—2 mm long, sparsely to densely hairy, awn 2—14 mm long and antrorsely scaberulous; upper glume as lower, 1.5—1.8 mm long, awn 1.5—3.5 mm long; 1st lemma 2.2—2.8 mm long, 7 veins, sparsely to densely hairy, awn 0.7—0.9 mm long; 1st palea absent; 2nd lemma 1.6—2.4 mm long; 2nd palea 1.5—2.3 mm long.

Probably not native; pantropical. First record 1959. Rare.

Shaded places, between rocks, in weedy fields, plantations and lawns.

This species is in Singapore only known from a few roads bordering the Botanic Gardens and in Peninsular Malaysia only from Kedah, Pahang and Penang.

Oplismenus compositus (L.) P.Beauv. – Fig. 95.

Common Wood Grass

Ridley 1907: 145; 1925: 221 (both excluding Singapore). Gilliland 1971: 171 (excluding Singapore). Scholz 1981: 85. Veldkamp 1999b: 234. Duistermaat 2004: 42.

Sheath 1.5—3.5 cm long. Ligule 1.2 mm long, basal part 0.5 mm long, free hairs 0.7 mm long. Blade 4.5—5.5 cm long, 5—7 mm wide. Inflorescence 2.5—9 cm long; longest branch 1—1.5 cm long, simple or branched. Spikelet 2.5—3 mm long, 1.2 mm wide; lower glume 2.4 mm long, sparsely to densely hairy, awn 4—12 mm long and smooth; upper glume as lower, 2 mm long, awn 0.4 mm long; 1st lemma 2.2 mm long, 9 veins, glabrous to margins ciliate, 0.1 mm apiculate; 1st palea 1.5 mm long, hyaline; 2nd lemma 1.9 mm long; 2nd palea 1.9 mm long.

Status unknown; pan(sub)tropical. First record 1959. Rare.

Moderately shaded soil, open places in primary and secondary forest.

The inflorescence branches and spikelets are shorter than mentioned in Veldkamp (1999b), but Scholz (1981) recognized them as *O. compositus* var. *rariflorus* (J.Presl) Scholz. The wider species concept of the latter is followed, but not the recognition of her overlapping varieties.

The species is known throughout Peninsular Malaysia but is there more common in the north (Gilliland 1971).

Oryza L.

Duistermaat 1987: 157—193.

Oryza rufipogon Griff. has been mentioned for Singapore by Duistermaat (1987: 171), but material has not been found. As its occurrence is often associated with rice cultivation, it is now probably extinct here. It is different from *O. sativa* as follows:

1a. Spikelets articulating, falling off at maturity. Anthers 3.5—6.2 mm long. ***O. rufipogon***
1b. Spikelets not articulating, remaining attached to pedicel at maturity. Anthers 0.8—2.5 mm long. ***O. sativa***

Oryza sativa L. – Fig. 93.

Rice, *Padi*

Gilliland 1971: 99. Duistermaat 1987: 174.

Culms single or in small tufts, erect to ascending, 50—190 cm long; nodes glabrous. Sheath glabrous, (obscure) transverse veins present. Auricles deciduous, linear-lanceolate, falcate, 1—5 mm long, 0.5—1 mm wide, with up to 2 mm long hairs. Ligule membranous, (6—)10—

36 mm long, glabrous. Young leaf blade inrolled. Blade 24—60 cm long, 6—22 mm wide, glabrous, margins scabrous or rarely smooth. Inflorescence panicle, central rachis 9—30 cm long, branches many; longest branches 2—13 cm long, simple or branched. Pedicel 1—7 mm long, glabrous to slightly pubescent, at tip cup-shaped. Spikelets single, 7—10.9 mm long, 2.65—4.6 mm wide, not articulating, laterally flattened, 3-flowered, awned or unawned; the two lowest bracts 0.2—0.4 times as long as spikelet; lower and upper glume absent; 1st and 2nd lemma sterile, 1.4—4 mm long, herbaceous, glabrous, margin serrate; 1st and 2nd palea absent; 3rd lemma fertile, 6—10 mm long, strongly indurated, finely reticulate, covered by glassy hairs, 5 veins, acuminate, awn from tip and up to 60 mm long, antrorsely scaberulous, callose at base; 3rd palea as 3rd lemma, 5.8—9.5 mm long, 3 veins, awn 0.2—0.45 mm long.

Not native; Southeast Asia, now cultivated in (sub-)tropical regions. First record 1880s. Cultivated (last record 1970).

Rice is no longer cultivated in Singapore but it can still be found as a casual from bird-seed.

The glumes are reduced to minute auricles that form a cup at the tip of the pedicel.

Ottochloa Dandy

Ottochloa nodosa (Kunth) Dandy – Fig. 96.

Slender Panic Grass

Gilliland 1971: 143. Keng *et al.* 1998: 174.

Hemigymnia fusca Ridl. 1925: 228.

Hemigymnia multinodis Stapf; Ridley 1925: 228.

Panicum nodosum Kunth; Ridley 1907: 137.

Culms erect to geniculate or creeping to scrambling, 30—120 cm long; nodes glabrous or hairy. Sheath 3—6.5 cm long, rounded, glabrous to densely patent hairy, at least one margin hairy. Ligule membranous, 0.5—0.7 mm long, tip ciliolate. Young leaf blade inrolled. Blade (5—)8—17 cm long, (5—)7—12 mm wide, glabrous to densely hairy, base rounded and margin glabrous to sparsely hairy, pseudopetiole 0.7—2 mm long. Inflorescence panicle, central rachis 10—26 cm long, branches (3—)6—9 in groups of 1—3; longest branch (1—)6.5—16 cm long, (simple or) branched, ultimate branches short and not or only slightly overlapping. Pedicel 0.5—1.3 mm long. Spikelets single, 2.7—3.3 mm long, 0.8—1 mm wide, not flattened, 2-flowered with 1st floret sterile and 2nd bisexual, unawned; the two lowest bracts 0.4—0.5 times as long as spikelet; glumes and 1st lemma herbaceous; lower glume 1.2—1.4 mm long, margin (at tip) ciliate, 3—5 veins, obtuse; upper glume as lower, 1.5—1.7 mm long, 7 veins; 1st lemma 2.5—3 mm long, glabrous or hairy, 7 or 9 veins, truncate to obtuse; 1st palea absent; 2nd lemma 2.3—2.6 mm long, glabrous, 5 veins, truncate, 0.1 mm long apiculate, somewhat indurated; 2nd palea 2—2.3 mm long.

Native; India and west Malesia. First record 1889. Common.

In open to (partly) shaded places, forest margins, also on wet soil.

This species is very variable with respect to indument density on sheath and blade, the number and the length of the panicle branches and the colour of the spikelets (green to purple). Different forms may grow next to each other. A monstrosity with the upper floret having 4 ovaries each with 2 or 3 stigmas occurs rarely.

The upper glumes of *Panicum* species are 0.9—1 times as long as the spikelet.

Figure 94. *Oplismenus burmanni* (Retz.) P.Beauv.
Figure 95. *Oplismenus compositus* (L.) P.Beauv.
Figure 96. *Ottochloa nodosa* (Kunth) Dandy.
Figure 97. *Panicum auritum* J.Presl ex Nees.

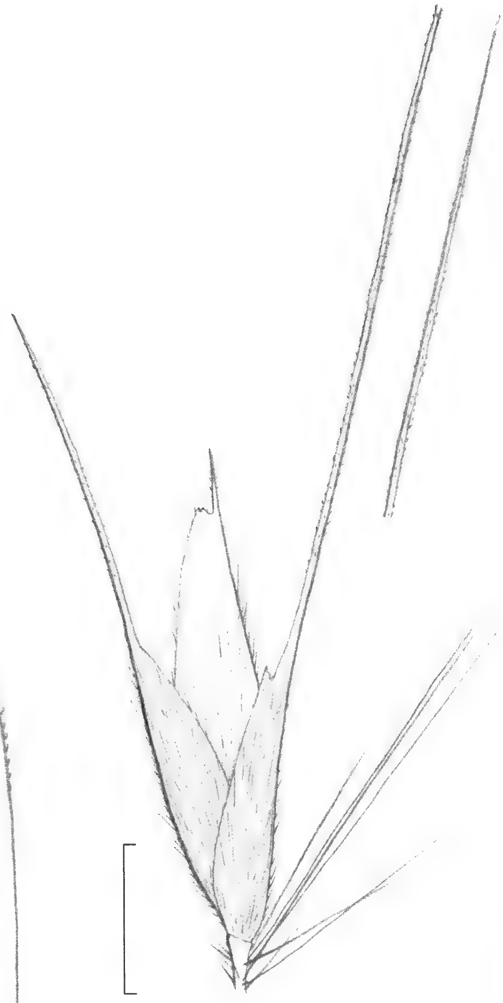


Fig. 94

Fig. 96

Fig. 97

Fig. 95

Panicum L.

Veldkamp 1996a: 181—216. Aliscioni *et al.* 2003: 796—821. Duistermaat 2004: 35—37. Sheath rounded. Auricles absent. Young leaf blade inrolled. Inflorescence panicle, central rachis present, branches 6 or more (or less in *P. laxum*), rounded, branched (with only 2 spikelets in *P. trichocladum*). Pedicel present. Spikelets single or paired, not flattened, 2 (or 3)-flowered with 1st floret sterile or male and 2nd bisexual, unawned; 2nd lowest bract 0.9—1 times as long as the spikelet; glumes (thin) herbaceous; 1st lemma as upper glume; 1st palea hyaline; 2nd lemma and palea (slightly) indurated, palea (almost) as long as lemma.

Panicum is retained here in its traditional wider delimitation (Duistermaat 2004: 35), rather than following Aliscioni *et al.* (2003).

Inflorescences with a few 3-flowered spikelets have been seen in *P. maximum*.

The key follows Veldkamp (1996a).

1a. Lower glume collar-shaped (Fig. 18a). **2**
1b. Lower glume ovate (Fig. 18b) or triangular. **3**

2a. Sheaths and blades glabrous. Ligule a hairy collar. Spikelets 3.3—4.5 mm long. Upper glume 3.3—4.1 mm long. 1st floret sterile; palea up to 0.7 times as long as the lemma (or absent). ***P. paludosum***
2b. Sheath margins and blades hairy. Ligule a membranous ciliolate collar. Spikelets 2.6—3.25 mm long. Upper glume 2.6—3 mm long. 1st floret male; palea more than 0.8 times as long as the lemma. ***P. repens***

3a. Ligule a membranous glabrous or ciliolate collar (hairs at the tip much shorter than the basal part). **4**
3b. Ligule *either* a ciliate collar (hairs at the tip (almost) as long as the basal part), *or* a row of hairs, *or* membranous with abaxially a row of long hairs. **7**

4a. Blades ovate-lanceolate, at base cordate, margin pectinate. Lower glume 1.6—3 mm long. ***P. brevifolium***
4b. Blades linear, at base truncate to cordate, margin glabrous (or pectinate in *P. auritum*). Lower glume 0.3—1.3 mm long. **5**

5a. Panicle branches naked at base. Lower glume triangular, 0.1—0.2 times as long as the spikelet. 1st palea present; 2nd lemma tip apiculate, incurved. ***P. trichocladum***
5b. Panicle branches with spikelets (almost) to base. Lower glume ovate, 0.3—0.7 times as long as the spikelet; 1st palea absent or present; 2nd lemma tip obtuse to acuminate, straight. **6**

6a. Culms 80—120 cm long. Spikelet 2—3 mm long. 1st palea up to 0.75 times as long as 1st lemma. ***P. auritum***
6b. Culms 20—45 cm long. Spikelet 1.3—1.4 mm long. 1st palea as long as 1st lemma. ***P. laxum***

7a. **(3)** Culms scrambling. Nodes glabrous (to puberulous). Pedicels smooth, sometimes viscid. Spikelets obtuse; 2nd lemma apiculate. ***P. sarmentosum***

7b. Culms erect or geniculate at base. Nodes hairy. Pedicels scaberulous or hairy under the spikelet, not viscid. Spikelets acute to caudate; 2nd lemma obtuse, acute, or acuminate. **8**

8a. Glumes with a distinct internode. Upper glume and 1st lemma with transverse veinlets. 2nd lemma sessile, smooth, shiny, obtuse to acute. ***P. luzonense***

8b. Glumes without a distinct internode. Upper glume and 1st lemma without transverse veinlets. 2nd lemma stipitate, transversely rugulose, dull, acuminate. ***P. maximum***

Panicum auritum J.Presl ex Nees – Fig. 97.

Giant Panic Grass, *Rumput Kumpai*

Ridley 1907: 135; 1925: 226. Gilliland 1971: 137. Veldkamp 1996a: 187. Keng *et al.* 1998: 174.

Culms single, erect or with short rhizomes, 80—120 cm long; internodes hollow; nodes glabrous. Sheath 7—9 cm long, glabrous, minute transverse veins present (visible only from inside), one margin hairy. Ligule membraneous, 0.4—1 mm long, glabrous, tip entire or ciliolate. Blade 18—30 cm long, 9—23 mm wide, glabrous, margin scaberulous, base rounded to cordate and pectinate. Inflorescence spike-like, central rachis 16—40 cm long, branches erect; longest branch 2—12 cm long, with spikelets almost from the base. Pedicel 0.5—1.8 mm long, scaberulous. Spikelet 2.2—3 mm long, 0.7—0.8 mm wide, acute to acuminate, glumes without a distinct internode, 1st floret sterile; lowest bract 0.4 times as long as spikelet; lower glume 0.8—1.3 mm long, ovate, 3—5 veins, glabrous; upper glume 2—2.5 mm long, 5 veins, transverse veins present (obscure), glabrous; 1st lemma 1.6—2.8 mm long, acute; 1st palea 0.6—1.7 mm long; 2nd lemma 1.6—2.4 mm long, scaberulous at tip. Anthers 2, 0.7—0.8 mm long.

Native; India to S. China and Indonesia, New Guinea. First record 1880s. Extinct (1966).

Moist places, river banks, ditches.

The Singapore material is different from that of Veldkamp (1996a) in having sheaths with one margin hairy and blades that are pectinate at base.

Hymenachne amplexicaulis is different in having culms filled with pith, blades hairy on the upperside and long-acuminate spikelets (3—)3.9—4.9 mm long with the upper glume 0.7—0.9 times as long as the spikelet. *Sacciolepis* has blades up to 6 mm wide, panicles with up to 0.5 cm-long branches and gibbous spikelets.

Panicum brevifolium L. – Fig. 98.

Short-leaved Panic Grass

Gilliland 1971: 139. Veldkamp 1996a: 189. Keng *et al.* 1998: 175.

P. hirtifolium Ridl. 1907: 141; 1925: 228 (both excluding Singapore).

P. ovalifolium Poir. in Lam.: Ridley 1907: 141; 1925: 227.

Culms creeping to geniculate, 20—50 cm long; internodes hollow; nodes glabrous. Sheath 1.5—5 cm long, transverse veins absent, glabrous, margins hairy. Ligule membranous, 0.5 mm long, glabrous, tip ciliolate. Blade 3—4.5 cm long, 15—20 mm wide, sparsely hairy, base cordate and pectinate. Inflorescence open, central rachis 9—11 cm long, branches erecto-patent; longest branch 5.5 cm long, empty at base. Pedicel 1.5 mm long, glabrous. Spikelet 1.6 mm long, 0.6 mm wide, acute, glumes with a distinct internode, 1st floret sterile; lowest bract as long as spikelet; lower glume 1.6 mm long, ovate, sparsely hairy; upper glume 1.5 mm long, 5 veins, transverse veins absent, sparsely hairy; 1st lemma 1.6 mm long, truncate; 1st palea 1.3 mm long; 2nd lemma 1.3 mm long, smooth. Anthers 3, 0.75—1 mm long.

Possibly native; Paleotropics, possibly introduced in at least part of Malesia. Single record 1894 from Government Hill (now the Istana). Extinct (1894).

Shaded places.

The spikelets are shorter than reported by Veldkamp (1996a: 1.9—2.1 mm long).

Panicum laxum Sw. – Fig. 99.

Duistermaat 2004: 36.

Steinchisma laxa (Sw.) Zuloaga: Simon 2003: 562.

Culms single or tufted, geniculate to prostrate, 20—45 cm long; internodes hollow; nodes glabrous. Sheath 2.5—6.5 cm long, minute transverse veins present, glabrous, margin hairy at least at tip. Ligule membranous, 0.3—0.4 mm long, glabrous, tip ciliolate. Blade 4—11 cm long, 2—10 mm wide, glabrous, base rounded. Inflorescence open, central rachis 5—13 cm long, branches patent; longest branch 2.5—6 cm long, with spikelets almost from the base at adaxial side only, branchlets appressed to 1st order branch (spike-like). Pedicel 0.5—1 mm long, scaberulous. Spikelet 1.3—1.4 mm long, 0.7 mm wide, obtuse, glumes without a distinct internode, 1st floret sterile; lowest bract 0.4—0.5 times as long as spikelet; lower glume 0.5—0.6 mm long, ovate, 1 or 3 veins, midvein near tip keeled and with few spicules; upper glume as lower, 1.2 mm long, 5 veins, transverse veins absent; 1st lemma 1.2—1.3 mm long, 3 veins, obtuse to acute; 1st palea 1.2—1.3 mm long; 2nd lemma 1.1—1.2 mm long, scaberulous at tip. Anthers 2, 0.5 mm long.

Not native; America, introduced in tropical Africa and Australia and according to Veldkamp (*pers. comm.*) recently also found in Borneo. First record 2002. Rare.

Open to shaded roadsides or fields, on clayey or sandy soil or in cracks of concrete drain.

The inflorescence is reminiscent of that of *Urochloa subquadripara*, which differs in the simple branches and much longer spikelets (3.5—4.3 mm). The 1st paleas are reported to enlarge (Aliscioni *et al.* 2003), but this could not be ascertained.

Plants with single and prostrate culms (rather than being tufted and geniculate) have a potential as a turf grass for shaded conditions (Simon 2003).

Panicum luzonense J.Presl – Fig. 100.

Ridley 1907: 136. Veldkamp 1996a: 195. Keng *et al.* 1998: 175.

P. caesium Nees ex Hook.f.: Ridley 1925: 225.

P. cambogiense Balansa: Gilliland 1971: 141.

Culms tufted, geniculate, 40—50 cm long; internodes hollow; nodes hairy. Sheath 6—9 cm long, transverse veins absent, densely patent hairy, margins hairy. Ligule row of hairs fused in basal half, 1—2.1 mm long. Blade 9—14 cm long, 5—7 mm wide, hairy, base rounded and pectinate. Inflorescence open, central rachis 15—30 cm long, branches patent; longest branch

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Figure 98. *Panicum brevifolium* L.
Figure 99. *Panicum laxum* Sw.
Figure 100. *Panicum luzonense* J.Presl.
Figure 101. *Panicum maximum* Jacq.
Figure 102. *Panicum paludosum* Roxb.

Fig. 98

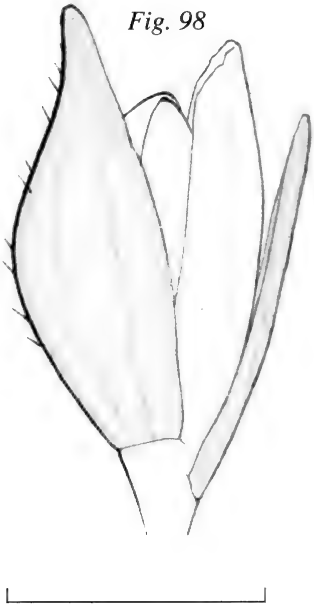
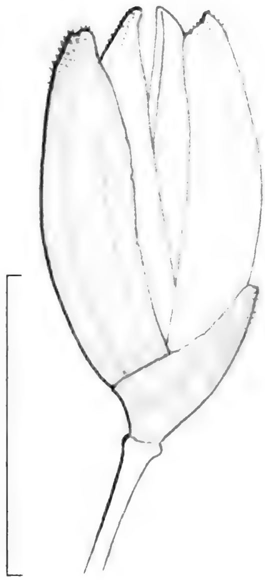


Fig. 99



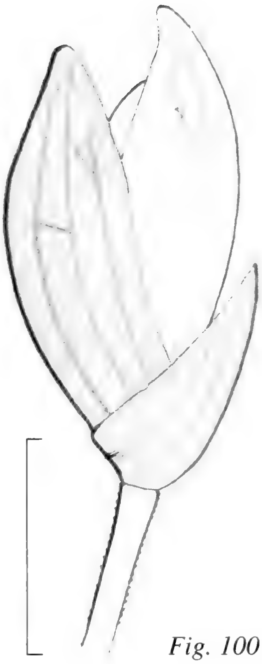


Fig. 100

Fig. 101

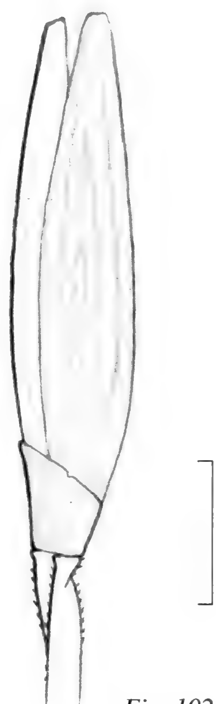


Fig. 102

7.5—15 cm long, with spikelets from the base or not. Pedicel 0.8—3 mm long, scaberulous. Spikelet 2—2.1 mm long, 0.7—1.1 mm wide, acute, glumes with a distinct internode, 1st floret sterile; lowest bract 0.5 times as long as spikelet; lower glume 0.9—1 mm long, ovate, 5 or 7 veins, glabrous; upper glume 1.6—1.9 mm long, 7—9 veins, transverse veins present, glabrous; 1st lemma 1.6—1.8 mm long, 5—7 veins, obtuse; 1st palea 1.6—1.7 mm long; 2nd lemma 1.3—1.4 mm long, smooth. Anthers 3, 0.7 mm long.

Native; Sri Lanka, India to Australia. First record 1894. Extinct (1959).

In open, unshaded to moderately shaded roadsides, waste areas, beaches, fields etc.

The upper glume and 1st lemma have fewer veins than reported in Veldkamp (1996a: upper glume 9—11-veined, 1st lemma 7—11-veined).

Panicum maximum Jacq. – Fig. 101, Plate 18.

Guinea Grass, *Rumput Benggala*

Ridley 1907: 140; 1925: 226. Gilliland 1971: 132. Veldkamp 1996a: 197. Keng *et al.* 1998: 175.

Urochloa maxima (Jacq.) R.D.Webster: Aliscioni *et al.* 2003: 810.

Culms with short rhizomes, erect to geniculate, 100—200 cm long; internodes hollow or solid upwards; nodes (densely) hairy. Sheath 10—34 cm long, transverse veins absent, glabrous or hairy, at least one margin hairy. Ligule membranous, 1—3 mm long, hairs at tip 0.3—0.5 mm long, abaxial row of hairs 1—3 mm long. Blade (9—)25—50 cm long, 6.5—25 mm wide, glabrous, margin scaberulous or hairy near base, base cuneate to slightly rounded and short-hairy. Inflorescence open, central rachis 27—50 cm long, branches patent; longest branch 13—32 cm long, naked at basal 2—9 cm. Pedicel 0.3—1.3(—3) mm long, scaberulous or with few long hairs. Spikelet 3.2—3.6 mm long, 1—1.2 mm wide, acute, glumes without a distinct internode, 1st floret male; lowest bract 0.4—0.5 times as long as spikelet; lower glume 1.4—1.5 mm long, ovate, 3 (or 5) veins, glabrous; upper glume 2.4—3.3 mm long, 5 veins, transverse veins absent, glabrous; 1st lemma as upper glume, 3—3.5 mm long; 1st palea 2.6—3 mm long; 2nd lemma 2.3—2.5 mm long, transversely rugulose; 3rd floret sometimes present, reduced. Anthers 3, 1—1.5 mm long.

Not native; Africa, introduced (sub-)pantropically. First record 1901. Common.

In disturbed areas, grassy places, riverbanks, thickets, margins of secondary forest, etc.

This species was originally introduced as a fodder crop.

Panicum paludosum Roxb. – Fig. 102.

Gilliland 1971: 134 (excluding Singapore). Veldkamp 1996a: 200. Duistermaat 2004: 35.

P. proliferum auct., non Lam.: Ridley 1907: 139; 1925: 225 (both excluding Singapore).

Culms floating in water, *c.* 70 cm long; internodes hollow; nodes glabrous. Sheath 7—9 cm long, transverse veins absent, glabrous, margins glabrous. Ligule row of hairs fused at basal 0.5 mm, 1.5 mm long. Blade 12—16 cm long, 7—9 mm wide, glabrous, base rounded. Inflorescence open, central rachis 11—15 cm long, branches erecto-patent; longest branch 6—9 cm long, naked at base. Pedicel 1.5—2 mm long, scaberulous. Spikelet 3.4—3.5 mm long, 1 mm wide, acute, glumes without a distinct internode, 1st floret sterile; lowest bract 0.15—0.25 times as long as spikelet; lower glume 0.6—0.8 mm long, collar-shaped, 0 veins, glabrous; upper glume 3.3—3.4 mm long, glabrous; 1st lemma *c.* 3.2 mm long, acute; 1st palea 1.5—2.1 mm long; 2nd lemma 2—2.2 mm long, smooth. Anthers 3, *c.* 1.2 mm long.

