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Lythraceae

(W.J.J.O. de Wilde & B.E.E. Duyfjes)

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ABSTRACT

Flora Malesiana. Series I, Volume 22 (2016) iv + 1– 64, by W.J.J.O. de Wilde & B.E.E. Duyfjes (edited by P.W. van Welzen), published by Naturalis Biodiversity Center, The Netherlands, under the auspices of Foundation Flora Malesiana.[1]

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Contains a taxonomic revision of Lythraceae for Malesia, i.e. the area covering the countries Indonesia, East Timor, Malaysia, Singapore, Brunei Darussalam, The Philippines, and Papua New Guinea.

W.J.J.O. de Wilde & B.E.E. Duyfjes, **Lythraceae**, pp. 1–64.

Lythraceae, with in Malesia 11 genera, is a well-defined family with the exception of the morphologically deviating *Trapa*. The largest native genus is *Lagerstroemia* with 14 species, followed by the (sub)tropical genera *Ammannia* (7 species) and *Rotala* (8 species) and the native genera *Lawsonia*, *Pemphis*, and *Woodfordia* (all with 1 species). The genus *Cuphea* is represented by 6 introduced species of which some are naturalised. The genera *Duabanga* and *Sonneratia* (both formerly Sonneratiaceae), *Punica* (formerly Punicaceae), and *Trapa* (formerly Trapaceae) are only shortly discussed as they have been previously treated in Flora Malesiana (see list of revised families).

The introductory part contains treatises on wood anatomy (by P. Baas) and pollen morphology (by R.W.J.M. van der Ham). The genus and species treatments comprise keys, descriptions, drawings, references, synonyms, typifications, distribution, habitat and miscellaneous notes.

Index to accepted names and synonyms, pp. 65–66.

Lists of revised families in Flora Malesiana, pp. 67–68.

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[1] Desk-editing: C.G.G. Baak.

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LYTHRACEAE

(W.J.J.O. de Wilde & B.E.E. Duyfjes, Leiden, The Netherlands)[1]

Lythraceae J.St.-Hill., Expos. Fam. Nat. 2 (1805) 175 ('*Lythrariae*'), nom. cons.; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 1; Miq., Fl. Ned. Ind. 1[1], 4 (1856) 611; C.B.Clarke in Hook.f., Fl. Brit. India 2 (1879) 565; Craib, Fl. Siam. 1 (1931) 715; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 251; Verdc. in Dassan. et al., Revis. Handb. Fl. Ceylon 9 (1995) 202; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 274; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 226; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 547. — Type: *Lythrum* L.

Punicaceae Bercht. & J.Presl, Prir. Rostlin 2, 94 (1825) [378], nom. cons. — Type: *Punica* L.

Trapaceae Dumort., Anal. Fam. Pl. (1829) 36 [descr.], 39 [nom.], nom. cons. — Type: *Trapa* L.

Sonneratiaceae Engl. in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 1 (1897) 261, nom. cons. — Type: *Sonneratia* L.f., nom. cons.

Duabangaceae Takht., Florist. Reg. World (1986) 332. — Type: *Duabanga* Buch.-Ham.

Trees, shrubs, or terrestrial or aquatic herbs (for characters of *Trapa* see under that genus); young stems often quadrangular; bark of older twigs often thinly flaky or/and finely fibrous. *Leaves* opposite, often decussate, or whorled, rarely (sub)alternate, simple, margin entire (toothed in *Trapa*); venation pinnate; stipules absent or rudimentary. *Inflorescences* cymes, racemes, or panicles, rarely flowers solitary. *Flowers* axillary or terminal, mostly 4–6-merous, bisexual, regular or (somewhat) zygomorphic, sometimes heterostylous; pedicel usually 2-bracteolate; floral tube (*calyx tube*[2]) free or partly united with ovary, perigynous or epigynous, persistent in fruit, often 6–12-ribbed; sepals (calyx lobes) valvate, mostly shorter than floral tube, persistent; epicalyx appendages alternating with sepals or absent; *petals* inserted at rim of floral tube, alternating with sepals, crumpled in bud, clawed or not, often caducous, rarely absent; *stamens* either (about) twice as many as sepals or numerous, inserted near base of floral tube or higher; anthers versatile (rarely basifixed); *ovary* superior, hemi-inferior, or inferior, (incompletely) 2–6- or multi-locular, with (2–)many ovules per locule; style simple; stigma capitate or punctiform; placentation usually axillary, sometimes central at fruit maturity. *Fruit* partly or completely surrounded by (or fused with) the persistent floral tube, loculicidally or irregularly dehiscent capsules, sometimes indehiscent, leathery, or berry-like. *Seeds* usually numerous, winged or unwinged, without endosperm; embryo straight, cotyledons flat or convolute.

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1) With contributions by P. Baas (wood anatomy) and R.W.J.M. van der Ham (pollen morphology). — Drawings by Jan van Os.

2) For a definition of calyx tube see Fig. 8, page 24.

DISTRIBUTION

About 30 genera and 650 species world-wide; widespread in tropical regions, less common in temperate regions. In Malesia 11 genera: 1) *Ammannia* with about 75 species occurring world-wide in the tropics and subtropics; 2) *Cuphea* with about 260 species confined to tropical and subtropical America, some species introduced or running wild in Malesia; 3) *Duabanga* with 2 species in SE Asia east to New Guinea (formerly in Duabangaceae or Sonneratiaceae); 4) *Lagerstroemia* with about 55 species (14 species in Malesia) in tropical and subtropical Asia, east to Australia, north to Japan; 5) *Lawsonia* with one species in E Africa and SW Asia, introduced in Malesia; 6) *Pemphis* with one coastal species in E Africa, S and SE Asia, east to the Marshall Islands in the Pacific Ocean, and north to Japan (Ryukyu Islands); 7) *Punica* with one species, in Malesia only known from cultivation (formerly in Punicaceae); 8) *Rotala* with more than 40 species, world-wide, mainly (sub)tropical; 9) *Sonneratia* with 5 species in East Africa, Asia, Malesia east to New Caledonia (formerly in Sonneratiaceae); 10) *Trapa* with about 2 species in Europe, China, Asia, and Malesia (formerly in Hydrocaryaceae or Trapaceae); and 11) *Woodfordia* with 2 species in Africa, the Arabian Peninsula, Madagascar, and SE Asia.

TAXONOMY

Lythraceae is related to Crypteroniaceae, Myrtaceae, Onagraceae, and Combretaceae. The genera *Duabanga*, *Sonneratia*, *Punica*, and also the aquatic *Trapa* are included in the modern concept of the family Lythraceae, based on DNA analyses (Huang & Shi 2002, Graham 2007). *Trapa*, aquatic, with floating leaves, is morphologically most divergent, and was for this reason not included in the recent treatment of the family for China (Qin et al. 2007), though it is sister to *Sonneratia* (Huang & Shi 2002).

Duabanga and *Sonneratia* were formerly regarded as belonging to Sonneratiaceae, *Punica* to Punicaceae, *Trapa* to Hydrocaryaceae or Trapaceae. These families are already published in Flora Malesiana and are only briefly mentioned in the present treatment.

References: Graham, S.A., Lythraceae, in: K. Kubitzki (ed.), The families and genera of vascular plants 9 (2007) 226–246. Springer, Berlin, Heidelberg. — Huang, Y.-L. & S.-H. Shi, Phylogenetics of Lythraceae sensu lato: a preliminary analysis based on chloroplast rbcL gene, psaA-ycf3 spacer, and nuclear rDNA internal transcribed spacer (ITS) sequences, Int. J. Pl. Sci. 163 (2002) 215–225. — Qin, H.N., S.A. Graham & M.G. Gilbert, Lythraceae, in: Wu Zhengyi & P.H. Raven (eds.), Flora of China 13 (2007) 274–289. Missouri Botanical Garden Press, St. Louis.

WOOD ANATOMY

(P. Baas)

The wood anatomy of the Lythraceae has been studied in detail by Baas & Zweypfenning (1979), Bridgewater & Baas (1978, Punicaceae), and Rao et al. (1987, Sonneratiaceae). For a full bibliography see Gregory (1994). Information on commercial timbers in the family can be found in the PROSEA Timber Volumes 5, 2 & 3 (Lemmens et al.

1995; Sosef et al. 1998). All Malesian woody genera treated here, including the former Sonneratiaceae and Punicaceae are pictured and described with standard codes in the InsideWood web database (www.InsideWood.lib.ncsu.edu 2004 onwards; IAWA Committee 1989; Wheeler 2011). All Lythraceae share the typical Myrtalean character combination of vestured pits in the vessel walls and intraxylary (internal) phloem near the pith (Van Vliet & Baas 1984). Inclusion of the former Sonneratiaceae and Punicaceae in the Lythraceae is fully supported by wood anatomy. The wood anatomical diversity in the family is sufficient to enable identification down to the genus or genus groups or even to species or species groups, as in *Lagerstroemia* (Baas & Zweypfenning 1979).

The wood of Lythraceae is typically diffuse-porous, with simply perforated vessels, alternate vestured pits of different, diagnostic sizes; vessel-ray pits are either similar to the intervessel pits or have weakly to strongly reduced borders producing a reticulate pattern. Vascular tracheids associated with the vessels are restricted to *Woodfordia*. Fibres have minutely bordered to simple pits (libriform), and are usually septate, but predominantly nonseptate in *Woodfordia*, and exclusively nonseptate in *Pemphis* and *Duabanga*. Axial parenchyma is absent or extremely scanty in *Punica* and *Sonneratia*; scanty paratracheal in *Woodfordia* and in the secondary xylem of perennial 'woody herbs' such as *Ammannia* and *Cuphea* as well as in taxa with fibre dimorphism (*Lagerstroemia* p.p. and *Lawsonia*). Vasicentric to aliform parenchyma characterizes *Duabanga* and *Pemphis;* aliform to banded parenchyma occurs in *Lagerstroemia* p.p. (see below). Rays are typically narrow, almost exclusively uniseriate and composed of procumbent cells only in *Lagerstroemia* and *Sonneratia*; uniseriate and heterocellular rays characterize *Duabanga* and *Punica;* the other genera have 1–2(–3)-seriate heterocellular rays. Prismatic crystals in chambered fibres or chambered parenchyma strands are common in *Lagerstroemia, Lawsonia*, and *Punica*; crystals are restricted to ray cells in *Sonneratia* and occur in both ray cells and axial parenchyma in *Duabanga*. Crystals are absent from the wood of *Pemphis* and *Woodfordia* and from the secondary xylem of most woody herbs.

Within *Lagerstroemia* two distinct anatomical species groups exist, one including *L. calyculata, L. floribunda, L. indica, L. loudonii*, and *L. subcostata* with scanty paratracheal parenchyma and fibre dimorphism, where bands or groups of thin-walled and short fibres alternate with normal fibres, and a species group having more abundant aliform to confluent or banded axial parenchyma and no fibre dimorphism. *Lawsonia* also shows fibre dimorphism, a feature that is rare in dicots as a whole (Wheeler et al. 2007).

The fossil wood record contains numerous records of Lythraceae (*Duabangoxylon, Lagerstroemioxylon, Punicoxylon*, and *Sonneratioxylon*), mainly from the early to late Tertiary, but with two putative Lythraceous fossils from the Upper Cretaceous (Gregory et al. 2009).

Duabanga produces a low density timber that is only of local commercial importance (Lemmens et al. 1995). Other Lythraceae timbers have been ranked as 'lesser-known', and include some species of *Lagerstroemia* with medium density timber that resembles teak and is used for construction work; *Pemphis acidula* with very hard and heavy timber

that is locally used, but not widely traded because of its limited supply; and light to heavy woods produced by *Sonneratia* species (Sosef et al. 1998).

References: Baas, P. & R.C.V. Zweypfenning, Wood anatomy of the Lythraceae. Acta Bot. Neerl. 28 (1979) 117–155. — Bridgewater S.D. & P. Baas, Wood anatomy of the Punicaceae. IAWA Bull. (1978 (1)) 3–6. — Gregory, M., Bibliography of systematic wood anatomy of Dicotyledons. IAWA J., Suppl. 1 (1994) 1–265. — Gregory, M., I. Poole & E.A. Wheeler, Fossil dicot wood names – an annotated list with full bibliography. IAWA J., Suppl. 6 (2009) 1–220. — IAWA Committee, IAWA list of microscopic features for hardwood identification. IAWA J. 10 (1989) 219–332. — InsideWood database, http://insidewood.lib.ncsu.edu (2004 onwards). — Lemmens, R.H.J.M.J., I. Soerianegara & W.C. Wong (eds.), Plant Resources of Southeast Asia 5, 2. Timber Trees: minor commercial timbers (1995) 210–215 (Duabanga). — Rao, R.V., S.S. Bisen, B. Sharma & R. Dayal, Reinvestigations of the wood anatomy of Duabanga and Sonneratia with particular reference to their systematic position. IAWA Bull n.s. 8 (1987) 337–345. — Sosef, M.S.M., L.T. Hong & S. Prawirohatmodjo (eds.), Plant Resources of South-East Asia 5, 3. Timber trees: Lesser-known timbers (1998) 322–325 + 616 (Lagerstroemia); 435–436 + 618 (Pemphis), and 529–532 + 621 (Sonneratia). — Van Vliet, G.J.C.M. & P. Baas, Wood anatomy and classification of the Myrtales. Ann. Missouri Bot. Gard. 71 (1984) 783–800. — Wheeler E.A., InsideWood – a web resource for hardwood anatomy, IAWA J. 32 (2011) 199–212. — Wheeler, E.A., P. Baas & S. Rodgers, Variations in dicot wood anatomy: A global analysis based on the InsideWood database, IAWA J. 28 (2007) 229–258.

POLLEN MORPHOLOGY

(R.W.J.M. van der Ham)

A short account of Sonneratiaceae pollen was published in the Addenda to this family in Flora Malesiana (Muller 1972). Later, Muller (1978, 1981) extended his palynological study of the Sonneratiaceae, including the Lythraceae s.str. and also functional aspects (harmomegathy). The pollen morphology of all 31 genera of the Lythraceae (s.l.: incl. Punicaceae, Sonneratiaceae, and Trapaceae; S.A. Graham 2007) was extensively described by Patel et al. (1984) and A. Graham et al. (1985, 1987, 1990) on the basis of light microscopy as well as scanning and transmission electron microscopy. The following family description is largely a summary of these studies.

Pollen grains of the Lythraceae are mostly small to medium-sized monads (P by E = 14–44 by 11–29 μm) with an oblate to prolate shape (P/E = 0.7–1.7). *Diplusodon*, *Lafoensia*, *Lagerstroemia*, *Pemphis*, *Sonneratia*, and *Trapa* have relatively large monads (P by E = 35–76 by 25–58 μm). In *Diplusodon*, *Lafoensia*, and *Sonneratia* this may be part of the chiropterophilous pollination syndrome (Muller 1981; but see Stroo 2000). *Lythrum* pollen was reported as much oblate (P/E = 0.5), but pollen shape depends a lot on the harmomegathic state of the pollen (Halbritter & Hesse 2004, f. 8A, B; see also S.A. Graham et al. 1993).

The aperture system is usually 3-colporate, sometimes 4-colporate (*Lythrum*, *Pemphis*, *Rotala*), 3-syncolporate (*Cuphea*), or 3-porate (*Duabanga*). In about half of the genera, one or two distinct to indistinct meridional pseudocolpi (colpus-like sexine thinnings without pores) occur between each two colpi, so that three or six pseudocolpi may be present in one grain, which is then designated as heterocolpate (Booi et al. 2003). Sometimes, the pseudocolpi are large and more or less connected around the apices of each of the three 'real colpi'. *Trapa* pollen, which looks strange at first sight, may be

conceived as having three extremely large pseudocolpi leaving three narrow meridional sexine zones that are connected at the poles and possess pores at the equator. In general, the pores in Lythraceae pollen are circular or sometimes lalongate.

The exine is tectate and columellate, sometimes columellate-granular, and usually 1–2.5 μm, sometimes (*Diplusodon*, *Duabanga*) up to 5 μm thick. Dimorphic pollen (fertile vs feed pollen and thin-walled vs thick-walled) is known in *Lagerstroemia* and *Lythrum* (Muller 1981, Nepi et al. 2003, S.A. Graham 2007). The tectum is more or less psilate, scabrate to verrucate, finely striate or striate(-rugulate).

The diverse fossil record, including wood, leaves, flowers, pollen, and seeds, has been reviewed by A. Graham & S.A. Graham (1971). The oldest fossils considered to have lythraceous affinities are partial leaf impressions and wood with associated fruits from the late Cretaceous or early Palaeocene of western India, and fossil pollen (*Florschuetzia*/*Sonneratia*) from the late Palaeocene of France (see summary by S.A. Graham 2007).

S.A. Graham et al. (2005) did a combined molecular/morphological cladistic analysis, including three pollen characters: pollen shape (prolate to prolate-spheroidal or oblate to oblate-spheroidal), the number of pseudocolpi (absent, three, or six), and exine ornamentation (psilate-scabrate to verrucate, striate, or 'onagraceous'). The number of pseudocolpi appeared to be the most informative character. Pseudocolpi occur in several other families within the Myrtales. The results of the analysis showed that within the Lythraceae the non-pseudocolpate condition is plesiomorphic, while the pseudocolpate condition arose multiple times across the family. There was also one reversal from six to zero pseudocolpi.

