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A TAXONOMIC REVISION OF MALLOTUS SECTION MALLOTUS (EUPHORBIACEAE) IN MALESIA

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SUMMARY

A revision of *Mallotus* section *Mallotus* in Malesia is given. Descriptions, distribution maps, habit drawings and a key to all species are provided. The diagnostic characters for the section are briefly discussed. Four species (*M. barbatus*, *M. macrostachyus*, *M. mollissimus*, *M. paniculatus*) and one variety (*M. paniculatus* var. *formosanus*) are recognised.

Key words: Euphorbiaceae, Rottlerinae, *Mallotus*, Malesia, taxonomy.

INTRODUCTION

Mallotus Lour. is a genus of shrubs, trees and climbers, with c. 150 species. It is classified in the subfamily Acalyphoideae, subtribe Rottlerinae (Euphorbiaceae s.s.) together with other genera (Radcliffe-Smith, 2001). The genus occurs mainly in (sub)tropical Asia, Australia and the Pacific, with only a few species in tropical Africa and Madagascar (Webster, 1994).

The large number of species in *Mallotus* together with the variable morphology has resulted in three main subgeneric classifications by Müller Argoviensis (1865, 1866), Pax & Hoffmann (1914), and Airy Shaw (1968). In the latest classification, eight sections are recognised: *Axenfeldia*, *Hancea*, *Mallotus*, *Oliganthae*, *Polyadenii*, *Rottlera*, *Rottleropsis*, and *Stylanthus*. This article continues the revisional work on Malesian species of the separate sections of *Mallotus*, viz. *Polyadenii* (Bollendorff et al., 2000), *Hancea* and *Stylanthus* (Slik & Van Welzen, 2001a), and *Philippinenses* (Sierra et al., 2005).

In the morphological phylogeny of *Mallotus* by Slik & Van Welzen (2001b) it was suggested that section *Mallotus* is monophyletic and that *Macaranga* is closely related to it, but since not all of its species were included in the analysis its monophyly is not certain; the genus *Mallotus* differs from *Macaranga* in the presence of stellate and simple hairs (simple in *Macaranga*), alternate or opposite leaves (alternate in *Macaranga*), and of 2-celled anthers (4-celled in *Macaranga*). Until the phylogenetic studies of the genus *Mallotus* based on molecular and morphological data are completed we accept the traditional sectional delimitations as circumscribed by Airy Shaw (1968).

Section *Mallotus* was formerly known as sect. *Echinus* (Lour.) Pax & K. Hoffm., but because it contained the type species (*M. cochinchinensis* Lour. = *M. paniculatus* (Lam.)

Müll. Arg. var. *paniculatus*) of the genus this was invalid as an autonym is required. Airy Shaw (1968) was the first author to apply the correct name when he changed sect. *Echinus* into sect. *Mallotus*, which at the time under the ICBN of Edinburgh (Lanjouw et al., 1966) was a superfluous name; since the rule on autonomy was adopted in 1969 he should have used sect. '*Trelotra*'.

In this revision we provisionally accept the sectional composition as circumscribed by Pax & Hoffman (1914) and recognise five taxa: *Mallotus barbatus* Müll. Arg., *M. macrostachyus* (Miq.) Müll. Arg., *M. mollissimus* (Geiseler) Airy Shaw, *M. paniculatus* (Lam.) Müll. Arg. var. *paniculatus*, and *M. paniculatus* (Lam.) Müll. Arg. var. *formosanus* (Hayata) Hurus. These can be distinguished by a combination of several characters such as the presence of stellate hairs, and sessile, globular to disc-shaped, light yellow to orange glandular hairs on most parts; alternate leaves, subpeltate or peltate, with basal and marginal extrafloral nectaries, 3- or palminerved; dark coloured exudate in fresh twigs; bisexual or unisexual inflorescences; and hairy spines on the fruits.

Based on obvious characters, such as the presence of alternate leaves and spiny fruits, it can be inferred that the non-Malesian taxa *M. apelta* (Lour.) Müll. Arg., *M. japonicus* Müll. Arg., *M. lianus* Croizat, *M. metcalfianus* Croizat, and *M. tetracoccus* (Roxb.) Kurz should probably be considered part of this section.

Nomenclature follows the rules as accepted by the Botanical Congress of St. Louis (Greuter et al., 1999).

MALLOTUS section MALLOTUS

Mallotus Lour. sect. *Mallotus*: Airy Shaw (1968) 386, Pax & K. Hoffm. (1914) 162. — *Mallotus* sect. *Eumallotus* Müll. Arg. (1865) 186, nom. inval. — Type: *Mallotus cochinchinensis* Lour. [= *Mallotus paniculatus* (Lam.) Müll. Arg. var. *paniculatus*].

Echinus Lour. (1790) 633. — *Mallotus* sect. *Echinus* Pax & K. Hoffm. (1914) 162, nom. superfl. — Type: *Echinus trisulcus* Lour. [= *Mallotus paniculatus* (Lam.) Müll. Arg. var. *paniculatus*].

Rottlera Roxb. ex Willd. sect. *Trelotra* Baill. (1858) 425. — Type: *Rottlera japonica* (Thunb.) Spreng. [= *M. japonicus* Müll. Arg.].

Mallotus sect. *Melanolepis* auct. non Müll. Arg.: Müll. Arg. (1865) 184, quoad *Mallotus barbatus* Müll. Arg.

Rottlera Roxb. ex Willd. sect. *Eurottlera* auct. non Rchb.f. & Zoll.: Rchb.f. & Zoll. (1857) 314, quoad *Rottlera zippelii* Zoll. & Moritzi, *Rottlera zippelii* Zoll. & Moritzi var. *minor* Rchb.f. & Zoll. (nom. nud.), *Rottlera paniculata* (Lam.) Blume.

Shrubs to small trees, monoecious or dioecious; branches glabrescent. Dark coloured exudate present in fresh twigs. *Indumentum* composed of stellate hairs, and sessile, globular to disc-shaped, light yellow to orange glandular hairs. *Stipules* with entire or subentire margin. *Leaves* alternate to apically subopposite, simple; petiole basally pulvinate; blade subpeltate or peltate, upper surface glabrescent, extrafloral nectaries basally or marginally, orbicular to elliptic, midrib, nerves and veins occasionally with glandular hairs, prominent, 3- or palminerved, nerves looping to ending in the margin, veins scalariform, veinlets reticulate. *Inflorescences* axillary or terminal, unisexual or bisexual; bracts 1 per node; bracteoles present or absent, both triangular to linear triangular, hairy, margin entire or subentire, apex acuminate. *Flowers* actinomorphic, not exceeding 1 cm diam.; pedicels hairy; sepals persistent, valvate, densely hairy outside, subglabrous to sparsely hairy inside, with glandular hairs on both sides, margin entire,

apex acute; petals and disc absent. *Staminate inflorescences* panicles, erect, with several flowers per bract. S*taminate flowers*: sepals 3–5, ovate to elliptic, free, reflexed; stamens 40–90, glabrous, anthers basifixed, thecae 2, separate from each other, ovoid, opening extrorse and lengthwise, sometimes the apex with glandular hairs, connective widened, papillose; pistillode present (or absent), flattened to raised, 0.1–0.3 mm long, consisting of wart-like, glabrous appendices. *Pistillate inflorescences* racemes, panicles or spikes, becoming pendulous, with one flower per bract. *Pistillate flowers*: pedicels absent or present; calyx 3–5, lobes ovate, connate (on the base or almost to the apex), erect, persistent in fruits; ovary with visible spines or not, with glandular hairs, locules 3–5, 1 ovule per locule; style up to 1.5 mm long; stigmas narrowly triangular, plumose, densely covered with papillae above, outer surface hairy and with glandular hairs; staminodes present or absent. *Fruits* dehiscent capsules, surface spiny and densely hairy; wall glabrous inside. *Seeds* ellipsoid to globose, somewhat trigonous in transverse section; caruncle or aril absent.

Distribution — From India (W Bengal) to South China and South Japan, throughout Southeast Asia and Malesia to East Australia and West Pacific (Solomon Islands).