Possibly native; India, S. China, southward to Australia. First record 1959. Extinct (1965).

Aquatic, in shallow water, bogs, ditches, rice fields etc.

Its natural status is doubted, as in Peninsular Malaysia it is known only from the northern and central states of Kedah, Pahang and Penang (Duistermaat 2004).

Panicum repens L. – Fig. 103, Plate 21.

Creeping Panic Grass

Ridley 1907: 139; 1925: 225. Gilliland 1971: 135. Veldkamp 1996a: 202. Keng *et al.* 1998: 175.

Culms with stolons, up to 85(—150) cm long; internodes hollow; nodes glabrous. Sheath 4—8.5 cm long, transverse veins present, glabrous to scabrous, only one margin hairy. Ligule 0.5—0.8 mm long, basal 0.4 mm membranous, hairs at tip 0.1—0.4 mm long. Blade 13—20 cm long, 4—5 mm wide, (sparsely) hairy at least at upperside, base cuneate. Inflorescence open, central rachis 15—20 cm long, branches erecto-patent; longest branch 10—13 cm long, naked at base. Pedicel 1—3.5 mm long, scaberulous. Spikelet 2.5—3.1 mm long, 0.9—1 mm wide, acute, glumes without a distinct internode, 1st floret male; lowest bract *c.* 0.2 times as long as spikelet; lower glume 0.6—0.7 mm long, collar-shaped, 0 veins, glabrous; upper glume 2.9—3 mm long, glabrous; 1st lemma 2.6—2.7 mm long, acute; 1st palea 2.3—2.5 mm long; 2nd lemma 2—2.2 mm long, smooth. Anthers 3, 1—1.4 mm long.

Probably not native; pantropical. First record 1880s. Common.

In lawns on damp sandy soil, sunny to slightly shaded, and surviving periodic inundation.

According to Veldkamp (1996a), it is probably introduced in Malesia. He reports slightly longer anthers (1.3—1.5 mm long).

It is usually a seashore plant, but it is also found inland on sandy places (Ridley 1907, 1925). It is used as a sandbinder and for lawns and turfs (Veldkamp 1996a). In America it is known as Torpedo Grass.

Differences with *Eriochloa procera* and *Urochloa subquadripara* are mentioned under the respective species.

Panicum sarmentosum Roxb. – Fig. 104.

Scrambling Panic Grass, *Rumput Janggut Ali*

Ridley 1907: 140; 1925: 227. Gilliland 1971: 139. Veldkamp 1996a: 203. Keng *et al.* 1998: 176. Veldkamp 1999b: 235.

Culms scrambling, 70—800 cm long; internodes solid; nodes glabrous or hairy. Sheath 9—10 cm long, transverse veins absent, (densely) hairy, margins hairy. Ligule 0.6—0.8 mm long, basal part membranous and 0.3—0.4 mm long, hairs at tip 0.3—0.4 mm long. Blade 18—33 cm long, 12—22 mm wide, hairy, base cuneate. Inflorescence open, central rachis 16—43 cm long, branches patent; longest branch 6—24 cm long, with spikelets almost from the base. Pedicel 0.2—1 mm long, glabrous. Spikelet 1.9—2.4 mm long, 0.7—0.9 mm wide, obtuse, glumes without a distinct internode, 1st floret sterile or male; lowest bract 0.5 times as long as spikelet; lower glume 1.1—1.2 mm long, ovate, 3 veins, glabrous; upper glume 1.9—2.4 mm long, 5 veins, glabrous; 1st lemma 1.8—2.1 mm long, acute; 1st palea 1.3 mm long; 2nd lemma 1.5—1.8 mm long, smooth. Anthers 3, 1 mm long.

Native; India to S China and S to Australia. First record 1889. Rare.

Forest margins and scrub.

Veldkamp (1996a) reports that the 1st floret is sterile.

Panicum trichocladum Hack. ex K.Schum. in Engl. – Fig. 105.

Veldkamp 1999b: 235. Duistermaat 2004: 35.

Culms scrambling, 50—250 cm long; internodes hollow; nodes glabrous. Sheath 4—6 cm long, margin at tip short-hairy. Ligule membranous, 0.4—0.5 mm long, tip ciliolate. Blade 5—8 cm long, 5—8 mm wide, glaucous, hairy, base cuneate to rounded, pseudopetiole 1—2 mm long. Inflorescence open, central rachis 7—9 cm long, branches patent; longest branch *c.*

4.5 cm long, naked at basal 1.5—2 cm, each branchlet with 2 spikelets only. Pedicel *c.* 2.5 mm long, scaberulous. Spikelet 2.1—2.4 mm long, 0.9—1 mm wide, obtuse to acute, glumes without a distinct internode, 1st floret male; lowest bract 0.15—0.20 times as long as spikelet; lower glume 0.3—0.5 mm long, ovate, 0 veins, glabrous; upper glume 1.9—2.2 mm long, 5 veins, glabrous; 1st lemma 2—2.2 mm long, obtuse; 1st palea 2—2.1 mm long; 2nd lemma 1.8—2 mm long, smooth. Anthers 3, 1.4 mm long.

Not native; Africa: Zaire to Ethiopia, introduced in Surinam and Singapore. First record 1994. Rare.

In shaded places.

Paspalum L.

De Koning and Sosef 1985: 279—318.

Nodes glabrous. Ligule membranous, glabrous. Young leaf blade inrolled. Inflorescence panicle; branches 2—11, 0.7—3 mm wide, distinctly winged, simple. Pedicel flattened to more or less rounded. Spikelets single or paired, alternate in 2 rows on one side of branch, dorsiventrally flattened, 2-flowered with 1st floret sterile and 2nd bisexual, unawned; the two lowest bracts as long as spikelet; lower glume and 1st palea absent; upper glume and 1st lemma outer veins marginal, thin herbaceous; 2nd lemma and palea indurated, palea almost as long as lemma.

Paspalum dilatatum, earlier mentioned for Singapore (Gilliland 1971: 183, Keng *et al.* 1998: 176), is not included. The only Singapore collection of this American species originated from material that was cultivated in the Botanic Gardens. As in *P. conjugatum*, it has an upper glume with a fringe of hairs, but the inflorescence has 3—5(—9) branches and the spikelets are paired and *c.* 3.3 mm long.

The key follows that of De Koning and Sosef (1985).

1a. Upper glume with a marginal fringe of relatively long, white hairs fringing the spikelet. ***P. conjugatum***

1b. Upper glume without such a fringe. **2**

2a. Spikelets paired, at least in the middle of the branch, one sometimes abortive and reduced to minute glumes. **3**

2b. Spikelets solitary, without an abortive 2nd spikelet. **5**

3a. Spikelets oblong to ovate or obovate, upper glume and 1st lemma with a conspicuous dark centre and paler margin; 2nd lemma and palea dark brown, shiny. ***P. plicatulum***

3b. Spikelets broadly ovate to obovate; upper glume and 1st lemma of one colour; 2nd lemma and palea pale to brown, dull. **4**

4a. Branches (4—)6—11, 2—3 mm wide. Both spikelets of a pair usually well-developed in the middle of the branch. Upper glume pubescent, very rarely glabrous. ***P. longifolium***

Figure 103. *Panicum repens* L.

Figure 104. *Panicum sarmentosum* Roxb.

Figure 105. *Panicum trichocladum* Hack. ex K.Schum. in Engl.

Figure 106. *Paspalum conjugatum* P.J.Bergius.

Figure 107. *Paspalum longifolium* Roxb.

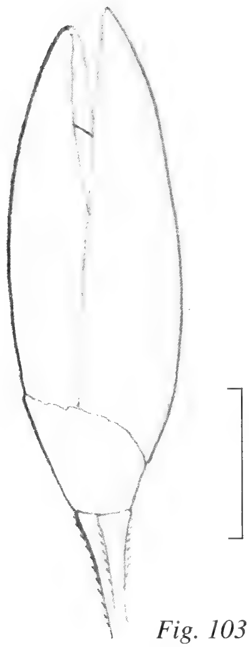


Fig. 103

Fig. 104

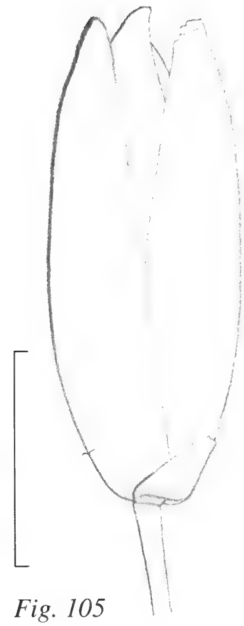


Fig. 105

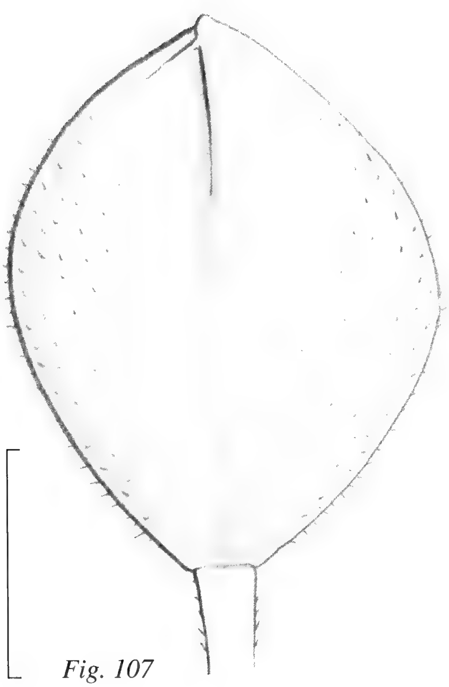


Fig. 107

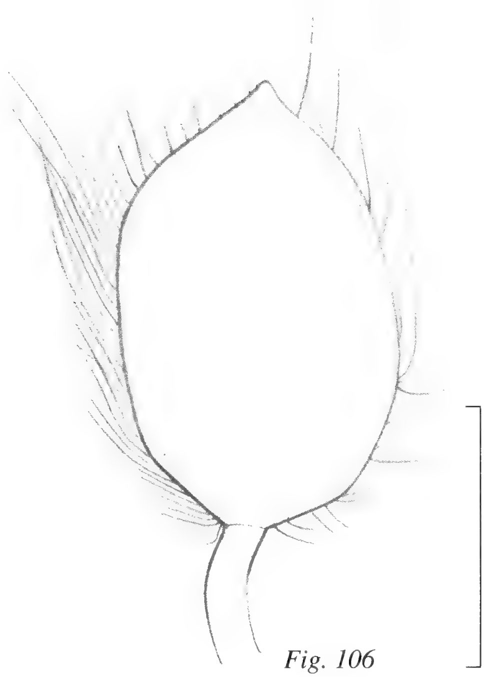


Fig. 106

4b. Branches 2—4(—6), 1—1.5(—1.9) mm wide. One of the spikelets of a pair usually reduced. Upper glume glabrous. ***P. orbiculare***

5a. Culms with stolons. Spikelets oblong, acute. ***P. vaginatum***
5b. Culms tufted, stolons absent. Spikelets ovate or obovate to suborbicular, blunt. **6**

6a. Spikelets usually broadly obovate, (1.25—)1.3—1.8 times as long as wide, yellow-brown to brown; upper glume and 1st lemma 3- or 5-veined, smooth, veins distinctly darker than between the veins; 2nd floret yellow-brown to brown in fruit. ***P. orbiculare***
6b. Spikelets usually suborbicular, 1.05—1.25(—1.5) times as long as wide, brown to dark brown; upper glume 5- or 7-veined, somewhat rumpled; 1st lemma 5—9-veined, veins the same colour as between the veins; 2nd floret dark brown in fruit. ***P. scrobiculatum* var. *bispicatum***

Paspalum conjugatum P.J.Bergius – Fig. 106, Plate 22.

Buffalo Grass, *Rumput Kerbau*

Ridley 1907: 124; 1925: 218. Gilliland 1971: 180. De Koning and Sosef 1985: 290. Keng *et al.* 1998: 176.

Culms with long stolons, erect part 15—60 cm long. Sheath 1.5—13 cm long, narrowing towards tip, more or less flattened, midrib raised, glabrous, margin with up to 1 mm-long white hairs, external ligule short-hairy. Ligule 0.2—0.7 mm long. Blade (1—)2—9(—20) cm long, (1—)3—9 mm wide, sparsely hairy, margin hairy, base cuneate. Inflorescence central rachis 3—10 mm long, branches 2; longest branch 7—16.5 cm long, 0.7—0.8 mm wide, with few long hairs at base only. Pedicel 0.5—0.8 mm long, glabrous. Spikelets single, 1.5—1.7 mm long, 1—1.2 mm wide, ovate; upper glume 1.5—1.7 mm long, 2 concolorous veins (midvein suppressed), smooth, marginal hairs 1.5—2 mm long and white; 1st lemma 2 veins, glabrous; 2nd lemma 1.4—1.5 mm long, pale green.

Not native; America, introduced in Africa, Asia and Australia. First record 1884. Common.

In unshaded to shaded, dry to moist places as lawns, roadsides, open wasteland, etc.

De Koning and Sosef (1985) report a much longer ligule (0.7—1.6 mm long). *Axonopus compressus* has hairy nodes, densely fringed ligules and a less dense external ligule.

Paspalum longifolium Roxb. – Fig. 107.

Ridley 1925: 217. Gilliland 1971: 182. De Koning and Sosef 1985: 297. Keng *et al.* 1998: 176.

P. platycoleum Ridl. 1925: 217 (excluding Singapore).

Culms tufted, 50—125 cm long. Sheath 5—24 cm long, more or less flattened, midrib raised, glabrous to densely long-hairy, margins glabrous or hairy in upper half. Ligule 0.8—2.5 mm long. Blade (3—)17—36 cm long, (3—)4—7 mm wide, base cuneate and hairy at upperside. Inflorescence central rachis 5—10 cm long, branches (4—)6—11; longest branch 6.5—8 cm long, 2—3 mm wide, margins at least at base hairy. Pedicel 0.5—1.5 mm long, glabrous. Spikelets in pairs, 2—2.4 mm long, 1.3—1.7 mm wide, broadly (ob-)ovate; upper glume 2—2.4 mm long, 3 concolorous veins, smooth, (sparsely) hairy; 1st lemma 3 veins, (sparsely) hairy; 2nd lemma 1.6—2 mm long, pale brown.

Native; India to Vietnam, and SE to the Pacific and N. Australia. First record 1880s. Rare.

In moist to wet places or in up to 60 cm-deep water, sometimes floating on open water.

Paspalum orbiculare G.Forst. – Fig. 108.

Ridley 1925: 217. Gilliland 1971: 184. De Koning and Sosef 1985: 299. Keng *et al.* 1998: 176.

Culms single or tufted, erect to geniculate, 9—80 cm long. Sheath up to 20 cm long, more or less flattened, midrib raised, glabrous. Ligule 0.7—1 mm long. Blade 3—13(—50) cm long, 2.5—5.5 mm wide, glabrous, base somewhat rounded and glabrous to long-hairy. Inflorescence central rachis 1—4 cm long, branches 2—6; longest branch 2—6 cm long, 1—1.2 mm wide, margins scaberulous, base hairy. Pedicel 0.5—0.6 mm long, scaberulous. Spikelets single or in pairs with the inner often reduced to tiny glumes, 1.9—2.1 mm long, 1.6—1.9 mm wide, (broadly) obovate (to suborbicular); upper glume 1.9—2.1 mm long, 3 or 5 dark-coloured veins, smooth, glabrous; 1st lemma 5—9 veins, glabrous; 2nd lemma 1.5—1.9 mm long, yellow-brown to brown in fruit.

Native; India to Taiwan and Hong Kong, and S to Polynesia and N. Australia. First record 1932. Common.

In dry to wet unshaded places or in water up to 25 cm deep.

It is difficult to distinguish this species from *P. scrobiculatum* var. *bispicatum*. The way the upper glume fits around the spikelet (smooth vs rumpled) seems to be the easiest character to use in the field.

Paspalum plicatulum Michx. – Fig. 109.

De Koning and Sosef 1985: 313. Duistermaat 2004: 37.

Culms tufted, 30—150 cm long. Sheath with midrib raised, hairy in marginal area or upper half. Ligule 1.5 mm long. Blade 6—18 cm long, *c.* 10 mm wide, hairy on underside. Inflorescence central rachis 3—15 cm long, branches *c.* 10; longest branch *c.* 9 cm long, 0.9—1 mm wide, sparsely hairy at base. Pedicel 0.5 mm long, glabrous. Spikelets in pairs, *c.* 2.5 mm long, *c.* 1.6 mm wide, obovate; upper glume 2.5 mm long, 5 concolorous veins, smooth, glabrous, with dark red-coloured spot in the centre; 1st lemma as upper glume; 2nd lemma 2 mm long, dark brown.

Not native; (sub-)tropical America, introduced in temperate Asia and Australasia. Single record 2003 from Pulau Sakijang. Rare.

The species is cultivated for its high palatability to cattle in (sub-)tropical America, the Chinese province of Gansu and in Papua New Guinea.

Paspalum scrobiculatum L. **var. *bispicatum*** Hack. – Fig. 110, Plate 23.

Kodo Millet

De Koning and Sosef 1985: 305. Keng *et al.* 1998: 177.

P. cartilagineum J.Presl: Gilliland 1971: 184.

P. commersonii Lam.: Ridley 1925: 218.

P. scrobiculatum L.: Ridley 1907: 124. Gilliland 1971: 185.

Culms tufted, 40—60 cm long. Sheath 8—13 cm long, more or less flattened, midrib raised, glabrous. Ligule 0.5—1 mm long. Blade 8—40 cm long, 5—7 mm wide, glabrous, margin glabrous or sparsely hairy, base cuneate and glabrous or hairy. Inflorescence central rachis 1.5—3 cm long, branches 2—6; longest branch 5—9.5 cm long, 1.5—2.5 mm wide, glabrous or hairy at base. Pedicel 0.5 mm long, glabrous. Spikelets single, 2—2.3 mm long, 1.5—1.9 mm wide, suborbicular to broadly (ob-)ovate; upper glume 2—2.3 mm long, 5 concolorous veins, rumpled, glabrous; 1st lemma 5 or 7 veins, glabrous; 2nd lemma 1.7—2 mm long, dark brown in fruit.

Native; tropical Africa, Asia, Pacific and Australia. First record 1889. Common.

In unshaded to shaded, dry to moist places, roadsides, wastelands; seems less common in urban environments.

The difference with *P. orbiculare* is mentioned there.

Paspalum vaginatum Sw. – Fig. 111, Plate 24.

Saltwater Paspalum, *Rumput Dawai*

Gilliland 1971: 182. De Koning and Sosef 1985: 309. Keng *et al.* 1998: 177.

P. distichum Ridl.: 1907: 124; 1925: 218.

Culms much branched at base, with stolons up to 300 cm long, erect shoots 25—80 cm long. Sheath 2—4.5 cm long, rounded to somewhat flattened, midrib not or slightly raised, glabrous, margin at tip hairy. Ligule 1 mm long. Blade (2—)8—15 cm long, 1.5—3.5 mm wide, glabrous, base cuneate and much narrower than sheath. Inflorescence central rachis absent, branches 2; longest branch 2.5—5.5 cm long, 1—1.6 mm wide, glabrous, empty at basal 4—6 mm. Pedicel 0.5—0.7 mm long, glabrous to scaberulous. Spikelets single, 2.7—4.4 mm long, 1.2—1.5 mm wide, oblong; upper glume 2.6—4.4 mm long, 5 or 6 concolorous veins, smooth, glabrous; 1st lemma 5 or 7 veins, glabrous; 2nd lemma 2.2—3 mm long, pale green.

Native; pan(sub)tropical. First record 1890. Rather common.

Halophilous (i.e. growing in saline soil), in open habitats as beaches, mangrove margins, tidal pools; can withstand flooding.

Pennisetum Rich.

Culms usually tufted, erect to ascending (or with stolons in *P. polystachion*); basal internodes 10—15 mm diameter; nodes glabrous or appressed hairy. Sheath rounded. Ligule membranous at base, with hairs at tip. Young leaf blade inrolled. Blade at base (somewhat) rounded, margins scaberulous, midvein at upperside at least at base prominent and white. Inflorescence dense spike. Spikelets in groups of 1—3, each group surrounded by involucre of bristles falling off together with the spikelet(s); involucral bristles (slightly) longer than the spikelets, fused only at the very base, the longest in basal half plumose. Spikelet not flattened, 2-flowered with 1st floret sterile or male and 2nd bisexual, unawned; glumes and 1st palea hyaline (or absent); lemmas and 2nd palea (thin) herbaceous; 2nd floret glabrous, palea slightly shorter than lemma. Anthers 3.

Pennisetum glaucum, *P. macrostachyum* and *P. setaceum* have been grown in the Botanic Gardens and in the garden of the University of Singapore. They are not included here.

Differences with *Cenchrus* and *Setaria* are mentioned under *Cenchrus*.

1a. Inflorescences 2—4 per culm; central rachis with ridges or winged below the spikelets, glabrous. Spikelets single, 3.5—5 mm long. Anthers 1.1—1.4 mm long, glabrous. ***P. polystachion***

Figure 108. *Paspalum orbiculare* G.Forst.

Figure 109. *Paspalum plicatulum* Michx.

Figure 110. *Paspalum scrobiculatum* L. var. *bispicatum* Hack.

Figure 111. *Paspalum vaginatum* Sw.

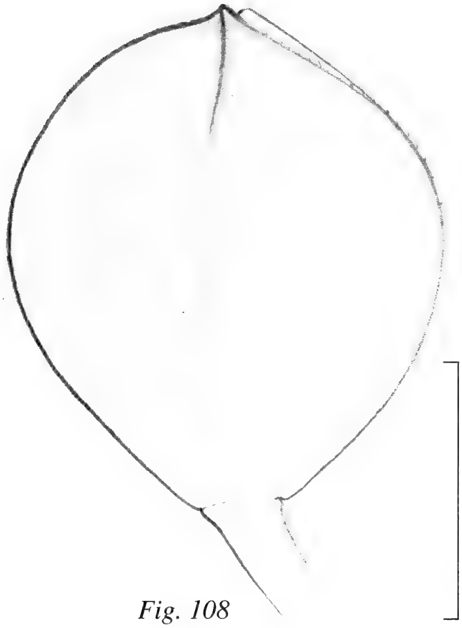


Fig. 108

Fig. 109

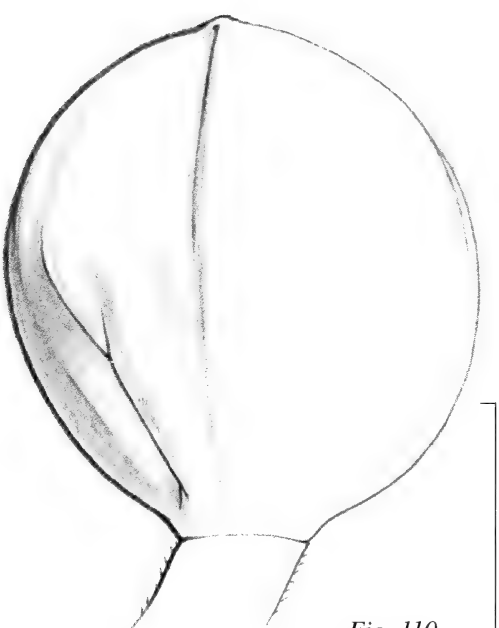


Fig. 110

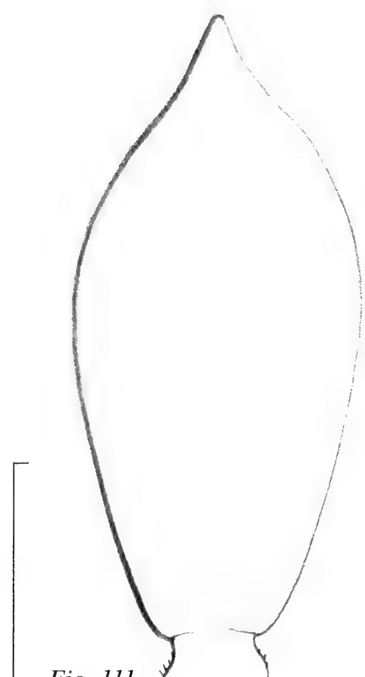


Fig. 111

1b. Inflorescences 1 (or 2) per culm; central rachis smooth to inconspicuously ribbed, densely hairy. Spikelets in groups of 1—3, 5—5.8 mm long. Anthers 2.3—3 mm long, ciliolate at tip. ***P. purpureum***

Pennisetum polystachion (L.) Schult. – Fig. 112, Plate 25.

Feather Pennisetum

Holm *et al.* 1977: 367—371. Veldkamp 1997a: 211. Keng *et al.* 1998: 177.