References: Booi, M., W. Punt & P.P. Hoen, Lythraceae. The Northwest European pollen flora 68. Rev. Palaeobot. Palynol. 123 (2003) 163–180. — Graham, A. & S.A. Graham, The geologic history of the Lythraceae. Brittonia 23 (1971) 335–346. — Graham, A., S.A. Graham, J.W. Nowicke, J.J. Skvarla, V. Patel & S. Lee, Palynology and systematics of the Lythraceae. III. Genera Physocalymma through Woodfordia, addenda, and conclusions. Amer. J. Bot. 77 (1990) 159–177. — Graham, A., J. Nowicke, J.J. Skvarla, S.A. Graham, V. Patel & S. Lee, Palynology and systematics of the Lythraceae. I. Introduction and genera Adenaria through Ginoria. Amer. J. Bot. 72 (1985) 1012–1031. — Graham, A., J.W. Nowicke, J.J. Skvarla, S.A. Graham, V. Patel & S. Lee, Palynology and systematics of the Lythraceae. II. Genera Haitia through Peplis. Amer. J. Bot. 746 (1987) 829–850. — Graham, S.A., Lythraceae. In: K. Kubitzki, C. Bayer & P.F. Stevens (eds.), The families and genera of vascular plants 9 (2007) 226–246. Springer, Berlin, Heidelberg. — Graham, S.A., J.V. Crisci, P.C. Hoch, Cladistic analysis of the Lythraceae sensu lato based on morphological characters. Bot. J. Linn. Soc. 113 (1993) 1–33. —Graham, S.A., J. Hall, K. Sytsma & S.-H. Shiz, Phylogenetic analysis of the Lythraceae based on four gene regions and morphology. Int. J. Pl. Sci. 166 (2005) 995–1017. — Halbritter, H. & M. Hesse, Principal modes of infoldings in tricolp(or)ate Angiosperm pollen. Grana 43 (2004) 1–14. — Muller, J., Addenda, corrigenda et emendanda. Sonneratiaceae: Palynology, Fossil pollen. Fl. Males., Ser. 1, 6 (1972) 975. — Muller, J., New observations on pollen morphology and fossil distribution of the genus Sonneratia (Sonneratiaceae). Rev. Palaeobot. Palynol. 26 (1978) 277–300. — Muller, J., Exine architecture and function in some Lythraceae and Sonneratiaceae. Rev. Palaeobot. Palynol. 35 (1981) 93–123. — Nepi, M., M. Guarnieri & E. Pacini, "Real" and feed pollen of Lagerstroemia indica: ecophysiological differences. Pl. Biol. 5 (2003) 311–314. — Patel, V.C., J.J. Skvarla, P.H. Raven, Pollen characters in relation to the delimitation of Myrtales. Ann. Missouri Bot. Gard. 71 (1984) 858–969. — Stroo, A., Pollen morphological evolution in bat pollinated plants. Pl. Syst. Evol. 222 (2000) 225–242.

USES

Most genera comprise useful species: *Cuphea* is known for its ornamental plants; some *Lagerstroemia* species are used as ornamental trees in gardens and along roadsides; the leaves of *Lawsonia inermis* produce a dye; *Punica granatum* has edible fruits with medicinal use; some species of *Rotala* are ornamental marsh herbs in paludaria, along ponds, and in aquaria; *Trapa natans* has edible seeds; and the leaves of *Woodfordia fruticosa* have medicinal uses (Graham 1995), while its flowers are used for a dye.

Reference: Graham, S.A., Systematics of Woodfordia (Lythraceae). Syst. Bot. 20 (1995) 482–502.

KEY TO THE GENERA

1a. Aquatic herb with floating leaves. Fruit 2–4-horned. Cotyledons very unequal in size. Seed one . . . . . **10. Trapa**
b. Amphibious or terrestrial herb, shrub, or tree. Fruit not horned. Cotyledons equal in size. Seeds few to numerous 2
2a. Floral tube (calyx tube) long, more than two times longer than broad 3
b. Floral tube (calyx tube) less than two times longer than broad 4
3a. Minor shrub or herb, leaves not punctate. Flowers zygomorphic; stamens (6–)11. Naturalized (or ornamental) . . . . . **2. Cuphea**
b. Shrub or small tree, leaves black-punctate underneath. Flowers ± zygomorphic, i.e. stamens and style bent to one side; stamens 12. Growing wild . . **11. Woodfordia**
4a. Ovary largely inferior. Fruit 5–12 cm diam., seeds with juicy sarcotesta **7. Punica**
b. Ovary superior or largely superior. Fruit less than 5 cm diam., seeds dry (without sarcotesta) 5
5a. Herb, stem juicy (woody). Flowers small, petals 0.2–4 mm long. Stamens 1–8 . 6
b. (Low) shrub or tree, stem woody. Flowers larger, petals 3–25 mm long. Stamens 8 or more (numerous). 7
6a. Capsule smooth, dehiscing irregularly. Inflorescence cymose; flowers usually 3 or more per axil . . . . . **1. Ammannia**
b. Capsule finely transversely striate (lens!), dehiscing septicidally. Inflorescence racemose; flowers usually solitary . . . . . **8. Rotala**
7a. (Low) shrub. Flowers smallish, petals 4–8 mm long. Stamens 8 or 12 8
b. (Shrubs or) trees. Flowers usually large, petals (3–)25 mm long. Stamens 15 to numerous 9
8a. Petals 4, yellow or red. Stamens 8. Ornamental/cultivated . . . . . **5. Lawsonia**
b. Petals 6, white. Stamens 12. Sea-shore . . . . . **6. Pemphis**
9a. Ovary largely free from calyx tube. Petals pink, purple, or white. Fruit a capsule. Seeds winged . . . . . **4. Lagerstroemia**
b. Ovary partially united with the calyx tube. Petals white or red. Fruit a capsule or berry-like. Seeds not winged 10
10a. Fruit capsular, 4–8-locular. Inland tree . . . . . **3. Duabanga**
b. Fruit berry-like, 10–15-locular. See-shore (mangrove) tree . . . . . **9. Sonneratia**

1. AMMANNIA

Ammannia L., Sp. Pl. 1 (1753) 120; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 42; S.A.Graham, J. Arnold Arbor. 66 (1985) 395; in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 236; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 275. — Lectotype (designated by Britton & Brown, Ill. Fl. N. U.S., ed. 2, 2, 1913: 577): *Ammannia latifolia* L.

Nesaea Comm. ex Kunth, Nov. Gen. Sp. (1823) 151; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 240. — Type: *Nesaea triflora* (L.f.) Kunth.

Cryptotheca Blume, Bijdr. Fl. Ned. Ind. 17 (1826) 1128; Mus. Bot. (1856) 129. — *Ammannia* L. subg. *Cryptotheca* (Blume) Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 262. — Lectotype (designated by Blume 1856): *Cryptotheca dichotoma* Blume (= *Ammannia dichotoma* (Blume) S.G.Panigrahi).

Ammannella Miq., Fl. Ned. Ind. 1[1], 4 (1856) 618. — Type: *Ammannella linearis* Miq. (= *Ammannia octandra* L.f.).

Ammannia L. subg. *Diplostemon* (DC.) Wight & Arn., Prodr. Fl. Ind. Orient. (1834) 304. — *Diplostemon* (DC.) Miq., Fl. Ned. Ind. 1[1] (1856) 615. — *Ammannia* L. sect. *Diplostemon* ('*Dyplostemonae*') DC., Prodr. 3 (1828) 80. —Lectotype (designated by Wight & Arnott 1834): *Ammannia octandra* L.f.

Ammannia L. subg. *Hapalocarpum* Wight & Arn., Prodr. Fl. Ind. Orient. (1834) 305. — *Hapalocarpum* (Wight & Arn.) Miq., Fl. Ned. Ind. 1[1] (1856) 618. — Lectotype (designated by De Wilde & Duyfjes, Blumea 59 (2014) 11): *Ammannia vescicatoria* Roxb.

Annual (or biennial), mostly erect herbs of marshy places, glabrous (calyx glabrous or hairy), branches ± quadrangular. *Leaves* decussate, sessile, 1-nerved. *Inflorescences* dichasial, (1–)3–many-flowered, sessile or peduncled; bracteoles 2, minute. *Flowers* actinomorphic, 4(–6)-merous, *calyx tube* campanulate or urceolate, less than twice as long than broad, 4–8-nerved, epicalyx-like appendages distinct, minute, or absent, sepals (calyx lobes) short; *petals* absent or small, fugacious; *stamens* 4(–8), inserted in the lower half of the calyx tube, episepalous, included or exserted; *ovary* superior, incompletely (1–)2–4(–5)-locular, placenta mostly central; style shorter or longer than ovary; disc absent. *Capsules* (sub)globose, thin-walled, not transversely striate, smooth, irregularly transversely rupturing. *Seeds* numerous, concave-convex, angular, 0.3–1 mm long; cotyledons of equal size.

Distribution — About 75 species world-wide in the tropics and subtropics; in *Malesia* 7 species.

Note — Recently the genus *Nesaea* (mainly Africa) has been merged with *Ammannia*, rendering the genus description wider, and increasing the number of species to c. 75 (see S.A.Graham et al., Bot. J. Linn. Soc. 166 (2011) 1).

KEY TO THE SPECIES

1a. Plant (sub)perennial, main stem decumbent, rooting at the nodes. (Plants from montane area in E New Guinea.) . . . . . **7. A. uniflora**
b. Plant annual (biennial), main stem erect. (Plants from lowland or montane area.) . 2
2a. Leaves attenuate at base. Flowers in congested (sub)sessile fascicle-like thyrses. Petals absent. Stamens 4 . . . . . **2. A. baccifera**
b. Leaves at base broad, (broadly) rounded or cordate. Flowers either congested, subsessile, or flowers in short-pedunculate cymes. Petals present (sometimes minute and early deciduous). Stamens 2–8 3

3a. Flowers small, calyx (calyx tube) 0.5–2 mm long. Inflorescence sessile or peduncled 4
b. Flowers larger, calyx (calyx tube) (2.5–)3–5 mm long. Inflorescence (sub)sessile 6
4a. Stamens 2. Placenta parietal . . . . . **4. A. dichotoma**
b. Stamens 4(–8). Placenta central 5
5a. Plant branching in upper part. Inflorescences (shortly) peduncled. Style as long as or longer than ovary . . . . . **1. A. auriculata**
b. Plant branching at base. Inflorescence (sub)sessile. Style shorter than ovary . . . . . **5. A. herbacea**
6a. Calyx tube with low ridges (veins), not conspicuously angular or sharply ridged. Stamens 4(–7) . . . . . **3. A. coccinea**
b. Calyx tube 4-angular or sharply ridged or (nearly) winged. Stamens 8 . . . . . **6. A. octandra**

1. Ammannia auriculata Willd.

Ammannia auriculata Willd., Hort. Berol. 1 (1803) pl. 7; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 45, f. 5B; S.A.Graham, J. Arnold Arbor. 66 (1985) 403; Hewson in A.S.George, Fl. Austral. 18 (1990) 99, f. 32D–F; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 31, f. 3680; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 276; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 292: 5–7; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 13; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 549. — Type: unknown collector *B-W 3081* (B, barcode B-W 03081-010, photo), Egypt.

Ammannia multiflora Roxb., Fl. Ind. 1 (1820) 447; Backer, Onkruidfl. Jav. Suikerrietgr. (1930) 465; in Backer & Bakh.f., Fl. Java 1 (1964) 253; in Steenis, Atl. Weeds Sugar-cane Fields (1973) pl. 440. — Type: *Roxburgh s.n.* (iso K, barcode K000729678, right-hand specimen), East India.

Ammannia microcarpa DC., Rev. Lythr. (1826) 93; Prodr. 3 (1828) 78. — Type: unknown collector, 'Timor', see note 3.

Ammannia debilis auct. non Aiton: Moritzi, Syst. Verz. (1846) 12. — *Ditheca debilis* (Aiton) Miq., Fl. Ned. Ind. 1[1] (1856) 615, p.p., based on misidentification of a Zollinger specimen from Java, not seen, see note 4.

Erect, annual herbs, 40–60 cm tall, much branched in upper part; stem 4-angular. *Leaves* sessile; blade narrowly elliptic or lanceolate, (0.5–)1.5–8 by 0.2–0.8(–1.2) cm, base broadened, broadly rounded or shallowly cordate, apex acute, 1-nerved; leaves often deciduous when plant fruiting. *Inflorescences* 3–15(–20)-flowered cymes; peduncle slender, (1–)4–10(–18) mm long. *Flowers* 4-merous; pedicel 0.5–3(–6) mm long, articulate at apex and with 2 minute bracteoles; *calyx tube* glabrous, campanulate, 1–1.5 mm long, (4- or) 8-ribbed, lobes suberect, broadly triangular, c. 0.3 mm long, acute, calyx appendages minute or absent; *petals* pink or red, spreading, obovate, 0.7–1(–1.5) mm long, margin (sub)entire, caducous; *stamens* 4(–8, not seen in Malesia), c. 1.5 mm long, exserted; *ovary* broadly ellipsoid, c. 1 mm diam., style red, slender, 1–1.2 mm long, as long as or longer than the ovary; placenta central. *Capsules* purple, subglobose, 1.5–2 mm diam., somewhat exserted from the calyx. *Seeds* numerous, brown, flattish at one side, c. 0.3 mm long. — **Fig. 1.**

Distribution — Tropical and subtropical N & S America, Africa, SE & E Asia, east to Australia; in *Malesia*: East Java, Philippines (Luzon).

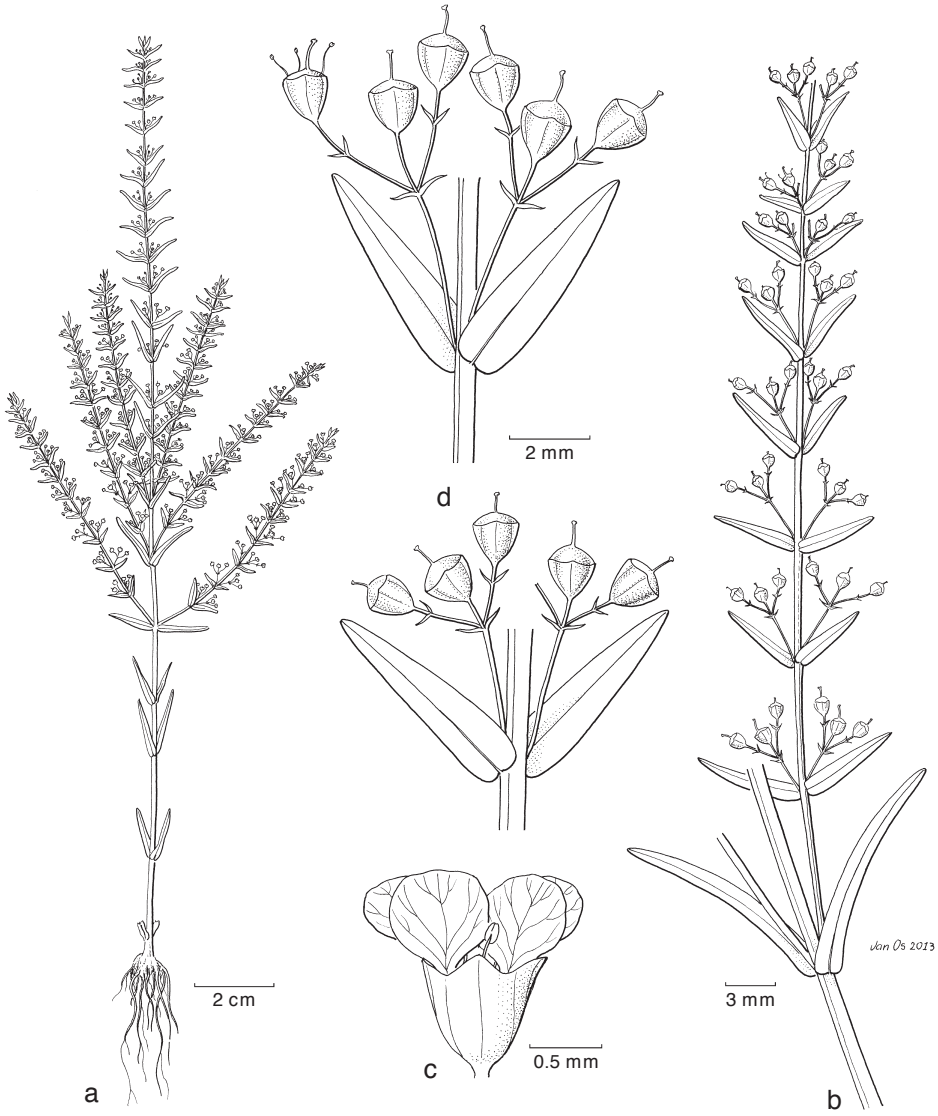


Fig. 1. *Ammannia auriculata* Willd. a. Habit of flowering and fruiting plant; b, d. portion of infructescences; c. flower (a, b, d: *Smitinand 3850*, c: *Merrill 4246*; all L).