KEY TO THE SPECIES

1a. Domatia, if present, without a dense tuft of woolly hairs. Leaf blade not thickened near petiole insertion, rarely curved upwards. Pistillate inflorescences in racemes and/or panicles 2
b. Domatia with a dense tuft of woolly hairs. Leaf blade thickened near petiole insertion, frequently curved upwards. Pistillate inflorescences in spikes . . . . . **2. M. macrostachyus**
2a. Indumentum tomentose; leaf base subpeltate (up to 1.5 mm), never peltate, basal extrafloral nectaries 0–2. Pistillate inflorescences in panicles or occasionally solitary racemes. Fruit spines sparse, up to 30, exocarp visible . . **4. M. paniculatus**
b. Indumentum rarely tomentose; leaf base subpeltate (up to 1.5 mm) or peltate (1.6–80 mm), basal extrafloral nectaries 0–4. Pistillate inflorescences in racemes, sometimes with side branches. Fruit spines dense, more than 30, exocarp not visible 3
3a. Stipules linear triangular, 10–17 by 0.8–1.2 mm. Indumentum always very soft-floccose, flocci up to 6 mm long, never tomentose. Leaves up to 80 mm peltate, blade 10.5–58 by 9–45 cm, domatia absent. Pistillate flowers sometimes with staminodes, ovary without individually visible spines. Fruit spines straight, hairs forming a continuous layer . . . . . **1. M. barbatus**
b. Stipules narrowly triangular, 0.7–1.5 by 0.1–0.3 mm. Indumentum sometimes soft-floccose, flocci up to 4 mm long, rarely tomentose. Leaves up to 40 mm peltate, blade 10–29 by 8–25 cm, domatia absent or present. Pistillate flowers never with staminodes, ovary with individually visible spines. Fruit spines curly, hairs not forming a continuous layer . . . . . **3. M. mollissimus**

1. Mallotus barbatus Müll.Arg. — Fig. 1; Map 1

Mallotus barbatus Müll.Arg. (1865) 184; Backer & Bakh.f. (1964) 482; Airy Shaw (1982) 28; Corner (1988) 305; Welzen, Slik & Bollendorff in Van Welzen et al. (2000) 97. — [*Rottlera barbata* Wall. (1847) no. 7822, nom. nud.; Baill. (1858) 423, nom. nud.]. — Lectotype (selected here):

Amherst 1483 = Wallich Numer. List 7822C (holo G no. 1165; iso G no. 1164, K-W (photo in L), LE), Myanmar.

Mallotus esquirolii H. Lév. (11 Aug. 1911b) 461, non H. Lév. (10 May 1911a), (see Lauener (1983) 482). — *Mallotus leveilleanus* Fedde (1911) 144 ('*Léveillanus*'). — *Mallotus leveillei* Fedde ex H. Lév. (1914) 165, nom. superfl. — Type: *Esquirol 120* (holo E; photo in A), China, Kweichow, Ouang-Mou.

Mallotus barbatus Müll.Arg. var. *congestus* F.P. Metcalf (1931) 487 ('*congesta*'). — *Mallotus lotingensis* F.P. Metcalf (1941) 206. — Lectotype (selected here): *Tsiang 1131* (holo SYS; iso A, NY), China, Kwangtung, San Kai Tin.

Mallotus barbatus Müll.Arg. var. *pedicellaris* Croizat (1938) 135. — Type: *Fang 680* (holo A), China, Szechuan, Chung-hsien.

Mallotus croizatianus F.P. Metcalf (1941) 204. — *Mallotus barbatus* (Wall.) Müll.Arg. var. *croizatianus* (F.P. Metcalf) S.M. Hwang (1985) 295. — Type: *Taam 4* (holo SYS; iso A), China, Kwangsi, Pai-shou, Liang-chiang.

Mallotus luchenensis F.P. Metcalf (1941) 206. — Type: *Ching 5699* (holo SYS; iso A, NY), China, Kwangsi, Shan Fang, N. Luchen.

Mallotus barbatus Müll.Arg. var. *hubeiensis* S.M. Hwang (1985) 296. — Type: *Li 7620* (holo SCIB n.v.), China, Hubei.

Mallotus barbatus Müll.Arg. var. *wui* H.S. Kiu (2003) 99. — Type: *Exped. Yue 74-4586* (holo SCIB n.v.), China, Guandong, Fengkai, Qixing.

Shrubs to small trees up to 12 m high, dbh up to 15 cm, monoecious or dioecious. Outer *bark* finely striate, smooth, up to 6 mm thick, greyish with patches of brown, on cross section reddish brown; sapwood straw coloured with pinkish brown streaking. *Indumentum* densely hairy, very soft-floccose, flocci up to 6 mm long. *Stipules* linear-triangular, 10–17 by 0.8–1.2 mm, persistent, margin subentire, apex acuminate. *Leaves*: petiole 3–40 by 2–7 mm, blade peltate for 10–80 mm, broadly ovate to ovate, 10.5–58 by 9–45 cm, length/width ratio 1–1.3, base truncate, rounded or obtuse, margin dentate, sometimes 2-lobed at widest part of blade, longest lobes up to 50 mm, upper surface pinkish red when young, dull green when old, basally with 0–4 extrafloral nectaries, 1.2–4.5 by 0.7–2 mm, marginal nectaries 0–9 per side, 2–6(–18) mm from margin, 0.7–1 by 0.5–1 mm, lower surface brownish green, palminerved, nerves 7–11 per side, mostly ending in the margin. *Inflorescences* terminal, unisexual or bisexual, axes greenish tawny, basally 2–5 mm thick; bracts 5–20 by c. 1 mm, bracteoles linear triangular 2.7–4.3 by 0.4–0.6 mm, persistent, margin subentire. S*taminate inflorescences* up to 65 cm long, side branches up to 30 cm long, with 2 or 3 flowers per node, nodes per branch up to 130. *Staminate flowers* 6–9 mm diam.; pedicels 3–5.5 mm long; sepals 4 or 5, 3–5 by 1.3–3 mm, pale light cream to tan cream; stamens 60–85, pale light green to yellow, filaments 1–4 mm long, anthers 0.3–0.4 by 0.2–0.3 mm, pale light yellow; pistillode absent (stamens absent from middle of flower, centre sometimes with reduced wart-like appendices). *Pistillate inflorescences* racemes, up to 55 cm long, occasionally with side branches, up to 10 cm long, nodes up to 80. *Pistillate flowers* 4–6 mm diam.; pedicels 1–45 mm long; calyx (3-) or 4- or 5- or (6-)lobed, connate on the base, 2.5–5 mm long, lobes 2–3 by 1.5–2.5 mm; ovary 3(–5)-locular, 2.5–3.5 by 2.2–3 mm, spines not individually visible; style up to 1.5 mm long; stigmas 2–6 mm long, yellow; staminodes sometimes present, also persistent in fruits. *Fruit* 10–21 by 14–20 mm, with strong smell, yellow with reddish touch, spines numerous, straight, thin, less hairy, up to 7 mm long, hairs forming a continuous layer, rubbing off; column 7–9 by 1–1.5 mm. *Seeds* ellipsoid, 4.8–5.5 by 3–4.5 by 2–4 mm, surface smooth, black; hilum c. 1 by c. 1.3 mm.