Culm 98—200 cm long, stolons up to 1.5 m long sometimes present. Sheath 9—15(—19) cm long, glabrous to hairy, margins glabrous to hairy in upper half, external ligule an herbaceous rim or absent. Ligule basal part 0.5—0.7 mm long, hairs at tip 1—1.8 mm long. Blade (5—) 17—30 cm long, (2—)5—7 mm wide, hairy. Inflorescences 2—4 per culm; central rachis 9—21 cm long, with prominent ridges to decurrently winged below the spikelets, glabrous. Involucral bristles up to 24 mm long, hairs up to 0.5 mm long. Pedicel absent. Spikelets single, 3.5—5 mm long, 0.7 mm wide; lowest bract as long as and 2nd bract *c.* 0.6 times as long as spikelet; lower glume absent; upper glume 3.5—5 mm long, 5 veins, glabrous to short-hairy, acute; 1st lemma 2.8—3.2 mm long, tip 3-lobed; 1st palea absent; 2nd lemma 2—2.3 mm long, tip truncate and ciliate. Anthers 1.1—1.4 mm long, glabrous.

Not native; probably native to Africa, now pantropical. First record 1929 from the Botanic Garden, 1959 in the wild. Rather common.

In open or partly shaded waste land, on well-drained soil.

It was introduced as a fodder crop, but today in many countries around the world it is regarded as a weed (see Veldkamp 1997a).

Pennisetum purpureum Schumach. – Fig. 113, Plate 27.

Elephant Grass, Napier Grass

Holm *et al.* 1977: 367—371. Gilliland 1971: 162. Keng *et al.* 1998: 177.

Culm up to 250 cm long. Sheath 9—16 cm long, glabrous, external ligule absent. Ligule basal part 0.3—0.5 mm long, hairs at tip 3.2—4 mm long. Blade (16—)27—45 cm long, (7—)15—17 mm wide, underside glabrous, upperside (sparsely) hairy. Inflorescence 1 (or 2) per culm; central rachis 8—27 cm long, smooth to inconspicuously ribbed, densely hairy. Pedicel 0.3—2.3 mm long, scaberulous. Spikelets in groups of 1—3, 5—5.8 mm long, 0.9—1.7 mm wide; involucral bristles up to 19 mm long, hairs up to 1.2 mm long; either lowest bract *c.* 0.1 and 2nd 0.2—0.3 times as long as spikelet, or lowest 0.2—0.3 times as long as and 2nd as long as spikelet; lower glume absent or 0.4—0.5 mm long; upper glume 1.2—1.8 mm long, 0 veins, glabrous, obtuse; 1st lemma 4.1—5 mm long, acute; 1st palea 4.1 mm long or absent; 2nd lemma 4.7—5.5 mm long, acuminate. Anthers 2.3—3 mm long, ciliolate at tip.

Not native; Africa, now pantropical. First record 1931. Rather common.

In open or partly shaded waste land, generally on clayey soil.

Holttum (*Holttum s.n.*, 1931, SING) records that this species was used as food for Chinese carp and also as fodder for dairy cows.

Perotis Aiton

Veldkamp and Van Steenbergen 1992: 609—614.

Figure 112. *Pennisetum polystachion* (L.) Schult., spikelet surrounded by involucre of bristles.

Figure 113. *Pennisetum purpureum* Schumach., group of three spikelets surrounded by involucre of bristles.

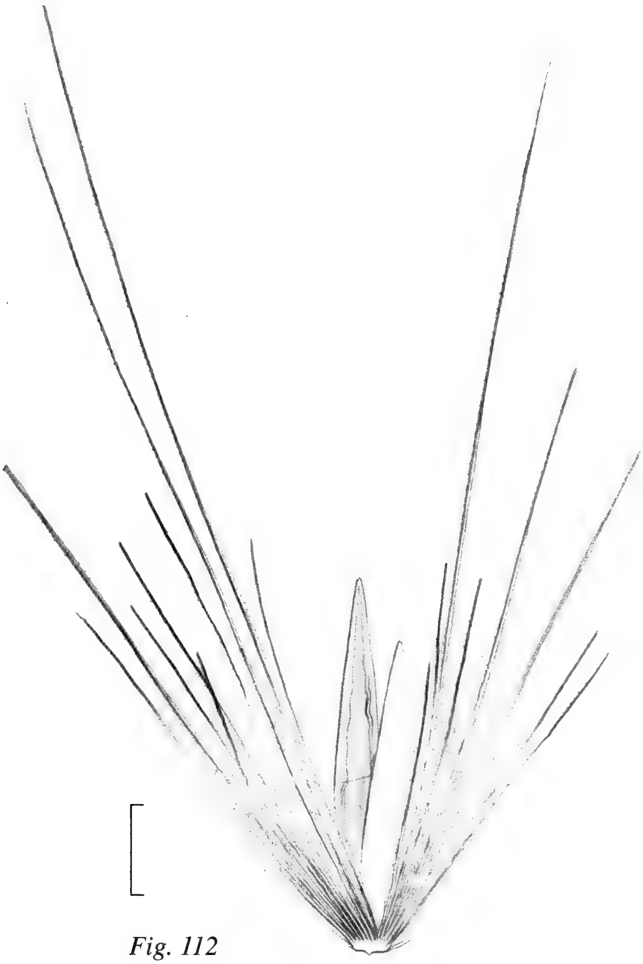


Fig. 112

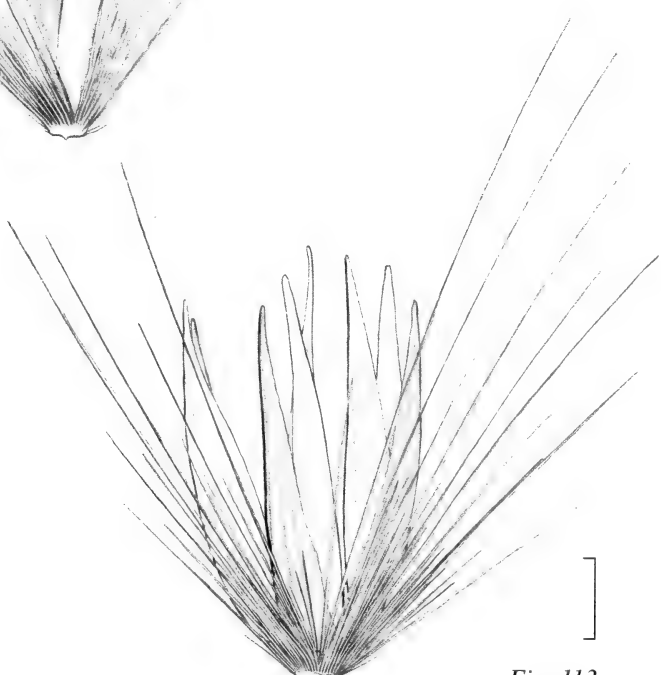


Fig. 113

Perotis indica (L.) Kuntze – Fig. 114.
Cat's Tail Grass, *Rumput Ekor Kucing*

Gilliland 1971: 113. Veldkamp and Van Steenbergen 1992: 610. Keng *et al.* 1998: 178.

P. latifolia Aiton: Ridley 1907: 149; 1925: 243.

Culms tufted, geniculate to decumbent, 20—40 cm long; nodes glabrous. Sheath 1—5 cm long, rounded, glabrous. Ligule membranous, 0.3 mm long, tip ciliolate. Young leaf blade inrolled. Blade 1—3.5 cm long, 3—6 mm wide, glabrous, base cordate to amplexicaul and pectinate. Inflorescence raceme, rachis 7—15 cm long, 0.1—0.2 mm wide, scaberulous to bristle-hairy. Pedicel 0.3 mm long, bristle-hairy, persistent. Spikelets single, 1.7—2 mm long, 0.4 mm wide, patent, easily falling off from base upwards leaving pedicel attached to rachis, laterally flattened, 1-flowered, awned; callus 0.3 mm long, hispid, falling off with spikelet; lowest bract as long as and 2nd 0.9 times as long as spikelet; lower glume 1.7—2 mm long, hyaline to thin herbaceous, 1 vein, short hairy, obtuse, awn from tip 7—10 mm long and antrorsely scaberulous; upper glume 1.5—1.9 mm long, thin herbaceous, 1 vein, glabrous, obtuse to acute, awn from tip 6.5—9 mm long; lemma 0.5—1 mm long, hyaline; palea 0—0.7 mm long, hyaline.

Native; India to E China, throughout Malesia to Australia. First record 1880s. Rare.

On sandy soil near the coast, under *Casuarina* species, in coconut plantations, dry grasslands.

Phragmites Adans.

Phragmites vallatoria (Pluk. ex L.) Veldk. – Fig. 115.
Common Reed, *Rumput Gedabung*

Veldkamp 1992: 232. Keng *et al.* 1998: 178.

P. communis auct., non Trin.: Ridley 1925: 240 (excluding Singapore).

P. karka (Retz.) Steud.: Ridley 1907: 175 (excluding Singapore). Gilliland 1971: 49.

Culms up to 300 cm long; internodes hollow, up to 15 mm diameter; nodes glabrous. Sheath 10—12 cm long, rounded, glabrous. Ligule of younger leaves row of hairs and 4—6 mm long, of flag leaf with basal part membranous and 0.1—0.3 mm long and hairs at tip 0.3—0.4 mm long; just behind ligule few up to 1 mm long hairs on blade. Young leaf blade inrolled. Blade *c.* 32 cm long, *c.* 10 mm wide, glabrous, base rounded. Inflorescence panicle, silky hairy, central rachis *c.* 26 cm long, branches many; longest branch *c.* 15 cm long, thin, branched. Pedicel 3—4 mm long, thinner than branch, scaberulous. Spikelets single, at least 11 mm long and 5 mm wide, 4—more-flowered with 1st floret sterile and others bisexual, unawned; rachilla between the glumes and the 1st lemma 0.5 mm long and glabrous and persistent, between the upper florets 0.5 mm long and with up to 5 mm-long hairs and articulated; the two lowest bracts up to 0.3 times as long as spikelet; lower glume 3.3 mm long, enveloping, thin herbaceous, glabrous, 3 veins; upper glume as lower, 3.6 mm long; 1st lemma 7 mm long, herbaceous, 3 veins, glabrous, acute; 1st palea 3 mm long, thin herbaceous; 2nd lemma as 1st, 8.5 mm long; 2nd palea as 1st; 3rd and higher florets as 2nd, but gradually smaller in size.

Native; Asia and Australia. Single record 1880s around Freshwater Isle (unknown locality). Extinct (1880s).

Figure 114. *Perotis indica* (L.) Kuntze.

Figure 115. *Phragmites vallatoria* (Pluk. ex L.) Veldk., spikelet with rachilla articulated above the first floret.

Figure 116. *Pogonatherum crinitum* (Thunb. in Murray) Kunth.

Figure 117. *Polytrias indica* (Houtt.) Veldk.

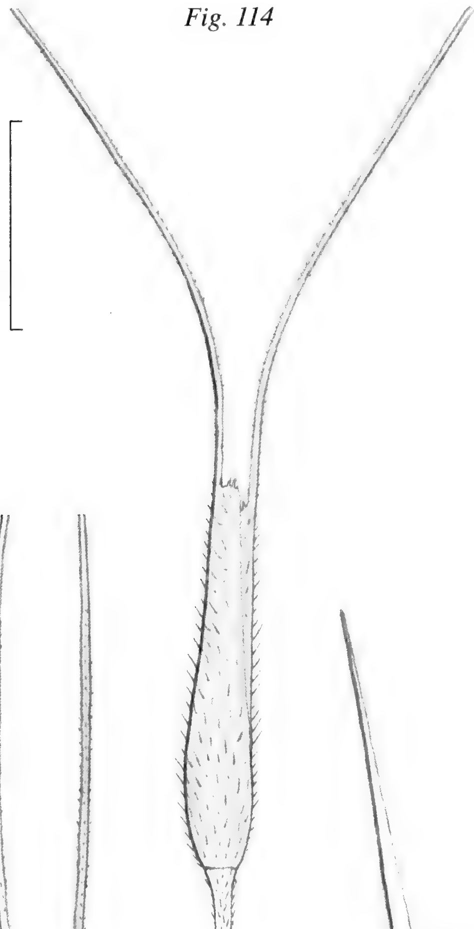


Fig. 114

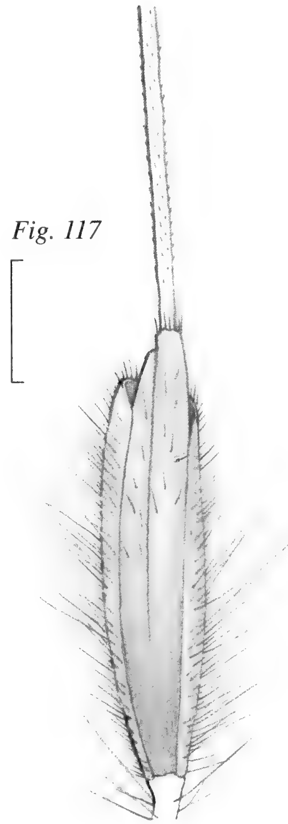


Fig. 117

Fig. 116

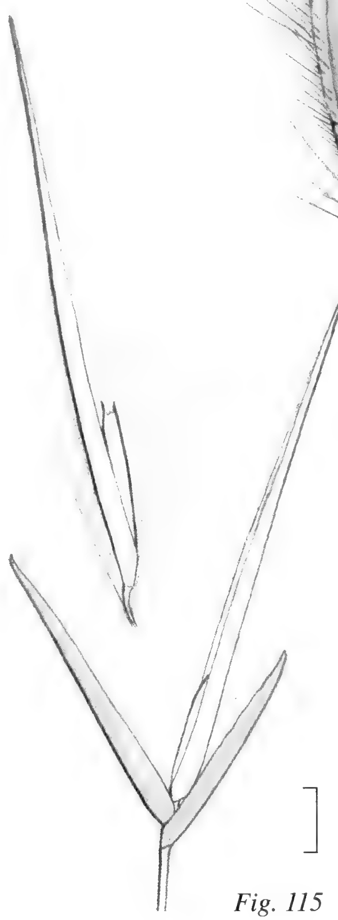


Fig. 115

In wet places.

Differences with the other species with silky-hairy panicles are mentioned under *Imperata*.

Pogonatherum P.Beauv.

Pogonatherum crinitum (Thunb. in Murray) Kunth – Fig. 116, Plate 26.

Bamboo Grass, *Rumput Sembor Batu*

Keng *et al.* 1998: 178.

P. paniceum (Lam.) Hack.: Gilliland 1971: 251.

P. saccharoideum P.Beauv. var. *monandra* Hack.: Ridley 1907: 154; 1925: 195 (both excluding Singapore).

Culms tufted, sometimes woody at base, stolons absent, 12—50 cm long; nodes hairy. Sheath 2—3(—5) cm long, rounded, glabrous, one margin hairy. Ligule membranous, 0.4—0.5 mm long, tip ciliolate. Young leaf blade inrolled. Blade 3.5—5.5 cm long, 1—3 mm wide, glabrous, margin smooth to scaberulous, base cuneate and long-hairy. Inflorescence spike-like raceme; central rachis 1.5—3.5 cm long, hairy. Pedicel 0.7 mm long, flattened, hairy. Spikelets in pairs of 1 sessile and 1 pedicelled. Sessile spikelet 1.5—2 mm long, 0.4—0.5 mm wide, laterally flattened, 1- or 2-flowered with 1st floret sterile or absent and 2nd bisexual, awned; callus very short, with up to 1 mm-long hairs; lowest bract *c.* 0.9 times as long as and 2nd as long as spikelet; lower glume 1.1—1.5 mm long, thin herbaceous, glabrous, tip truncate and ciliolate; upper glume 1.5—1.7 mm long, thin herbaceous, glabrous or hairy in upper half, awn from tip 12—17 mm long and golden brown; 1st lemma and palea absent or 1—1.4 mm long and hyaline; 2nd lemma 1—1.1 mm long, hyaline, glabrous, tip bifid and ciliolate, awn from notch 23 mm long and golden brown; 2nd palea 0.4—1 mm long, hyaline. Pedicelled spikelet as sessile, 1.4 mm long, 1-flowered.

Native; India to Japan, S to Peninsular Malaysia and Singapore. First record 1950. Rare.

On shaded to sunny granite outcrops, rocky places, and unplastered brick walls.

Contrary to what the English name suggests this is not a bamboo. It is much smaller than bamboos and not woody. Moreover, real bamboos have two types of leaves (culm and foliage), and clusters of spikelets scattered along a rachis (nodular inflorescence). It is cultivated as an ornamental.

Polytrias Hack.

Polytrias indica (Houtt.) Veldk. – Fig. 117.

Brown-top Grass

Veldkamp 1991: 180. Keng *et al.* 1998: 179.

Eulalia praemorsa (Nees) Stapf ex Ridl. 1925: 197.

P. amaura (Büse) Kuntze: Gilliland 1971: 244.

P. praemorsa Hack.: Ridley 1907: 164.

Culms geniculate or with stolons, 25—40 cm long; nodes hairy, upper ones glabrescent. Sheath 1.5—5.5 cm long, rounded, glabrous or sparsely hairy at tip, margins glabrous or hairy at base. Ligule membranous, 0.5 mm long, tip ciliolate. Young leaf blade inrolled. Blade 2.5—4 cm long, 2—3.5 mm wide, hairy, base rounded and with long hairs. Inflorescence spike-like raceme; rachis 4—6.5 cm long, rounded, with a longitudinal row of hairs between the spikelets. Pedicel 2 mm long, thinner than rachis, flattened, hairy. Spikelets in threes, both the lateral sessile and the middle pedicelled but otherwise similar, 3.5—3.7 mm long, 0.8—0.9 mm wide, dorsiventrally flattened, 1-flowered (but see note), awned; lowest bract *c.* 0.9 times as long as and 2nd as long as spikelet; lower glume 3.4—3.5 mm long, herbaceous, 4 or 5 veins, hairy, tip truncate and with protruding marginal veins; upper glume 3.5—3.7 mm long, thin herbaceous, 3 veins, hairy in upper half, obtuse; lemma 1.2—1.5 mm long, hyaline, tip bifid and sparsely hairy, awn from notch 10—13 mm long and geniculate with lower part twisted and upper part antrorsely scaberulous; palea 0.6 mm long, hyaline.

Probably not native; possibly native to Java, now pantropical. First record 1889. Extinct (1963).

In dry, sunny places, e.g. lawns, waste ground.

Technically speaking, the spikelets are 2-flowered, with the 1st lemma and palea lacking. The lemma that is present is positioned next to the upper glume; if the spikelet was truly 1-flowered, the lemma would be positioned opposite the upper glume (adjacent to the lower glume).

It was probably introduced as a lawn grass. Veldkamp (1991) reports that it occurs especially in areas with a strong East monsoon but that in moister areas it is outcompeted by *Axonopus*.

Rottboellia L.f.

Veldkamp *et al.* 1986: 281—307.

The genus is said to be different from *Mnesithea* in having a male 1st floret (Veldkamp *et al.* 1986).

Rottboellia cochinchinensis (Lour.) Clayton – Fig. 118.

Veldkamp *et al.* 1986: 305. Duistermaat 2004: 38.

R. exaltata L.f.: Holm *et al.* 1977: 139.

Culms tufted, with short rhizomes and thick roots, *c.* 80 cm long; nodes glabrous. Sheath 6—7 cm long, rounded, spiny-hairy, margin hairy. Ligule membranous, 1.5 mm long, tip ciliolate. Young leaf blade inrolled. Blade 21—45 cm long, 11 mm wide, spiny-hairy at upperside, margin scaberulous, base rounded. Inflorescence 1 per sheath, several from 1 culm, spike-like raceme, 5—7 cm long; rachis articulating, glabrous, simple; internodes at articulation with a central knob, basal part flattened and 2—3.8 mm wide, upper part rounded and 2—4.5 mm wide. Pedicel 3.5 mm long, glabrous, flattened, one margin fused with rachis. Spikelets in pairs of 1 sessile and 1 pedicelled, unawned. Sessile spikelet 4.5—5 mm long, 1.7—4 mm wide, not flattened, 2-flowered with 1st floret male and 2nd bisexual; the two lowest bracts as long as spikelet; lower glume 4—5 mm long, flattened, indurated, glabrous, minutely granular, submarginal keels smooth and in upper part winged or not, tip obtuse or minutely bifid; upper glume 4.5—5 mm long, boat-shaped, indurated, glabrous, upper half minutely granular, tip acute and keeled; 1st lemma 3.5—4.5 mm long, thin herbaceous; 1st palea 3—4.3 mm long; 2nd lemma *c.* 3 mm long, hyaline; 2nd palea absent or *c.* 1 mm long. Pedicelled spikelet reduced to 2 flattened herbaceous glumes enclosing 0—2 hyaline bracts.

Not native; Paleotropics. First record 1995. Rare.

Found on reclaimed land.

Material was undoubtedly introduced with sand brought in for land reclamation. It is likely to spread further as it is one of the world's worst weeds (Holm *et al.* 1977).

The internodes of the inflorescence are corky, allowing them to float on water after articulation. Dispersal by ants, which are attracted by the central knob (or elaiosome) that contains oily substances, is reported by Veldkamp *et al.* (1986: 295).

The species is probably more variable than previously thought (Veldkamp *et al.* 1986, Duistermaat 2004). *Mnesithea glandulosa* is different in having free pedicels and lower glumes with 2—7 gland-like warts in the lower half of the keels.

Saccharum L.

Whalen 1991: 109—125. Hodkinson *et al.* 2002: 381—392.

Ripidium Trin., non Bernh.

Culms with rhizomes and tufted, 100—500 cm long; internodes solid, 5—45 mm diameter, just above the node with 1 or more rows of root-eyes; nodes glabrous. Sheath 20—40 cm long, rounded, margins glabrous or at throat hairy, shouldered, auricles triangular and glabrous. Ligule membranous, 0.5—3 mm long, tip ciliolate. Young leaf blade inrolled. Blade 50—200 cm long, glabrous, margin serrulate, base cuneate. Inflorescence panicle, silky hairy, central rachis present, branches many and articulated; longest branch widest part 3 mm wide, branched. Spikelets in pairs of 1 sessile (falling off with rachis internode and pedicel) and 1 pedicelled, otherwise similar, not flattened, 2-flowered, unawned; the two lowest bracts 0.9—1 times as long as spikelet; both lemmas hyaline, 1st lemma almost as long as glumes, 2nd lemma absent to 0.75 times as long as glumes; 1st palea absent; 2nd palea absent to as long as 2nd lemma, hyaline.

Ripidium probably has to be split off (Hodkinson *et al.* 2002: 391), which would here only include *Saccharum arundinaceum.*

Almost all modern-day commercial sugarcanes are complex hybrids of *S. officinarum* with *S. spontaneum* and/or *S. sinense* (Whalen 1991). For this reason, *S. sinense* is included in the key but hybrids are not included. Plants rarely seem to flower in Singapore. Unfortunately, most can only be identified when flowering.

Differences with the other species with silky-hairy panicles are mentioned under *Imperata*.

The key (leads 2—4) follows Whalen (1991).

1a. Root-eyes in 1 row above node (Plate 28). Sheath glabrous. Callus glabrous. Lower glume with *c.* 3 mm long silky hairs. ***S. arundinaceum***

1b. Root-eyes in 2—9 rows above node (Plate 29). Sheath hairy or glabrous. Callus with up to 12 mm long silky hairs. Lower glume glabrous or with ciliate margin or tip. **2**

2a. Sheath hairy. Peduncle and central rachis glabrous or sparsely hairy, hairs up to 0.5 mm long. 2nd lemma absent or much reduced. Culms 20—45 mm diameter, green to yellow, red or violet. ***S. officinarum***

2b. Sheath hairy or glabrous. Peduncle and central rachis densely hairy, hairs *c.* 2.5 mm long. Both lemmas present. Culms 5—30 mm diameter. **3**

3a. Rhizome short (plant bunch forming). Culms 15—30 mm diameter, with leaf sheaths falling off. Sheath hairy or glabrous. Blade 25—60 mm wide. Lodicules glabrous. ***S. sinense***

3b. Rhizome elongate. Culms 5—15 mm diameter, with persistent leaf sheaths. Sheath glabrous. Blade 3—30 mm wide. Lodicules ciliate. ***S. spontaneum***

Figure 118. *Rottboellia cochinchinensis* (Lour.) Clayton, part of the rachis with a pair of spikelets.

Figure 119. *Saccharum arundinaceum* Retz.

Figure 120. *Saccharum spontaneum* L.