Habitat & Ecology — In paddy fields at low altitudes; flowering all year round.

Notes — 1. *Ammannia auriculata* is here, for the Malesian area, accepted in a broad sense as discussed by Graham (1985) for the western hemisphere but as also widely occurring in the Old World including SE Asia.

2. The synonym *A. multiflora* covers plants from SE Asia with generally smaller flowers. This name is employed in Backer (1964) for Java. The names *A. auriculata*

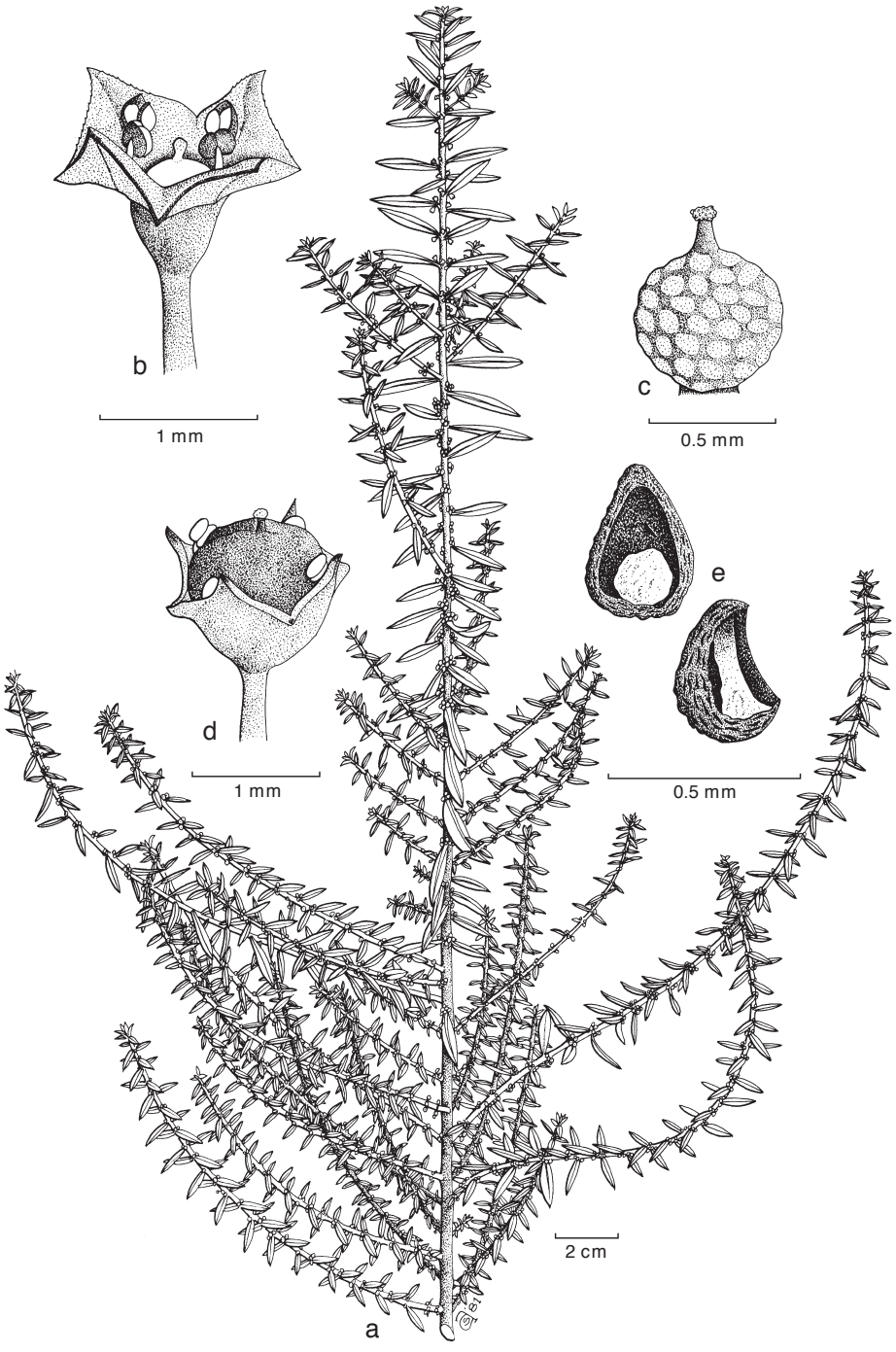


Fig. 2. *Ammannia baccifera* L. a. Habit of apex of stout plant; b. flower; c. pistil; d. fruit within persistent calyx; e. seed, two views (reproduced with permission from Soerjani et al. 1987).

and *A. multiflora* (both widespread and considered closely related) are employed in Qin & Graham (2007) for China and by Hewson (1990) for Australia.

3. The epithet '*microcarpa*' could raise the presumption that De Candolle (1826) had *A. dichotoma* (also occurring in Timor) in mind, namely a species with small flowers and small fruits, but De Candolle's description does not match the species. De Candolle described a plant from Timor with leaves cordate at base, flowers without petals, with 4 stamens, the capsule about as long as the calyx, and with a central placenta. Although the alleged type specimen G-00454022 (G-DC) belongs to *A. dichotoma*, the specimen described by De Candolle is still unknown, but obviously concerns *A. multiflora*, which is a synonym of the widespread polymorphic *A. auriculata*.

4. *Ammannia debilis* was described by Aiton (Hort. Kew. (1789) 163) from plants cultivated in Kew, introduced by Banks from East India. The description mentions leaves narrowed at the base (as in *A. baccifera*) and petals present (as in *A. multiflora*, here treated as a synonym of *A. auriculata*). Moritzi (1846) cited *A. debilis*, a misidentification of a Zollinger collection, for Java; Miquel (1856) accepted *Ditheca debilis* (based on *A. debilis*) for Java without having seen specimens.

2. Ammannia baccifera L.

Ammannia baccifera L., Sp. Pl. 1 (1753) 120; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 53; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 967, f. 105: 3; Backer, Onkruidfl. Jav. Suikerrietgr. (1930) 464; Craib, Fl. Siam. 1 (1931) 715; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 253; in Steenis, Atl. Weeds Sugar-cane Fields (1973) pl. 438; Hewson in A.S.George, Fl. Austral. 18 (1990) 97; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 31, f. 3681; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 275; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 292: 1–4; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 13, f. 1; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 549. — Lectotype (designated by S.A.Graham, J. Arnold Arbor. 66 (1985) 405): Herb. Linn. No. 156.4 (LINN), 'Habitat in China. Osbeck'.

Erect, annual herbs, 10–40(–100) cm tall, often branched from the base, branches ascending; stem ± 4-angular, not winged. *Leaves* sometimes alternate, sessile; lamina (narrowly) elliptic or oblanceolate, 1–7 by 0.2–0.8(–1.5) cm, base attenuate (broad in var. *aegyptiaca* (Willd.) Koehne, Africa), apex (sub)acute, 1-nerved. *Inflorescences* congested, few- or many-flowered fascicle-like thyrses, peduncle 1–2 mm long. *Flowers* greenish, 4-merous; pedicel 0.5–2.5 mm long, bracteoles minute; *calyx tube* narrowly campanulate, 1–1.5 mm long, 8-ribbed; lobes purplish at apex, wide-triangular, 0.5–1 mm long; calyx appendages (almost) absent; *petals* absent; *stamens* 4, inserted about halfway the calyx tube, as long as calyx lobes or shorter; *ovary* 1-locular, globose, style short, to 0.3 mm long; placenta central. *Capsules* covered to (over) halfway by the persistent calyx, (depressed) globose, 1(–2) mm diam. *Seeds* red, numerous, concave-convex, c. 0.3 mm diam. — **Fig. 2.**

Distribution — Widespread: Africa, S & SE Asia, Australia; introduced in America and Europe; in *Malesia*: widespread (locally common, possibly overlooked, in SING only 1 collection).

Habitat & Ecology — Lowland; soggy rice fields, wet open places; flowering and fruiting all year round.

3. Ammannia coccinea Rottb.

Ammannia coccinea Rottb., Pl. Horti. Univ. Rar. Progr. (Hafn.) (1773) 7; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 49; S.A.Graham, J. Arnold Arbor. 66 (1985) 407; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 14. — Neotype (designated by S.A.Graham 1985): *G. Proctor 18339* (holo NY; iso A), Jamaica.

Robust, erect, annual, (sub)glabrous herbs, 30–100 cm tall, (unbranched or) much-branched; stem ± 4-angular. *Leaves* sessile; lamina linear-oblong or narrowly elliptic, 2–8 by 0.2–0.3(–1.5) cm, base auriculate or cordate, apex acute. *Inflorescences* sessile or short-peduncled, 3–5-flowered cymes; peduncle to 9 mm long, with 2 small bracts. *Flowers* 4-merous; pedicel 2 mm long or less, bracteoles minute; *calyx tube* urceolate (campanulate), (2.5–)3–4 mm long, with (4 or) 8 longitudinal low ridges, lobes 4 (or 5), triangular, appendages long or short, thickened, outwards directed; *petals* 4 (or 5), deep rose-purple, obovate, c. 2 mm long; *stamens* 4(–7), exserted, anthers yellow; *ovary* subglobose, c. 2.5 mm diam., style slender, equal to or longer than the ovary, exserted; placenta central. *Capsules* subglobose, 3.5–5 mm long, included or slightly exserted from calyx. *Seeds* numerous, c. 0.3 mm long.

Distribution — North, Central, and NE South America; naturalized in the Pacific Islands (Guam, Hawaii), China (Taiwan); Europe (Portugal, Italy); in *Malesia*: Philippines.

Habitat & Ecology — Lowland paddy fields; flowering and fruiting from October to March.

Note — *Ammannia coccinea* is a hybrid species derived from *A. auriculata* and *A. robusta* (an American species); see Graham (1985).

4. Ammannia dichotoma (Blume) S.G.Panigrahi

Ammannia dichotoma (Blume) S.G.Panigrahi, Bull. Bot. Surv. India (1979 ('1976')) 186; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 14, f. 2. — *Cryptotheca dichotoma* Blume, Bijdr. Fl. Ned. Ind. (1826) 1129; Mus. Bot. (1856) 129. — *Suffrenia dichotoma* (Blume) Miq., Fl. Ned. Ind. 1[1] (1856) 616. — Lectotype (designated by De Wilde & Duyfjes 2014): *Blume s.n.* (holo L, barcode L0931682), Java.

Ammannia microcarpa auct. non DC.: Decne., Nouv. Ann. Mus. Hist. Nat. (1834) 453; Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 247; in Engl., Pflanzenr. 17.IV.216 (1903) 55; Backer, Onkruidfl. Jav. Suikerrietgr. (1930) 465; in Backer & Bakh.f., Fl. Java 1 (1964) 253; in Steenis, Atl. Weeds Sugarcane Fields (1973) pl. 439.

Erect, annual herbs, 25–85 cm tall, much-branched; stem 4-angular. *Leaves* sessile; lamina narrowly elliptic or linear, 1.5–7.5 by 0.2–1.2 cm, base broadened, rounded or cordate, apex acute. *Inflorescences* short-peduncled, 3- to many-flowered cymes; peduncle 5(–10) mm long. *Flowers* 4-merous; pedicel 2–4 mm long, bracteoles minute; *calyx tube* obpyramidal, (1–)1.5 mm long, faintly 8-ribbed, lobes triangular, acute, appendages minute; *petals* 4, red, obovate or circular, nearly 0.5 mm long, margin entire or somewhat toothed, caducous; *stamens* 2, exserted, filaments red, anthers yellow; *ovary* ellipsoid, c. 1.5 mm long, 1-locular, style 1.5(–2) mm long, faintly curved; placenta 1, parietal. *Capsules* ellipsoid, c. 2 mm long, exserted for 1/3–1/2, style usually curved. *Seeds* c. 0.3 mm diam. — **Fig. 3.**

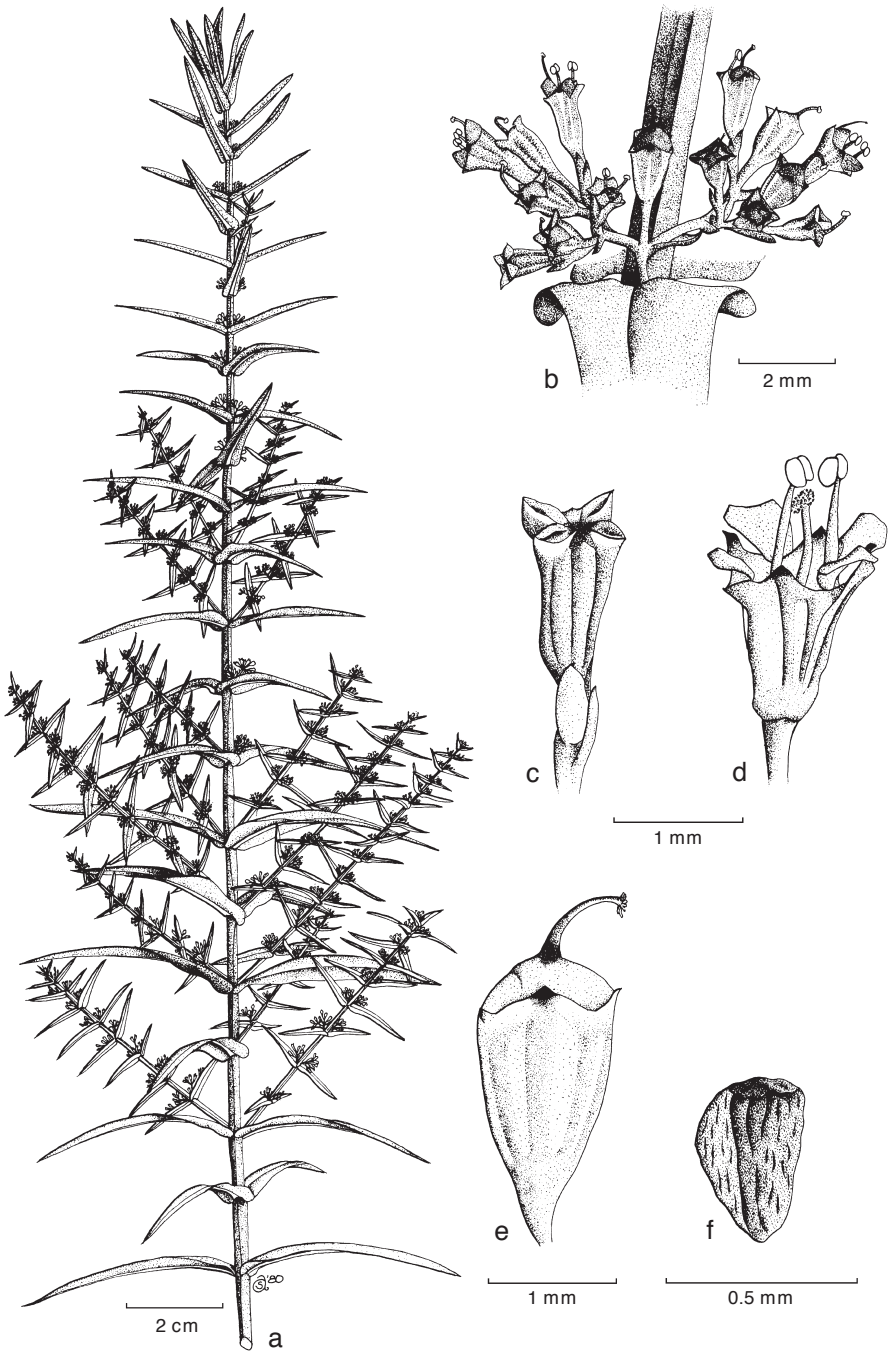


Fig. 3. *Ammannia dichotoma* (Blume) S.G.Panigrahi. a. Habit; b. node, one leaf with dichasial inflorescence; c. flowers (petals caducous); d. (sub)mature fruit in persistent calyx, lateral view and longitudinal section (*Verheijen s.n.*, 17-06-1986; L).

Distribution — *Malesia*: Sumatra, Java, S Sulawesi, Lesser Sunda Islands (Lombok, Flores, Timor).

Habitat & Ecology — In wet and muddy places, often in rice fields; also on limestone; from sea level to 1500 m; flowering and fruiting all year round.

5. **Ammannia herbacea** W.J.de Wilde & Duyfjes

Ammannia herbacea W.J.de Wilde & Duyfjes, Blumea 59 (2014) 14. — Type: *Clason 267* (holo L), E Java.

Erect, annual herbs, 25–50 cm tall, few-branched at base, the branches about as long as the main stem; stem 4-angular, angles rounded. *Leaves* sessile; lamina narrowly elliptic, 1.5–4 by 0.4–1.2 cm, base broadened, subauriculate, apex blunt (rounded) or acute, 1-nerved. *Inflorescences* 1–4-flowered, (sub)sessile clusters; peduncle up to 0.5 mm long. *Flowers* 4-merous; pedicel 0.2(–0.5) mm long, (articulate?); *calyx tube* campanulate, (0.5–)1 mm long, faintly 8-ribbed, lobes patent, broad-triangular, c. 0.5 mm long, acute, appendages conspicuous, 0.3(–0.5) mm long, acute; *petals* pale pink, subcircular, c. 0.2 mm diam.; *stamens* 4, included, inserted towards the base of the tube; *ovary* broad-ellipsoid, c. 0.8 mm long, style c. 0.3 mm long; placenta central. *Capsules* globose, (1.5–)2 mm diam., for c. 1/3 exserted from calyx; style c. 0.4 mm long, shorter than ovary. *Seeds* numerous, yellow-brown, c. 0.3 mm long.