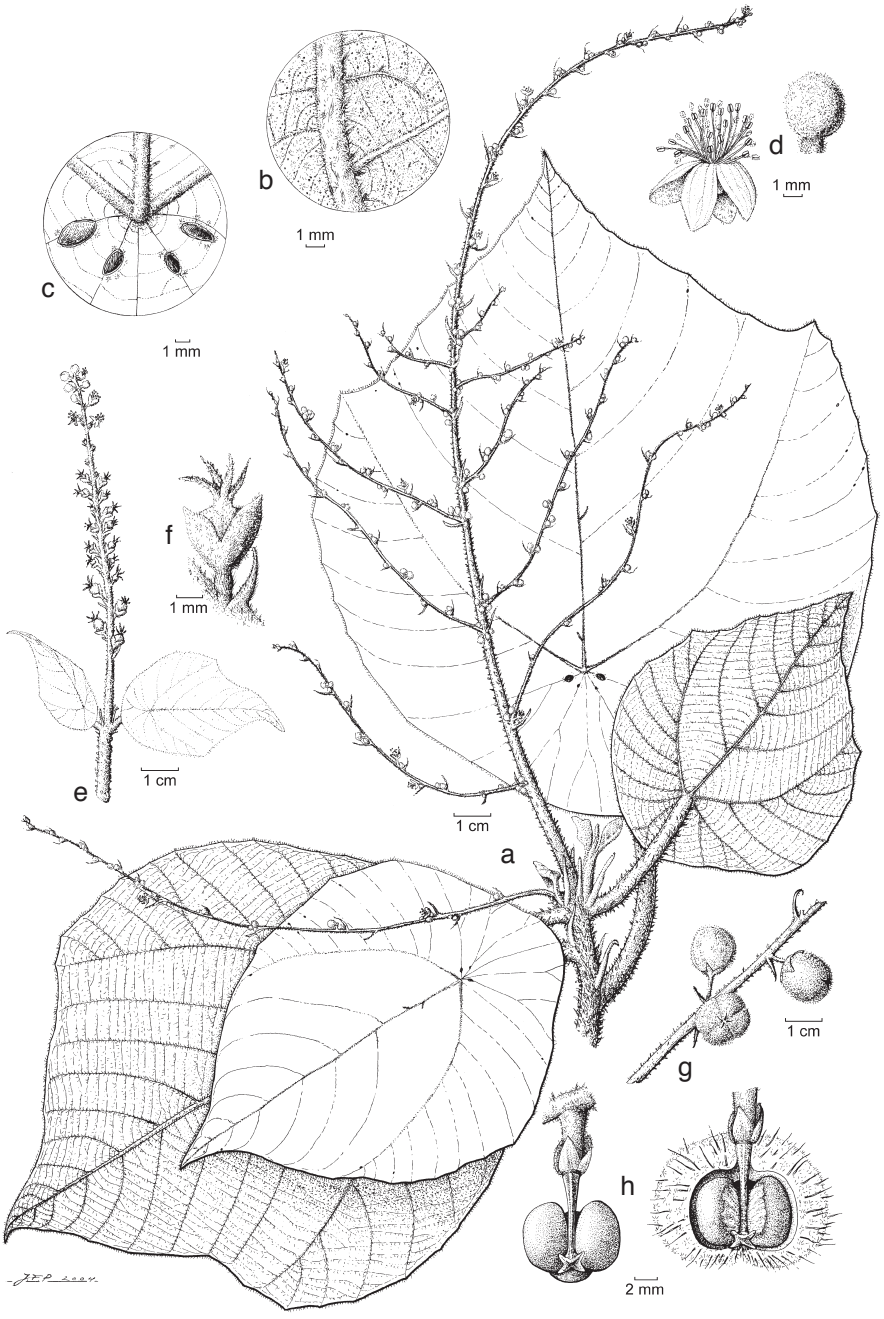
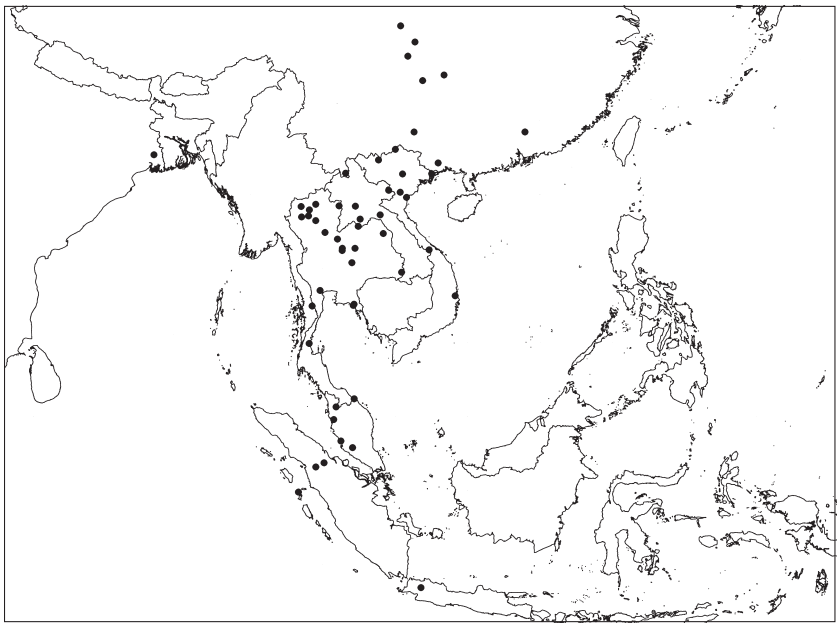


Fig. 1. *Mallotus barbatus* Müll. Arg. a. Habit with male inflorescence; b. detail of leaf lower surface with glandular hairs; c. base of leaf upper surface with extrafloral nectaries; d. staminate flower and bud; e. pistillate inflorescence; f. pistillate flower; g. immature fruits; h. dehisced fruit showing seeds and column (a, d: *Garrett 760*; b, c, g, h: *Geesink et al. 5653*; e, f: *Put 1618*; all L).



Map 1. Distribution of *Mallotus barbatus* Müll.Arg.

Distribution — From India (W Bengal) to South China, Southeast Asia mainland, Malay Peninsula, Sumatra, and Java.

Habitat & Ecology — Locally common in deciduous and evergreen forest, mostly in open, often very disturbed or burned places, along road and river sides; on a large variety of soil types, like shale, limestone, sandstone, and sandy clay. Altitude: sea level up to 1400 m. Flowering and fruiting the whole year through.

Uses — The roots and fruits are used against muscle stiffness. The seeds yield a fatty oil used for making candles.

Vernacular names — Laos: Dtong dtah waen (Lao). Malay Peninsula: Baleh anging, ba-le-a-nging, balek angin, balik angin, tampun (Malay). Thailand: tawng-yow (Lao); hu chang, kalo khon, kalo yai thai, khi thao, krakok khon, mueat tao, po hun, po tao, salapang, salapang bai yai, sa-po-sa, tao khon, tao tep; tong tao, ya khi thut (Thai); siamese pom-pom tree (English). Vietnam: Cay co nhum. Partly after Smitinand (2001).

2. Mallotus macrostachyus (Miq.) Müll.Arg. — Fig. 2; Map 2

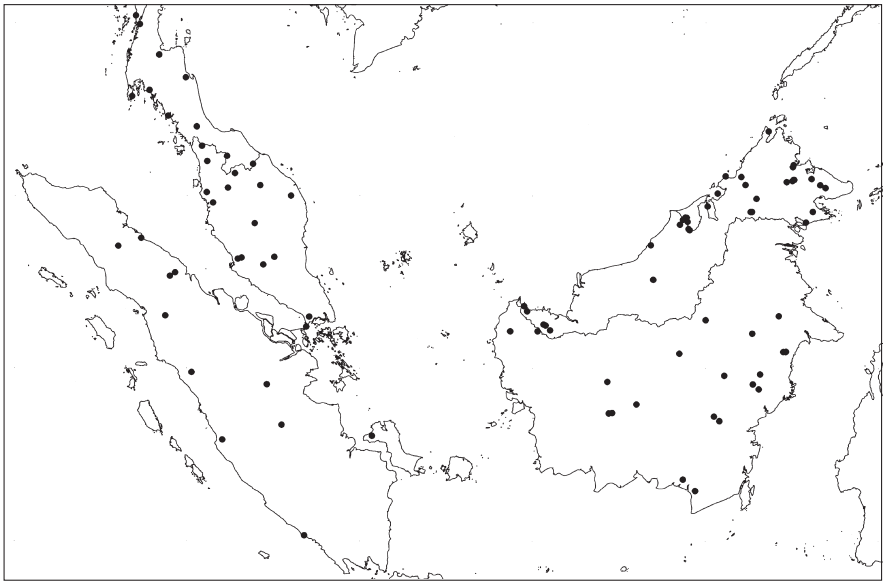
Mallotus macrostachyus (Miq.) Müll.Arg. (1866) 963; Airy Shaw (1975) 165; Corner (1988) 306; Welzen, Slik & Bollendorff in Van Welzen et al. (2000) 101. — *Rottlera macrostachya* Miq. (1860) 454. — Lectotype (selected here): *Teijsmann HB 3245* (U), Indonesia, Sumatra.

Mallotus insignis Müll.Arg. (1865) 193; (1866) 975. — Type: *Schomburgk 52* (holo K), Singapore.

Mallotus albus auct. non (Roxb.) Müll.Arg.: Müll.Arg. (1865) 188, quoad *Motley 530* (CGE, K), Indonesia, Borneo; *Wallich Numer. List 7820* (K-W mixed), Malay Peninsula, Penang.

Mallotus barbatus auct. non Müll.Arg.: Müll.Arg. (1865) 184, quoad *Wallich Numer. List 7820* (K-W mixed), Malay Peninsula, Penang.

Shrubs to small trees up to 16 m high, dbh up to 25 cm, dioecious, occasionally monoecious. Crown spreading, flat; outer *bark* finely fissured, soft, brownish grey, inner bark fibrous inwards, yellowish green, cambium yellow, sapwood white. *Indumentum* tomentose to puberulent. *Stipules* triangular, 2.8–7 by 1–1.8 mm, persistent, margin entire, apex acute. *Leaves*: petiole 2–36 by 1–4 mm; blade subpeltate for 1.5 mm, peltation near petiole insertion often thick and frequently curved upwards, broadly ovate to ovate, 9.2–31 by 7.8–25 cm, length/width ratio 1–1.3, base truncate, rounded, to slightly cuneate, margin dentate, or serrate, rarely shallowly 2-lobed at widest part of blade, upper surface dark green, basally with 0–2 extrafloral nectaries, 1.3–3 by 0.5–2.5 mm, marginal nectaries 0–9 per side, 1.5–10 mm from margin, 0.6–1 by 0.6–8 mm, lower surface brownish grey, domatia with a dense tuft of woolly hairs, 3-nerved, nerves 7 or 8 per side, mostly ending in the margin. *Inflorescences* axillary or terminal, unisexual or bisexual, axes light brownish, basally 2–4 mm thick; bracts triangular, 1–2.5 by 0.6–10 mm, persistent, margin entire, bracteoles absent. S*taminate inflorescences* up to 112 cm long, side branches up to 65 cm long, with 1 or 2 flowers per node, nodes per branch up to 120. *Staminate flowers* 4–4.5 mm diam., fragrant; pedicels 3.2–4.2 mm long; sepals 3 or 4, 2–2.7 by 1.2–1.7 mm; stamens 60–90, filaments 1–3 mm long, white, anthers 0.3–0.35 by 0.2–0.25 mm, light yellow; pistillode present. *Pistillate inflorescences* spikes, up to 80 cm long, seldomly with side branches (up to 14 cm long), nodes up to 150 (see note 1). *Pistillate flowers* 3–7 mm diam., sessile; calyx 4- or 5-lobed, connate almost to the apex, 3–5 mm long, lobes 0.5–1.7 by 0.8–1.5 mm, light brownish; ovary 3-locular, 3.2–4 by 1.8–2.2 mm, spines individually not visible, style up to 1.2 mm long; stigmas 4–5 mm long, dark brown; staminodes absent. *Fruits* 11–16 by 10–14 mm, light green with brown tomentum, spines numerous, straight, thin, less hairy, up to 4 mm long, hairs forming a continuous



Map 2. Distribution of *Mallotus macrostachyus* (Miq.) Müll.Arg.