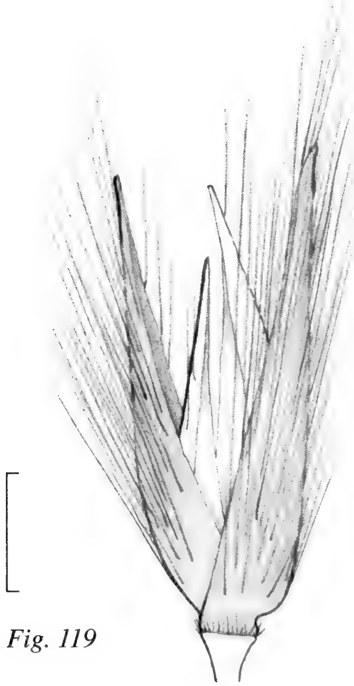


Fig. 119

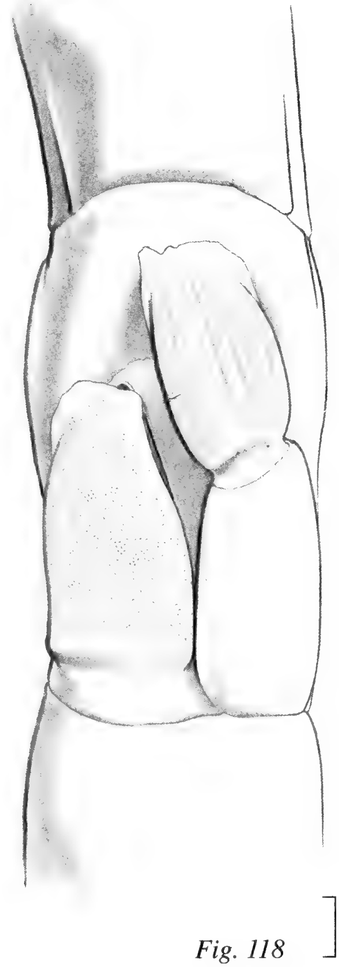


Fig. 118

Fig. 120

Saccharum arundinaceum Retz. – Fig. 119, Plate 28.

Tebu Salah

Ridley 1907: 153; 1925: 193. Gilliland 1971: 226. Keng *et al.* 1998: 179.

Ripidium arundinaceum (Retz.) Grassl

Culms with short rhizomes, erect to ascending; basal internodes *c.* 10 mm diameter, root-eyes in 1 row. Sheath more or less persistent, glabrous. Ligule 1 mm long and abaxially with row of 5 mm long hairs. Blade 10—42 mm wide. Inflorescence 6—30 cm wide, peduncle and central rachis glabrous, central rachis 29—90 cm long; longest branch 9—45 cm long; internodes ultimate branches 4—6.5 mm long, with up to 10 mm long silky hairs at base only. Pedicel 2.5—3 mm long, sparsely hairy, hairs up to 2.5 mm long. Spikelet 2.8—4.2 mm long, *c.* 1.5 mm wide; callus 0.4 mm long, glabrous; lower glume 2.8—4.2 mm long, herbaceous, hairy, hairs *c.* 3 mm long; upper glume up to 3.9 mm long, hyaline, long-hairy; 1st lemma with hairs up to 1 mm long; 2nd lemma up to 3.1 mm long. Lodicules ciliate.

Native; India to S. China, Malesia to New Guinea. First record 1900. Rare.

On river banks.

Saccharum officinarum L. – Fig. 121, Plate 29.

Sugar Cane, *Tebu*

Gilliland 1971: 227. Whalen 1991: 118. Keng *et al.* 1998: 179.

Culms with short rhizomes, erect; basal internodes 20—45 mm diameter, root-eyes in 2—9 rows. Sheath deciduous, hairy. Ligule 0.5—3 mm long. Blade 40—60 mm wide. Inflorescence 14—17 cm wide, peduncle and central rachis sparsely hairy with hairs appressed and *c.* 0.5 mm long, central rachis 40—60 cm long; longest branch *c.* 15 cm long; internodes ultimate branches 4—6.5 mm long, with up to 10 mm-long silky hairs at base only. Pedicel 2.5—3 mm long, ciliate at tip. Spikelet 3.2—3.6 mm long, 0.8—0.9 mm wide; callus 0.4 mm long, hairy, hairs up to 2 mm long; lower glume 3.2 mm long, herbaceous, glabrous or hairy at tip; upper glume herbaceous, glabrous, margins hairy, hairs up to 0.9 mm long; 1st lemma margins hairy; 2nd lemma absent or much reduced. Lodicules glabrous.

Not native; Melanesia, now cultivated throughout the tropics. First record 1921 (Botanic Gardens). Cultivated.

In gardens and waste places where rhizomes were dumped.

This species is a hybrid between *Miscanthus floridulus* and *S. robustum*. It is only known from cultivation, where it is grown for sugar and juice and is one of the few economically important crops from Papuasia. In Singapore it rarely flowers.

Saccharum sinense Roxb.

India Cane

Whalen 1991: 113.

This species is used for modern cultivar hybrids (see note under *Saccharum*).

It is present in the Botanic Gardens, but the basal internodes are only 12 mm diameter and the leaves are just 13 mm wide. It is probably one of the clones resembling *S. spontaneum* (Whalen 1991: 115).

Saccharum spontaneum L. – Fig. 120.

Wild Cane

Gilliland 1971: 224. Whalen 1991: 112. Keng *et al.* 1998: 180.

Culms with long rhizomes, erect; basal internodes 5—15 mm diameter, root-eyes in 2 rows. Sheath persistent, glabrous. Ligule *c.* 3 mm long. Blade 3—30 mm wide. Inflorescence *c.* 5 cm wide, peduncle and central rachis densely hairy with hairs appressed and *c.* 2.5 mm long, central rachis 20—50 cm long; longest branch 4—5 cm long; internodes ultimate branches 2.5—3.5 mm long, with 3—10 mm-long silky hairs. Pedicel 1.2—1.6 mm long, sparsely hairy, hairs up to 2.5 mm long. Spikelet 3.4—3.9 mm long, *c.* 0.7 mm wide; callus 0.1 mm long, densely hairy, hairs up to 11.5 mm long; lower glume 3.3—3.8 mm long, basal part indurated, upper part hyaline, glabrous, margins ciliate; upper glume 3.4—3.7 mm long, margins and vein ciliate; 1st lemma ciliate in upper half; 2nd lemma up to 2.7 mm long. Lodicules ciliate.

Not native; Paleo(sub)tropics. First record 1946. Extinct (1954).

On sandy soil, near water.

According to Sinclair (*Sinclair* 40184, 1954, SING) it is not native to Singapore but had spread throughout the island. However, it has never been collected since his time.

Sacciolepis Nash

Culms single to loosely tufted or with short stolons, erect; internodes hollow; nodes glabrous. Sheath glabrous. Ligule membranous, tip ciliolate. Young leaf blade inrolled. Blade glabrous, margins smooth. Inflorescence spike-like panicle, central rachis glabrous, branches many; longest branch up to 0.5 cm long, simple. Pedicel 0.4—1 mm long, glabrous. Spikelets single, not flattened, gibbous, 2-flowered with 1st floret sterile and 2nd bisexual, unawned; lowest bract 0.45—0.55 times as long as and 2nd as long as spikelet; glumes and 1st lemma herbaceous; lower glume at base enveloping, cordate, glabrous, acute; 1st lemma glabrous or hispid at tip; 1st palea hyaline.

1a. Inflorescence 0.8—8 cm long. Spikelets elongate ovoid, 2—3.4 mm long, acute. ***S. indica***

1b. Inflorescence 12(—20) cm long. Spikelets subglobose to ovoid, up to 2 mm long, obtuse. ***S. myosuroides***

Sacciolepis indica (L.) Chase – Fig. 122, Plate 31.

Short-spiked Sacciolepis

Ridley 1925: 232 (excluding Singapore). Bor 1960: 357. Keng *et al.* 1998: 180. — *S. indica* var. *indica*: Gilliland 1971: 152.

Panicum indicum L.: Ridley 1907: 134.

S. angusta auct., non Stapf: Ridley 1925: 232.

S. turgida Ridl. 1925: 231. — *S. indica* var. *turgida* (Ridl.) Gilliland: Gilliland 1971: 154.

Culms 15—50(—90) cm long. Sheath 2.5—4.3 cm long, rounded to keeled at tip. Ligule 0.2—0.5 mm long. Blade 3—10.5(—19) cm long, 2—5.6 mm wide, base somewhat rounded. Inflorescence 0.8—8 cm long, not interrupted. Spikelet elongate ovoid, (2—)2.6—3.4 mm long, 0.7—1.5 mm wide, acute; lower glume 1.1—1.7 mm long, 5 or 7 veins; upper glume 1.9—3.2 mm long, 9 or 11 veins, glabrous to hispid in upper half, obtuse to cuspidate; 1st lemma 1.7—3 mm long, 7 or 9 veins, truncate to acute; 1st palea 0.7—1.2 mm long; 2nd lemma 1—1.5 mm long, hyaline to indurated; 2nd palea 0.9—1.4 mm long, hyaline to indurated.

Native; India to Australia. First record 1889. Common.

In unshaded to shaded, wet to moist grassland.

Gilliland mentioned both the length of the culm and leaf blade to distinguish this species from *S. myosuroides*. However, the character that seems to differentiate these species best is the shape of the spikelet (Bor 1960). *Hymenachne amplexicaulis* differs in having (partially) filled culms, sheaths with transverse veins, longer panicle branches (up to 6 cm long) and non-gibbous spikelets. *Panicum auritum* has blades 9—23 mm wide, inflorescences with the longest branches at least 2 cm long and spikelets that are not gibbous.

Sacciolepis myosuroides (R.Br.) A.Camus – Fig. 123.

Long-spiked Sacciolepis

Ridley 1925: 232. Bor 1960: 358. Gilliland 1971: 152. Keng *et al.* 1998: 180.

Panicum myosuroides R.Br.: Ridley 1907: 134.

Culms 65 cm long. Sheath 8—11 cm long, rounded. Ligule 0.5 mm long. Blade *c.* 25 cm long, 3.5 mm wide, base cuneate. Inflorescence 12(—20) cm long, interrupted. Spikelet subglobose to ovoid, 1.7—2 mm long, 0.9 mm wide, obtuse; lower glume *c.* 0.8 mm long, 3 veins; upper glume *c.* 1.7 mm long, 7 veins, glabrous, obtuse; 1st lemma 1.7 mm long, 9 veins, obtuse. 1st palea 1.6 mm long; 2nd lemma 1.3 mm long, indurated; 2nd palea 1.3 mm long, hyaline.

Native; India to Australia. Single record 1890 from Kranji. Extinct (1890).

In damp places.

The difference from *S. indica* is discussed there.

Schizachyrium Nees

Schizachyrium brevifolium (Sw.) Nees, mentioned as 'very shortlived in Singapore' (Gilliland 1971: 291) has not been found. Compared with *S. sanguineum*, this is a smaller plant with leaves up to 4 cm long and lower glume of the sessile spikelet up to 2.5 mm long.

Schizachyrium sanguineum (Retz.) Alston – Fig. 124.

Gilliland 1971: 289. Keng *et al.* 1998: 181.

Andropogon hirtiflorus auct., non Kunth: Ridley 1907: 166.

S. semiberbe Nees: Ridley 1925: 210.

Culms tufted, erect, 115 cm long; nodes glabrous. Sheath 5—8 cm long, glabrous, basal strongly keeled, upper rounded. Ligule membraneous, 1.2 mm long, tip ciliolate. Young leaf blade folded along midrib. Blade 14 cm long, 3.5 mm wide, glabrous, base rounded. Inflorescence spike-like raceme, 2—10 per culm; rachis 4—6 cm long, articulated, hairy on the callus with hairs up to 1.5 mm long, outside rounded, inside flattened. Pedicel 5 mm long, flattened, hairy on one margin. Spikelets in pairs of 1 sessile and 1 pedicelled; sessile spikelet 5.8—6.5 mm long, 0.5—0.6 mm wide, not flattened, 2-flowered with 1st floret sterile and 2nd bisexual, awned; callus hairy; lowest bract as long as and 2nd 0.9 times as long as spikelet; lower glume 5.8—6.5 mm long, herbaceous, glabrous, 5 veins, marginal ones keeled, tip bifid; upper glume 5.5—6 mm long, boat-shaped, hyaline, 1 vein, keeled, margins and keel ciliolate; 1st lemma 5.5 mm long, hyaline; 1st palea absent; 2nd lemma 5 mm long, deeply cleft for *c.* 4 mm, awn from notch 10—16 mm long with basal half twisted and upper half antrorsely scaberulous; 2nd palea 1.2 mm long, hyaline. Pedicelled spikelet as sessile, but 3.5—5 mm long, unawned; lower glume 3.5—5 mm long, aristate 0.5 mm; 2nd lemma 3.2 mm long, unawned.

Native; India to China and Malesia. First record 1880s. Extinct (1959).

In sandy places near the sea: beach or woodlands.

Scrotochloa Judz.

Judziewicz 1984: 299—304.

Scrotochloa is split off from *Leptaspis* because the inflorescence articulates as a whole and its central rachis bears only one node (Judziewicz 1984). In *Leptaspis* the inflorescence is persistent and its central rachis bears more than one node.

Figure 121. *Saccharum officinarum* L.

Figure 122. *Sacciolepis indica* (L.) Chase.

Figure 123. *Sacciolepis myosuroides* (R.Br.) A.Camus.

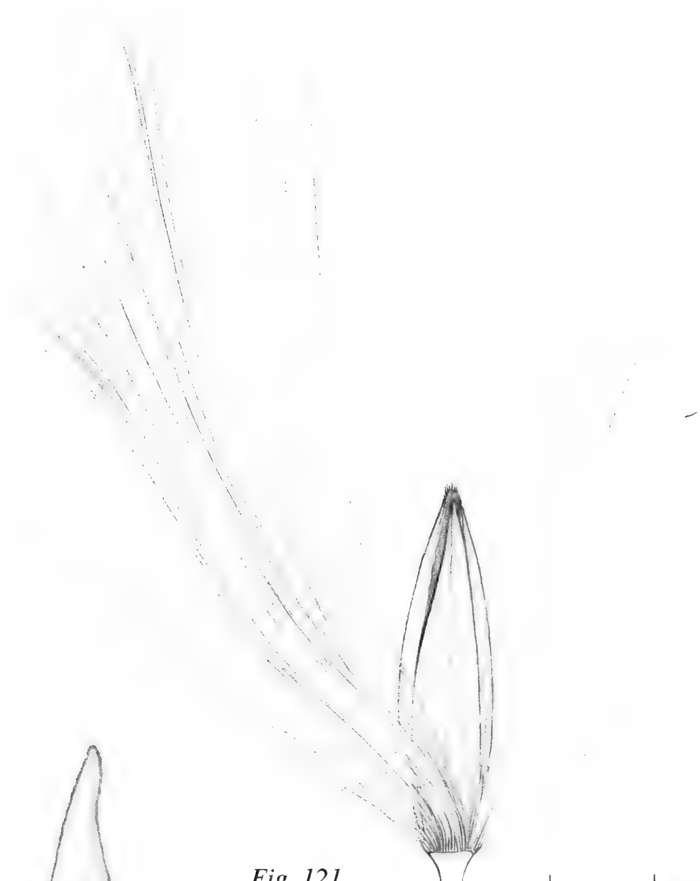


Fig. 121

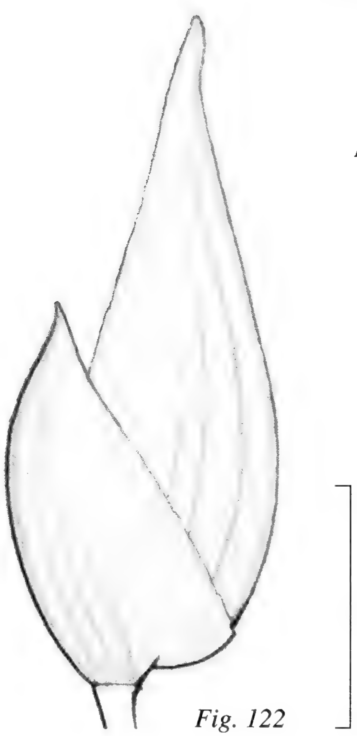


Fig. 122

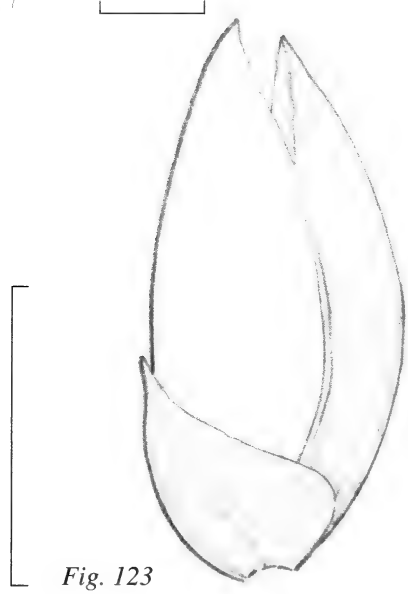


Fig. 123

Scrotochloa urceolata (Roxb.) Judz. – Fig. 125.

Shield Grass, *Rumput Babi*

Keng *et al.* 1998: 181. Judziewicz 1984: 300.

Leptaspis urceolata (Roxb.) R.Br.: Ridley 1907: 150; 1925: 255. Gilliland 1971: 47.

Culms single or in small tufts, erect, rhizome *c.* 9 mm diameter, 30—100 cm long. Sheath *c.* 9 cm long, rounded, with transverse veins visible from the inside, sparsely hairy, margins glabrous. Ligule basal part membranous and 0.3 mm long, hairs at tip 0.5 mm long. Young blade inrolled. Blade 11—32 cm long, 40—62 mm wide, twisted (underside facing upward), pinninerved and with transverse veins, glabrous, base abruptly narrowed, pseudopetiole 20—50 mm long, tip acuminate. Inflorescence panicle, deciduous as a whole, central rachis absent, branches 5—8; longest branch 10—18 cm long, densely hairy, simple or branched. Pedicel 4—6 mm long. Spikelets heteromorphous, unisexual, in pairs of 1 male and 1 female, 1-flowered, unawned. Female spikelet 6—7.5 mm long, 4—4.5 mm wide, globose-obovoid, not flattened; both glumes early caducous; lemma 6—7.5 mm long, indurated, 11 veins, obovoid, constricted at basal 1.5 mm, with many hooked hairs, margins fused but for pore at tip, tip beaked; palea 7—8.2 mm long, protruding through pore at tip of lemma, thin herbaceous, glabrous, tip bifid over 0.5—1 mm. Male spikelet 4—6 mm long, 0.7—2.3 mm wide, more or less laterally flattened, herbaceous; lower glume 1.5 mm long, glabrous, 1 vein, obtuse; upper glume as lower, 2.8 mm long; lemma 5 mm long, 9 veins, glabrous, truncate; palea 5.8 mm long.

Native; Sri Lanka, SE Asia, New Guinea, Solomon Islands. First record 1889. Rare. In moist and deeply shaded places in primary and mature secondary forest.

Setaria P.Beauv.

Veldkamp 1994: 373—384.

Ligule basal part membranous, with hairs at tip. Inflorescence 1 per sheath and 1—4 per culm, raceme or (spike-like) panicle, central rachis present. Pedicel present. Spikelets single, most or all with involucre of 1 or more bristles, bristles persistent (not falling off with the spikelet). Spikelet not flattened, 2-flowered with 2nd floret bisexual, unawned; lowest bract 0.25—0.45 times as long as spikelet; glumes and 1st lemma (thin) herbaceous; 1st palea hyaline; 2nd lemma and palea indurated, glabrous.

Setaria sphacelata (Schumach.) Stapf & C.E. Hubb. has been grown in the University Garden (now university campus adjacent to the Singapore Botanic Gardens and the Bukit Timah Road).

Differences with *Cenchrus* and *Pennisetum* are mentioned under *Cenchrus*.

The key is after Veldkamp (1994).

1a. Blades plicate (Fig. 7c). Inflorescence a lax panicle, longest branch 1—16 cm long. **2**

1b. Blades flattened. Inflorescence dense and bottle-brush-shaped, branches absent or up to 0.8 cm long. **3**

Figure 124. *Schizachyrium sanguineum* (Retz.) Alston, rachis with a pair of spikelets on basal internode and one sessile spikelet on the upper internode.

Figure 125. *Scrotochloa urceolata* (Roxb.) Judz., pair of spikelets. a. female spikelet, b. male spikelet.

Figure 126. *Setaria barbata* (Lam.) Kunth.

Figure 127. *Setaria palmifolia* (J.König) Stapf var. *palmifolia*.

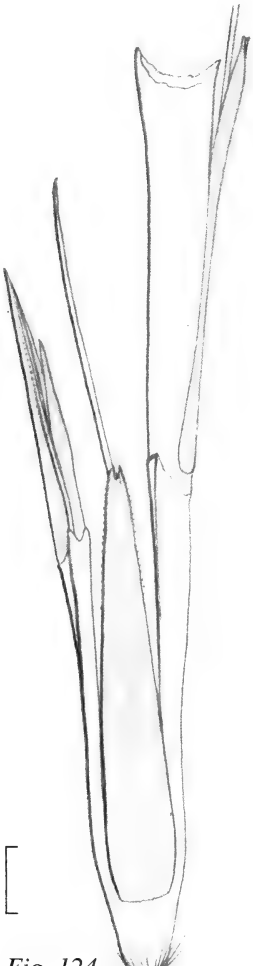


Fig. 124

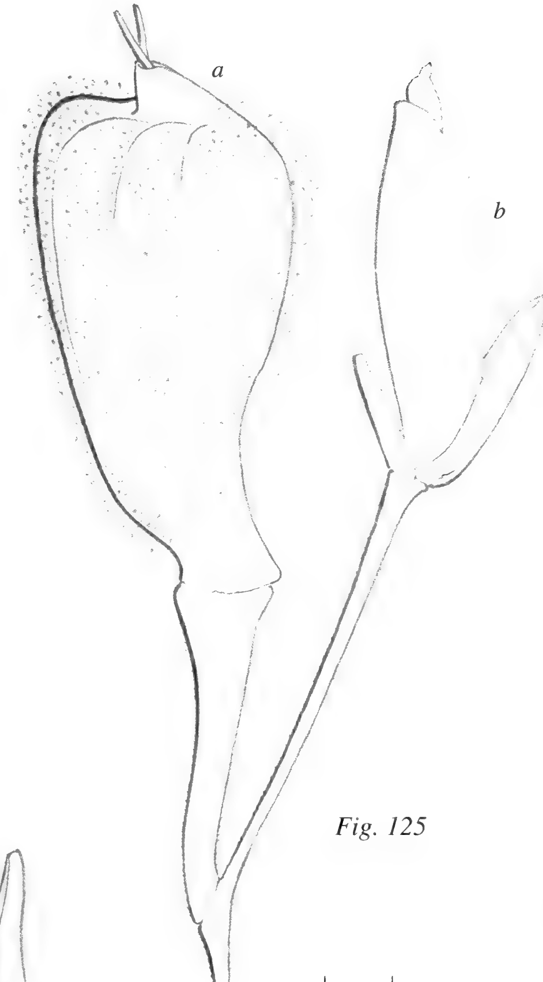


Fig. 125

Fig. 127

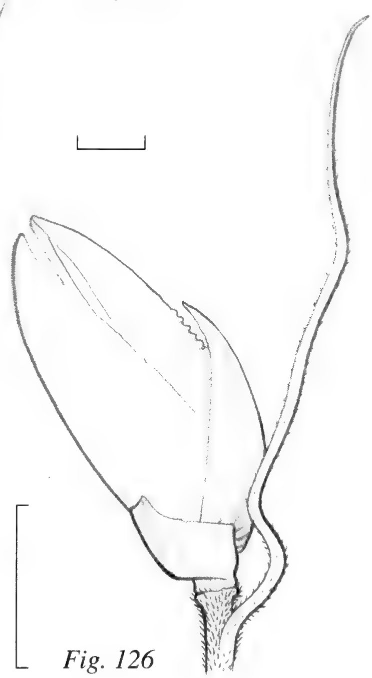


Fig. 126

2a. Blade margin at base hairy. Central rachis of inflorescence hairy; branches hairy. 2nd lemma easily detachable from the spikelet, (at maturity) transversally rugose. ***S. barbata***

2b. Blade margin at base glabrous. Central rachis of inflorescence glabrous, scaberulous; branches scaberulous, with short hairs at base only. 2nd lemma persistent, (at maturity) finely rugulose. ***S. palmifolia* var. *palmifolia***

3a. Involucre absent or consisting of 1—3 bristles. Lower glume enveloping; 2nd lemma easily detachable from the spikelet. ***S. italica***

3b. Involucre consisting of 4—15 bristles. Lower glume half enveloping; 2nd lemma persistent. ***S. parviflora***

Setaria barbata (Lam.) Kunth – Fig. 126, Plate 32.

Veldkamp 1994: 375; 1999b: 236. Keng *et al.* 1998: 182.