Distribution — E Java (Malang), only known from the type.

Habitat & Ecology — In ripe paddy fields on good soil; altitude not indicated; flowering and fruiting in June.

Collector's notes — Plant more sappy than other *Ammannia* species, locally common.

Note — This species, only known from a single gathering, was annotated as common. Possibly it originated as a hybrid, perhaps with *A. baccifera* and *A. auriculata* as parents, both widespread and extremely polymorphic species. However, *A. herbacea* distinctly differs in its general habit from both species. *Ammania baccifera* also differs in having leaf laminas attenuate at base (in Asia) and lacking petals, while *A. auriculata* differs in having peduncled inflorescences and a style longer than the ovary.

6. **Ammannia octandra** L.f.

Ammannia octandra L.f., Suppl. Pl. (1782) 127; Koehne, Bot. Jahrb. Syst. 1, 2 (1903) 50; Backer, Onkruidfl. Jav. Suikerrietgr. (1930) 466; in Backer & Bakh.f., Fl. Java 1 (1964) 253; in Steenis, Atl. Weeds Sugar-cane Fields (1973) pl. 441; Soerjani et al., Weeds of rice in Indonesia (1987) 342, f. 4.156; Verdc. in Dassan. et al., Revis. Handb. Fl. Ceylon 9 (1995) 219; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 17, f. 3. — Type: *Koenig s.n.* (holo BM (typ. cons.); iso C, LINN 156.5), India, Madepala.

Ammanella linearis Miq., Fl. Ned. Ind. 1[1] (1856) 619. — Type: *Horsfield s.n.* (holo BM; iso K, barcode K000729675, U).

Erect, annual herbs, 25–100 cm tall, much-branched; stem 4-angular. *Leaves* sessile; lamina glabrous, linear-lanceolate, 3–8 by 0.3–1 cm, base broadly cordate, apex acute, midrib stout, raised beneath. *Inflorescences* peduncled, 2–4-flowered cymes; peduncle 1.5–4 mm long, bracts minute. *Flowers* 4-merous; pedicel short, c. 0.5 mm long; *calyx tube* green, glabrous, 4–5 mm long, sharply 4-angled or ridged, or (nearly) winged,

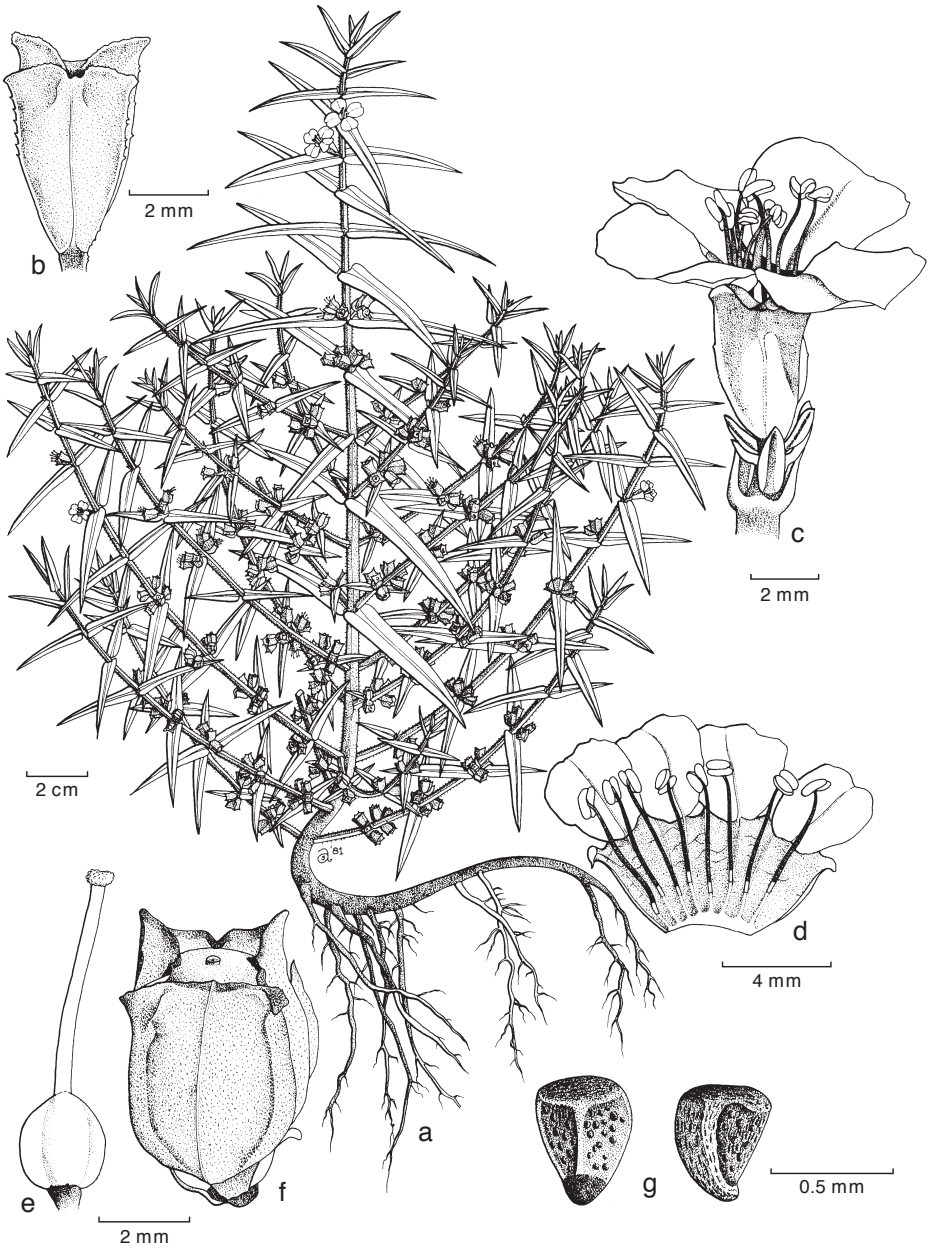


Fig. 4. *Ammannia octandra* L.f. a. Habit of plant; b. flower bud; c. flower; d. flower, opened; e. pistil; f. fruit within persistent calyx; g. seed, two views (reproduced with permission from Soerjani et al. 1987).

margin often finely serrate, lobes 1–1.5 mm long, appendages minute, acute, curved inwards; *petals* 4, red, broadly obovate, 3–4 mm long, caducous; *stamens* 8, inserted just below halfway the tube, filaments red, finally exserted, anthers yellow; *ovary* broadly ellipsoid, c. 2 mm long, faintly 4-grooved, style red with green at apex, 4–5 mm long, stigma minute; placenta central. *Capsules* included within the calyx, c. 5 mm long. *Seeds* brown-yellow, 0.3–0.4 mm long. — **Fig. 4.**

Distribution — India and Sri Lanka; in *Malesia*: West and East Java.

Habitat & Ecology — In wet paddy fields, at low altitudes; flowering all year round.

Note — *Ammannia octandra* is not common in Java but Backer (1964) noted that it is sometimes locally abundant.

7. Ammannia uniflora Meijden

Ammannia uniflora Meijden, Blumea 14 (1966) 245, f. 1; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 17. — Type: *Womersley NGF 15301* (holo L; iso BRI, CANB, LAE), Papua New Guinea, Western Highlands Distr., Lake Iviva, Wabag-Laiagam Road.

Decumbent, subperennial herbs, c. 10 cm tall, few-branched, rooting at the nodes; stem 4-angular, not or faintly winged. *Leaves* sessile; lamina subcircular or broadly ovate, 0.3–0.7 by (0.2–)0.3–0.6 cm, base narrowed into an up to 1 mm long petiole, apex broadly rounded; lateral nerves (1–)3(–4) on each side. *Inflorescences*: flowers solitary, sessile; peduncle absent. *Flowers* 4-merous; pedicel 1–2 mm long (in fruit to 4 mm long), at base with 2 minute bracteoles; *calyx tube* glabrous, (narrowly) campanulate, 1.5–2 by c. 1.5 mm, 8-nerved, lobes suberect, broadly triangular, c. 0.5 mm long, acute, appendages 0.1–0.2 mm long; *petals* 'pale blue' (see field notes), broadly ovate, 1–1.5 mm long, caducous; *stamens* 4, inserted at c. 1/3 from the base in the tube, included; *ovary* glabrous, broadly ellipsoid, c. 1 mm long, style c. 0.5 mm long, placenta central. *Capsules* greenish, subglobose, c. 1.8 mm diam., included or hardly exserted. *Seeds* 10–15, brownish, flattened at one side, c. 0.5 mm long.

Distribution — *Malesia*: Papua New Guinea (Western Highlands, known from 3 collections: *Eichler 18268*, *Walker ANU 563*, *Womersley NGF 15301*).

Habitat & Ecology — Prostrate herb in peat swamp; c. 2500 m altitude; flowering and fruiting May to August.

Field notes — The stem is recorded as juicy and the petals as pale blue, but it is likely that the colour of the latter is more purplish or pinkish.

Note — According to S.A. Graham (Missouri, pers. comm.), who examined all three collections known to date, this species belongs to the genus *Ammannia*. However, its procumbent habit is aberrant within *Ammannia* s.str., but a similar spreading growth habit occurs in some *Nesaea* species, a genus now included in *Ammannia*. Furthermore, the rather few and larger seeds are also a-typical. The pollen is of the *Ammannia-Nesaea* type, although very small (min. 16 by 12 μm) for the genus.

2. CUPHEA

Cuphea P.Browne, Civ. Nat. Hist. Jamaica (1756) 216; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 80; S.A.Graham, Syst. Bot. Monogr. 20 (1988) 40; 53 (1998) 30; Syst. Bot. 14 (1989) 43; in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 237. — Type: *Cuphea decandra* W.T.Aiton.

Herbs or subshrubs, terrestrial, annual or perennial, glabrous or (glandular) hairy; branches terete or (sub)angular. *Leaves* decussate (or whorled), rarely alternate, finely scabrous or not, not punctate. *Inflorescences* racemose, sometimes forming a panicle, flowers single or few per node, (decussate or) alternate, with always a single flower beside the leaves (bracts) because of concaulescence; bracteoles 2 (or absent) at apex of pedicel, joint not obvious. *Flowers* zygomorphous, 6-merous; *calyx tube* (floral tube) elongate, more than 2 times longer than broad, with 12 ribs, at base with (shallow) spur at posterior (adaxial) side; calyx appendages present or absent; *calyx lobes* (sepals) short; *petals* (2–)6, small or large, equal or unequal, persistent or caducous; *stamens* (6–)11, inserted in upper part of the calyx tube, often unequal, included or exserted; *ovary* sessile, incompletely 2-locular, with disc-appendage at base, ovules few or numerous, style included or exserted, stigma usually capitate, minute. *Fruit* a dorsally dehiscent capsule enclosed in the calyx tube, the seed-bearing placenta becoming erect, then also splitting the floral tube and exposing the seeds, ovules 4–6 or numerous. *Seeds* lentiform, sometimes with narrowly winged margin; cotyledons equal in size.

A genus of about 260 species confined to tropical and subtropical America; about 6 species in Malesia, introduced and commonly or rarely cultivated; some species locally escaped and possibly naturalized; one species, *C. carthagenensis*, widespread, weedy.

KEY TO THE SPECIES

1a. Floral tube (calyx tube) less than 10 mm long 2
b. Floral tube (calyx tube) 10 mm long or more 4
2a. Petals yellow (recently introduced ornamental in Singapore and Thailand, not included in descriptions) . . . . . *C. flava* Spreng.
b. Petals red or purple, or lilac-blue (or white) 3
3a. Leaves broadly ovate, or elliptic(-oblong), scabrous hairy. Petals red or purple . . . . . **1. C. carthagenensis**
b. Leaves (ob)lanceolate, sparsely hairy. Petals lilac-blue (or white) . . . . . **3. C. hyssopifolia**
4a. Petals absent or minute, caducous. Stem and leaves (sub)glabrous 5
b. Petals present, obvious. Stem and leaves hairy 6
5a. Floral tube (calyx tube) glabrous, 15–25 mm long, with spur at base, bright red but apex black and white. Plant to 60 cm tall . . . . . **4. C. ignea**
b. Floral tube (calyx tube) coarsely hairy, 25–30 mm long, spur not obvious, red, yellow at apex. Plant 75–150 cm tall . . . . . **5. C. micropetala**
6a. Floral tube (calyx tube) inside with 2 longitudinal wings. Petals unequal in length, the 2 larger ones red, dark red, or purple-black, 8–10 mm long. Filaments sparsely hairy. Flowers solitary or mostly in short smaller-leaved lateral racemes . . . . . **2. C. hookeriana**
b. Floral tube (calyx tube) without wings inside. Petals subequal in length, all light purple or pink, 10–15 mm long. Filaments hairy. Flowers all solitary at the nodes towards the top of the main branches. — Ephemeral garden escape . . . . . **6. C. procumbens** (including the closely resembling . . . . . *C. lanceolata* Aiton, a species cultivated for the oily seeds in China)

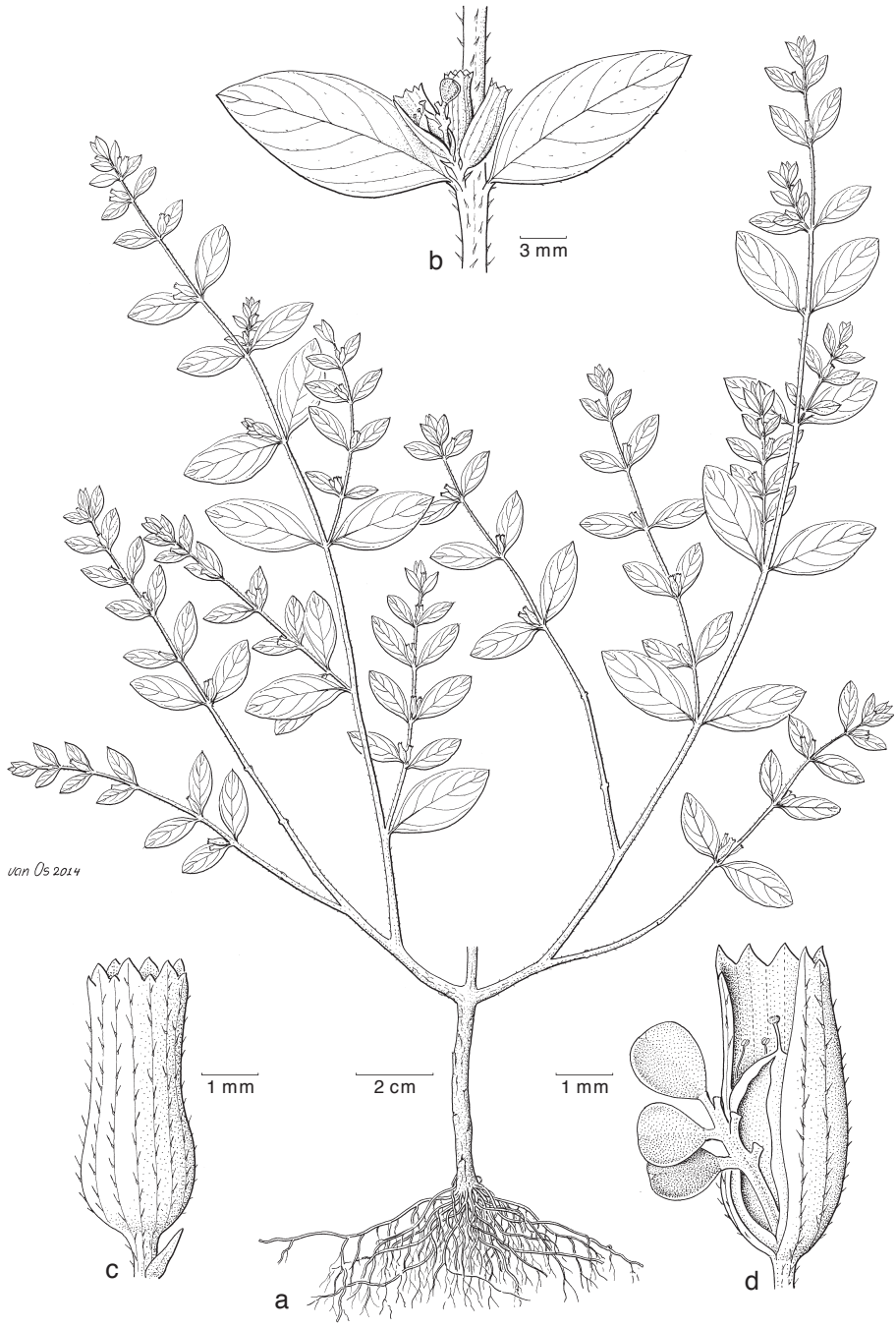


Fig. 5. *Cuphea carthagenensis* (Jacq.) J.F.Macbr. a. Habit; b. detail of node with flowers in few-flowered short raceme; c. flower (calyx tube); d. ditto with seed-bearing placenta exposed (*Verheijen 4688*; L).