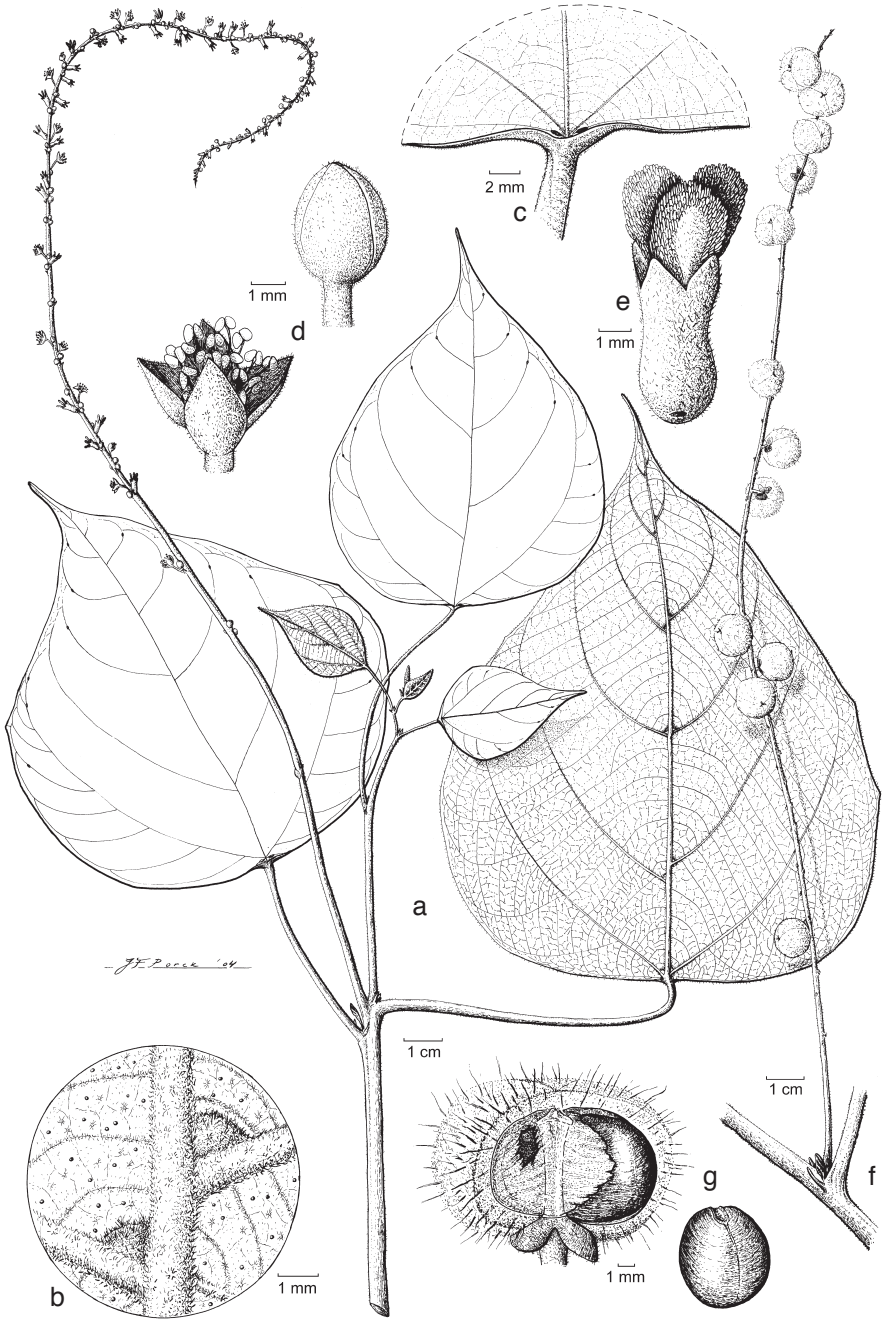


Fig. 2. *Mallotus macrostachyus* (Miq.) Müll.Arg. a. Habit with bisexual inflorescence; b. detail of leaf lower surface with glandular hairs and domatia; c. base of leaf upper surface with extrafloral nectaries; d. staminate flower and bud; e. pistillate flower; f. infructescence; g. dehisced fruit showing seeds and column (a–e: *Davies & Unam 97009*; f, g: *Shimizu et al. T-27167*; all L).

layer, rubbing off; column 5–6 by 1.2–2 mm. *Seeds* ellipsoid, 4–5 by 4–4.5 by 3.5–4 mm, surface irregular, dark brown; hilum 2.3–2.5 by 1.8–2 mm.

Distribution — Thailand to Singapore, Sumatra, and Borneo.

Habitat & Ecology — Locally common in deciduous and evergreen forest, mostly in open, often very disturbed or burned places, along road and river sides, swampy areas; on a large variety of soil types, like shale, limestone, sand, and basalt. Altitude: sea level up to 800 m. Flowering and fruiting the whole year through. The male flowers are visited by *Trigona* bees.

Uses — The leaves are used as an antidote against snake-poison. The wood is used as firewood.

Vernacular names — Thailand: fame, fami, lo, lo khon, lua, plao thong, plao-yai (Thai); common pom-pom tree (English). Malay Peninsula: Selau, balek angin. Singapore: Balek angin. Sumatra: Baliek anggien, batang balik; pedau-pedau (Dusun); si tarak balanggingan. Indonesia (Borneo): Kapit mawat (Kenyah), kayu balik angin, kayu kapit, buah beliangin, kajoe si tarak balanggingan. Sabah: Dahau (K'zan K'gan); dahu (Dusun/Bundu Tuhan); dauah (Dusun Putatan); mangabong, ngoludon, padauh-padau (Dusun); tondon tondon (Suluk). Sarawak: Balek angin; entupak, kelempah pinggai, kelipak pinggai, kerimpah pinggai (Iban). Brunei: Lekon abai, lokon (Dusun); entupak, nentupak (Iban). Partly after Smitinand (2001).

Note — *BS 2576* has aberrant female inflorescences, probably infected by a virus.

3. **Mallotus mollissimus** (Geiseler) Airy Shaw — Fig. 3; Map 3

Mallotus mollissimus (Geiseler) Airy Shaw (1972) 297; Backer & Bakh.f. (1964) 482; Airy Shaw (1975) 165; (1980) 168; (1981) 326; (1982) 28; (1983) 37; P.I. Forst. (1999) 473, 494; Keßler (2002) 49; Welzen, Slik & Bollendorff in Van Welzen et al. (2000) 102. — *Croton mollissimus* Geiseler (March 1807) 73. — *Chrozophora mollissima* (Geiseler) A. Juss. ex Spreng. (1826) 851. — *Echinus mollissimus* (Geiseler) Baill. (1866) 316. —Type: *Herb. Vahl s.n.* (holo C; photo at A), China, see note 1.

Croton ricinoides Pers. (Sept. 1807) 586. — *Rottlera ricinoides* (Pers.) A. Juss. (1824) 111, t. 9, f. 29A. — *Mallotus ricinoides* (Pers.) Müll.Arg. (1865) 187, nom. superfl. — Lectotype (Forster, 1999): *Lahaye s.n.* (holo P, *Herb. A. Juss. 16578*, [IDC microfiche no. 6206]), India, see note 2.

Adisca zippelii Blume (1826) 611. — *Adisa zippelii* Steud. (1840) 28, sphalm. — *Rottlera zippelii* Hassk. (1844) 238. — *Mappa zippelii* Zoll. & Moritzi ex Moritzi (1846) 17. — *Mallotus zippelii* F. Muell. (1864) 139. — Lectotype (selected here): *Blume s.n.* (holo L barcode 0294214; iso L barcode 0294172), Java, Mt Salak.

Adelia bernardia auct. non L.: Blanco (1837) 814; Merr. (1918) 221. — *Adelia barbata* Blanco (1845) 561. — Neotype (selected here): *Merrill Species Blancoanae 474* (holo US; iso K, L), Philippines, Luzon, Rizal.

Mallotus pycnostachys F. Muell. (1864) 138. — Lectotype (Forster, 1999): *MEL 232430, 32-34*, Australia, Queensland, North Kennedy Distr., Mt Elliott.