Culms creeping, geniculate, ascending or scrambling, 30—200 cm long; nodes short-hairy. Sheath 3—9 cm long, keeled to winged, glabrous or hairy, margins hairy. Ligule basal part 0.3—1 mm long, hairs at tip 0.5—0.7 mm long. Young leaf blade plicate and more or less folded along midrib. Blade 13—68 cm long, (6—)19—35 mm wide, plicate, both sides with up to 1.5 mm-long hairs, base long cuneate (to pseudopetiolate) and at margin with up to 4.5 mm long hairs. Inflorescence 5.5—18 cm long, open, central rachis with *c.* 2 mm-long hairs; longest branch 1—3 cm long, hairy, branched. Pedicel 0.5—0.7 mm long; bristle 1, up to 4 mm long. Spikelet 2.4—2.6 mm long, 1.1—1.3 mm wide, 1st floret male; 2nd lowest bract *c.* 0.65 times as long as spikelet; lower glume 0.7—0.8 mm long, enveloping, 3 veins, glabrous; upper glume 1.6—1.7 mm long, 7 veins, glabrous; 1st lemma 2.3—2.5 mm long, 7 veins, glabrous; 1st palea 2.1—2.2 mm long; 2nd lemma 1.9—2.2 mm long, transversely rugose (at maturity), easily detachable from the spikelet; 2nd palea 1.8—2 mm long, rugulose.

Not native; probably native to West Africa, now pantropical. First record 1971. Common.

Weed in moist and (partly) shaded roadsides and margins of woodlands.

Setaria italica (L.) P.Beauv. – Fig. 128.

Italian Millet, *Sekoi*

Ridley 1907: 144; 1925: 234 (both excluding Singapore). Gilliland 1971: 156. Veldkamp 1994: 377. Keng *et al.* 1998: 182.

Culms single, erect, 25—90 cm long; nodes glabrous. Sheath 2—16 cm long, rounded, glabrous or sparsely hairy towards tip, margins hairy. Ligule basal part 0.5—0.7 mm long, hairs at tip 1.2—1.5 mm long. Young leaf blade inrolled. Blade 5—40 cm long, 4—16 mm wide, flattened, glabrous, margin scaberulous, base rounded and at margin with 1 mm long hairs. Inflorescence (0.5—)8—13 cm long, dense, central rachis with *c.* 1.5 mm-long hairs; longest branch up to 0.8 cm long, hairy, branched. Pedicel 0.5—0.8 mm long; bristles 0—3, up to 11 mm long. Spikelet 2.5—2.8 mm long, 0.9—1.3 mm wide, 1st floret sterile; 2nd lowest bract 0.85—0.95 times as long as spikelet; lower glume 1.2—1.3 mm long, enveloping, 3 or 5 veins, glabrous;

Figure 128. *Setaria italica* (L.) P.Beauv.

Figure 129. *Setaria parviflora* (Poir.) Kerguélen.

Figure 130. *Sorghum bicolor* (L.) Moench, sessile spikelet.

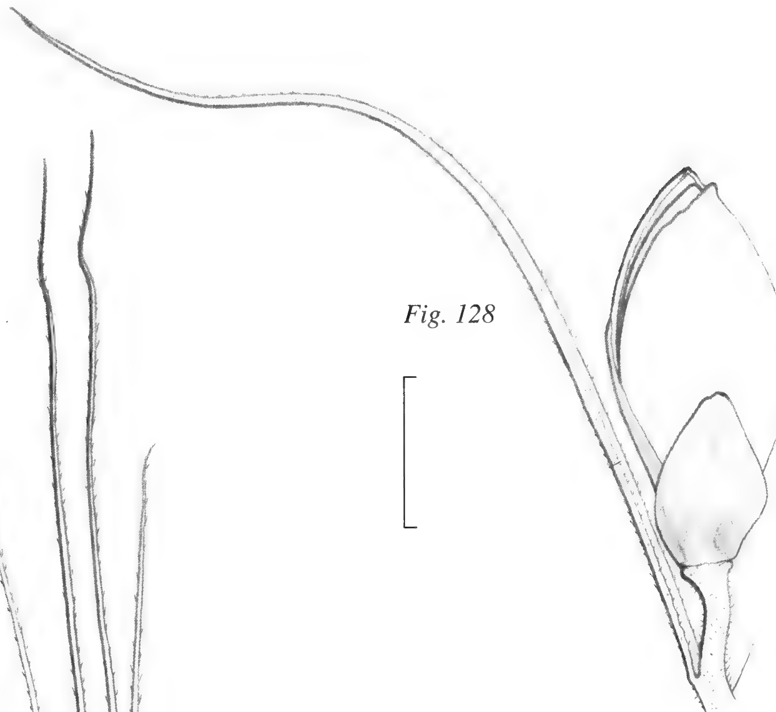


Fig. 128

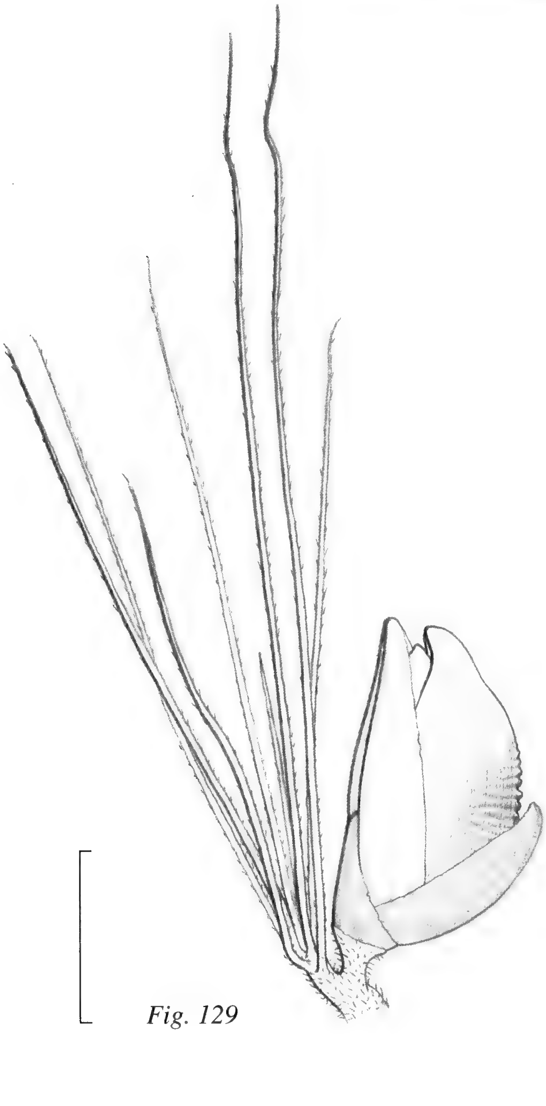


Fig. 129

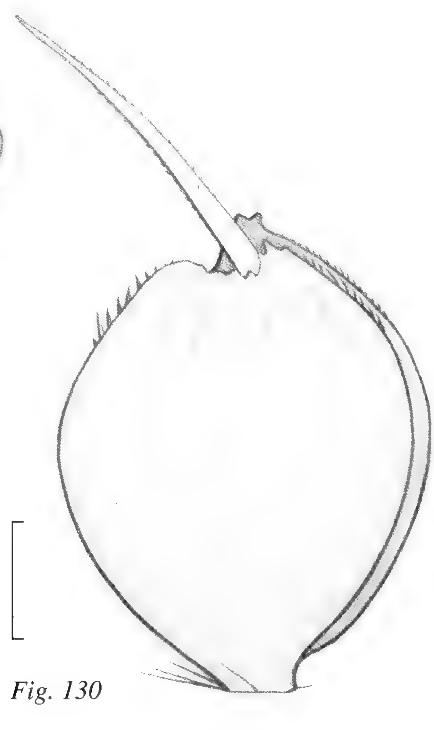


Fig. 130

upper glume 2.3—2.4 mm long, 5 or 7 veins, glabrous; 1st lemma 2.5—2.6 mm long, 5 or 7 veins, glabrous; 1st palea 1—1.4 mm long; 2nd lemma 2.4—2.5 mm long, scaberulous, easily detachable from the spikelet; 2nd palea *c.* 2 mm long, scaberulous.

Not native; probably native to warm-temperate subtropical Eurasia. First record 1962. Extinct (1969).

On dry waste ground.

The species is grown for its grain and in Singapore has disappeared after its cultivation ceased.

Setaria palmifolia (J.König) Stapf **var. *palmifolia*** – Fig. 127.

Broad-leaved Bristle-grass

Veldkamp 1994: 379.

Panicum plicata auct., non Lam.: Ridley 1907: 136 (excluding Singapore).
S. palmifolia (J.König) Stapf: Gilliland 1971: 157. Keng *et al.* 1998: 182.
S. plicata auct., non Cooke: Ridley 1925: 235 (excluding Singapore).

Culms tufted, erect, *c.* 85 cm long; nodes sparsely short-hairy. Sheath 20 cm long, rounded, sparsely hairy, margins glabrous or hairy. Ligule basal part 1.4 mm long, hairs at tip 0.6 mm long. Young leaf blade plicate and more or less folded along midrib. Blade 24—33 cm long, 14—38 mm wide, plicate, glabrous or upperside hairy, base cuneate and with up to 5 mm long hairs. Inflorescence 25—37 cm long, open, central rachis scaberulous; longest branch 6—16 cm long, scaberulous, hairy at base, branched, ending in a bristle. Pedicel 0.5—0.8 mm long; bristle 0—1, up to 9 mm long. Spikelet 3.3—3.5 mm long, 1.1—1.2 mm wide, 1st floret sterile; 2nd lowest bract *c.* 0.7 times as long as spikelet; lower glume 1.3—1.5 mm long, half enveloping, 3 (or 5) veins, glabrous; upper glume 1.9—2.2 mm long, 7 veins, glabrous; 1st lemma 3—3.3 mm long, 6 veins, glabrous; 1st palea 1.4—1.6 mm long; 2nd lemma 2.5—2.7 mm long, rugulose at maturity, persistent; 2nd palea 2.4—2.5 mm long, rugulose.

Probably not native; India to China, Japan, Malesia to New Guinea, not in Australia. First record 1904 from the Botanic Gardens, 1962 in the wild. Extinct (1963).

Forest grass on lightly shaded and fairly moist but not wet ground.

The species was probably cultivated in the Botanic Gardens. In the wild it was found only in one area adjacent to the Botanic Gardens from where it probably had spread.

Setaria parviflora (Poir.) Kerguélen – Fig. 129.

Veldkamp 1994: 379. Keng *et al.* 1998: 183.

S. glauca auct., non (L.) P.Beauv.: Ridley 1907: 144.
S. pallidifusca (Schumach.) Stapf & C.E.Hubb.: Gilliland 1971: 159 ('*pallide-fusca*').
S. pumila auct., non (Poir.) Roem. & Schult.: Tan 1995: 147.
S. rubiginosa Miq.: Ridley 1925: 234.

Culms tufted, with short rhizomes, 40—150 cm; nodes glabrous. Sheath 2—6 cm long, basal flattened and midrib raised, upper rounded, glabrous. Ligule 0.8—1.5 mm long, basal part 0.3—1 mm long, hairs at tip 0.5—1 mm long (hairs shorter to longer than membrane). Young leaf blade inrolled. Blade 5—17 cm long, 4—7 mm wide, flattened, glabrous, scaberulous, base cuneate to somewhat rounded and scaberulous or with few up to 3 mm long hairs. Inflorescence 2—17 cm long, dense, central rachis with c. 1 mm-long hairs; longest branch 0—0.4 cm long, hairy, simple. Pedicel 0.3—0.5 mm long; bristles 4—9, up to 7 mm long. Spikelet 1.9—2.3 mm long, 0.9—1 mm wide, 1st floret sterile; 2nd lowest bract *c.* 0.5 times as long as spikelet; lower glume 0.8—1 mm long, half enveloping, 3 veins, glabrous; upper glume 1—1.3 mm long, 5 veins, glabrous; 1st lemma 1.7—2.3 mm long, 5 veins, glabrous; 1st palea 1.5—2 mm long; 2nd lemma 1—2 mm long, rugulose, persistent; 2nd palea 1.5—1.7 mm long, rugulose.

Native; pan(sub)tropical. First record 1889. Rare.

On dry roadsides, fields, sandy sea shore.

The inclusion of *S. pumila* in Tan (1995: 'rare') most probably refers to *S. parviflora*. Material of the former, which differs from *S. parviflora* in having spikelets of 2.8—3.5 mm long (Veldkamp 1994), has not been found.

Sorghum Moench

Culms tall, erect; basal internodes at least 5 mm diameter. Sheath rounded, margins glabrous. Ligule membranous, tip ciliolate to ciliate. Young leaf blade inrolled. Blade glabrous, midvein at upperside at least at base prominent and white, base hairy. Inflorescence panicle, central rachis present, branches many and branched. Pedicel flattened, margins hairy. Spikelets in pairs or threes of 1 sessile and 1 or 2 pedicelled, 2-flowered. Sessile spikelet callus hairy; the two lowest bracts *c.* as long as spikelet; lower glume flat to rounded, upper glume boat-shaped; both lemmas and 2nd palea hyaline; 1st palea absent. Pedicelled spikelet lanceolate, 3—5 mm long, 0.8—0.9 mm wide, dorsiventrally flattened, male or sterile, unawned.

1a. Culms tufted. Spikelets nearly globose at maturity, sometimes awned. ***S. bicolor***

1b. Culms long stoloniferous. Spikelets oblong-lanceolate, dorsiventrally flattened, not much enlarged at maturity, unawned. ***S. propinquum***

Sorghum bicolor (L.) Moench – Fig. 130.

Great Millet

Keng *et al.* 1998: 183.

S. vulgare (L.) Pers.: Gilliland 1971: 231.

Culms tufted, 135 cm long; nodes glabrous. Sheath 9—16 cm long, glabrous. Ligule 2—2.8 mm long, tip ciliolate. Blade 20—70 cm long, 21—42 mm wide, margins smooth, base rounded to cordate. Inflorescence 11—40 cm long, central rachis glabrous; longest branch 4—9 cm long, sparsely hairy at base. Pedicel 1—1.2 mm long. Sessile spikelet subglobose, 4—5.8 mm long, *c.* 3 mm wide, dorsiventrally flattened to subterete, awned or unawned; lower glume 3.6—5.4 mm long, indurated, 15 veins and 2nd from margin keeled, with appressed hairs in basal half, tip truncate; upper glume 3.7—5 mm long, indurated, 9 veins, glabrous to sparsely hairy; 1st lemma 3.5—4.5 mm long; 2nd lemma *c.* 3.6 mm long, 0.6 mm deep bifid, awn if present from notch and 4.5—10 mm long with basal part twisted and upper part scaberulous; 2nd palea *c.* 2 mm long. Pedicelled spikelet variously reduced.

Not native; Africa, now cultivated in tropical and warm-temperate regions throughout the world. First record 1892. Cultivated (not found after 1965).

This species has many cultivars; it is more variable than described above.

Sorghum propinquum (Kunth) Hitchc. – Fig. 131.

Tebu Tikus

Gilliland 1971: 229. Keng *et al.* 1998: 184.

S. affine auct.: Ridley 1925: 195 (excluding Singapore).

Culms single, with long stolons, 120—250 cm; nodes short-hairy. Sheath 19—21 cm long, glabrous, external ligule a fringe of hairs. Ligule 1.3—2.2 mm long, basal part 0.3—0.9 mm long, hairs at tip 1—1.5 mm long. Blade 40—65 cm long, 11—21 mm wide, margins serrulate, base rounded. Inflorescence 25—42 cm long, central rachis with hairlike spicules; longest branch 8—19 cm long, densely hairy at base. Pedicel 1.4—2 mm long. Sessile spikelet oblong-lanceolate, 4.2—5.2 mm long, 1.5—1.8 mm wide, more or less dorsiventrally flattened, unawned; lower glume 3.7—4.9 mm long, herbaceous, 9 veins, marginal ones keeled, transverse veinlets present, entirely with appressed hairs, tip acute; upper glume 4—5 mm long, herbaceous, 5 veins, sparsely hairy in lower 2/3rd; 1st lemma 3.2—4.5 mm long; 2nd lemma 2—3.2 mm long; 2nd palea 1.6—2.5 mm long. Pedicelled spikelet 3.8—5 mm long.

Probably not native; India to China and SE Asia. First record 1954. Rather rare.

In wasteland and on roadsides.

According to Keng *et al.* (1998) it is introduced in Singapore.

Sphaerocaryum Nees ex Hook.f.

Sphaerocaryum malaccense (Trin.) Pilg. – Fig. 132.

Elegant Roundseed

Gilliland 1971: 126. Keng *et al.* 1998: 184.

S. elegans Nees ex Steud.: Ridley 1907: 170; 1925: 241.

Culms creeping, erect part 10—20 cm long; nodes hairy. Sheath *c.* 4 mm long, rounded, hairy, one margin hairy. Ligule row of hairs, 0.5—1 mm long. Blade 1—2.5 cm long, 4—9 mm wide, glabrous, base cordate and at margin hairy. Inflorescence panicle, 2—4 cm long, central rachis glabrous, branches many; longest branch *c.* 1.2 cm long, glabrous, simple. Pedicel 1—2.5 mm long, glabrous. Spikelets single, *c.* 1 mm long, *c.* 0.4 mm wide, not flattened, 1-flowered, unawned; lowest bract *c.* 0.6 and 2nd bract almost as long as spikelet; lower glume 0.6 mm long, early caducous, thin herbaceous, glabrous, obtuse; upper glume as lower, 1 mm long, acute; lemma 1 mm long, thin herbaceous, short-hairy; palea as lemma, but narrower.

Native; India to Thailand, Peninsular Malaysia and Singapore. Twice recorded 1889 from Ang Mo Kio and Krangi. Extinct (1889).

In moist to wet places, swampy streams in forests, fields.

Sporobolus R.Br.

Baaijens and Veldkamp 1991: 393—458.

Nodes glabrous (or at base covered by sheaths). Sheath glabrous or with few hairs at throat and/or margins. Ligule membranous, tip ciliolate. Young leaf blade inrolled. Blade glabrous, base cuneate, glabrous (or with few hairs). Inflorescence panicle, central rachis present, branches many and branched. Pedicel glabrous. Spikelets single, glabrous, 1-flowered, unawned.

The key to the species follows Baaijens and Veldkamp (1991).

1a. Stoloniferous plants. Lower glume 0.55—0.9 times as long as spikelet, upper glume 0.75—1 times as long. ***S. virginicus***

1b. Tufted plants. Lower glume 0.2—0.5 times as long as spikelet, upper glume up to 0.67 times as long. **2**

2a. Pedicel 0.3—0.7 mm long. Spikelet 1.4—1.9 mm long; lemma and palea herbaceous. ***S. indicus***

Figure 131. *Sorghum propinquum* (Kunth) Hitchc., a group of one sessile and two pedicelled spikelets.

Figure 132. *Sphaerocaryum malaccense* (Trin.) Pilg.

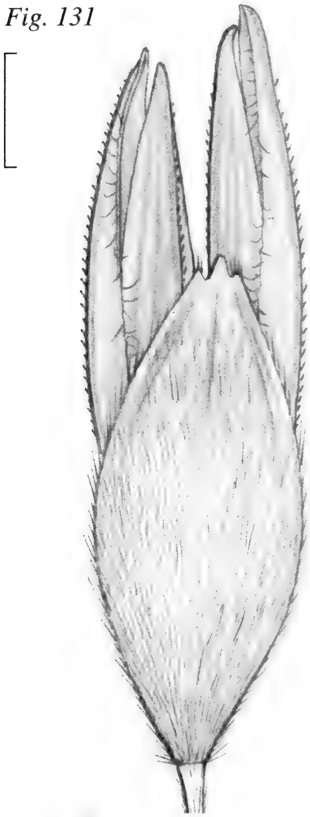
Figure 133. *Sporobolus virginicus* (L.) Kunth.

Figure 134. *Sporobolus indicus* (L.) R.Br. var. *pyramidalis* (P.Beauv.) Veldk.

Figure 135. *Sporobolus tenuissimus* (Schrank) Kuntze.

Figure 136. *Sporobolus indicus* (L.) R.Br. var. *flaccidus* (Roem. & Schult.) Veldk.

Fig. 131



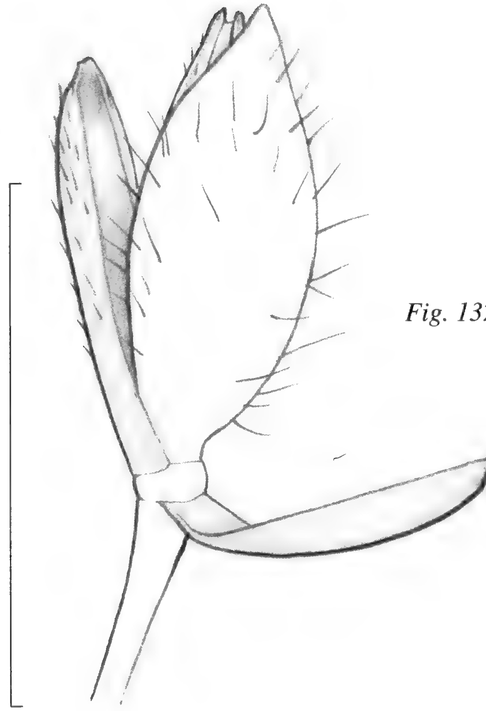


Fig. 132

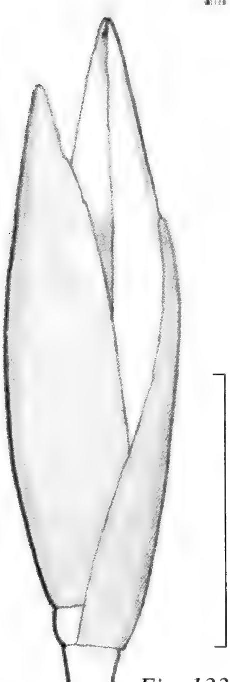


Fig. 133

Fig. 134

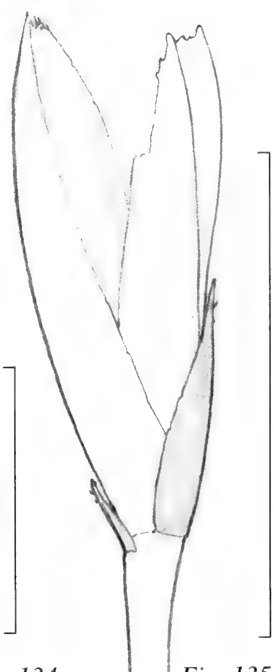


Fig. 135

Fig. 136

2b. Pedicel 2—6 mm long. Spikelet 0.9—1.25 mm long; lemma and palea hyaline. ***S. tenuissimus***

Sporobolus indicus (L.) R.Br.

Literature and synonymy: see varieties.

Culms single or tufted, rhizomes absent, erect, not rooting at lower nodes, basal internodes almost absent and only elongating in flowering culm. Leaves of non-flowering plants all basal, covering the nodes. Sheath 3—10 cm long, rounded, throat with up to 0.5 mm long hairs, one margin hairy. Ligule 0.2—0.4 mm long. Blade 4—35 cm long, 2—4.5 mm wide, base glabrous or sparsely hairy. Pedicel 0.3—0.7 mm long. Spikelet not flattened; glumes hyaline; lemma 1.2—1.9 mm long, herbaceous; palea 1.2—1.8 mm long, herbaceous.

Native; pantropical. First record 1877. Common.

In unshaded to partly shaded, dry to moist places, e.g. roadsides, fields, beaches.

Although fungus infections of the spikelets have been reported frequently, they are not known from Singapore, possibly because mowing reduces the chances of infection (Baaijens and Veldkamp 1991: 425).

This is a very variable species. At present three varieties are known for Singapore, but these are difficult to distinguish. The key to the varieties in Singapore is after Baaijens and Veldkamp (1991):

1a. Upper glume truncate, less than half as long as the spikelet, slightly longer than the lower glume. ***S. indicus* var. *pyramidalis***

1b. Upper glume more or less acute, 0.4—0.67 times as long as spikelet, distinctly longer than the lower glume. **2**

2a. Panicle usually somewhat lax and spikelets well-spaced. Spikelets usually 1.4—1.6 mm long. Anthers usually 2, 0.5—0.8 mm long. Seed 0.6—0.9 mm long. ***S. indicus* var. *flaccidus***

2b. Panicle usually contracted and spikelets crowded. Spikelets usually 1.8—1.9 mm long. Anthers usually 3, 0.7—1 mm long. Seed 0.9—1.1 mm long. ***S. indicus* var. *major***

Sporobolus indicus (L.) R.Br. **var. *flaccidus*** (Roem. & Schult.) Veldk.

Lesser Dropseed – Fig. 136, Plate 34.

Baaijens and Veldkamp 1991: 433. Keng *et al.* 1998: 184.

S. diandrus (Retz.) P.Beauv.: Ridley 1907: 170; 1925: 244. Gilliland 1971: 106 (as *diander*).

Culms 20—100 cm long. Panicle 14—21 cm long, usually somewhat lax; longest branch 2—4.5 cm long, erecto-patent to patent, spikelets well-spaced. Spikelets usually 1.4—1.6 mm long; lowest bract 0.25—0.30 and 2nd 0.4—0.6 times as long as spikelet; lower glume 0.3—0.5 mm long, obtuse to truncate; upper glume 0.5—0.9 mm long, acute, serrate. Anthers usually 2, 0.5—0.8 mm long. Seed 0.6—0.9 mm long.