1. Cuphea carthagenensis (Jacq.) J.F.Macbr.

Cuphea carthagenensis (Jacq.) J.F.Macbr., Publ. Field Columb. Mus., Bot. Ser. 8 (1930) 124. — *Lythrum carthagenense* Jacq., Enum. Syst. Pl. (1760) 22. — Type: Not indicated, Barbados.

Cuphea balsamona Cham. & Schltdl., Linnaea 2 (1827) 363; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 122, f. 16d; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 254. — Syntypes: *Beyrich s.n.*, Brazil (Rio janeiro); *Sellow s.n.*, Brazil (Estrella de Maxade), both not found.

Branched, erect herbs, ± woody at base, 10–75 cm tall, densely (glandular) hairy. *Leaves*: petiole short; lamina scabrous hairy on both surfaces, broadly ovate or elliptic (-oblong), 1–4(–5.5) cm long, base narrowed, apex acutish. *Flowers* solitary or in short smaller-leaved racemes; pedicel less than 2 mm long; *calyx tube* with (few) coarse hairs, 4–6 mm long; *petals* red or purple, 2–4 mm long; *stamens* 11; style enclosed within the calyx, ovules 4–8. *Seeds* c. 1.5 mm long. — **Fig. 5.**

Distribution — Native of tropical America; in *Malesia*: widely naturalized as a weed.

Habitat & Ecology — In open places; 700–1600 m altitude.

2. Cuphea hookeriana Walp.

Cuphea hookeriana Walp., Repert. Bot. Syst. 2 (1843) 107; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 175, f. 26a, a'; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 254; S.A.Graham, Syst. Bot. Monogr. 53 (1998) 57, f. 30. — Lectotype (designated by S.A. Graham 1998): *Sinclair s.n.* (holo K, K000532941, photo), Mexico, Nayarit.

Erect or ascending, somewhat flaccid herbs, 30–75(–200) cm tall, ± woody at base with flaking bark, scabrous hairy. *Leaves*: petiole 1–2 mm long (or longer?); lamina appressed scabrous hairy, (narrowly) ovate, 1.5–4(–11) cm long, base ± rounded, apex narrowed, acuminate. *Flowers* densely hairy, solitary or often in short raceme-like lateral shoots; pedicel 5–7 mm long; *calyx tube* 10–20 mm long, inside with 2 longitudinal wings; *petals* red, dark red, or purple-black, unequal in length, the two larger posterior ones c. 10 mm long; *stamens* 11, filaments sparsely hairy; style (slightly) protruding, ovules many. *Seeds* c. 2 mm long.

Distribution — Native of Mexico and Central America; in *Malesia*: naturalized in West Java (near Cibodas), Lesser Sunda Islands (Flores).

Habitat & Ecology — Locally running wild; 1000–1200 m altitude.

Note — Two collections from Flores (*Verheijen 776* and *Verheijen 777*) deviate from the Java material in leaves with long petioles, 5–10 mm long, and laminas narrowed at base.

3. Cuphea hyssopifolia Kunth

Cuphea hyssopifolia Kunth in Humb. et al., Nov. Gen. Sp. 6 (1823) 199; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 127, f. 17a–h; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 552. — Type: *Humboldt & Bonpland 4435* (holo P photo), Mexico, Xalapa.

Shrub-like, much branched, somewhat woody herbs, 10–50 cm tall, sparsely finely (appressed) hairy. *Leaves* decussate, subsessile; lamina (ob)lanceolate, 1–2.5 cm long, apex (sub)obtuse or acute. *Flowers* solitary; pedicel c. 5 mm long; *calyx tube* glabrous, 5–6(–8) mm long; *calyx lobes* minute; *petals* lilac-blue (rarely white), inserted at the

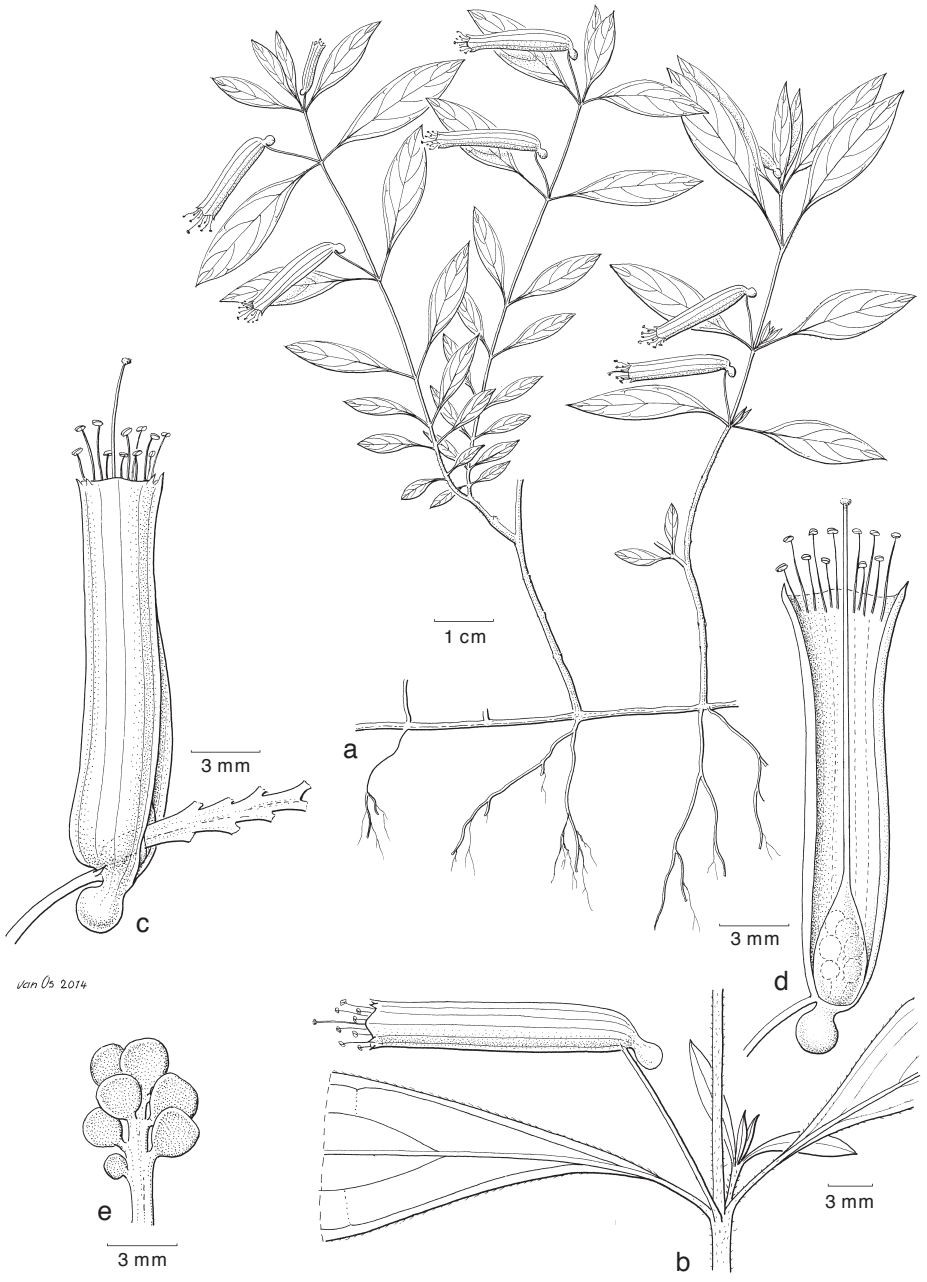


Fig. 6. *Cuphea ignea* A.DC. a. Habit; b. detail of node with axillary flower; c. flower, split at base showing seed-bearing placenta (seeds fallen); d. ditto, longitudinal section showing ovary, style, stigma, and 11 stamens; e. placenta with seeds (*Teo & Pachiappan 267*; L).

calyx throat, spreading, obovate, c. 4 mm long; *stamens* c. 11, included. *Capsule* about as long as the calyx tube, included, ovules about 6. *Seeds* lentiform, c. 1.5 mm long.

Distribution — Originally from South America (Mexico, Guatemala); in *Malesia*: cultivated and running wild.

4. Cuphea ignea A.DC.

Cuphea ignea A.DC., Fl. Serres Jard. Eur. 5 (1849) 499; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 254. — Neotype (designated by S.A.Graham, pers. comm., to be published): *Martin 190* (holo MEXU photo), Mexico (Oaxaca).

Cuphea platycentra auct. non Benth.: Lem., Fl. Serres Jard. Eur. 2 (1846) pl. 180; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 167, f. 23e.

Herbs, branched, somewhat woody at base, 20–60 cm tall, glabrous. *Leaves*: petiole 2–5(–7) mm long; lamina elliptic, 2–3(–8) cm long, base attenuate, apex narrowed, acuminate. *Flowers* solitary, pedicel 5–15 mm long; *calyx tube* red, with spur at base, glabrous, 15–20(–25) mm long, at apex blackish with white margin, in throat white fimbriate or not; *petals* absent; *stamens* 11, ± exserted; style exserted, ovules c. 20. *Seeds* c. 2 mm long. — **Fig. 6.**

Distribution — Mexico and West Indies; in *Malesia*: widely cultivated (Peninsular Malaysia, Java) and rarely naturalised in the mountains.

5. Cuphea micropetala Kunth

Cuphea micropetala Kunth in Humb. et al., Nov. Gen. Sp. 6 (1824) 209, t. 551; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 161, f. 22D; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 254; Verdc. in Dassan. et al., Fl. Ceylon 9 (1995) 207. — Type: *Humboldt & Bonpland 3998* (holo P, P00679432, photo), Mexico.

Erect or ascending herbs, 75–150 mm tall, sparingly hairy, scabrous. *Leaves*: petiole 5–10 mm long; lamina narrowly elliptic, 5–15 cm long, base narrowed, apex acute. *Flowers* solitary at the nodes of smaller-leaved lateral shoots towards the apex of main stems; pedicel 3–5 mm long; *calyx tube* red, yellow towards apex, spur not obvious, 25–30 mm long, coarsely hairy, glandular hairy at throat; *petals* minute; *stamens* 10 or 11, just exserted; style exserted, ovules numerous. *Seeds* c. 2 mm long.

Distribution — Mexico; in *Malesia*: cultivated in gardens at higher altitudes; occasionally naturalised (Java, Flores).

6. Cuphea procumbens Ortega

Cuphea procumbens Ortega, Nov. Rar. Pl. Descr. Dec. (1797) 17; S.A.Graham, Syst. Bot. Monogr. 20 (1988) 122. — Neotype (designated by S.A. Graham 1988): *Graham 686* (holo MICH photo), Mexico, Veracruz.

Cuphea procumbens Cav., Icon. Descr. Pl. 4 (May 1798) 55, t. 380, nom. superfl.; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 154; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 255. — Type: t. 380 in Cavanilles, Icon. Descr. Pl. 4 (May 1798), Mexico.

Ascending or erect, branched herbs, 20–50 cm tall, viscid hairy. *Leaves*: petiole up to 5 mm long; lamina appressed hairy, (narrowly) elliptic or ovate, 3–10 cm long, base narrowed or broadly rounded, apex acute or obtuse. *Flowers* solitary at the nodes

towards apex of branches; pedicel 2–4 mm long; *calyx tube* 10–20 mm long, hairy, inside without ridges; *petals* light purple or pink, subequal in length, 10–15 mm long, including claw; *stamens* 11, not or hardly exserted, filaments villose-hairy; style exserted, ovules numerous. *Seeds* c. 2.5 mm long.

Distribution — Mexico; in *Malesia*: cultivated as ornamental, occasionally found running wild on waste places (West Java).

Note — In China the much resembling *C. lanceolata* Aiton is reported as widely cultivated for the oily seeds. Whether this latter species occurs in Malesia as distinct from *C. procumbens* is as yet to be ascertained.

3. DUABANGA

Duabanga Buch.-Ham., Trans. Linn. Soc. London 17 (1837) 177; Backer & Steenis in Steenis, Fl. Males., Ser. 1, 4 (1951) 288; V.C.Vu in Aubrév. & Tardieu, Fl. Cambodge, Laos & Vietnam 4 (1965) 204; R.Geesink, Blumea 18 (1970) 453; Santisuk in Smitinand & K.Larsen, Fl. Thailand 5, 4 (1992) 434; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 276; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 238, f. 83.

For the treatment of *Duabanga*, formerly in family Sonneratiaceae, see Backer & Steenis (1951). — In Malesia 2 species: *D. grandiflora* (DC.) Walp., and *D. moluccana* Blume. — **Plate 1a.**

Note — According to Geesink (1970) a third species *D. taylorii* Jayaw. (Sri Lanka), most likely is a hybrid between the two species, because it is intermediate in all characters. Normally, *D. grandiflora* and *D. moluccana* are biogeographically separated in SE Asia and the Malay Peninsula versus Borneo up to New Guinea, respectively, and no hybrids are formed. However, *D. taylorii* is originated in the Bogor Botanical Garden (Kebun Raya), where two parent species grow close to each other. Specimens were later grown in the Royal Botanic Garden at Peradeniya, Sri Lanka, which were newly described as *D. taylorii* by Jayaweera.

4. LAGERSTROEMIA

Lagerstroemia L., Syst. Nat., ed. 10 (1759) 1068, 1076, 1372; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 252; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 186; S.Gardner et al., Field Guide Forest Trees Northern Thailand (2000) 202; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 240; W.J.de Wilde & Duyfjes, Thai Forest Bull., Bot. 41 (2013) 90; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 553; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 113. — Type: *Lagerstroemia indica* L.

Munchausia L. in Münchh., Hausvater 5 (1770) 356. — Type: *Munchausia speciosa* L. (= *Lagerstroemia speciosa* (L.) Pers.).

Adambea Lam., Encycl. 1 (1783) 39. — Type: *Adambea glabra* Lam. (= *Lagerstroemia speciosa* (L.) Pers.).

Pterocalymma Turcz., Bull. Soc. Imp. Naturalistes Moscou 19 (1846) 508. — Type: *Pterocalymma paniculata* Turcz. (= *Lagerstroemia paniculata* (Turcz.) S.Vidal).

Shrubs or trees. Young twigs terete or 4-angled, glabrous or hairy, often glabrescent. *Leaves* (sub)opposite or alternate (distichous), (sub)sessile or petiolate; stipules absent or rudimentary. *Inflorescences* terminal or axillary, paniculate, cymose (or raceme-

like); bracts small, caducous. *Flowers* often showy, actinomorphic (but see note 3), 5–7(–9)-merous; floral tube (*calyx tube*) campanulate or turbinate, less than 2 times as long as wide, leathery, smooth or with broad or narrow ribs or ridges, at base gradually or ± abruptly narrowed into a shorter or longer stipe (pseudopedicel; see note 2); *calyx lobes* (sepals) glabrous or hairy, (long-)triangular, sometimes subtended within by a line-shaped annulus (China); epicalyx appendages (auricles) absent or alternating with sepals, small or prominent; *petals* 6(–12), pink, purple or white, slenderly clawed; *stamens* 12–100 or more, inserted inside halfway or near base of floral tube, exserted, dimorphic in most species: 6 solitary in front of sepals with thick filaments and larger anthers, 12–100 or more in clusters in front of petals with thin filaments and small anthers, rarely monomorphic, then all filaments thin, subequal; *ovary* superior, sessile, (largely) free from calyx tube (floral tube), globose or ellipsoid, 3–6-locular; style long-exserted; stigma small, capitate. *Fruit* a dry, hard *capsule*, at base more or less adnate to the base of the calyx tube, globose or ellipsoid, glabrous or (partially) hairy, loculicidally dehiscent, 3–6-valved, apex rounded or pointed. *Seeds* numerous, flattish, obpyramidal, with wing from raphe, without sarcotesta; cotyledons convolute, equal in size.

Distribution — About 55 species: tropical and subtropical Asia to Australia, north to Japan and China; in *Malesia*: 14 species, of which 3 introduced.

Uses — *Lagerstroemia* contains some species planted as ornamentals along roads and in gardens, mainly because of profuse flowering. In Malesia the most important ones are *L. indica*, *L. speciosa*, *L. floribunda*, and *L. loudonii*, the latter not frequently encountered because it seems difficult to be reproduced. A small-statured putative horticultural hybrid of *L. indica* and *L. speciosa* is possibly a candidate for wider use.

Notes — 1. *Bark*. The bark of mature *Lagerstroemia* trees is diverse and its appearance is characteristic for the species. The bark facies can be divided into 3 types: 1) thick and coarse, vertically and horizontally cracked, and dark (brown-)black in colour; 2) relatively thin and smooth, flaking in roundish pieces, and whitish (pale) in colour; and 3) more or less intermediate (in some species). Although each species has its own characteristic bark appearance, this division into three facies proved to be practical.