Mallotus barbatus auct. non Müll.Arg.: Merr. (1912) 397. — *Mallotus confusus* Merr. (1920) 559. — Type: *BS (Ramos & Edaño) 29153* (holo PNH†; iso A, P, US), Philippines, Luzon, Tabayas Province, Mt Tulaog.

[*Mappa* sp.: Moritzi (1846) 17]. — *Rottlera zippelii* Zoll. & Moritzi var. *minor* Rchb.f. & Zoll. (1857) 315, nom. nud. — *Rottlera peltata* auct. non Roxb.: Miq. (1859) 395. — Voucher: *Zollinger 319* (G, L), Indonesia, Java.

Shrubs to small trees up to 12 m high, dbh up to 15 cm, dioecious, occasionally monoecious. *Bole* up to 5 m high; crown up to 6 m long; outer *bark* rough to finely fissured or pustular lenticellate, up to 2 mm thick, yellowish green, under surface light reddish

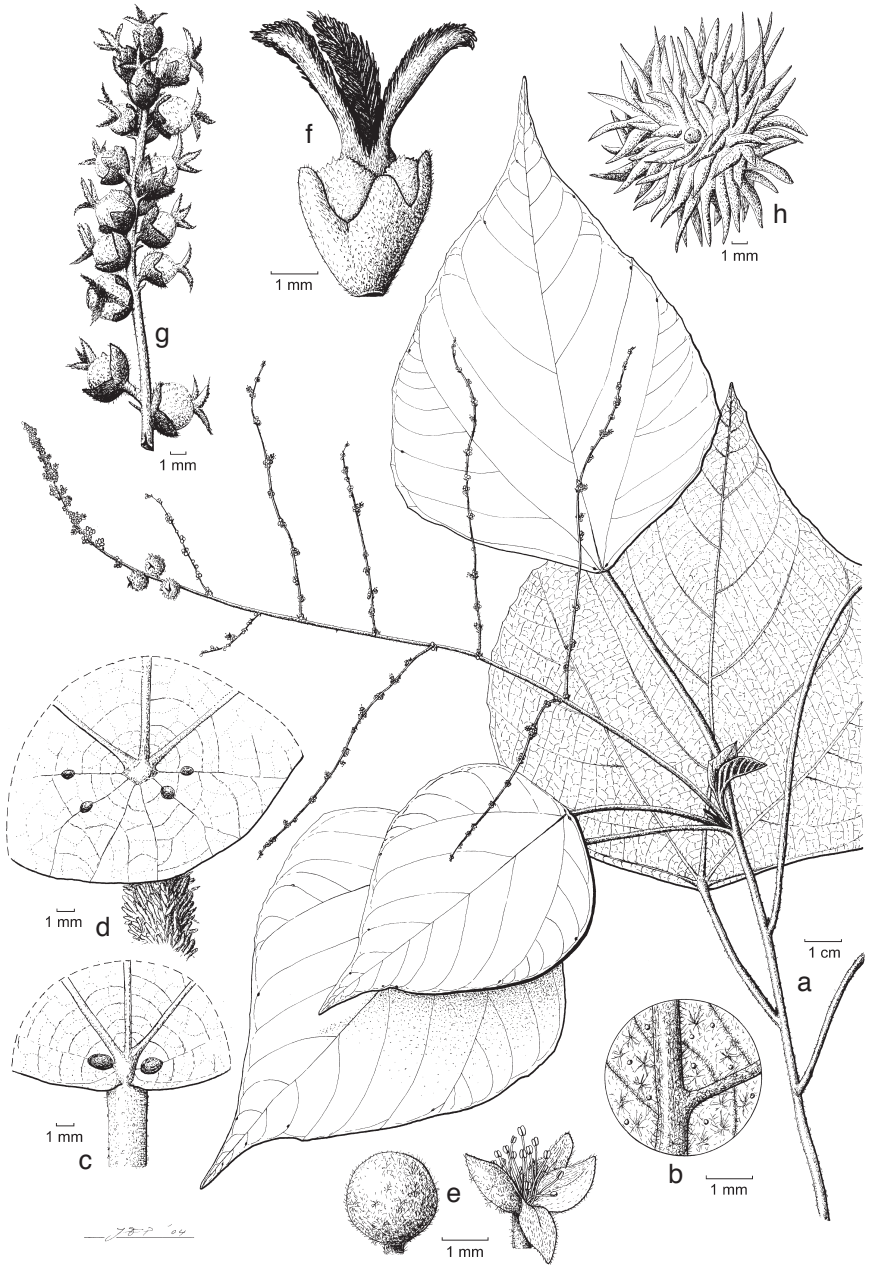


Fig. 3. *Mallotus mollissimus* (Geiseler) Airy Shaw. a. Habit with bisexual inflorescence; b. detail of leaf lower surface with glandular hairs; c. base of leaf upper surface with 2 extrafloral nectaries; d. peltate leaf upper surface with 4 extrafloral nectaries and floccose indumentum; e. staminate flower and bud; f. pistillate flower; g. young infructescence; h. fruit (a: *University of San Carlos 883*; b: *University of San Carlos 839*; c: *Santos 4769*; d: *PNH 36026* (*Frake*); e: *PNH 1613* (*Alcasid*); f, g: *PNH 11282* (*Edaño*); h: *Santos 5302*; all L).

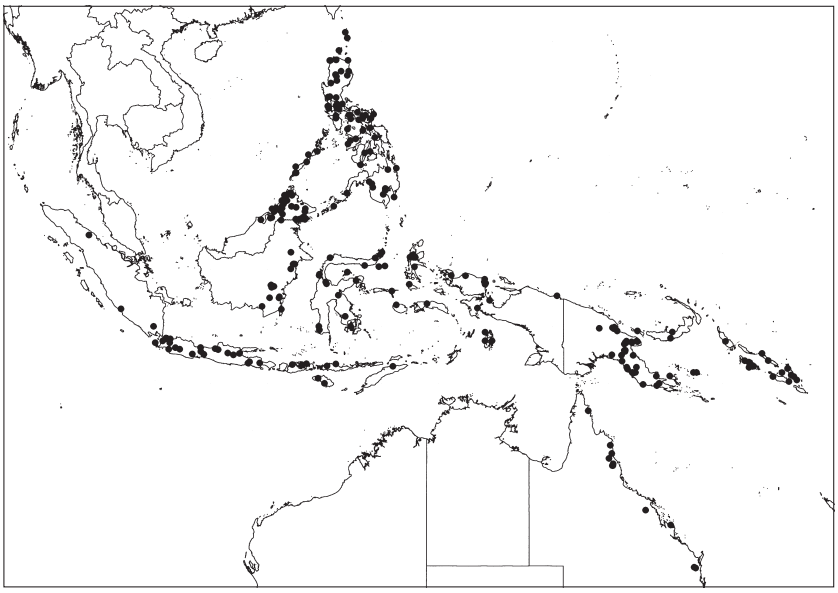
brown; inner bark up to 6 mm thick, fibrous, light greenish; sapwood cream with watery sap; wood medium hard, cream. *Indumentum* dense, sometimes soft-floccose, flocci up to 4 mm long, rarely tomentose. *Stipules* narrowly triangular, 0.7–1.5 by 0.1–0.3 mm, caducous to persistent, margin subentire, apex acuminate. *Leaves*: petiole 30–200 by 1.5–4 mm; blade subpeltate or peltate for 1.5–40 mm, ovate, 10–35 by 8–30 cm, length/width ratio 1.2–1.4, reddish brown when young, base truncate to cuneate, margin entire to dentate, seldom 2-lobed at the widest part of the blade, longest lobes up to 15 mm long, upper surface green, basally with 0–2(–4) extrafloral nectaries, 0.8–4 by 0.4–1.8 mm, marginal nectaries 0–15 per side, 2–10 mm from margin, 0.5–1 by 0.5–1 mm, lower surface greenish grey to brownish, with domatia or not; 3- or palminerved, nerves 8–11 per side, mostly ending in the margin. *Inflorescences* axillary or terminal, unisexual or bisexual, axes greenish tawny, basally 1–4 mm thick; bracts narrowly triangular, 1.8–3 by 0.2–0.5 mm, caducous to persistent, margin subentire; bracteoles absent. S*taminate inflorescences* up to 43 cm long, side branches up to 20 cm long, with 3–5 flowers per node, nodes per branch up to 100. *Staminate flowers* 3–5 mm diam.; pedicels 3–3.5 mm long; sepals 3 or 4, elliptic, 2–3 by 1.5–2 mm, greyish; stamens 50–80, yellowish, filaments 1.5–3 mm long, anthers 0.2–0.3 by 0.1–0.2 mm; pistillode present. *Pistillate inflorescences* racemes, up to 35 cm long, occasionally side branches up to 13 cm long, nodes up to 130; bracts caducous to persistent. *Pistillate flowers* 3–4 mm diam.; pedicels up to 0.5 mm long; calyx 3–5-lobed, connate on the base, 2–3 mm long, green with brown indumentum, lobes ovate, 1.5–2 by 1–1.7 mm; ovary 3-locular, 2.2–3 by 2–3 mm, spines individually visible; style up to 1.2 mm long; stigmas 2.2–2.8 mm long, greenish yellow; staminodes absent. *Fruits* 10–16 by 11–17 mm, greenish brown, smelling strong when dried, see note 3, spines numerous, curly, thin, less hairy, up to 7 mm long, hairs not forming a continuous layer, easily rubbing off; column 5–6 by 1–1.8 mm. *Seeds* ellipsoid, 4–5 by 3.8–4 by 3–3.2 mm, smooth, black, shiny; hilum c. 1 by 0.6–0.7 mm.