Native; Mauritius, Pakistan, India, Malesia to Polynesia and Australia. First record 1877. Common.

Sporobolus indicus (L.) R.Br. **var. *major*** (Büse) Baaijens

Common Dropseed

Baaijens and Veldkamp 1991: 437. Keng *et al.* 1998: 184.

S. fertilis (Steud.) Clayton: Gilliland 1971: 106.

S. indicus (L.) R.Br.: Ridley 1907: 171; 1925: 244.
Culms 20—100 cm long. Panicle 15—32 cm long, usually contracted; longest branch 2—3.5 cm long, erect, spikelets crowded. Spikelets usually 1.8—1.9 mm long; lowest bract 0.25—0.30 and 2nd 0.4—0.6 times as long as spikelet; lower glume 0.4—0.5 mm long, obtuse to truncate; upper glume 0.6—1 mm long, obtuse to erose and denticulate. Anthers usually 3, 0.7—1 mm long. Seed 0.9—1.1 mm long.

Native; India to Japan, Malesia to Australia. First record 1892. Rather common.

Sporobolus indicus (L.) R.Br. var. ***pyramidalis*** (P.Beauv.) Veldk. – Fig. 134.

Baaijens and Veldkamp 1991: 439. Duistermaat 2004: 39.

Culms *c.* 155 cm long. Panicle 30—40 cm long, lax; longest branch 9 cm long, patent, spikelets crowded. Spikelet *c.* 1.9 mm long; lowest bract 0.15 and 2nd 0.3 times as long as spikelet; lower glume 0.3 mm long, truncate; upper glume 0.6 mm long, truncate. Anthers 3, 0.9 mm long. Seed 0.8—1 mm long.

Not native; Africa, S. America. First record 2004. Rare.

Unshaded, open vegetation, sandy soil.

Sporobolus tenuissimus (Schrank) Kuntze – Fig. 135, Plate 35.

Baaijens and Veldkamp 1991: 444. Veldkamp 1997b: 512; 2003: 500. Duistermaat 2004: 38.

Single, erect, stolons absent, not rooting at lower nodes, 15—70 cm long, basal internodes well developed. Leaves scattered along culm. Sheath 9—10 cm long, rounded, midrib slightly raised, glabrous. Ligule 0.1 mm long. Blade *c.* 15 cm long, 2 mm wide. Inflorescence 9—20 cm long, lax; longest branch *c.* 3.5 cm long, erecto-patent, spikelets well-spaced. Pedicel 2—6 mm long. Spikelet *c.* 1.1 mm long, 0.7 mm wide, laterally flattened; lowest bract *c.* 0.15 and 2nd *c.* 0.45 times as long as spikelet; lower glume 0.15 mm long, hyaline; upper glume 0.5 mm long, hyaline; lemma 1 mm long, hyaline; palea 0.9 mm long, hyaline. Anthers 3, 0.3—0.4 mm long. Seed 0.7 mm long.

Not native; tropical S America, Africa and India, introduced in Vietnam and Malesia. First record 2003. Rare.

In flowerbeds and on roadsides, open vegetation, unshaded.

This species is likely to spread further in Singapore. It often grows in association with *Eragrostis amabilis*, which differs in the more prostrate to ascending habit, the many-flowered spikelets with a jagged and not globose profile, and the distinctly setose paleas.

Sporobolus virginicus (L.) Kunth – Fig. 133.

Beach Dropseed

Gilliland 1971: 108. Baaijens and Veldkamp 1991: 445.

Culms long stoloniferous, lower nodes rooting, erect part *c.* 20 cm long; basal internodes shorter than sheaths; nodes covered by sheaths. Leaves scattered along culms. Sheaths overlapping, rounded, margin at tip with few hairs. Ligule 0.5 mm long. Blade 8—9 cm long, 3.5 mm wide, base with a few hairs. Inflorescence *c.* 6 cm long, *c.* 0.5 cm wide; longest branch *c.* 1 cm long, appressed. Pedicel 0.3—1.5 mm long. Spikelet *c.* 2.3 mm long, 0.5 mm wide, somewhat laterally flattened; lowest bract *c.* 0.7 and 2nd *c.* 0.95 times as long as spikelet; lower glume 1.6 mm long, thin herbaceous; upper glume 2.1 mm long, thin herbaceous; lemma 2.1 mm long, thin herbaceous; palea 1.9 mm long, thin herbaceous. Anthers 3, 1.1 mm long. Seed *c.* 0.9 mm long.

Native; pan(sub)tropical. Single record 1941 from Changi. Extinct (1941).

Sandy sea-beach above high-water mark.

In Peninsular Malaysia it is only known from Langkawi. However, the species might have been overlooked, as it rarely seems to flower (according to Van Steenis on annotated material from Bali; Baaijens and Veldkamp 1991: 448). Also, because of the unstable substrate populations may be very temporary.

Stenotaphrum Trin.

Sauer 1972: 202—222.

Stenotaphrum secundatum (Walt.) Kuntze – Fig. 137, Plate 33.

St. Augustine Grass, *Rumput St. Augustine*

Sauer 1972: 210. Keng *et al.* 1998: 185.

S. dimidiatum auct., non (L.) Brongn.: Gilliland 1971: 205.

Culms with long stolons, erect part *c.* 20 cm long; nodes glabrous. Sheaths 2—5.5 cm long, flattened, midrib raised, glabrous, margin (at tip) with 1—1.5 mm long hairs. Ligule membranous, 0.5 mm long, tip ciliolate. Young leaf blade folded along midrib. Blade (0.7—) 5—15 cm long, 4—7 mm wide, glaucous, sparsely hairy, base cuneate to rounded with margins glabrous or sparsely hairy, tip obtuse. Inflorescence spike-like panicle; central rachis 6—9 cm long, 3—4 mm wide, glabrous, sinuous and alternately broadly winged; branches many, up to 0.5 cm long, simple and each with 3 spikelets. Pedicel 0.2—3.5 mm long, flattened, margins sparsely hairy. Spikelets single, basal 2 on each branch sessile to shortly pedicelled and uppermost long pedicelled (and vestigial), 4.3—4.8 mm long, 1.6 mm wide, not flattened, 2-flowered with 1st floret male and 2nd bisexual, unawned; lowest bract 0.25—0.3 and 2nd 0.95—1 times as long as spikelet; lower glume 1.2—1.4 mm long, orbicular, hyaline, glabrous, obtuse; upper glume 3.9—4.3 mm long, herbaceous, 7 veins, glabrous, acute; 1st lemma 4.3—4.6 mm long, indurated, glabrous, acute; 1st palea 3.8—4.4 mm long, indurated; 2nd lemma 4 mm long, herbaceous, hairy at tip; 2nd palea 3.8—4 mm long. Pollen irregularly shaped.

Not native; paleotropics. First record 1950. Common.

On roadsides, lawns.

Originally being a coastal pioneer, it seems to grow better in places with well-drained soil. It only propagates vegetatively through its long stolons. Flowering plants are rare, pollen is misshapen, and fruits have not been found in Singapore.

Themeda Forssk.

Culms erect, stolons absent, with drooping branches; internodes solid; nodes glabrous. Sheath keeled, margins glabrous or hairy (in basal half). Ligule membranous, tip lacerate. Spatheate inflorescence branched, with several spike-like racemes arising from spathes (much reduced leaves). Ultimate spathe with a cluster of 1—8 spike-like racemes; each spike-like raceme at base with involucre of 2 pairs of sterile (or rarely male) and unawned spikelets, upper part with 1 or 2 fertile and 0—3 sterile spikelet(s). Fertile spikelet not flattened, 2-flowered, awned; callus densely hairy; the two lowest bracts about as long as spikelet; glumes indurated; lemmas hyaline, 2nd with awn from tip; paleas absent.

1a. Young leaf blade folded along midrib. Sheath at least in upper half sparsely to densely hairy. Ultimate spathe with cluster of 4—8 spike-like racemes

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Figure 137. *Stenotaphrum secundatum* (Walt.) Kuntze.

Figure 138. *Themeda arguens* (L.) Hack., inflorescence with spathe.

Figure 139. *Themeda villosa* (Poir.) A.Camus.

a. spike-like raceme, b. pair of spikelets.

Figure 140. *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda.

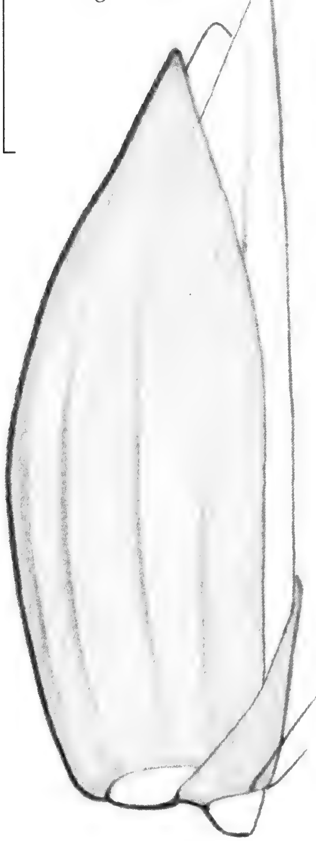


Fig. 137

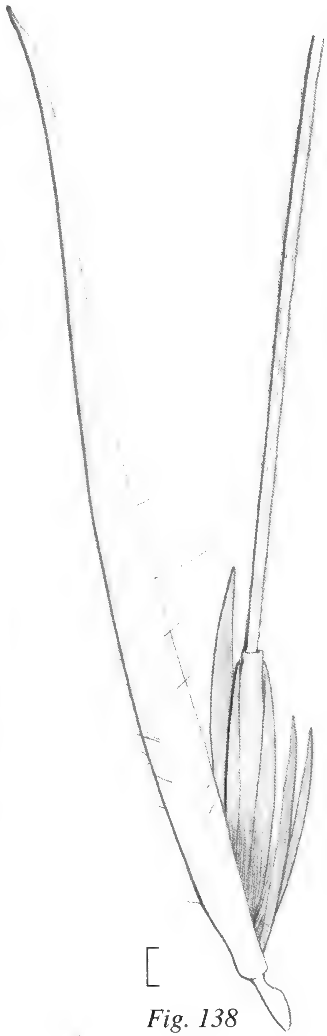


Fig. 138

Fig. 139

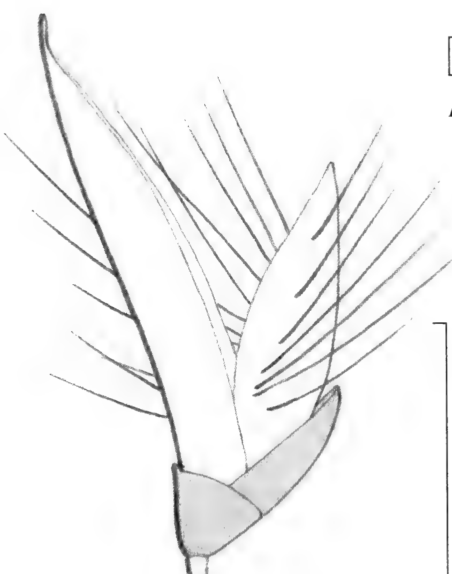


Fig. 140

with 4—8 awns. Spike-like raceme (nearly) sessile with peduncle up to 3 mm long, fertile spikelet 1. ***T. arguens***

1b. Young leaf blade inrolled. Sheath glabrous or hairy on the margin. Ultimate spathe with 1—2 spike-like racemes with 2—4 awns. Spike-like raceme with peduncle 15—28 mm long, fertile spikelets 2. ***T. villosa***

Themeda arguens (L.) Hack. – Fig. 138.

Lesser Tasselgrass, *Rumput Misai Adam*

Ridley 1925: 212. Gilliland 1971: 300. Keng *et al.* 1998: 185.

Anthistiria arguens Willd.: Ridley 1907: 168.

Culms single or tufted, 30—120 cm long. Sheath 3.5—5.5 cm long, at least in upper half sparsely to densely hairy, margins glabrous or hairy in basal half. Ligule 1—1.4 mm long, glabrous. Young leaf blade folded along midrib. Blade up to 45 cm long, 5—6 mm wide, glabrous or hairy at margin and/or upperside, base rounded and hairy. Spatheate inflorescence 15—50 cm long. Ultimate spathe 3—4 cm long, hairy in basal half, with cluster of 4—8 spike-like racemes. Spike-like raceme sessile, upper part with 1 pedicelled fertile spikelet. Involucral spikelets 1 glume each, sessile spikelet 5—8 mm long, pedicelled spikelet 0.4 mm long. Pedicel of fertile spikelet 1.3 mm long, glabrous. Fertile spikelet 6—6.5 mm long, 1.5 mm wide; callus 2.5 mm long; lower glume 6—6.4 mm long, setose near tip; upper glume 6.3—6.5 mm long, upper half setose; 1st lemma 3.1—3.5 mm long, glabrous; 2nd lemma 3—3.2 mm long, threadlike, awn 65—85 mm long with basal 3 mm glabrous and upper part twisted and setose.

Native; SE Asia and Australia. First record 1893. Rare.

Locally abundant in open dry places, on roadsides, railway tracks, sometimes as a pioneer.

Themeda villosa (Poir.) A.Camus – Fig. 139, Plate 36.

Greater Tasselgrass, *Rumput Riong*

Ridley 1925: 212. Gilliland 1971: 301. Keng *et al.* 1998: 185.

Culms tufted, 200—300 cm long; internodes of non-flowering plants very short. Leaves of non-flowering plants all basal and distinctly distichous, shoot fan-shaped. Sheath 12—23 cm long, glabrous. Ligule 1—1.8 mm long, glabrous or hairy at the back. Young leaf blade inrolled. Blade 60—100 cm long, 7—10 mm wide, glabrous, base cuneate to somewhat rounded and margin sparsely hairy. Spatheate inflorescence up to 100 cm long. Ultimate spathe 4—8 cm long, glabrous, scaberulous, with cluster of 1—2 spike-like racemes. Spike-like raceme peduncled, upper part with a pair of 1 sessile fertile and 1 pedicelled sterile spikelet, and a triplet of 1 sessile fertile and 2 pedicelled sterile spikelets. Involucral spikelets all similar, 2 herbaceous glumes (and sometimes 2 hyaline lemmas), 9—14.2 mm long. Fertile spikelets 7—7.8 mm long, 1.8—1.9 mm wide; callus 1.5 mm long; lower glume 7—7.8 mm long, indurated, densely hairy; upper glume 7—7.6 mm long, densely hairy; 1st lemma 4.8—5.5 mm long, glabrous; 2nd lemma 4.5—5.3 mm long, awn up to 32 mm long and twisted in basal half. Pedicel of sterile spikelet 2 mm long, glabrous. Sterile spikelets as the involucral spikelets.

Native; SE Asia. First record 1880s. Rare.

In unkempt sandy places, margin of woodland, riverbanks, near the sea (just above high tide mark).

Thuarea Pers.

Thuarea involuta (G.Forst.) R.Br. ex Roem. & Schult. – Fig. 141, Plate 37.

Sea Nut-grass

Gilliland 1971: 207. Keng *et al.* 1998: 186.
T. sarmentosa Pers.: Ridley 1907: 146; 1925: 236.
Culms with stolons 40—110 cm long, erect part 6—10 cm long; nodes hairy. Sheath 1.5—3 cm long, rounded, basal part glabrescent, upper part hairy, margins hairy. Ligule row of hairs, 0.5—1 mm long. Young leaf blade inrolled. Blade 0.8—4.6 cm long, 2—10 mm wide, underside narrowly and densely ribbed (when dry), hairy, margins hairy, base cuneate. Inflorescence deciduous, spike, 1—1.5 cm long; rachis 3.6 mm wide, longitudinally folded (U-shaped), with transverse veins, hairy, narrowing towards tip, at base with 1 bisexual spikelet followed by 4 or 5 male spikelets, after flowering widening and bending down to enclose mature bisexual spikelet. Pedicel absent. Bisexual spikelet persistent, single, 4.2—4.7 mm long, laterally flattened, 2-flowered with 1st floret male and 2nd female, unawned; the two lowest bracts as long as spikelet; lower glume absent; upper glume 3.5—4.5 mm long, thin herbaceous, 7 veins, hairy, obtuse; 1st lemma as upper glume, 4.1—4.6 mm long, 5 veins; 1st palea 4—4.3 mm long, hyaline; 2nd lemma 4—4.5 mm long, indurated, 5 veins, upper part sparsely hairy, tip truncate and apiculate; 2nd palea 3.9—4.3 mm long, indurated. Male spikelets deciduous after flowering, as bisexual spikelet but gradually decreasing in size, both florets male, all bracts herbaceous.

Native; Indo-Pacific. First record 1890. Rare.

On sandy beaches.

Its last record on the main island (Tanjong Rhu up to Changi) dates back to 1921. Today, it is only known from some of the southern islands.

The incurved rachis forms a nut-like structure. It articulates as a whole and, being watertight, will float in seawater thus aiding dispersal of the seed.

Thysanolaena Nees

Thysanolaena latifolia (Roxb. ex Hornem.) Honda – Fig. 140.

Tiger Grass, *Buluh Tebrau*

Keng *et al.* 1998: 186.
T. agrostis Nees: Ridley 1907: 143; 1925: 241 (both excluding Singapore).
T. maxima (Roxb.) Kuntze: Gilliland 1971: 45.
Culms tufted, erect, (40—)200—300 cm long; internodes solid, at least 3 mm diameter; nodes glabrous. Sheaths 12 cm long, rounded, with transverse veins near margin at tip, submarginally hairy. Ligule membranous, 1—2 mm long, tip ciliolate. Young leaf blade inrolled. Blade 40—63 cm long, 28—70 mm wide, with transverse veins present (best visible at underside), glabrous, margin smooth to minutely scaberulous, base cuneate to rounded, pseudopetiole 2—3 mm long and glabrous or hairy. Inflorescence panicle, (20—)50—62 cm long, central rachis glabrous, branches many; longest branch 15—35 cm long, 1.2 mm wide, glabrous, straight or upward sinuous, branched; ultimate branchlets 0.5—1 cm long, 0.2 mm wide, appressed, well-spaced to somewhat overlapping, spikelets crowded. Pedicel 0.5—1.4 mm long, scaberulous. Spikelets single or in pairs, homomorphous, (1.6—)2—2.1 mm long, 0.6 mm wide, not flattened, (thin) herbaceous, 2-flowered (sometimes proliferating or abortive), unawned; rachilla between 1st and 2nd floret 0.4 mm long, at tip with 0.3 mm long hairs; the two lowest bracts *c.* 0.3 times as long as spikelet; lower glume 0.4—0.5 mm long glabrous; upper glume (0.5—)0.6—0.7 mm long, glabrous; 1st lemma (1.5—)1.8—2 mm long, glabrous; 1st palea absent; 2nd lemma (1—)1.5 mm long, with submarginal row of 0.7—1 mm long setae on both sides; 2nd palea 0.7—0.9 mm long, glabrous, hyaline.

Not native; India to China and S to Peninsular Malaysia, usually above 300 m asl, introduced in Africa and Singapore. First record 1959. Rather rare.

In open places, on rocky, sandy or clayey soil.

It is used as an ornamental plant. The leaves are used for wrapping glutinous rice and the inflorescences for making brooms.

Tripsacum L.

Tripsacum dactyloides (L.) L. – Fig. 142.

Gama Grass

Gilliland 1971: 309. Keng *et al.* 1998: 186.

Culms tufted, outer culms geniculate, 110 cm long; internodes 30 mm diameter; nodes glabrous. Sheath 13—20 cm long, rounded, glabrous. Ligule membranous, 1—1.2 mm long, hairy at the back, tip ciliolate with hairs *c.* 0.2 mm long. Blade 45—140 cm long, 56—75 mm wide, hairy at upperside, margin scaberulous, base rounded to cordate. Inflorescence raceme, 1 per sheath and up to 6 along upper 20—35 cm of culm; rachis 5—6 cm long, at base 4—5.5 mm wide and indurated and glabrous, in upper half *c.* 2 mm wide and herbaceous and hispid. Pedicel 0.5—2 mm long, hispid. Spikelets unisexual, not flattened, 2-flowered, unawned, basal 4—10 of the raceme single and female, upper ones in pairs and male; the two lowest bracts as long as spikelet, acute; lemmas and paleas hyaline. Female spikelet 8 mm long, 4 mm wide, sunken into hollow rachis; lower glume dorsally flattened, indurated, glabrous; upper glume boat-shaped, thin herbaceous, glabrous. Male spikelet 8.5 mm long, 2 mm wide; lower glume dorsally flattened, herbaceous, 23—25 veins, submarginally keeled, keels hispid, tip emarginate; upper glume boat-shaped, 5 veins, glabrous, tip acute.

Not native; Neotropics, introduced in Africa and Australasia. Cultivated (last record 1969).

It has only been grown in the 1960s in the Botanic Gardens. It is closely related to *Zea* with which it has been hybridized.

Urochloa P.Beauv.

Veldkamp 1996b: 413—437.

Young leaf blade inrolled. Ligule basal part of fused hairs or membranous, hairs at tip as long as to longer than basal part. Blade base rounded. Inflorescence panicle, central rachis present, branches triquetrous to flattened with the spikelets adaxially. Pedicel present. Spikelets more or less dorsiventrally flattened, 2-flowered with 1st floret sterile (or male in *U. mutica*) and 2nd bisexual, unawned; 2nd lowest bract (almost) as long as spikelet; glumes and 1st lemma (thin) herbaceous; lower glume (half) enveloping; upper glume and 1st lemma in upper part with (obscure) transverse veins; 1st palea absent or hyaline; 2nd lemma and palea indurated, glabrous, transversely rugulose.

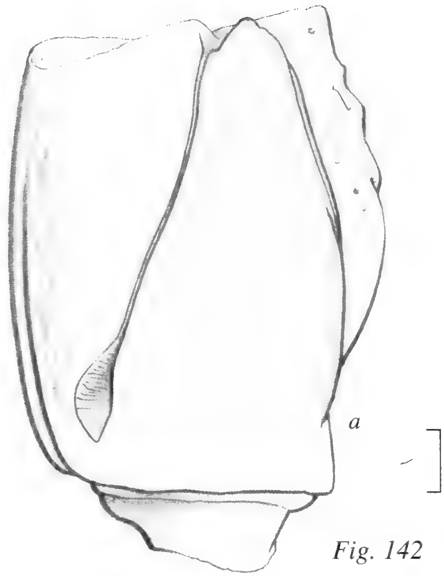
The key to the species follows Veldkamp (1996b).

1a. Spikelets at least in middle of the branch paired. Lower glume margins not overlapping. **2**
1b. Spikelets solitary. Lower glume margins overlapping. **3**

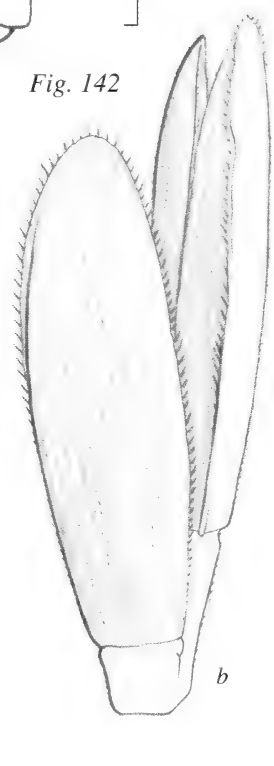
2a. Lower glume 5—7-veined, *c.* 0.9 times as long as spikelet. ***U. glumaris***
2b. Lower glume 0- or 1-veined, 0.25—0.45 times as long as spikelet. ***U. mutica***

Figure 141. *Thuarea involuta* (G.Forst.) R.Br. ex Roem. & Schult., inflorescence with lower spikelet bisexual and following spikelets male.
Figure 142. *Tripsacum dactyloides* (L.) L.
a. part of the rachis with female spikelet, b. pair of male spikelets.
Figure 143. *Zea mays* L., male spikelet.

Fig. 141



a



b

Fig. 142

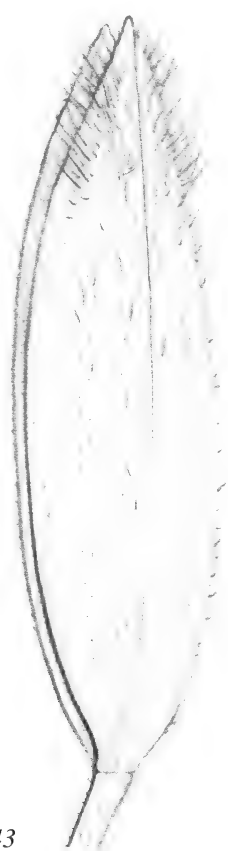


Fig. 143

3a. Upper glume distally hairy. ***U. piligera***
3b. Upper glume glabrous. ***U. subquadripara***

Urochloa glumaris (Trin.) Veldk. – Fig. 147.

Veldkamp 1996b: 420. Keng *et al.* 1998: 186.