In Thailand these types are traditionally known as 'salao' (bark rough and course), 'tabaek' (bark thin and smooth), and 'inthanin' (bark more or less intermediate). — **Fig. 7.**

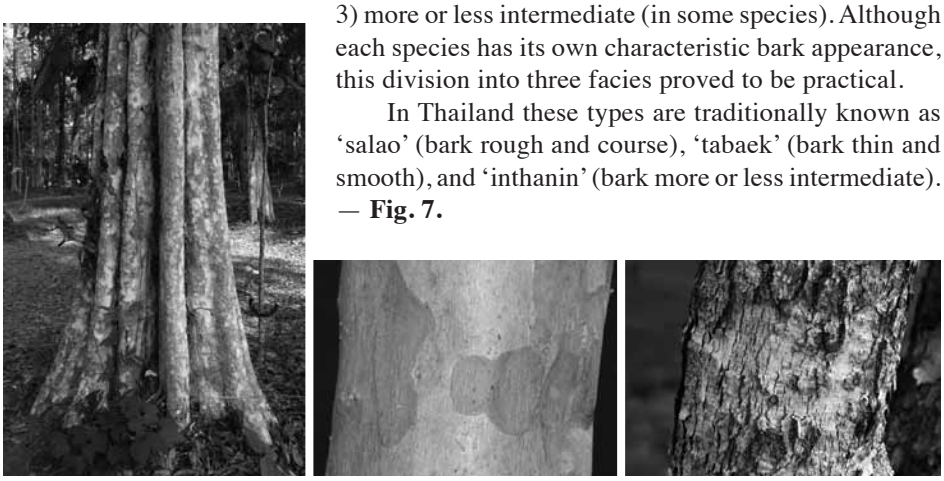


Fig. 7. a. *Lagerstroemia calyculata* Kurz, bark flaking. — b. *Lagerstroemia floribunda* Jack, bark flaking. — c. *Lagerstroemia ovalifolia* Teijsm. & Binn., bark cracked.

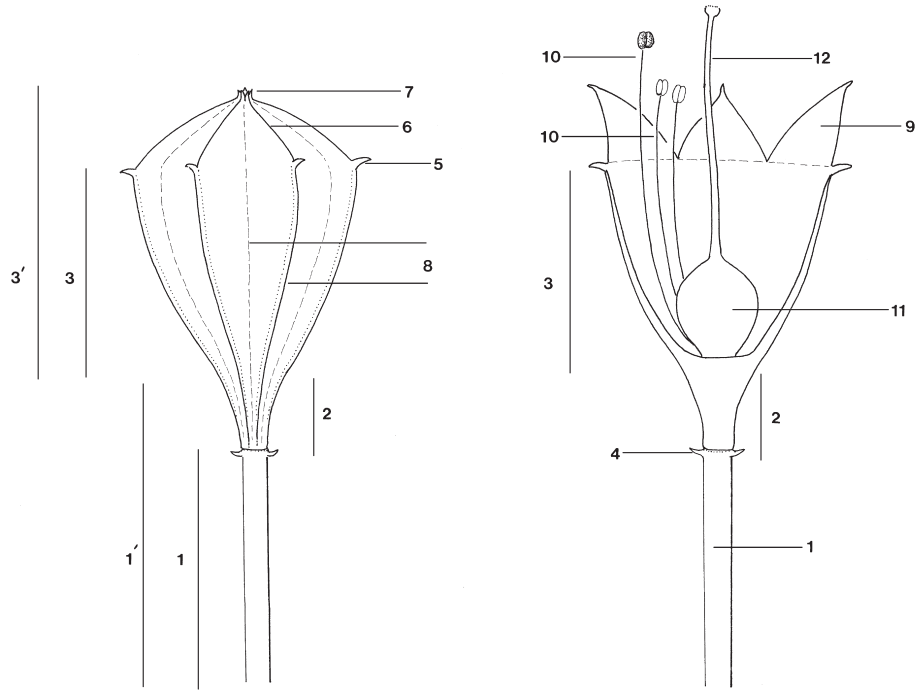


Fig. 8. Flower bud and longitudinal section of a schematic *Lagerstroemia* flower in anthesis; petals omitted. (1) pedicel (excluding pseudopedicel); (1') pedicel, including pseudopedicel; (2) pseudopedicel, i.e. the narrowed pedicelliform basal part of the calyx; (3) calyx tube here defined as excluding pseudopedicel; (3') length of flower bud, i.e. comprising the calyx tube (3) and with at apex the valvately closed calyx lobes (sepals), but without the pseudopedicel (2); (4) joint and bracteole(s), separating pedicel and flower (including pseudopedicel); (5) calyx appendage (or epicalyx segment), or in *Lagerstroemia* called *auricle*; (6) suture of connate (valvate) calyx lobes; (7) connate apices of calyx lobes, or *nipples*; (8) ridge on calyx tube (either only below sinuses of the calyx lobes, or also over and below the middle of the calyx lobes); (9) calyx lobe (or sepal), in open flower; (10) stamens (outer stamens frequently largest with anthers with fertile pollen); (11) ovary; (12) style and stigma.

2. *Pseudopedicel*. In flower and fruit the base of the floral tube is either gradually or more or less abruptly narrowed into a shorter or longer stipe, described by Furtado & Srisuko (1969: 264) as "pedicellike part of calyx tube" or "pedicelliform base" of the flower bud. This pedicel-like part is here called pseudopedicel, because it has a basal articulation with the true flower pedicel. The pedicel at apex usually bears 2 bracteoles. The length of the pseudopedicel, especially in fruit, is important for the definition of some species. — **Fig. 8.**

3. *Androecium*. Preferably to be seen in living flowers. The stamens are either *monomorphic*, when all are more or less similar in appearance and length, similar in filament colour (pale, whitish, pinkish, or greenish), and similar in anther colour (yellow), or *dimorphic*. When dimorphic the flower contains two distinct types of stamens: a restricted number of longer outer ones, and numerous shorter stamens. When the longer outer stamens are all erect they are *radially dimorphic* e.g. in *L. celebica*. The stamens

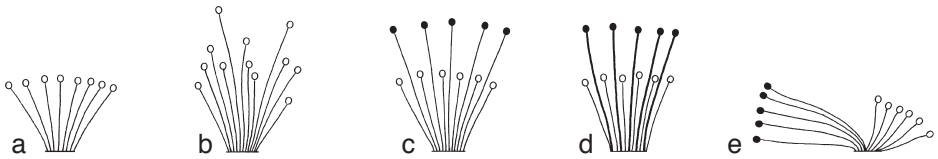


Fig. 9. Stamens in *Lagerstroemia* (schematically). a. Stamens monomorphic, all stamens similar in length; b. stamens monomorphic, all stamens more or less similar in length; c, d. stamens radially dimorphic, outer stamens longer than inner ones, filaments of outer ones in d also thicker; e. stamens asymmetrically dimorphic, outer stamens longer than inner ones and directed to one direction.

are *asymmetrically dimorphic* e.g. in *L. floribunda*). Here, the numerous shorter stamens are generally upright and the (few) larger stamens (often of a different colour) curved to one side, where two petals are somewhat wider spaced, making the flower slightly zygomorphic. The upright shorter stamens with whitish or pale greenish filaments usually have yellow anthers (and pollen), and presumably serve as food for pollinators (bats); the longer stamens with reddish filaments and often greenish or blackish anthers contain fertile pollen (Graham 2007). — **Fig. 9.**

4. *Fruit surface*. According to the appearance of the fruit surface in the dry state *Lagerstroemia* can be divided into two groups, viz. a group with a fine crepe-like or finely longitudinally crinkled and finely granulately short-fissured surface here called *shagreen*, and a group without this structure, here called *smooth*. In the latter group the smooth surface is variously longitudinally or irregularly striate or netted, but not shagreen. In species with the shagreen fruit-type the fruit is always glabrous and the outer coat of the older valves may wither away with age leaving coarse fibres attached to the remaining portions of the fruit. Shagreen fruit is often of a dull grey-brown colour. The non-shagreen (smooth) fruit is usually dark brown or blackish, often shiny, either glabrous or hairy. Together with characters like fruit size, number of valves, and fruit either glabrous or hairy, the 'shagreen character' is a useful addition for the determination of herbarium collections in fruit (De Wilde & Duyfjes 2013).

5. *Precocious flowering*. Some *Lagerstroemia* species can flower already at small size and sometimes at an early age, e.g. in *L. indica*.

1. KEY TO THE SPECIES FOR FLOWERING SPECIMENS

1a. Flower buds (excluding pseudopedicel) globose, 2–6 mm diam., broadly rounded at base, (sub)glabrous. — Exotic, cultivated 2
b. Flower buds subglobose, 7–8 mm diam., or obovoid[1], narrowed below the middle, and base not rounded; buds farinose. — Wild or cultivated 3
2a. Buds 5–6 mm diam. Flowers large; petals more than 10 mm long. Leaves (sub)-sessile . . . . . **5. L. indica**

1) Obovoid includes here also obconical, pyriform, turbinate, and clavate, i.e. forms usually longer than broad, widest above the middle. The shape of the bud, when dry, in the herbarium, may vary with the state of development (either mature or submature) or the mode of drying.

b. Buds 2–3 mm diam. Flowers small; petals c. 3 mm long. Leaves with petiole . . . . . **13. L. subcostata**
3a. Flowers large, c. 50 mm diam. or more; petals (including claw) c. 25 mm long 4
b. Flowers smaller; petals (including claw) 20 mm long or less 5
4a. Inflorescences usually lateral. Petal margin fimbriate. (Fruit smaller, (10–)12–20 mm long.) — Exotic, cultivated. . . . . **7. L. loudonii**
b. Inflorescences terminal. Petal margin irregularly undulate. (Fruit 15–25 mm long.) — Wild or cultivated . . . . . **12. L. speciosa**
5a. Buds obovoid, (sub)sessile; pseudopedicel 1 mm long or less. — W Malesia and Luzon. 6
b. Buds obovoid or subglobose, pedicelled; pseudopedicel more than 1 mm long. — W & E Malesia 8
6a. Buds c. 6 mm long, smooth (not ridged), densely hairy. Calyx lobes 6. — N Peninsular Malaysia . . . . . **1. L. calyculata**
b. Buds larger, 10–15 mm long, conspicuously ridged or winged, minutely hairy. Calyx lobes 6–9. — W Malesia or Luzon 7
7a. Calyx lobes (6 or)7–9. Calyx lobe sutures in bud ridged. — W Malesia . . . . . **8. L. ovalifolia**
b. Calyx lobes 6(–7). Calyx lobe sutures in bud winged. — Luzon**10. L. pterosepala**
8a. Ovary hairy. (Fruit not shagreen.) 9
b. Ovary glabrous. (Fruit shagreen.) 11
9a. Calyx tube 6-ridged (sometimes faintly 12-ridged in dry buds). Calyx lobes glabrous (always?) within. — E Malesia . . . . . **3. L. engleriana**
b. Calyx tube 12-ridged. Calyx lobes glabrous or hairy within. — W Malesia . . 10
10a. Calyx ridges shallow or deep; calyx lobes hairy within. Wild in Peninsular Malaysia, and widely cultivated . . . . . **4. L. floribunda**
b. Calyx ridges deep and sharp; calyx lobes glabrous within. — N Peninsular Malaysia . . . . . **6. L. langkawiensis**
11a. Flowers small, c. 8 mm diam.; petals including claw c. 3 mm long. — C Java . . . . . **14. L. vanosii**
b. Flowers larger, c. 15 mm diam. or more; petals including claw 6–20 mm long 12
12a. Buds (or calyx when in flower) conspicuously winged both along ridges *as well as* along calyx lobe sutures — Philippines (Luzon). 13
b. Buds winged or not; when winged then only along calyx tube ridges, not along calyx lobe sutures 14
13a. Tree, 15–18 m tall. Inflorescences paniculate, many-flowered. Wings of calyx tube ridges simple . . . . . **9. L. paniculata**
b. Shrub or treelet. Inflorescences small, 1–3(–5)-flowered. Wings of calyx tube ridges double (always?) . . . . . **10. L. pterosepala**
14a. Leaves 3–12 cm long. Calyx lobes comparatively short, shorter than calyx tube, not constricted in the basal part, hairy within. (Fruit 12–20 mm long.) — Widespread in E Malesia, also Sumatra, Borneo; not in Java . . . . . **2. L. celebica**
b. Leaves 12–17 cm long. Calyx lobes comparatively long, as long as calyx tube, lobes seemingly ± constricted (margin out-curved) in the basal part, glabrous within. (Fruit 20–25 mm long.) — Borneo . . . . . **11. L. pustulata**

2. KEY TO THE SPECIES FOR FRUITING SPECIMENS

1a. Fruit not shagreen, glabrous or hairy (when approaching the shagreen facies, then at least apically hairy) 2
b. Fruit shagreen, glabrous. Fruit not known in *L. paniculata*, and doubtful in *L. pterosepala* 10
2a. Fruit small, c. 10 mm long 3
b. Fruit larger (10–)12 mm long or more 5
3a. Fruit pedicellate; fruiting pseudopedicel more than 2 mm long. — Exotic, cultivated 4
b. Fruit (sub)sessile; fruiting pseudopedicel to 1 mm long. — N Peninsular Malaysia . . . . . **1. L. calyculata**
4a. Fruit subglobose, c. 10 mm long . . . . . **5. L. indica**
b. Fruit broadly ellipsoid, 5–8 mm long . . . . . **13. L. subcostata**
5a. Fruit (fruit apex) glabrous 6
b. Fruit (fruit apex) hairy 7
6a. Infructescences mostly lateral. Fruit smaller, (10–)12–20 mm long. — Exotic, cultivated . . . . . **7. L. loudonii**
b. Infructescences terminal. Fruit 15–25 mm long. — Wild or cultivated . . . . . **12. L. speciosa**
7a. Fruiting calyx tube not obviously ridged. Infructescences mostly lateral . . . . . **7. L. loudonii**
b. Fruiting calyx tube ridged. Infructescences terminal 8
8a. Fruiting calyx tube with 6 ridges. — E Malesia . . . . . **3. L. engleriana**
b. Fruiting calyx tube with 10–12 ridges. — W Malesia 9
9a. Calyx ridges shallow or deep, not sharp; calyx lobes hairy within. — Wild (and widely cultivated) . . . . . **4. L. floribunda**
b. Calyx ridges deep and sharp; calyx lobes glabrous within. — N Peninsular Malaysia . . . . . **6. L. langkawiensis**
10a. Fruiting calyx lobes (rarely 6–)7–8(–9). — W Malesia . . . . . **8. L. ovalifolia**
b. Fruiting calyx lobes (4–5–)6. — W & E Malesia 11
11a. Fruit small, c. 10 mm long. (Flowers small, c. 8 mm diam.) — C Java . . . . . **14. L. vanosii**
b. Fruit larger, 12–25 mm long. Fruit not known in *L. paniculata*, and doubtful in *L. pterosepala*. (Flowers larger.) 12
12a. Bud (and possibly fruiting calyx) conspicuously winged along both calyx ridges *as well as* along the calyx lobes sutures. — Philippines (Luzon) 13
b. Bud winged or not, not winged along calyx lobe-sutures 14
13a. Tree. Wings on calyx tube ridges (in flower) single; pseudopedicel present . . . . . **9. L. paniculata**
b. Shrub or small tree to 5 m. Wings on calyx tube ridges double (always?); pseudopedicel absent . . . . . **10. L. pterosepala**
14a. Fruit 20–25 mm long. Leaves 12–17 cm long. — Borneo . . . . **11. L. pustulata**
b. Fruit smaller, 12–20 mm long. Leaves generally smaller, 3–17 cm long. — Widespread in E Malesia, also Sumatra, Borneo; not in Java 15

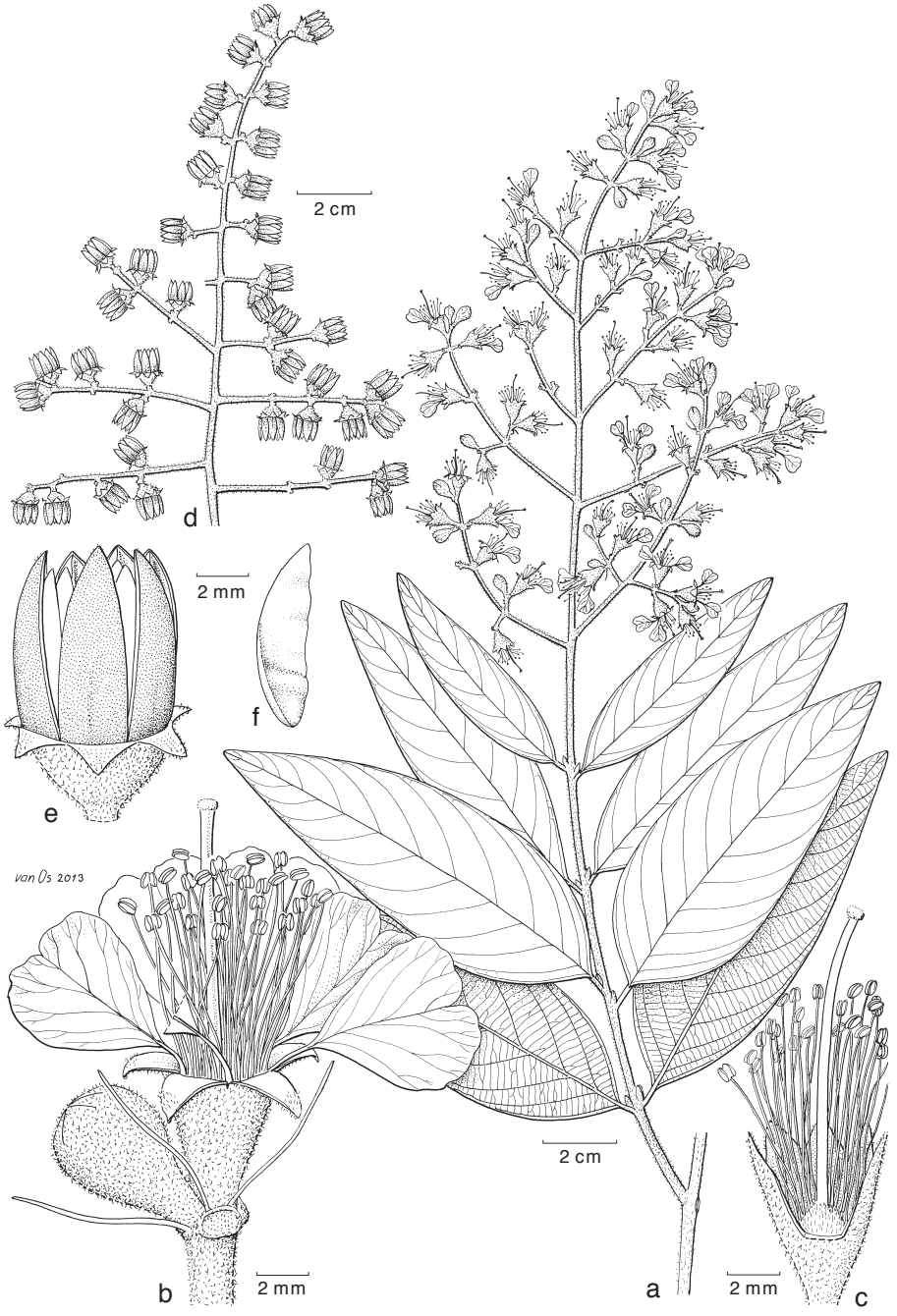


Fig. 10. *Lagerstroemia calyculata* Kurz. a. Habit of flowering twig; b. flower; c. longitudinal section of flower, petals removed; d. portion of infructescence; e. fruit; f. seed (a: *Phengnaren 728*; b, c: *Phonsena et al. 6927*; d–f: *Mitsuta et al. T-50515*; all L).