Distribution — From Sumatra to East Australia and West Pacific (Solomon Islands).

Habitat & Ecology — Locally common in deciduous and evergreen forest, mostly in open, often very disturbed or burned places, gallery forest, mangrove edges, swamp forest, riparian vegetation, notophyll vineforest, on mountain slopes, open grasslands and along hill and road sides; on a large variety of soil types, like alluvial, basalt rocks, clay, coral limestone, loam, rocky, sandy, ultrabasic, and volcanic. Altitude: sea level up to 1700 m. Flowering and fruiting the whole year through. Observed to be visited by small brown ants.

Uses — The roots are used against headaches and malaria. The inner bark is used as a strap for carrying and for sing sing decorations. The leaves are used as food covering, against stomach cramp, and together with the bark used to cure the spleen. The wood is used for making scabbards, ritual spears, building construction, and as firewood.

Vernacular names — Sumatra: Kajoe si balihangin. Java: Djalikangin, toetoep beling. Sabah: dapulan, dul-long perampuang (Bajau); patau jantan (Bajec); kasobong (Daho); andalamit, angkut angkut, dahu, dau, kedayan, lukabang, padau-padau, padahu, pandau pandu (Dusun); laba-laba (Kinabatangan); bajau papar, murut tenom (Kwijau); ambutan, dawoh, dusun, lapakon, (Murut); dapulon-dapulon, pais tahun (Suluk); apat retu, apatmaratu, pit dau (Sungei); andalasan, kehat, labah-labah, labah lahat, ludai, padauk,



Map 3. Distribution of *Mallotus mollissimus* (Geiseler) Airy Shaw.

porak sembelik, purak sambalik. Sarawak: Labah-labah (Kedayan); lalapakon (Murut). Brunei: jabai, laba-laba, markubong, prestaang, toka toka, tuka, sawar bubu. Philippines: hanonomo (Bisáya); indang (Lánao); bampalan (Súlu); hinlaumo (Tagálog); ipalan (Yakán); aab-ben, anumoh, anumú tagabas, atay-atay, baray, cahoy-dalaga, gapas gapas, malang-malang, maracapau, tagaan. Sulawesi: Kayou wollo sola, laransiana oeroene, lemoro, ota-ota. Papua (Irian Jaya): Bekoeaap, bekwaap, bie grai, majetrip (Hattam); mangafafin (Biak). Papua New Guinea: Atatiza (Garaina, Waria); majetrip (Hattam); wapi (Marok); siripupo (Orakiva); wasittatt (Wein); ah papper, goreh-gobu, hukoitiiti, hukopu, kikikanauant, la putu la basi, moraka, ongohn, tiwotiwo, ukoiitiiti. Solomon Islands: A'rafu, airafu, airahu, albuis, suamango, suamangokwao, suamangongwane (Kwara'ae); hohoe, tukituki hohoe.

Notes — 1. Forster (1999) states that Müller Argoviensis (1866; 964 sub. *M. ricinoides*) mentioned a Staunton collection from China as the type of *M. mollissimus*. But actually Müller Argoviensis indicated two specimens from China: a Staunton collection in herbarium G and a Vahl collection in herbarium C. Part of the confusion has arisen because when reading Müller Argoviensis one can think that there is one single collection (*Staunton s.n.*) with the holotype in G and the isotype in C. However, Müller Argoviensis added 'i.e.', meaning a single form! (id est), this is the original specimen to the C sheet.

Moreover the *Staunton* collection cannot be the type of *M. mollisimus*, because there is no evidence that Geiseler ever saw it. It was given by Lambert to De Candolle in 1816, as was written on the label (for additional information see also Miller, 1970: 543).

Since the Crotonis Monographiam from Geiseler (1807) is based on material from Vahl at the Copenhagen Herbarium, by circumstantial evidence, the most likely speci-

men to be the type is the Vahl specimen found in C as was actually said by Müller Argoviensis. Like Croizat (1938: 141) we doubt the Chinese origin of this specimen as no other one has come to our attention. The nearest occurrence could be Tu Phap in North Vietnam, but the provenances given by the collector d'Aleizette cannot always be trusted. The specimens cited by Gagnepain (1925: 357) and *Poilane 1685* cited by Croizat as well, as far as seen belong to *M. metcalfianus*.

A letter by Croizat on July 14, 1938, that is after the publication of his paper (April 27, 1938) suggests a possible Indonesian origin and this seems a good suggestion.

2. *Croton ricinoides* was described from India. The lectotype was collected by Lahaye, who never was in India (cf. Van Steenis-Kruseman, 1950: 307) but did collect in Malesia.

3. *Mallotus metcalfianus* Croizat can be easily confused with *M. mollissimus*, in particular because of the fruits. The main differences are found on the stellate indumentum: dark brownish, densely tomentose (light brown, dense to scattered, big, rarely densely tomentose in *M. mollissimus*); glandular hairs not very visible (visible glandular hairs in *M. mollissimus*); the presence of 2–6 basal extrafloral nectaries (0–2(–4) in *M. mollissimus*) on the upper side of the blade; big buds and flowers (small buds and flowers in *M. mollissimus*); female flowers with connate sepals (connate at the base in *M. mollissimus*); ovary 3- or (4-)locular (ovary 3-locular in *M. mollissimus*); rough seeds (smooth seeds in *M. mollissimus*); fruits with thicker layer of indumentum on the spines.

Collections studied of *M. metcalfianus*:

Kwangsi: Sup-man-ta Shan (*Liang 69716*, syntype). Thailand: Nong Khai (*Bunchuai 1826*), Plao Thong (*Niyomdham 4882*). Vietnam: Tu Phap (*Balansa 3320*, syntype); Dam ha: Sai Wong Mo Shan (*Tsang 30253*), Lung Wan (*Tsang 30032*); Annam: La' Han (*Poilane 1685*), Mt Dani (*J. & M.S. Clemens 3616*).

4. **Mallotus paniculatus** (Lam.) Müll.Arg.

Mallotus paniculatus (Lam.) Müll.Arg. (1865) 189; Backer & Bakh.f. (1964) 483; Airy Shaw (1975) 166; (1980) 169; (1981) 327; (1982) 29; (1983) 37; Corner (1988) 307; P.I. Forst. (1999) 478, 496; Keßler (2002) 50; Welzen, Slik & Bollendorff in Van Welzen et al. (2000) 103; W.J. Kress, DeFilipps, E. Farr & Yin Yin Kyi (2003) 232. — *Croton paniculatus* Lam. (1786) 207; A. Juss. (1824) 33, comb. in *Rottlera* not made!. — *Rottlera paniculata* (Lam.) Blume (24 Jan.1826) 604; Spreng. (Jan.–Mar.1826) 877 (isonym). — Lectotype (Forster, 1999): *Commerson s.n.* (holo P, *Herb. A. Juss. 16579* [IDC microfiche no. 6206]), Indonesia, Java.

Echinus trisulcus Lour. (1790) 633. — *Mappa cochinchinensis* Spreng. (1826) 878, nom. superfl. — *Lasipania tricuspis* Raf. (1838) 22, nom. superfl. — Type: *Loureiro s.n.* (holo BM? n.v.), Vietnam, Annam, Cây hón.

Mallotus cochinchinensis Lour. (1790) 635. — *Trewia tricuspidata* Willd. (1806) 835, nom. superfl. — [*Mallotus chinensis* Lour. ex Müll.Arg. (1866) 965, *in syn. sphalm. pro cochinchinensis*]. — Lectotype (selected here): *Loureiro s.n.* (BM [photo at BRI]), Vietnam, Annam.

Rottlera alba Roxb. [(1814) 73, nom. nud.] ex Jack (1820) 26; Roxb. (1832) 829, isonym. — *Mallotus albus* (Roxb.) Müll.Arg. (1865) 188, quoad basionym et *Wall. 7818*. — Lectotype (selected here): *William Roxburgh fil. s.n.* ≡ *Wallich Numer. List 7818A* (Hb. Roxb.!) (holo BR sh 849430 in fr., curiously the label says male, P, fide leaf fragment in A, Icon Ined. 1712; iso BR, CAL, K-W), Malaysia, P. Penang.

Croton appendiculatus Elmer (1908) 312. — Type: *Elmer 9215* (holo PNH†; iso L, NY, US), Philippines, Luzon.