Brachiaria paspaloides (J.Presl) C.E.Hubb.: Gilliland 1971: 179.

Panicum distachyum auct., non L.: Ridley 1907: 133.

Culm decumbent or with short stolons, 25—40 cm long; internodes up to 2 mm diameter; nodes hairy. Sheath 4.2—6.5 cm long, rounded, sparsely hairy at base (and tip), one margin hairy. Ligule basal part 0.1—0.7 mm long, hairs at tip 0.4—0.7 mm long. Blade 5—16 cm long, 3—5 mm wide, hairy, base at margin sparsely hairy. Inflorescence 4.5—12 cm long, central rachis hairy, branches 3—4; longest branch 3.5—7 cm long, 0.6 mm wide, triquetrous, hairy, simple or branched. Pedicel 0.5—1.8 mm long, setulose. Spikelets at least in middle of branch paired, 3.5—4.2 mm long, 1.3 mm wide; lowest bract *c.* 0.9 times as long as spikelet; lower glume 3—3.8 mm long, margins not overlapping, 5—7 veins, glabrous, tip acuminate to minutely caudate; upper glume 3.3—4.2 mm long, 7 veins, glabrous, tip acuminate to caudate and puberulous; 1st lemma 2.8—3.5 mm long, glabrous; 1st palea 0.1—0.6 mm long; 2nd lemma 2—2.6 mm long; 2nd palea 2.1—2.4 mm long.

Native; India to S China, Polynesia, Malesia, not in Australia. First record 1880s. Rare.

Open moist places.

It is easily distinguished from the other *Urochloa* species by the long lower glume.

Urochloa mutica (Forssk.) T.Q.Nguyen – Fig. 144, Plate 38.

Para Grass

Veldkamp 1996b: 424. Keng *et al.* 1998: 187.

Brachiaria mutica (Forssk.) Stapf: Ridley 1925: 219. Gilliland 1971: 178.

Panicum muticum Forssk.: Ridley 1907: 133.

Culms decumbent, creeping or scrambling, 30—500 cm long; internodes at least 5 mm diameter; nodes densely patent hairy. Sheath 5.5—20 cm long, rounded, (densely) patent hairy, margins glabrous or one sparsely hairy. Ligule basal part 0.3—0.5 mm long, hairs at tip 0.5—1.5 mm long. Blade 10—20 cm long, 8—19 mm wide, hairy at least at underside, throat hairy. Inflorescence 15—26 cm long, central rachis sparsely hairy, branches 14—20 and patent; longest branch 3—12 cm long, 0.8—1.2 mm wide, more or less flattened, glabrous, simple or branched. Pedicel 0.5 mm long, glabrous to sparsely hairy. Spikelets at least in middle of branch paired or in threes, 3—3.3 mm long, 1.3—1.4 mm wide; lowest bract 0.25—0.45 times as long as spikelet; lower glume 0.7—1.4 mm long, margins not overlapping, 1 vein, sparsely minute-hairy, tip obtuse to emarginate; upper glume 2.7—3.1 mm long, 5 veins, glabrous, tip acute; 1st lemma as upper glume, 2.9—3 mm long; 1st palea 2.8—3.1 mm long; 2nd lemma 2—2.3 mm long; 2nd palea 1.9—2 mm long.

Not native; Brazil, introduced elsewhere. First record 1893. Common.

Weed on moist to wet soil in roadsides, wasteland, river banks, mangrove, beach.

Figure 144. *Urochloa mutica* (Forssk.) T.Q.Nguyen.
a. facing lower glume, b. facing upper glume.

Figure 145. *Urochloa piligera* (F.Muell. ex Benth.) R.D.Webster.
a. facing lower glume, b. facing upper glume.

Figure 146. *Urochloa subquadripara* (Trin.) R.D.Webster.
a. facing lower glume, b. facing upper glume.

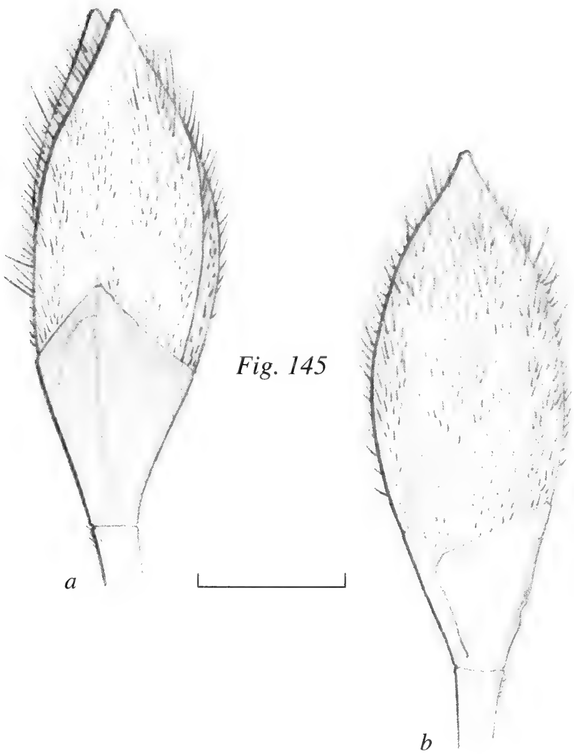


Fig. 145

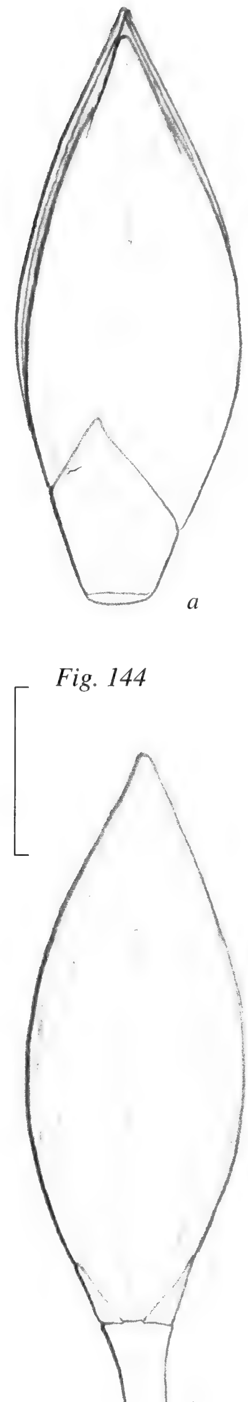


Fig. 144

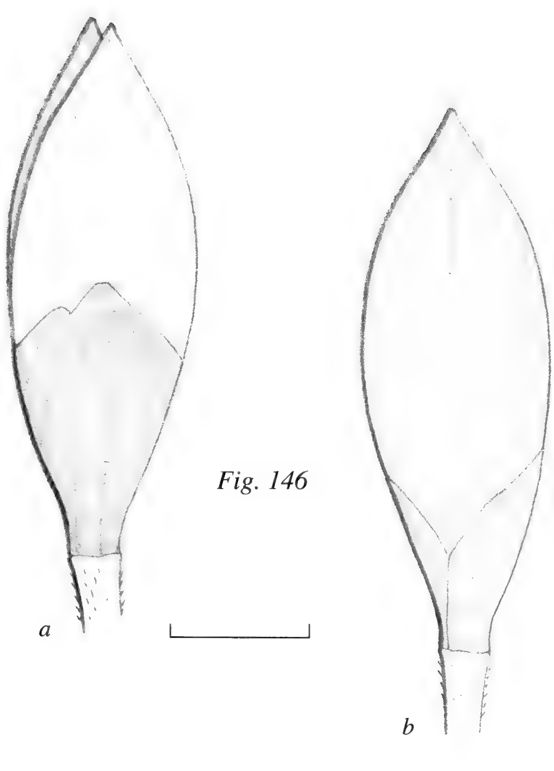


Fig. 146

It was introduced as a fodder crop for cattle and is now naturalized throughout Malesia. It flowers rarely, but is readily recognized by the long and rather stout stolons with patent-hairy nodes and sheaths.

Urochloa piligera (F.Muell. ex Benth.) R.D.Webster – Fig. 145.

Veldkamp 1996b: 425; 1999b: 237. Duistermaat 2004: 40.

Brachiaria piligera (F.Muell. ex Benth.) Hughes

Culms tufted, decumbent to geniculate, 40—70 cm long; internodes up to 2 mm diameter; nodes glabrous to sparsely hairy. Sheath 5—8 cm long, more or less flattened, midrib slightly raised, glabrous, margins glabrous or one hairy. Ligule basal part 0.1—0.2 mm long, hairs at tip 0.9—1 mm long. Blade 11—14 cm long, 7—8 mm wide, glabrous, margin sparsely hairy. Inflorescence 10—20 cm long, central rachis glabrous, branches 2—5; longest branch 2.5—5 cm long, 0.7—1 mm wide, flattened, glabrous, scaberulous, simple. Pedicel 0.3—0.5 mm long, glabrous. Spikelets single, 3—3.4 mm long, 1.3—1.4 mm wide; lowest bract 0.35—0.5 times as long as spikelet; lower glume 1.2—1.5 mm long, margins overlapping, 7—13 veins, glabrous, tip obtuse; upper glume 2.8—3.1 mm long, 7 veins, hairy, tip obtuse to acute; 1st lemma as upper glume, 2.3—2.9 mm long, acuminate; 1st palea absent; 2nd lemma 2.2—2.5 mm long; 2nd palea 2—2.3 mm long.

Not native; Australia, Sulawesi, Moluccas, New Guinea, introduced in Singapore. First record 1959. Rare.

In swampy places, on moist roadsides, on sandy clay.

Urochloa subquadripara (Trin.) R.D.Webster – Fig. 146, Plate 39.

Veldkamp 1996b: 429. Keng *et al.* 1998: 187.

Brachiaria distachya auct., non Stapf: Ridley 1925: 219. Gilliland 1971: 176.

Brachiaria subquadripara (Trin.) Hitchc.

Panicum distachyum auct., non L.: Ridley 1907: 133.

Culms geniculate or with short stolons, 30—90 cm long; internodes up to 2 mm diameter; nodes glabrous to densely hairy. Sheath 3—9 cm long, rounded at base and more or less flattened with midrib slightly raised at tip, glabrous or hairy, one margin hairy. Ligule basal part 0.4—0.5 mm long, hairs at tip 0.4—1 mm long. Blade 5—15 cm long, 5—10 mm wide, glabrous to sparsely hairy at upperside, base hairy. Inflorescence 6.5—13 cm long, central rachis glabrous to sparsely hairy, branches 3—8; longest branch 3—6.5 cm long, 0.6—1 mm wide, flattened, glabrous to hispid at base, scabrous, simple. Pedicel 0.5—0.7 mm long, glabrous to sparsely hairy. Spikelets single, 3.5—4.3 mm long, 1—1.2 mm wide; lowest bract *c.* 0.4 times as long as spikelet; lower glume 1.4—1.8 mm long, margins overlapping, 5—11 veins, glabrous, tip obtuse; upper glume 3—3.8 mm long, glabrous, 7 veins, tip obtuse to acute; 1st lemma as upper glume, 2.8—3.5 mm long; 1st palea 0.1—3 mm long; 2nd lemma 2.5—2.7 mm long; 2nd palea 2.3—2.5 mm long.

Native; Kashmir to S China, throughout Malesia to Queensland. First record 1890. Common.

In open waste places, damp grass fields, on roadsides, drought resistant.

It has been confused with *Eriochloa meyeriana*, *E. procera* and *Panicum repens*. Both *Eriochloa* species are distinguished by the presence of a cup-shaped callus at the base of the spikelet and the absence of transverse veins in the upper glume and 1st lemma. *Panicum repens* differs in having primary panicle branches with at least secondary branches, abaxial spikelets and lower glumes that are collar-shaped and much shorter (0.6—0.7 mm long).

Zea L.

Zea mays L. – Fig. 143.

Maize, *Jagung*

Gilliland 1971: 304. Keng *et al.* 1998: 187.

Culms single, erect, 100—200 cm long; internodes solid; nodes glabrous. Sheath at least 14 cm long, rounded, hairy, margin hairy. Ligule membranous, 4—5 mm long, tip ciliolate. Young leaf blade inrolled. Blade 47 cm long, 50 mm wide, sparsely hairy at upperside, base rounded. Male inflorescence terminal, a panicle, *c.* 25 cm long, central rachis hairy, branches 2—20; longest branch 20—30 cm long, simple. Pedicel 1.5—3 mm long, hairy. Male spikelets single or paired, 8.4 mm long, 3 mm wide, laterally flattened, 2-flowered with both florets male, unawned; the two lowest bracts as long as spikelet; glumes thin herbaceous, lemmas and paleas hyaline; lower glume 8.4 mm long, 7 veins, hairy in upper half, acute; upper glume 8.2 mm long, 7 veins, hairy, acute; 1st lemma 6.6 mm long; 1st palea 5.9 mm long; 2nd lemma, 5 mm long; 2nd palea, 5.7 mm long. Female inflorescence from lower sheath, enveloped by several bracts; female spikelets in rows on stout central rachis.

Not native; probably from Mexico, cultivated worldwide. First record 1920. Cultivated.

In America this species is called Corn, whereas in English corn is used for all sorts of grains, especially wheats, oats and maize.

Zizania L.

Zizania latifolia (Griseb.) Stapf – Fig. 148.

Manchurian Water Rice

Gilliland 1971: 104. Veldkamp 1997b: 512. Keng *et al.* 1998: 188.

Culms single, erect, 110—180 cm long; internodes 15 mm diameter; nodes glabrous. Sheath *c.* 30 cm long, rounded, with transverse veins, glabrous. Ligule membranous, 7—11 mm long. Young leaf blade inrolled. Blade 40—80 cm long, 19—27 mm wide, with transverse veins present, glabrous, base cuneate. Inflorescence panicle, 40—60 cm long, central rachis glabrous, branches many; longest branch 6—7 cm long, 0.3 mm wide, glabrous, branched. Pedicel 1—2 mm long, glabrous, tip cup-shaped. Spikelets single, heteromorphous, more or less laterally flattened, 1-flowered, unisexual, awned. Female spikelet in upper half of panicle, *c.* 50 mm long (including awn), 1.5 mm wide; glumes absent; lemma *c.* 50 mm long including *c.* 26 mm-long awn, herbaceous, glabrous, 5 veins, acuminate; palea as lemma, *c.* 24 mm long, 3 veins. Male spikelet in lower half of panicle, as female, *c.* 16 mm long (including *c.* 5 mm-long awn); palea *c.* 12 mm long.

Not native; India to Japan, introduced in Europe and Australasia. First record 1941. Cultivated and escaped (until 1950).

Aquatic, in wet or muddy places.

It was cultivated for its young shoots that are eaten as a vegetable. According to Sinclair (*SF* 40615, 1955) it was commonly planted, but did not flower. Today it is probably no longer grown.

Zoysia Willd.

Zoysia matrella (L.) Merr. – Fig. 149, Plate 40.

Siglap Grass, *Rumput Zoysia*

Gilliland 1971: 109. Keng *et al.* 1998: 188.

Z. pungens Willd.: Ridley 1907: 149; 1925: 243.

Culms decumbent or with long stolons, erect part 5—40 cm long; nodes glabrous. Sheath 1—1.6 cm long, rounded, glabrous, margin glabrous or hairy at throat. Ligule membranous, 0.2 mm long, tip ciliolate, with long hairs on blade behind the ligule. Young leaf blade inrolled.

Blade 1.3—9 cm long, 1—2.5 mm wide, inrolled to flat, glabrous or sparsely hairy at upperside, base cuneate and hairy just behind the ligule. Inflorescence raceme; rachis 1—3.5 cm long, glabrous, with spikelets crowded. Pedicel 0.8—3.3 mm long, glabrous. Spikelets single, 3—3.4 mm long (including awn), 0.6—0.8 mm wide, laterally flattened, glabrous, 1-flowered, (minutely) awned; either lowest bract 0.05—0.3 times as long as and 2nd as long as spikelet, or lowest as long as and 2nd 0.6—0.7 times as long as spikelet; lower glume absent or 0.2—1 mm long, herbaceous, 1 vein; upper glume 3—3.4 mm long, indurated, 1—7 veins, midvein slightly keeled, apiculate to awned, awn 0.3—0.9 mm long; lemma 2—2.2 mm long, hyaline, 1 vein, truncate to obtuse; palea absent or 0.1—1.5 mm long, hyaline.

Native; (sub)tropical Asia and Australia. First record 1878. Common.

In lawns and on roadsides with well-drained (sandy) soil.

In America this species is called Zoysia Grass.

Cynodon dactylon is very similar in appearance and can be found in similar habitats, but differs in having a ligule of hairs of unequal length, an inflorescence with 2 or more branches clustered at the tip of the peduncle and sessile spikelets of which the glumes are often gaping.

A related species with leaf blades narrowly inrolled and 0.7—1 mm diameter and the peduncle, even in fruit, not or hardly exserted from the uppermost sheath has been described as *Z. pacifica* (Goudswaard) M.Hotta & Kuroki (1994). It forms a dense, short turf and is widely cultivated as a lawn grass or in tennis lawns and golf greens. It is expected to occur in Singapore.

Key to Sterile Grass Plants of Singapore

Note: species that are thought to be extinct or known from cultivation only are not included in this key (except for a few that have perhaps been overlooked and/or seem to flower rarely).

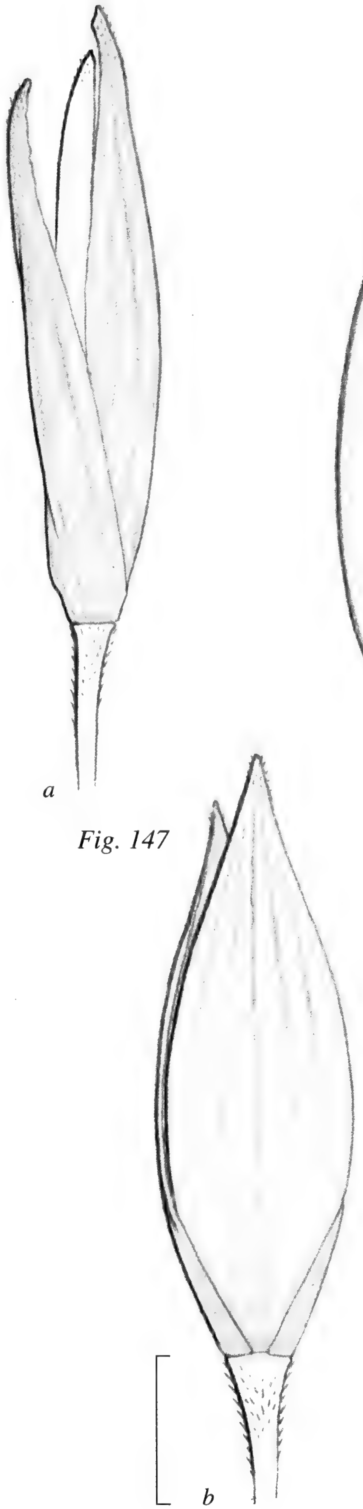
1a. Young blade *either* folded along midrib or plicate, *or* blades less than 1 mm wide. **2**
1b. Young blade inrolled, blades at least 1 mm wide. **9**

2a. Blades plicate. ***Setaria barbata***
2b. Blades *either* flat or folded along midrib, *or* less than 1 mm wide. **3**

3a. Ligule a row of free hairs. **4**
3b. Ligule membraneous, glabrous or hairy. **5**

4a. Culms with long rhizomes or stolons, rarely tufted and stolons absent. Blade 1.5—2.5 mm wide. ***Cynodon dactylon***

Figure 147. *Urochloa glumaris* (Trin.) Veldk.
a. lateral view, b. facing upper glume.
Figure 148. *Zizania latifolia* (Griseb.) Stapf.
a. male spikelet, b. female spikelet.
Figure 149. *Zoysia matrella* (L.) Merr., upper glume lateral view, lemma and palea hidden inside.



a

b

Fig. 147

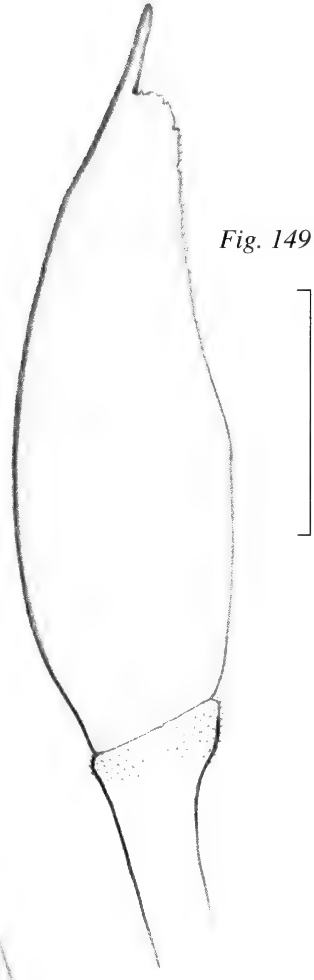
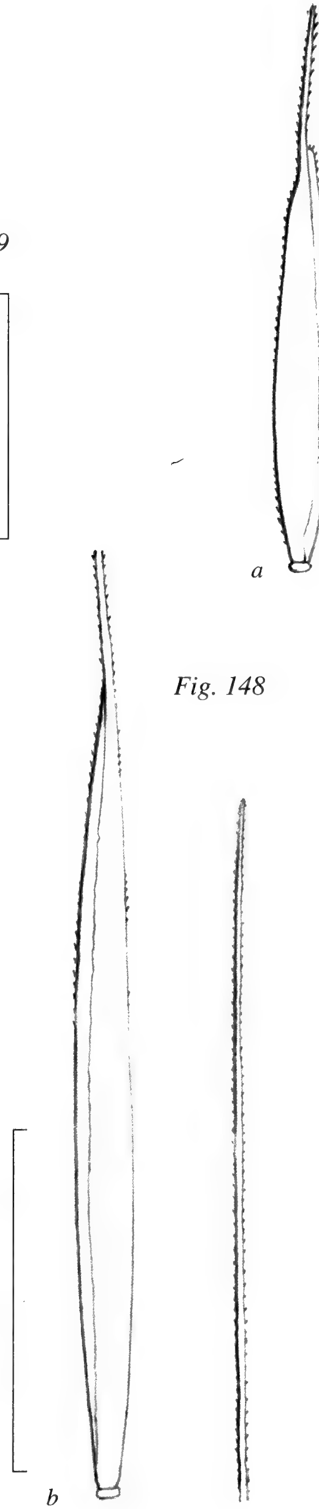


Fig. 149



a

b

Fig. 148

10 mm

4b. Culms tufted, erect, stolons absent. Blade *c.* 0.5 mm wide. ***Eriachne pallescens***

5a. Stolons absent. **6**
5b. Stolons present. **7**

6a. Sheath glabrous, margins hairy at least at tip. ***Eleusine indica***
6b. Sheath at least in upper half with bulbous-based hairs, margins glabrous or hairy in basal half. ***Themeda arguens***

7a. Sheath rounded, midrib not raised. Blade 0.6—1.7(—2) mm wide. ***Digitaria didactyla***
7b. Sheath flattened, midrib raised. Blade 3—7 mm wide. **8**

8a. Leaves glossy and (dark) green; sheath with margins in upper half glabrous or glabrescent; blade hardly wider than sheath. ***Axonopus fissifolius***
8b. Leaves glaucous; sheath with margins densely hairy in upper half; blade distinctly wider than sheath. ***Stenotaphrum secundatum***

9a. **(1)** Leaf blade with transverse veins present, 8.5—70 mm wide. **10**
9b. Leaf blade without transverse veins, 1—60 mm wide. **13**

10a. Leaf blade with pseudopetiole 0.5—3 mm long. **11**
10b. Leaf blade with pseudopetiole 7—50 mm long. **12**
(10c. Leaf blade without pseudopetiole, margins serrate. Cultivated. ***Chrysopogon zizanioides***)

11a. Internodes up to 2.5 mm diameter. Blade 3.5—11 cm long, 13—28 mm wide, hairy at least at upperside. ***Centotheca lappacea***
11b. Internodes at least 3 mm diameter. Blade 40—63 cm long, 28—70 mm wide, glabrous or pseudopetiole hairy. ***Thysanolaena latifolia***

12a. Blade 8.5—22 mm wide, pseudopetiole 7—20 mm long. ***Lophatherum gracile***
12b. Blade 40—62 mm wide, pseudopetiole 20—50 mm long. ***Scrotochloa urceolata***

13a. **(9)** Ligule absent. ***Echinochloa colona, E. crus-galli***
13b. Ligule present, *either* membranous or as a shallow rim, *or* as a row of hairs. **14**

14a. Ligule 0.5—4 mm long, *either* of free hairs, *or* hairs at tip at least as long as the membranous basal part. **15**
14b. Ligule 0.05—7.5 mm long,—*if* longer than 0.5 mm *then* membranous

with hairs at tip absent or shorter than basal part. **30**

15a. Ligule hairs free. **16**
15b. Ligule *either* hairs fused at base, *or* basal part membranous. **22**