15a. Fruit glabrous. Dry fruit surface shagreen . . . . . **2. L. celebica**
b. Fruit (apex) hairy. Fruit surface not shagreen, but sometimes resembling so . . . . . **3. L. engleriana**

1. Lagerstroemia calyculata Kurz

Lagerstroemia calyculata Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 41, 4 (1872) 307; Forest Fl. Burma 1 (1877) 522; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 959; Craib, Fl. Siam. 1 (1931) 719; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 306, f. 44; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 27, f. 3670; S.Gardner et al., Field Guide Forest Trees Northern Thailand (2000) 203; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 557; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 115; Sitih-Munirah, Conservation Malaysia 21 (2015) 6. — Type: collector not indicated, Myanmar; Kurz mentions 'Martaban' (see note 1).

Lagerstroemia angustifolia Pierre ex Laness., Pl. Util. Col. Franc. (1886) 322; Gagnep., Notul. Syst. (Paris) 3 (1918) 355. — Lectotype (designated by W.J.de Wilde & Duyfjes, Thai Forest Bull., Bot. 41, 2013: 98): *Pierre 4993* (holo P; iso K, BM), Vietnam.

Trees, 10–40 m tall; trunk fluted towards the base, when mature hollow (always?); bark cream or greyish white, rather smooth, flaking, leaving roundish scars. *Leaves*: petiole 0.5–1 cm long; lamina densely stellate short-hairy, upper surface glabrescent, 6–12(–20) by 1.5–4.5(–7.5) cm; lateral veins 6–10(–12) on each side; intercostal venation scalariform. *Inflorescences* terminal, lax, 10–20(–30) cm long, densely short stellate-hairy. *Flowers* c. 10 mm diam., fragrant, (sub)sessile; bud densely fine stellate-hairy, obovoid (obconical), c. 6 mm long, slightly nippled at apex, pseudopedicel absent or less than 1 mm long, not ridged; *calyx tube* c. 5 mm long, not or obscurely ridged, auricles absent; *calyx lobes* (sepals) 6, whitish hairy within, c. 2 mm long; *petals* white or purple, blade obovate, 3–7 mm long, margin entire, claw c. 3 mm long; *stamens* ± radially dimorphic (outer ones longest), filaments whitish with yellow anthers; *ovary* hairy. *Capsules* black, glossy, smooth (not shagreen), hairy at apex, ellipsoid, c. 10 mm long, 5(–6)-valved; *fruiting calyx* not ridged; lobes thin, in upper half hairy or glabrescent within, appressed to the capsule or reflexed; fruiting pseudopedicel c. 1 mm long or less. — **Fig. 10.**

Distribution — Myanmar, Thailand, Cambodia, Laos, Vietnam; in *Malesia*: Peninsular Malaysia (Perlis).

Habitat & Ecology — Semi-deciduous forest, possibly also on limestone; 240 m altitude; flowering in May.

Notes — 1. Furtado & Srisuko (1969) have seen *Kurz 1344/6* (CAL), Myanmar, Pegu. In Munich: *Kurz 1344*, 2 sheets, M-0146394 and M-0146395 (photos), Myanmar (but names Martaban or Pegu not mentioned).

2. This species can be distinguished by its almost sessile, densely hairy flowers, with the calyx lobes conspicuously whitish hairy within.

2. Lagerstroemia celebica Blume

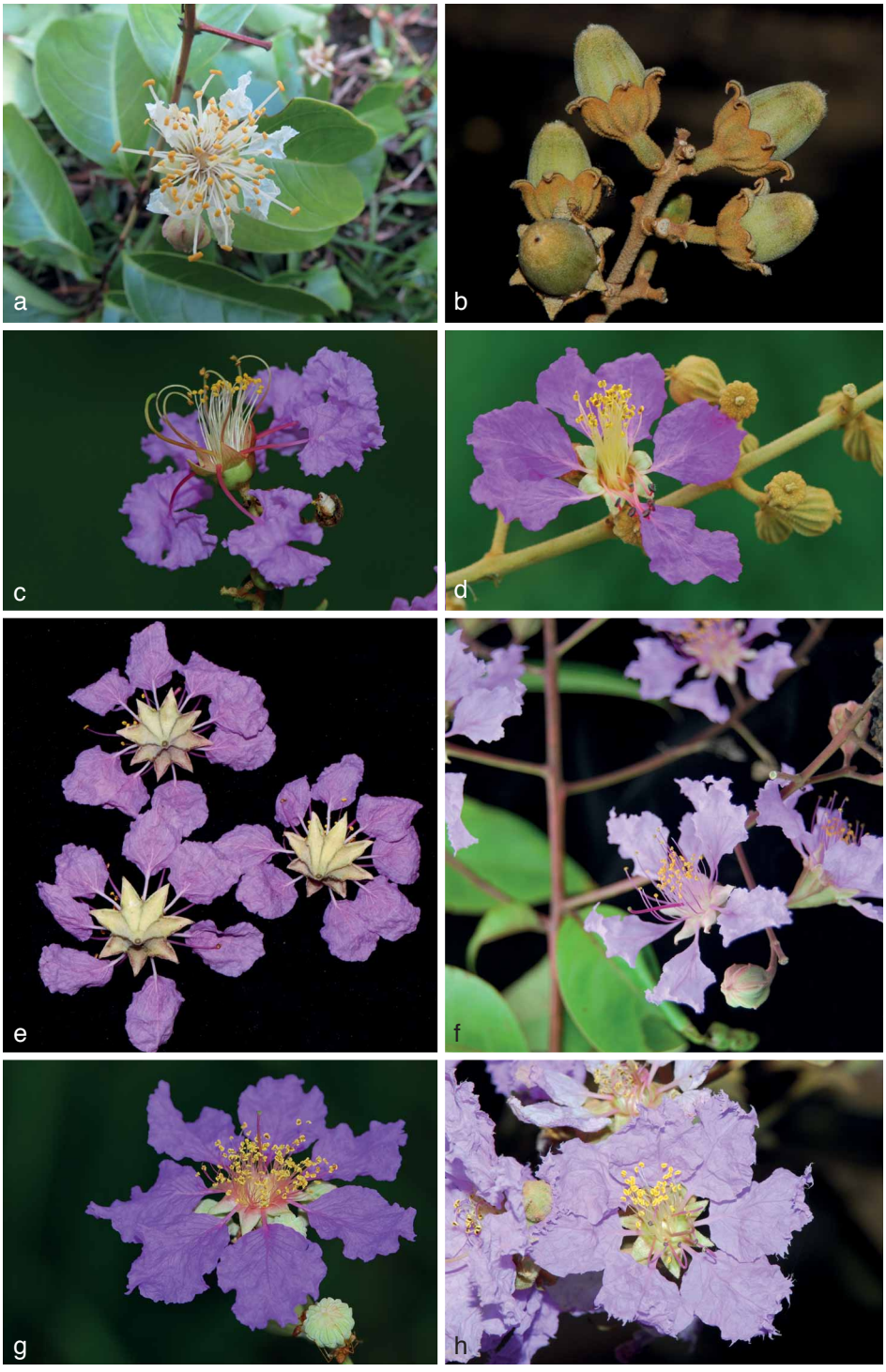
Lagerstroemia celebica Blume, Mus. Bot. 2 (February 1856) 127; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 115. — Lectotype (designated by De Wilde & Duyfjes 2014): *Forsten s.n.* (holo L, barcode L2479726; iso L, barcode L2479727), Sulawesi.

Lagerstroemia hexaptera Miq., Fl. Ned. Ind. 1[1], 4 (April 1856) 623; 1[1], 6 (1858) 1090. — Type: *Forsten s.n.* (holo L, barcode L2479729), Sulawesi.

Plate 1. a. *Duabanga grandiflora* (DC.) Walp. — b. *Sonneratia caseolaris* (L.) Engl. — c. *Trapa natans* L. var. *bicornis* (Osbeck) Makino, fruit. — d. *Woodfordia fruticosa* (L.) Kurz. Photos: a by P. Phonsena; b, c by B. Duyfjes; d by Sermpong Nualngam.

→

Plate 2. a. *Lagerstroemia celebica* Blume. — b, d. *Lagerstroemia floribunda* Jack var. *floribunda*, note sepals hairy inside and fruit hairy. — c. *Lagerstroemia indica* L. — e. *Lagerstroemia ovalifolia* Teijsm. & Binn., note eight sepals and petals. — f. *Lagerstroemia pustulata* Furtado & Srisuko. — g. *Lagerstroemia speciosa* (L.) Pers. — h. *Lagerstroemia loudonii* Teijsm. & Binn., note fringed petals. Photos: a by Roji Mahroji; b–d, h by B. Duyfjes; e by Siti-Munirah Mat Yunoh; f by Serena Lee; g by P. Phonsena.


a
b
c
d
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Lagerstroemia riedeliana Oliv., J. Linn. Soc., Bot. (1876) 99. — *Lagerstroemia ovalifolia* Teijsm. & Binn. var. *riedeliana* (Oliv.) Furtado & Srisuko (1969) 218, f. 10. — Type: *Riedel s.n.* (holo K, K000729702), Sulawesi, Gorontalo.

Lagerstroemia piriformis Koehne, Bot. Jahrb. Syst. 4 (1883) 23; Yii in Soepadmo et al., Tree Fl. Sabah & Sarawak 2 (1996) 228. — Type: *Cuming 1675* (holo B†; iso BM, K, L), Philippines.

Lagerstroemia batitinan S.Vidal, Rev. Pl. Vasc. Filip. (1886) 139. — *Lagerstroemia piriformis* Koehne forma *batitinan* (S.Vidal) Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 254, f. 28. — Lectotype (designated by Furtado & Srisuko 1969): *Vidal 356 bis* (holo A n.v.; iso K, L), Philippines, Luzon, Laguna Prov., San Antonio.

Lagerstroemia koehneana K.Schum. in K.Schum. & Hollrung, Fl. Kais. Wilh. Land (1889) 85; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 246, f. 24. — Type: *Hollrung 704* (holo B†; iso BO, K, L, P), Papua New Guinea, Augusta River.

Lagerstroemia ovalifolia Teijsm. & Binn. var. *apiculata* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 216, f. 9. — Type: *Lörzing 6407* (holo SING; iso BO, L, U), Sumatra, N of Bandarbaroe.

Lagerstroemia ovalifolia Teijsm. & Binn. var. *novoguineensis* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 220, f. 11. — Type: *Schram BW 6068* (holo LAE n.v.; iso A photo, BO, K, L, SING), Indonesia, Papua, Wersar.

Lagerstroemia crassifolia Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 232, f. 17. — Type: *Ahwing SAN 47262* (holo SING; iso L, SAN n.v.), Malaysia, Borneo, Sabah, Gomantong Forest Reserve.

Lagerstroemia borneensis Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 234, f. 18. — Type: *Kostermans 10249* (holo SING; iso BO, L), Indonesia, Borneo, Kalimantan, C Kutei, Belajan River.

Lagerstroemia cristata Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 236, f. 19. — Type: *Carr 12270* (holo SING; iso BM, K, L), Papua New Guinea, Central Distr., Koitaki.

Lagerstroemia inopinata Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 238, f. 20. — Type: *Ahern 204* (holo A photo; iso UC photo), Philippines, Luzon.

Lagerstroemia aruensis Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 240, f. 21. — Type: *bb 25424 = Buwalda 390* (holo A photo; iso BO, L, SING), Moluccas, Aru Isl., Pulau Kobroor.

Lagerstroemia alatulata Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 242, f. 22. — Type: *Sulit 8173* (holo A photo), Philippines, Luzon, Mt Makiling.

Lagerstroemia moluccana Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 244, f. 23. — Type: *bb 33802 = Tangkilisan 108* (holo SING; iso BM, L), Moluccas, Morotai.

Lagerstroemia piriformis Koehne var. *valleculata* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 250, f. 26. — Type: *Carr 12043* (holo SING; iso A photo, BM, K, L), Papua New Guinea, Central Distr., Koitaki.

Lagerstroemia piriformis Koehne var. *callosa* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 252, f. 27. — Type: *Darbyshire 928* (holo LAE n.v.; iso BO, BRI photo, K, L, PNH n.v., US photo), Papua New Guinea, Central Dist., Maipa Village.