Shrubs to small trees up to 15 m high, dbh up to 24 cm, dioecious, rarely monoecious. *Bole* up to 4 m high; crown up to 4 m long; *bark* with much tannic acid, outer bark rough to finely fissured or pustular lenticellate, reddish brown with yellowish brown lenticels, up to 10 mm thick; inner bark and wood white. *Indumentum* tomentose to puberulent. *Stipules* triangular, 0.8–1.5 by 0.4–0.7 mm, caducous, margin entire, apex acute. *Leaves*: petiole 30–180 by 0.5–2.5 mm, greenish tawny; blade subpeltate for 1.5 mm, broadly ovate to ovate, 4–23.5 by 3–15 cm, length/width ratio 0.8–2, reddish brown when young, base rounded to cuneate, margin entire to (irregularly) dentate, sometimes 2-lobed at widest part of blade, sometimes hastate, longest lobes up to 30 mm, upper surface dull dark green, basally with 0–2 extrafloral nectaries, 0.8–5 by 0.5–2.5 mm, yellowish green, marginal nectaries 0–11 per side, 2–4 mm from margin, 0.3–0.8 by 0.2–0.8 mm, lower surface light brownish grey to coppery, domatia absent, 3-nerved, nerves 6–8 per side, looping or ending in the margin. *Inflorescences* axillary or terminal, unisexual to rarely bisexual, axes greenish tawny, basally 2–4 mm thick; bracts triangular to narrowly triangular, 1.9–2.2 by 0.3–0.4 mm, bracteoles 0.4–1 by 0.3–0.5 mm, persistent, margin entire. S*taminate inflorescences* up to 45 cm long, side branches up to 28 cm long, with 3–7 flowers per node, nodes per branch up to 70, hairy. *Staminate flowers* 3–5 mm diam.; pedicels 3–4 mm long; sepals 3 or 4, elliptic, reflexed, 2.2–3 by 1.2–1.8 mm, pale yellow; stamens 40–65, filaments 1.5–2 mm long, white, anthers 0.2–0.3 by 0.1–0.2 mm, orange-yellow; pistillode present. *Pistillate inflorescences* panicles, occasionally racemes, up to 30 cm long, nodes up to 75 (per branch). *Pistillate flowers* 3–4 mm diam.; pedicels up to 1 mm long; calyx 3–5-lobed, connate on the base, 2–2.6 mm long, cream brown, lobes ovate, 1.5–2.2 by 0.7–1 mm; ovary 3-locular, 1.3–1.5 by 1.7–2 mm, cream brown, spines individually visible; style up to 1 mm long, yellow; stigmas 1.2–2 mm long, yellow; staminodes absent. *Fruits* 3–12 by 5.5–14 mm, greenish tawny, spines few, straight to curved, thick, hairy, up to 7 mm long, hairs not forming a continuous layer, not rubbing off; column 2.8–3.3 by 1.8–2.2 mm. *Seeds* globose, 2–3 by 2–3 by 2–2.5 mm, smooth, black, shiny; hilum c. 1 by c. 1 mm.

Note — The criteria used for the recognition of a variety are the slight differences in morphology which partly overlap or are otherwise not of importance for species delimitation and the absence of clear differences in their geographical distribution. *Mallotus paniculatus* and *M. paniculatus* var. *formosanus* slightly differ in their measurements, shape of the leaf margin, and the ending of the nerves (as can be seen in the descriptions), and are both found in Taiwan. Since these two taxa agree with the criteria mentioned above, we decided to maintain var. *formosanus*.

KEY TO THE VARIETIES

1a. Blade 4–23.5 cm long, nerves looping, margin entire to dentate, sometimes 2-lobed at widest part of blade, never hastate, base rounded to cuneate, basal extrafloral nectaries 1.8–5 by 1–2.5 mm. Fruits 5–12 by 6–14 mm, spines up to 7 mm long. — India to Taiwan, throughout Southeast Asia to East Australia and New Guinea . . . . . **4a.** var. **paniculatus**

b. Blade 5.5–13 cm long, nerves ending in the margin, margin irregularly dentate, always 2-lobed at widest part of blade, sometimes hastate, base cuneate, basal

extrafloral nectaries 0.8–1 by 0.5–0.8 mm. Fruits 3–3.5 by 5.5–6.2 mm, spines up to 3 mm long. — Taiwan . . . . . **4b.** var. **formosanus**

a. var. **paniculatus** — Fig. 4; Map 4

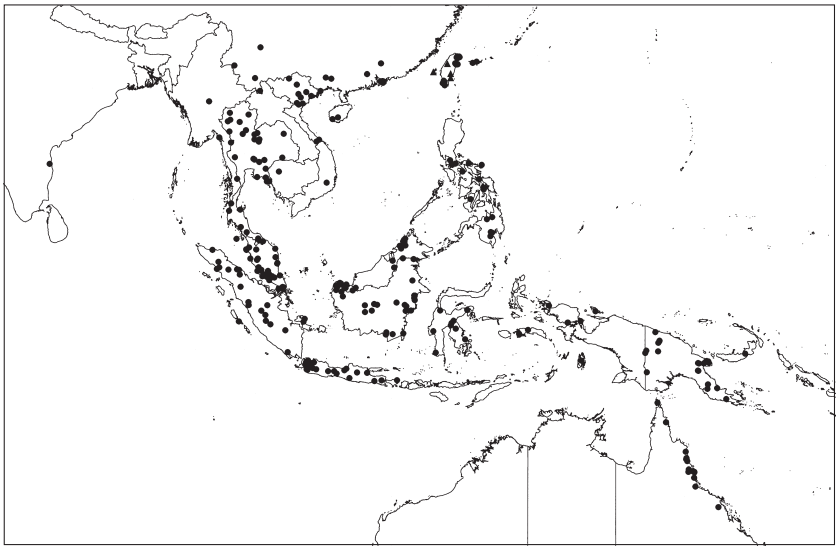
For synonymy see under the species.

Leaves: petiole 30–180 by 0.4–0.7 mm; blade 4–23.5 by 3–15 cm, length/width ratio 1.2–2, base rounded to cuneate, margin entire to dentate, sometimes 2-lobed, never hastate, nerves looping, extrafloral nectaries basally 1.8–5 by 1–2.5 mm, marginal nectaries 0.7–0.8 by 0.7–0.8 mm. *Fruits* 5–12 by 6–14 mm, spines up to 7 mm long; column 3–3.3 by 2–2.2 mm. *Seeds* 2.5–3 by 2.5–3 by 2–2.5 mm.

Distribution — From India to Taiwan, throughout Southeast Asia and Malesia to East Australia and New Guinea.

Habitat & Ecology — Locally common in deciduous and evergreen forest, mostly in open, often very disturbed or burned places, in ravines and on dry sites like plateaus, ridges and slopes, in thickets, and along rivers and roadsides; on a large variety of soil types, like basalt, clay, granite, laterite, limestone, loam, rocky, sandy, ultrabasic, and volcanic. Altitude: sea level up to 1800 m. Flowering and fruiting the whole year through. It grows fast and was observed to be visited by ants and birds eating the fruits.

Uses — The roots are boiled and drunk after child birth. The bark is used for construction, making strings, and it is used by the Loi (in China) to make a coarse cloth from which men's jackets were made. The leaves are used against fever. The indumentum of the young leaves is applied on the penis after circumcision. The wood is used for paper pulp, wallboard, light construction, and as firewood.



Map 4. Distribution of *Mallotus paniculatus* (Lam.) Müll.Arg. var. *paniculatus* (●), and *M. paniculatus* (Lam.) Müll.Arg. var. *formosanus* (Hayata) Hurus. (▲).