16a. Nodes hairy. **17**
16b. Nodes glabrous. **20**

17a. Sheath 0.5—3 cm long. **18**
17b. Sheath 6—17 cm long. **19**

18a. Ligule 1—1.6 mm long. Blade slender, underside with 3—9 prominent and well-spaced veins, base rounded. ***Isachne***
18b. Ligule 0.5—1 mm long. Blade stiffened, underside narrowly and densely ribbed (when dry), base cuneate. ***Thuarea involuta***

19a. Lower sheaths glabrous. ***Eriochloa procera***
19b. Lower sheaths densely hairy. ***Melinis repens***

20a. **(16)** Blade 1.5—2.5 mm wide. ***Cynodon dactylon***
20b. Blade 3—7 mm wide. **21**

21a. Sheath more or less flattened, midrib (slightly) raised, margins glabrous (hairs submarginal if present). Ligule 0.7—1 mm long. Blade 7—26 cm long. ***Cenchrus***
21b. Sheath rounded, midrib not raised, margins hairy. Ligule 1—4 mm long. Blade 1—7.8 cm long. ***Isachne***

22a. **(15)** Blade at base cordate. ***Alloteropsis cimicina***
22b. Blade at base cuneate to rounded. **23**

23a. Blade 2.5—5.5 cm long, 3.8—9 times longer than wide. ***Oplismenus***
23b. Blade 5—65 cm long, at least 12 times longer than wide. **24**

24a. Basal internodes at least 5 mm diameter. Midvein of blade at least at base prominent at upper side, white and broad. **25**
24b. Basal internodes up to 3 mm diameter. Midvein of blade not prominent at upper side, green and/or narrow. **27**

25a. Nodes densely patent hairy. ***Urochloa mutica***
25b. Nodes glabrous or with appressed hairs. **26**

26a. External ligule *either* as a herbaceous rim *or* absent (but sheath and

underside blade may be hairy). ***Pennisetum***
26b. External ligule present as a fringe of hairs. ***Sorghum propinquum***

27a. Sheath rounded, midrib not raised. **28**
27b. Sheath at least at tip more or less flattened, midrib (slightly) raised. **29**

28a. Nodes glabrous. ***Panicum paludosum***
28b. Nodes hairy. ***Urochloa glumaris***

29a. Blade at base distinctly rounded. ***Cenchrus, Urochloa***
29b. Blade at base cuneate to slightly rounded. ***Setaria parviflora***

30a. **(14)** Stolons absent (but rhizomes may be present). Leaves all basal, culm elongating only upon flowering. **31**
30b. Stolons absent or present. Leaves scattered along culm, not clustered at the base. **34**

31a. Leaves strictly distichous. Sheaths distinctly flattened. **32**
31b. Leaves irregularly arranged. Sheaths rounded. **33**

32a. Sheaths 2.5—7.5 cm long. Ligule *c.* 0.5 mm long. ***Chloris barbata***
32b. Sheaths 12—23 cm long. Ligule 1—1.8 mm long. ***Themeda villosa***

33a. Rhizomes present. Blade 6—22 mm wide. ***Imperata***
33b. Rhizomes absent. Blade 2—4.5 mm wide. ***Sporobolus indicus***
(33c. Rhizomes absent. Blade 8—20 mm wide, margins sharply serrate. Cultivated. ***Cymbopogon***)

34a. **(30)** Blade with pseudopetiole (0.7—)1—4 mm long. **35**
34b. Blade without pseudopetiole. **38**

35a. Culm erect or geniculate, not scrambling. Sheath 10—17 cm long. Ligule 2—7.5 mm long. ***Ischaemum magnum***
35b. Culm generally creeping or scrambling. Sheath 1.2—6.5 cm long. Ligule 0.4—0.7 mm long. **36**

36a. Sheath more or less flattened, midrib raised. Auricles fused with ligule, 0.3—1 mm long. ***Ischaemum muticum***
36b. Sheath rounded, midrib raised or not. Auricles absent. **37**

37a. Nodes, sheaths and blades glabrous or hairy. Blades not glaucous. ***Ottochloa nodosa***

37b. Nodes glabrous. Sheath with a few hairs at tip only. Blades glaucous, hairy. ***Panicum trichocladum***

38a. **(34)** Ligule 0.2—4 mm long, membraneous, *if* 0.2—0.5 mm long *then* glabrous. **39**
38b. Ligule 0.05—0.5 mm long,—*either* as a row of free hairs *or* membraneous and hairy. **68**

39a. Sheath (including margins and auricles) entirely glabrous. **40**
39b. Sheath at least partly hairy. **50**

40a. Nodes glabrous. **41**
40b. Nodes (sparsely) hairy. **45**

41a. Internodes 5—30 mm diameter. Blades 50—200 cm long. ***Saccharum***
41b. Internodes up to 3 mm diameter. Blades 1.5—20(—50) cm long. **42**

42a. Blades stiff, upperside with flat ribs. ***Lepturus repens* var. *repens***
42b. Blades slender, upperside without ribs (or minutely ribbed when dry). **43**

43a. Stolons absent or present. Sheath rounded. ***Digitaria***
43b. Stolons absent. Sheath more or less flattened. **44**

44a. Rhizomes absent. Ligule glabrous. ***Paspalum***
44b. Rhizomes present, short. Ligule with hairs at tip. ***Setaria parviflora***

45a. **(40)** Ligule hairy at abaxial side. **46**
45b. Ligule glabrous at abaxial side. **47**

46a. Sheath flattened. Blade glabrous or hairy at base only, midvein winged underneath. ***Leptochloa chinensis***
46b. Sheath rounded. Blade hairy at least at upperside, midvein not winged. ***Bothriochloa bladhii, Dichanthium annulatum***

47a. Hairs on nodes deflexed. Blade with margins serrulate. ***Leersia hexandra***
47b. Hairs on nodes appressed to patent. Blade with margins smooth to scaberulous. **48**

48a. Stolons present. ***Digitaria***
48b. Stolons absent. **49**

49a. Blade 2—9 mm wide. Ligule 1—3 mm long. ***Digitaria***
49b. Blade 1—2 mm wide. Ligule 0.4—0.7 mm long. ***Dimeria ornithopoda***

50a. **(39)** Nodes hairy. **51**
50b. Nodes glabrous. **57**

51a. Sheath 0.5—2(—4) cm long. Ligule glabrous to ciliolate at tip, never hairy at abaxial side. **52**
51b. Sheath 2—34 cm long, *if* shorter than 4 cm, *then* ligule hairy at abaxial side. **54**

52a. Sheath with margins hairy. ***Cyrtococcum patens***
52b. Sheath with margins glabrous (or submarginal hairs present). **53**

53a. Stolons present. ***Digitaria***
53b. Stolons absent, culm erect to decumbent. ***Dimeria ornithopoda***

54a. Ligule glabrous. ***Digitaria setigera***
54b. Ligule hairy at tip or abaxial side, or with a row of hairs at abaxial side. **55**

55a. Auricles present, grown with the margins of the ligule. ***Ischaemum ciliare, I. timorense***
55b. Auricles absent. **56**

56a. Culm erect to geniculate, stolons absent. Sheath (excluding basal bladeless sheaths) 10—34 cm long. Blade (9—)25—50 cm long. ***Panicum maximum***
56b. Culm decumbent or with stolons. Sheath 4—7 cm long. Blade 5—16 cm long. ***Urochloa glumaris***

57a. **(50)** Basal internodes 15—45 mm diameter. Root-eyes obvious on lower nodes, in 2—9 rows. ***Saccharum officinarum***
57b. Basal internodes 3—10 mm diameter. Root-eyes absent. **58**

58a. Ligule densely fringed or hairy. **59**
58b. Ligule entire (or torn once or twice) and glabrous. **62**

59a. Culm erect, stolons absent. Blade 10—25 mm wide. **60**
59b. Culm erect, ascending or decumbent, stolons absent or present. Blade 4—6 mm wide. **61**

60a. Sheath with soft hairs at tip only. Blade with soft hairs at base only. ***Mnesithea glandulosa***

60b. Sheath and blade upperside with stiff hairs. ***Rottboellia cochinchinensis***
61a. Sheath without transverse veins, margins glabrous (except for few long hairs at tip). Blade at base rounded, margins hairy. ***Dactyloctenium aegyptium***
61b. Sheath with transverse veins present, one margin hairy. Blade at base cuneate, margins glabrous. ***Panicum repens***

62a. **(58)** Stolons absent. **63**
62b. Stolons present. **65**

63a. Sheath more or less flattened, midrib raised. ***Paspalum***
63b. Sheath rounded, midrib raised or not. **64**

64a. Internodes up to 2 mm diameter. Sheath without transverse veins. ***Digitaria***
64b. Internodes *c*. 3 mm diameter. Sheath with (minute) transverse veins present. ***Hymenachne amplexicaule***

65a. External ligule hairy. ***Paspalum conjugatum***
65b. External ligule absent. **66**

66a. Stolons 2.5—3 mm wide. Blade at base cuneate, much narrower than sheath. ***Paspalum vaginatum***
66b. Stolons or basal part of creeping culm up to 2 mm wide. Blade at base (slightly) rounded, narrower or up to as wide as sheath. **67**

67a. Sheath not shouldered. ***Cyrtococcum accrescens***
67b. Sheath shouldered. ***Digitaria***

68a. **(38)** External ligule hairy. **69**
68b. External ligule absent. **70**

69a. Stolons present. Nodes hairy. ***Axonopus compressus***
69b. Stolons absent. Nodes glabrous. ***Eragrostis***

70a. Sheath hairy. **71**
70b. Sheath glabrous (or hairy at margins only). **72**

71a. Sheath 0.7—2(—4) cm long. Blade 1—2 mm wide. ***Dimeria ornithopoda***
71b. Sheath 4.2—6.5 cm long. Blade 3—5 mm wide. ***Urochloa glumaris***

72a. Sheath with (minute) transverse veins present. ***Panicum laxum, P. repens***
72b. Sheath without transverse veins. **73**

73a. Stolons present. **74**
73b. Stolons absent (but culms may be decumbent). **78**

74a. Sheath (2—)4—6 cm long. Blade with distinct flat ribs at upper side, stiff. (beach grasses). **75**
74b. Sheath 1—4.5 cm long. Blade not ribbed at upper side (or only minutely when dry), (rather) slender. **76**

75a. Stolon culm 1—1.5 mm wide. Sheath glabrous. ***Lepturus repens* var. *repens***
75b. Stolon culm *c.* 3 mm wide. Sheath hairy, at least the margin at tip. ***Sporobolus virginicus***

76a. Stolons with leaves densely crowded. Blade 4—6 mm wide, margins hairy at base. ***Chrysopogon aciculatus***
76b. Stolons with leaves well-spaced. Blade 1—6 mm wide, margins glabrous. **77**

77a. Blade 2—6 mm wide, base (somewhat) rounded, glabrous. ***Sacciolepis indica***
77b. Blade 1—2.5 mm wide, base cuneate, hairy just behind ligule. ***Zoysia matrella***

78a. **(73)** Blade 20—40 mm wide. ***Coix lacryma-jobi***
78b. Blade 1—7 mm wide. **79**

79a. Nodes hairy. **80**
79b. Nodes glabrous. **81**

80a. Sheath margins glabrous. ***Dimeria ornithopoda***
80b. Sheath with one margin hairy. ***Pogonatherum crinitum***

81a. Blade at base cordate to amplexicaul. ***Perotis indica***
81b. Blade at base cuneate to rounded. **82**

82a. Culms erect. ***Sporobolus tenuissimus***
82b. Culms geniculate to decumbent. **83**

83a. Blade 2—6 mm wide, base somewhat rounded, glabrous. ***Sacciolepis***
83b. Blade 1—2.5 mm wide, base cuneate, hairy just behind ligule. ***Zoysia***

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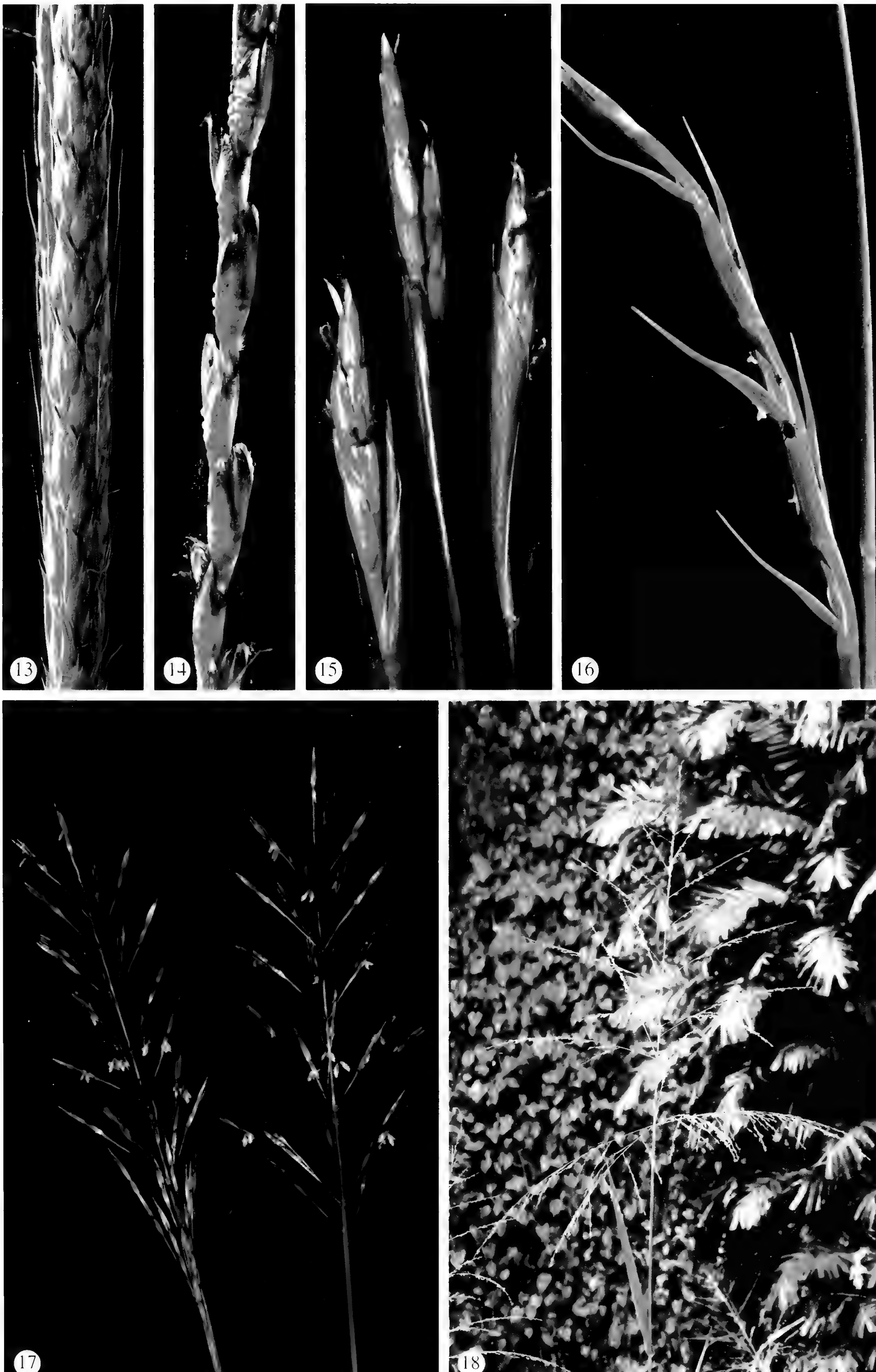
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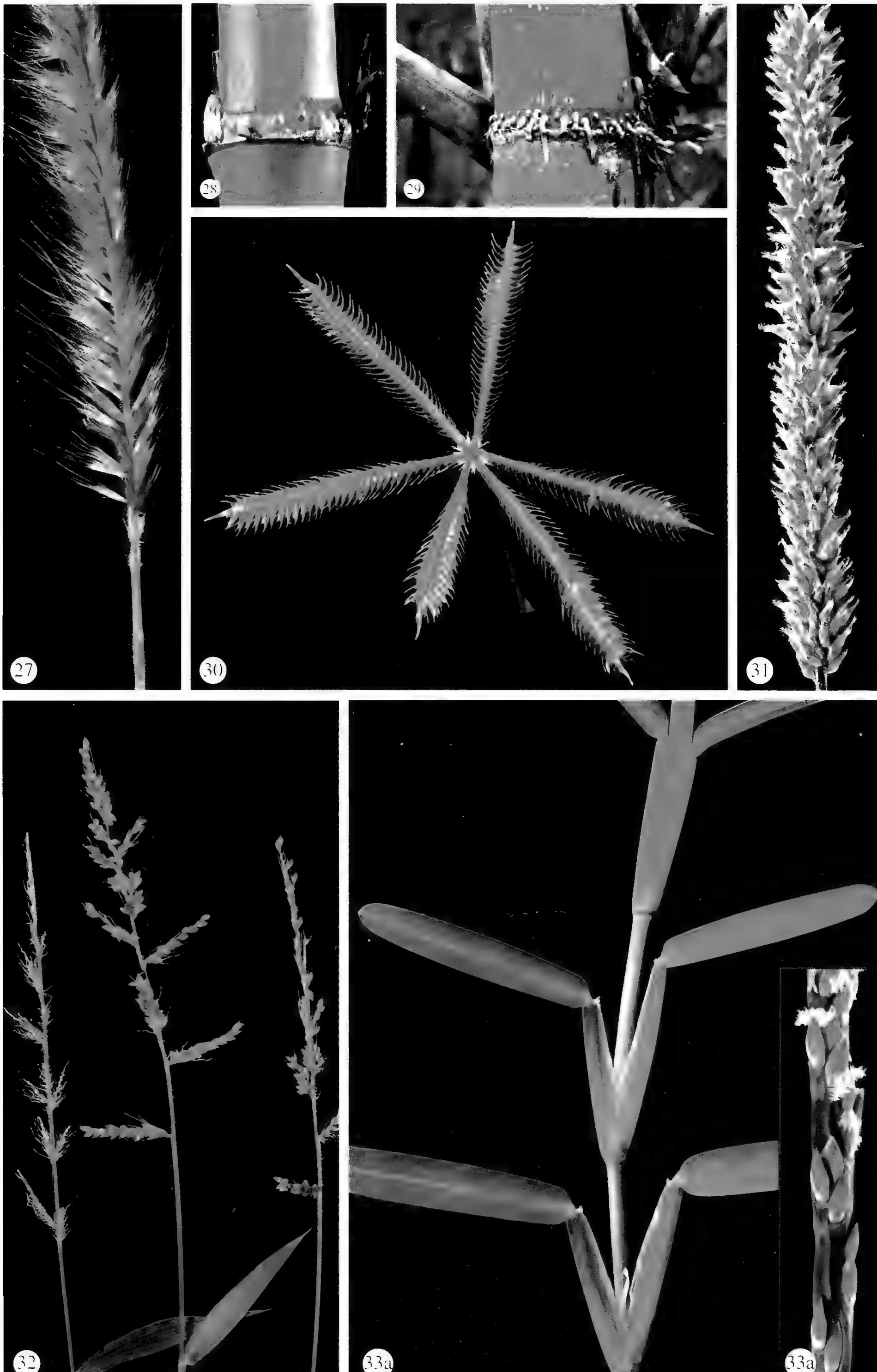
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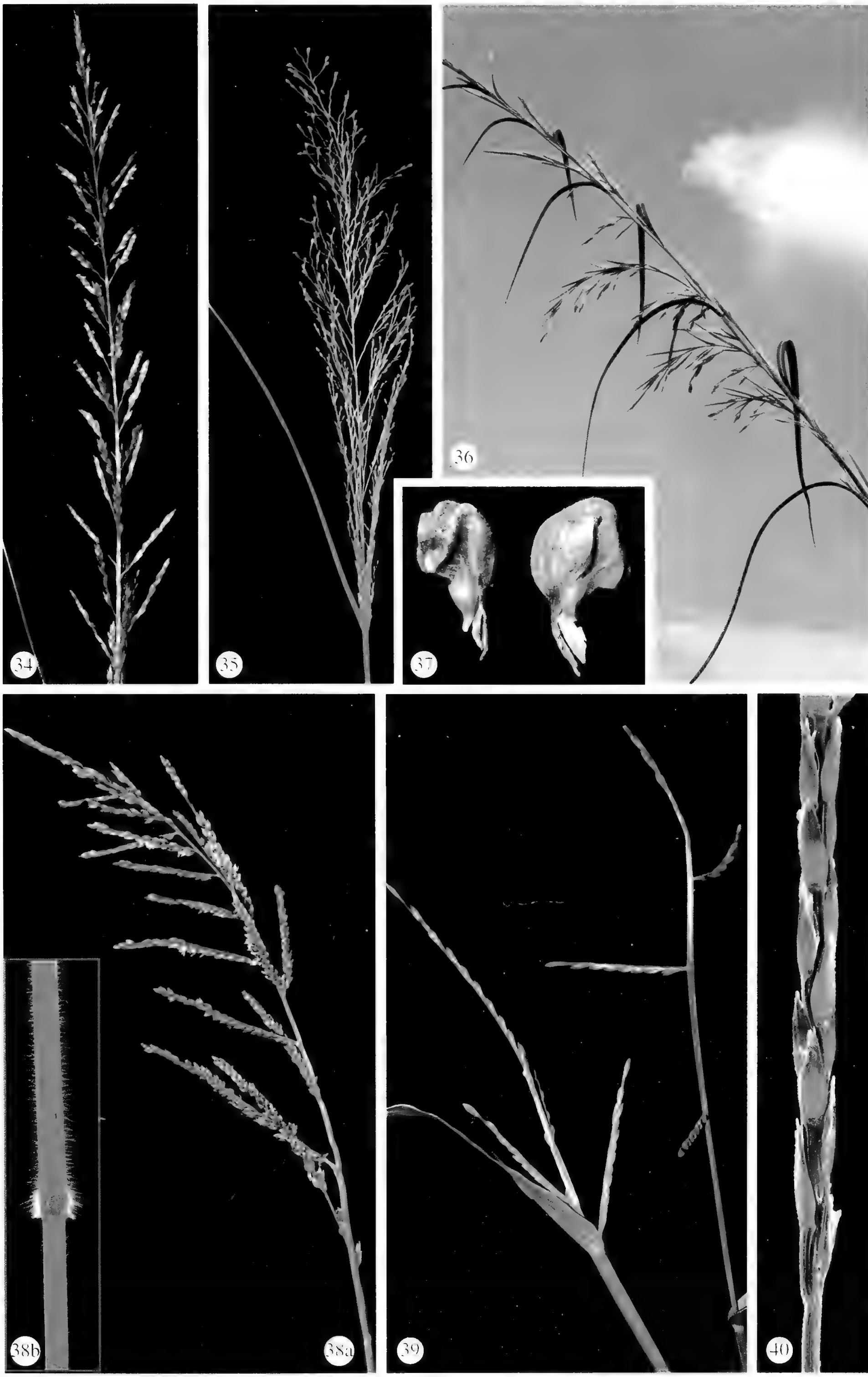
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The Author

The author was born in The Netherlands. She had a keen interest in plants before she could read and at nine she knew she wanted to be a botanist. Having completed secondary school, she studied Biology at the University of Leiden where she achieved her Masters in 1986, with a major subject on Malesian and Australian species of the grass genus Oryza supervised by Dr. J.F. Veldkamp and in 1996 her PhD-thesis on the generic delimitation of Arctium (Asteraceae) and a worldwide revision of its species. During these years she assisted and led several botanical excursions for students, experiencing the difficulties faced by relatively untrained people when using identification keys. These experiences were intensified when in 1993 she started working for FLORON, a network of mainly amateur naturalists investigating the species distribution of the flora of The Netherlands. Since 2000, she lives with her husband and three kids in Singapore. When the youngest of her kids went to school in 2002 she was very happy to return (as a volunteer) to the taxonomy of grasses. Her aim in writing this book is to stimulate more people to study the grasses.

About the Book

Grasses are very important to mankind, especially for food. They also form an important part of today's vegetation of Singapore, occupying at least 18% of its land surface. Nevertheless they are generally neglected, as they are considered difficult to identify. The purpose of this book is to provide all the necessary information with which anyone interested in grasses should be able to identify the 134 non-woody species and varieties that occur in Singapore. The book includes 16 new records, which were not mentioned for the country in any of the earlier accounts of the family. The characters used in the identification keys are easy-to-see and are explained in a separate section on Grass Morphology and in a Glossary. The Key to Sterile Grass Plants is a novelty for the region. It enables one to identify grasses that are not yet flowering, which is especially useful when doing a botanical survey of an area within a limited period of time. As turfs cover large areas, a shortened key to the grasses that are used for turf is also included. The text is fully illustrated and the species descriptions are arranged alphabetically. Separate indices to common (English and Malay) names and scientific names are included. The book should prove useful to the laymen, the student as well as the professional, with information on origin, abundance and ecology included. The book primarily focuses on Singapore. However, it is estimated that it also covers about 90% of the grass species occurring in central and southern Peninsular Malaysia (below 500 m altitude and not including limestone areas).

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