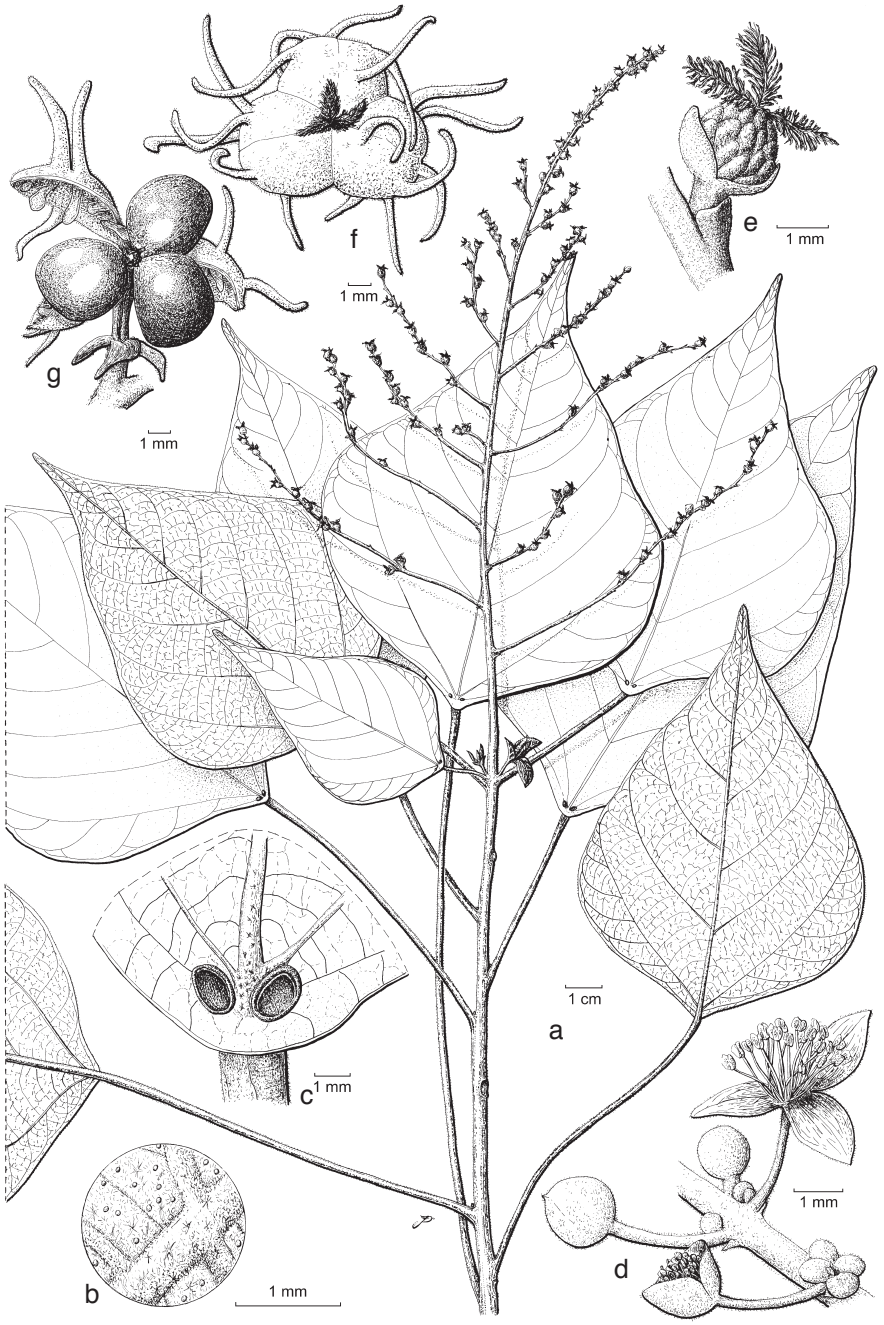


Fig. 4. *Mallotus paniculatus* (Lam.) Müll.Arg. a. Habit with pistillate inflorescence; b. detail of leaf lower surface with glandular hairs; c. base of leaf upper surface with extrafloral nectaries; d. staminate flower and bud; e. pistillate flower; f. fruit; g. dehisced fruit showing seeds and apex of column (a–c, e: *Furuse 1432*, K; d: *Wilkie 94134*, L; f: *Van Balgooy 3632*, L; g: *Hu & But 21908*, L).

Vernacular names — China: Pak pui shu, paak foi neung shue. Thailand: Khi non, khi tao, lang khao, saet, salat, salat pang, sa-ri nok, sati nam, sati ton, soi dao, sti num, sti ton, tak gua (Thai); turn-in-the-wind (English). Cambodia: Krabas pua phom. Singapore: Balak adap. Malaya: balek angin (Kechil, Semelai); bue-ra kae puteh (Malay Peninsula); balek (Sakai); balik angina, musapal itam, poko balek angina. Sabah: Balabakan (Bandukam, Bajau); parak balik (Dusun Kwijau); dauh (Dusun Putatan); entupak (Iban); sirindien (Land Dayak); balek angin. Sarawak: dagoh (Dusun); berlekut (Kelabit); sirindien jamis (Land Dayak); balek angin (Malay); balik angina. Indonesia (Kalimantan): Butaq (Tunjung Benua); bayur, keminting boeroeng, waring kangin laki. Philippines: Hinlaumong-puti (Bisáya); anaplán (Bukídnon); lamai. Sumatra: Balik angin (Alas); saringkut (Karo); bali-bali angina, balik angina, balik-balik angin silai, boedi, kajoe lappisi, kajoe si balik angina, kajoe si djoekkat, kajoe si tarak balanggingngan, lilouw. Java: Tjalik angin (Sundanese), ki tjoelih angin perak, ki-manggong, ki-talikangin, walung. Sulawesi: Kajukuo (Uma), Kapilah. Japan (Ryukyu): Urajiro-akamegashiwa. Papua (Irian Jaya): Kanibor (Kutubu); lengle (Miwaute); gayanbangemba (Waskuk); bangiam, kolamalama. Papua New Guinea: Poekwa (Hattam). Partly after Salvosa (1963) and Smitinand (2001).

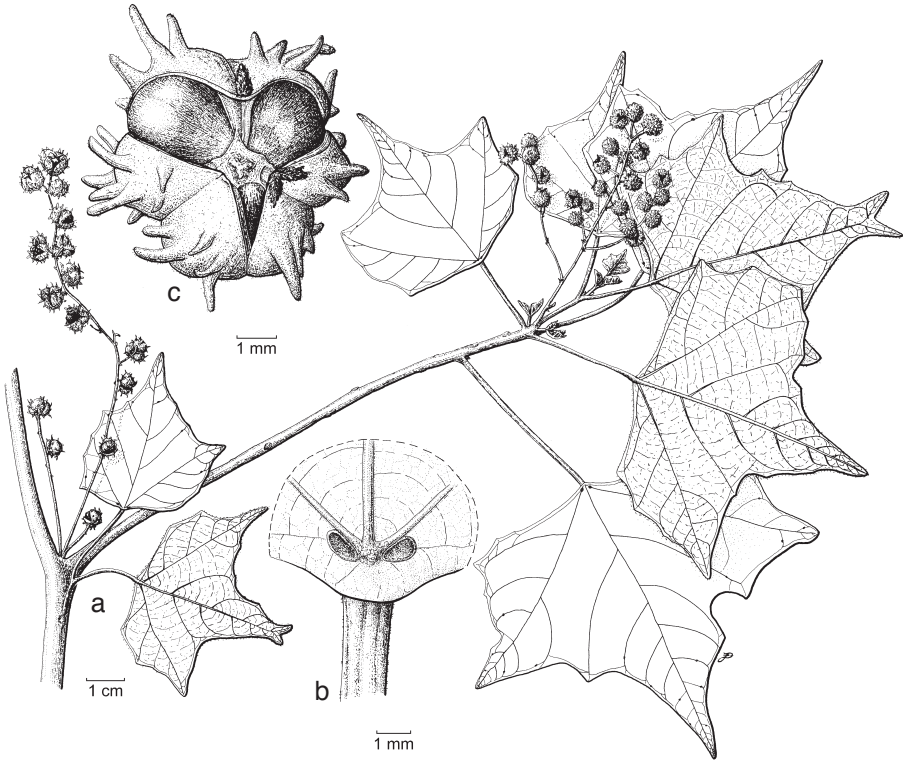


Fig. 5. *Mallotus paniculatus* (Lam.) Müll.Arg. var. *formosanus* (Hayata) Hurus. a. Habit with infructescence; b. base of leaf upper surface with extrafloral nectaries; c. dehisced fruit showing seeds and apex of column (all: *Liu 97*, A).

b. var. **formosanus** (Hayata) Hurus. — Fig. 5; Map 4

Mallotus paniculatus (Lam.) Müll.Arg. var. *formosanus* (Hayata) Hurus. (1954) 307. — *Mallotus formosanus* Hayata (1911) 269. — Lectotype (Kurosawa & Shimizu, 2000): *Unknown s.n.* (TI), Taiwan, Randai-san, Fukô.

Leaves: petiole 35–100 by 0.5–1 mm; blade 5.5–13 by 4–13 cm, length/width ratio 0.8–1.2, base cuneate, margin irregularly dentate, always 2-lobed, sometimes hastate, nerves ending in the margin, extrafloral nectaries basally 0.8–1 by 0.5–0.8 mm, marginal nectaries 0.3–0.4 by 0.2–0.3 mm. *Fruits* 3–3.5 by 5.5–6.2 mm (including spines), spines up to 3 mm long; column 2.8–3 by 1.8–2 mm. *Seeds* 2–2.5 by 2–2.5 by 2–2.2 mm.

Distribution — Taiwan.

Habitat & Ecology — Remnant of secondary evergreen forest, along hillsides and road margins. Altitude: sea level up to 500 m. Flowering: June to August; fruiting: December to January.

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IDENTIFICATION LIST

The numbers behind the collector numbers refer to the following taxa:

1 = *Mallotus barbatus* Müll.Arg.
2 = *Mallotus macrostachyus* (Miq.) Müll.Arg.
3 = *Mallotus mollissimus* (Geiseler) Airy Shaw
4a = *Mallotus paniculatus* (Lam.) Müll.Arg. var. *paniculatus*
4b = *Mallotus paniculatus* (Lam.) Müll.Arg. var. *formosanus* (Hayata) Hurus.

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