Trees, 8–42 m tall; bark smooth, grey or pale brown. *Leaves*: petiole 0.2–0.8 cm long; lamina glabrous or minutely hairy, especially on nerves, glabrescent, 3–12 by 2–5 cm; lateral nerves 5–8 on each side; intercostal venation reticulate. *Inflorescences* terminal, few- or many-flowered, lax, 7–20 by 7–15 cm, minutely grey hairy. *Flowers* c. 20 mm diam.; bud minutely hairy, obovoid (pyriform), 9–12 mm long, c. 5 mm diam., nipple absent or minute, pseudopedicel 1–10 mm long; *calyx tube* 5–8 mm long, 6-ridged, ridges superficial or ± angular, straight, usually extending on the pseudopedicel, auricles indistinct or absent; *calyx lobes* (sepals) 6, with the sutures (in bud) flat or wholly or partly ± thickened, or furrowed, not winged, variously finely short-hairy within, 2–4 mm long, not constricted; *petals* white or pale purplish, (broadly) elliptic, 6–12 mm long (including 2–5 mm long claw), margin entire or minutely fimbriate; *stamens* radially dimorphic, filaments white, as long as or longer than the petals, anthers

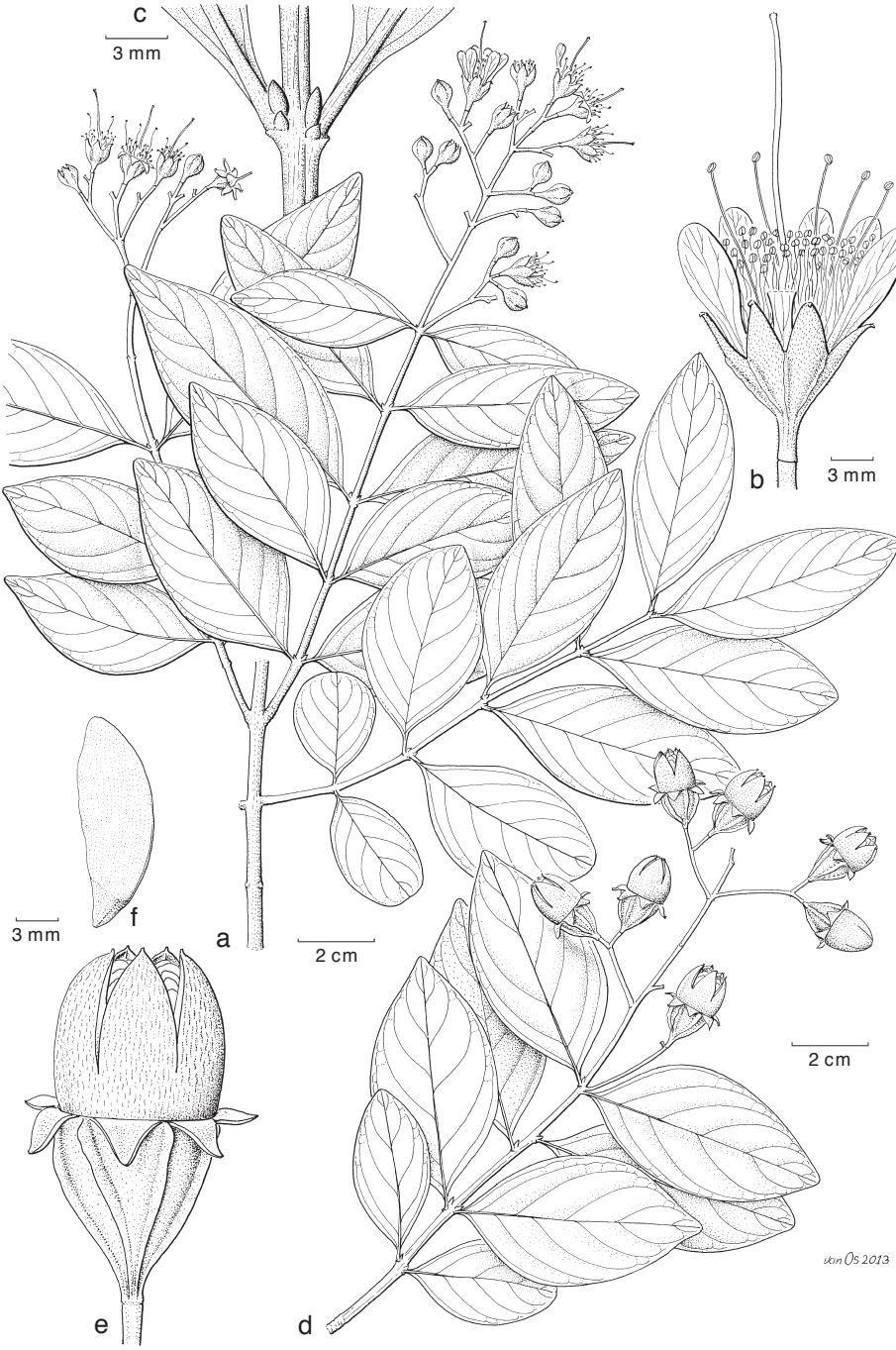

Fig. 11. *Lagerstroemia celebica* Blume. a. Branch with inflorescences; b. flower, one petal removed; c. node of twig, showing axillary buds and stipule-like appendages; d. twig with infructescence; e. fruiting calyx and fruit; f. seed (a–c: *Hoogland 5073*, d–f: *Polak 1107*; all L).

yellow; *ovary* glabrous, style white. *Capsules* grey-brown, glabrous, shagreen, 12–20 mm long, with or without short beak, (4–5–)6-valved; *fruiting calyx* 6-ridged, lobes thin, glabrous (glabrescent) within, patent or reflexed; fruiting pseudopedicel (1–)2–10 mm long. — **Fig. 11; Plate 2a.**

Distribution — *Malesia*: Sumatra, Borneo (Kalimantan, Sabah), Philippines (Luzon, Samar, Leyte, Mindanao), N Sulawesi (Menado), Lesser Sunda Islands (Sumbawa), Moluccas (Morotai, Halmahera, Ternate, Bacan, Aru), Papua (near Sorong, Freeport), Papua New Guinea (West Sepik, East Sepik, Madang, Southern Highlands, Gulf, Northern, Central, Eastern).

Habitat & Ecology — Primary forest often on wet places: riverbank forest, along streams, in swampy flats; in old secondary forest, remnants of forest, along roads; on sandy clayey soil, also on ultrabasic soil and on limestone; from sea level to 700 m altitude; flowering and fruiting all year round.

Vernacular names — Sumatra, Borneo: Bungur. Papua: Kininggi or kieniegie (Mooi). Papua New Guinea: Aia (Mawan), Biramapu (Mubi), Gigob (Kaigorin), Gori (Onjob), Kahu (Wagu), Mamis, Mapuep (Waskuk), Na'um (Koropa), Simi (Rawa), Sinsino (Rawa), Wali (Orne).

Notes — 1. *Lagerstroemia celebica* is here widely conceived as it appeared impossible to discriminate between the many taxonomic units, which are at present put into synonymy. The many synonyms of widespread *L. celebica* are the reflexion of the, often local, variation mainly in the elaboration of the ridges on the calyx tube and (in bud) the ornamentation on the sutures of the calyx lobes. The distinctions as propounded by Furtado & Srisuko (1969) cannot be traced and reproduced satisfactorily. Possibly in the future, when more material from all areas may have become available, and especially by fieldwork, a more obvious division could be discerned.

In New Guinea noteworthy variation in fruit is seen: the collection *Millar NGF 23520* (Central Province) deviates in having a long smooth pseudopedicel, to 10 mm long, and *Takeuchi & Kulang 11513* (Gulf Province) deviates in having small fruits, c. 10 mm long, with only 4 or 5 valves. These collections link up with *L. celebica*, in a broad sense, but more similar collections are needed for assessing a possibly different taxonomic status.

2. The species *L. paniculata* and *L. pterosepala* are accepted in the present treatment; they link up with forms of *L. celebica* with pronounced ridges on the calyx tube and sepal sutures, but in the former two species the wings on the sepal sutures (in bud) are much more obvious.

3. The collection *Ramos 1705* (Philippines) has by exception branched (or fused) filaments.

4. The collection *Gaerlan et al. PPI 13594* from Mindanao Sur (lake Maragang) is noted as found at an altitude of 2300 m, which is probably erroneous.

3. Lagerstroemia engleriana Koehne

Lagerstroemia engleriana Koehne, Bot. Jahrb. Syst. 4 (March 1883) 24; in Engl., Pflanzenr. 17.IV.216 (1903) 267; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 299; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 116. — Type: *Zeyl* (is *Zeye* in *Naumann*) *s.n.* (holo B†). Neotype (designated

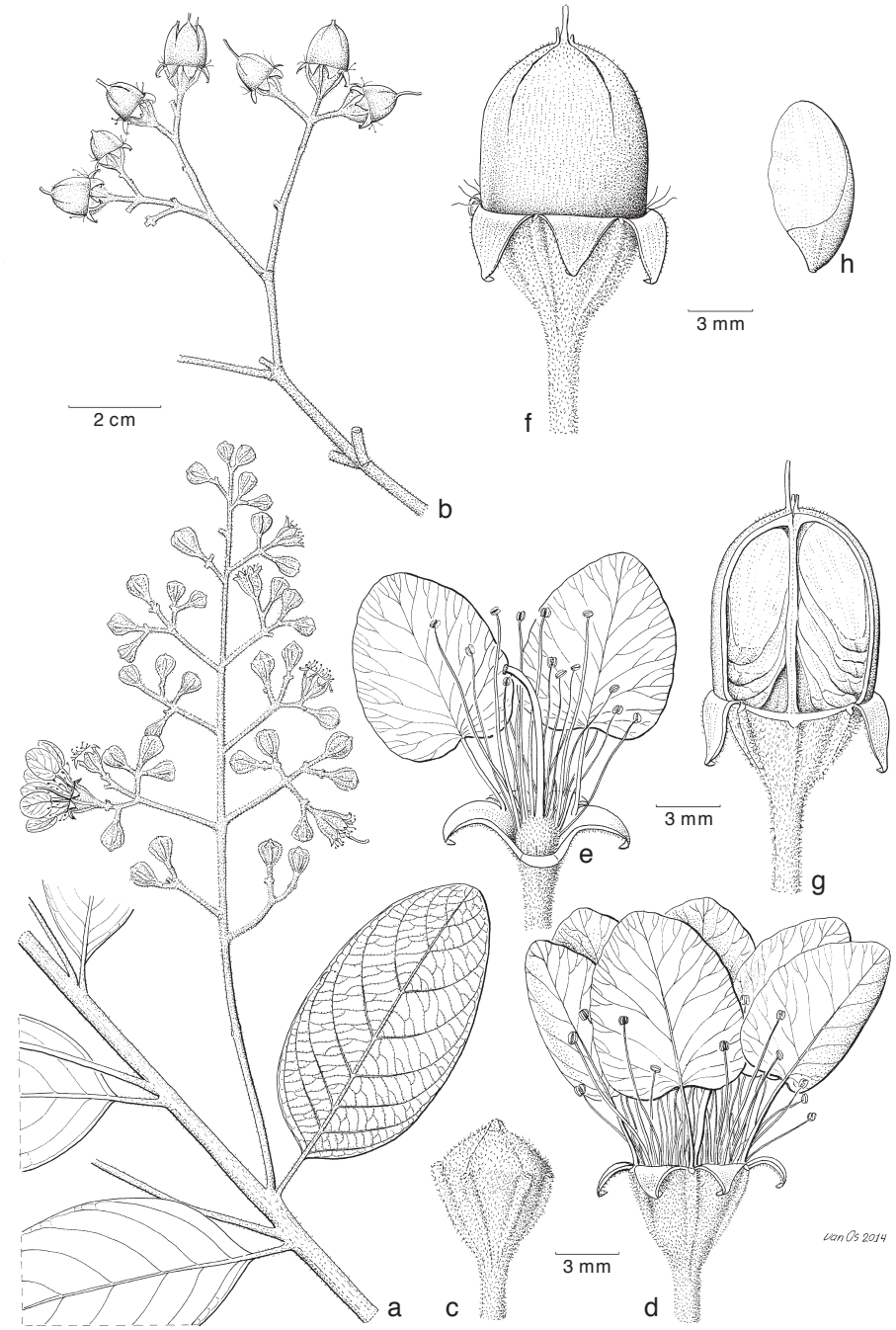

Fig. 12. *Lagerstroemia engleriana* Koehne. a. Habit of flowering twig; b. detail of fruiting twig; c. flower bud; d. flower; e. ditto, four petals removed; f. fruit; g. ditto, lengthwise opened, showing winged seeds; h. seed (a: *Kooy 317*, b, f–h: *Ridsdale & Galore NGF 33750*, c–e: *Pullen 6890*; all L).

by De Wilde & Duyfjes 2014): *bb 11128* (holo L; iso BO 2 sheets), Lesser Sunda Islands, Timor, Kupang.

Lagerstroemia archeriana F.M.Bailey, Syn. Queensl. Fl. (July 1883) 196, 809; Koehne, Bot. Jahrb. Syst. 4 (August 1883) 408; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 299; Hewson in A.S.George, Fl. Australia (1990) 112. — Type: *Baird s.n.* (holo BRI-A90023033, photo), Australia, Queensland, Palmer River.

Lagerstroemia subsessilifolia Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 267; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 222. — Type: *Hann 47* (holo B† n.v.; iso K 2 sheets), Australia, Queensland, Cape York.

Lagerstroemia dielsiana Mansf., Bot. Jahrb. Syst. (1927) 24; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 296. — Type: *Ledermann 10745* (holo B†), Papua New Guinea, Sepik.

Lagerstroemia floribunda auct. non Jack: Blume, Mus. Bot. 2 (1856) 126, t. 41B (based on the cited figure, drawn from material from Timor, the depicted flowers and fruit clearly represent *L. engleriana*, but there is no material in L from Timor collected before 1856).

Shrubs or trees, 3–12 m tall; bark creamy grey or pale brown, smooth, peeling or flaking. *Leaves*: petiole (0.1–)0.3–0.6 cm long; lamina brown-hairy on both surfaces, glabrescent, 7–17 by 4–9 cm; lateral nerves 5–11 on each side; intercostal venation reticulate. *Inflorescences* terminal, lax, broadly or narrowly pyramidal, 4–40 cm long, grey or rust coloured hairy. *Flowers* c. 30 mm diam.; bud densely hairy, obovoid (obconical), 10–12 mm long, c. 1 mm nippled at apex, pseudopedicel 3–4 mm long; *calyx tube* c. 6 mm long, 6-ridged (sometimes faintly 12-ridged in dry buds), with a small inwards bent auricle at each sinus, *calyx lobes* (sepals) 6, glabrous or possibly at apex somewhat hairy within, c. 3 mm long; *petals* pink-purplish, broadly elliptic, c. 16 mm long (including c. 5 mm long claw), margin entire; *stamens* radially dimorphic; *ovary* hairy. *Capsules* drying (brown-)black, not shagreen but often approaching this facies, (grey) hairy at least at apex, 15–18 mm long, (4–)5-valved; *fruiting calyx* 6-ridged; calyx lobes glabrous within; fruiting pseudopedicel 2–10 mm long. — **Fig. 12.**

Distribution — Eastern Malesia and Australia (Queensland); in *Malesia*: Sulawesi (only known from *Amir 45* (Kendari) and *Widjaja 664* (Pulau Kabaena)), Lesser Sunda Islands (Timor), Moluccas (Tanimbar Isl., Jamdena Isl.), Papua New Guinea (Western, Western Highlands, Central, Morobe).

Habitat & Ecology — Monsoon forest, monsoon scrub and in seasonal swamp, gallery forest in *Eucalyptus* savanna, in degraded forest and secondary regrowth; dark brown soil; from sea level to 1000 m altitude; flowering and fruiting all year round.

Vernacular names. — Moluccas: Katimpe (Jamdena), Popog (Timor).

Note — *Lagerstroemia engleriana* is apparently a tree of monsoon forest.

4. Lagerstroemia floribunda Jack

Lagerstroemia floribunda Jack, Malayan Misc. 1, 5 (1820) 38; Blume, Mus. Bot. 2 (1856) 126, p.p., for the type only; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 953; Craib, Fl. Siam. 1 (1931) 721; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 256; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 329, f. 55–56; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 563; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 117. — Type: *Jack s.n.*, Pulau Pinang, not extant. Neotype (designated by Furtado & Srisuko 1969): *King s.n.* (holo SING), Peninsular Malaysia, Penang.

Lagerstroemia turbinata Koehne, Bot. Jahrb. Syst. 4 (1883) 34. — Lectotype (designated by W.J.de Wilde & Duyfjes, Thai For. Bull., Bot. 41, 2013: 98): *Maingay 653/2* (L), Peninsular Malaysia, possibly Penang.

Lagerstroemia anisoptera Koehne, Bot. Jahrb. Syst. 4 (1883) 407; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 952; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 321, f. 51. — Type: *De Lanessan s.n.* (not found), Vietnam, Poulo Condor.

Lagerstroemia floribunda Jack var. *brevifolia* Craib, Fl. Siam. 1 (1931) 722; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 331. — Type: *Kerr 11028* (holo BM; iso BK, K), Thailand, Krung Thep Maha Nakhon (= Bangkok).

Lagerstroemia floribunda Jack var. *subecostata* Craib, Fl. Siam. 1 (1931) 722; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 333. — Type: *Kerr 13618* (holo BM; iso K), Thailand, Songkhla, Padang Besar.

Shrubs or trees, 4–25 m tall; bark of trunk brown grey, thin, peeling or flaking. *Leaves*: petiole 0.2–0.7 cm long; lamina glabrous, glabrescent beneath, variable in shape and size, 6–20 cm long; lateral veins (5–)8–12 on each side; intercostal venation reticulate or somewhat scalariform. *Inflorescences* terminal, lax, 20–50 cm long, wholly densely short-hairy, hairs rust coloured, stellate. *Flowers* c. 30 mm diam.; bud densely short-hairy, obovoid (obconical), 5–7 mm long, mostly flat at apex, often with a nipple (5-cleft to 2 mm deep), pseudopedicel 2–4 mm long; *calyx tube* 5–6 mm long, distinctly c. 12-ridged or rarely inconspicuously ridged, without auricles or with an auricle at each sinus between the calyx lobes, auricles patent; *calyx lobes* (sepals) 6, hairy within, 3–4 mm long; *petals* violet or pink, fading white with age, blade oblong, 8–15 mm long, margin entire, mostly undulate, claw 2–3 mm long; *stamens* asymmetrically dimorphic (outer 6–7 stamens longer than inner ones and directed towards a gap between the petals), long filaments purple with blackish anthers and cream connectives, the short ones whitish with yellow anthers; *ovary* densely hairy. *Capsules* dark brown or blackish, smooth (not shagreen), hairy, especially at apex, 12–18 mm long, 5–6-valved; *fruiting calyx* tube with 12–14 blunt or sharp ridges, calyx lobes in upper half hairy within, thin, mostly reflexed, without auricles or with inconspicuous auricles at the sinuses between the calyx lobes; fruiting pseudopedicel 2–5 mm long.

KEY TO THE VARIETIES

1a. Calyx tube without auricles . . . . . **a.** var. **floribunda**
b. Calyx tube with an auricle at each sinus between the calyx lobes **b.** var. **cuspidata**

a. var. **floribunda**

For synonymy see under species.

Calyx tube without auricles. — **Plate 2b, d.**

Distribution — Myanmar, Thailand, Cambodia, Laos, Vietnam; in *Malesia*: Peninsular Malaysia (Perlis, Kedah, Selangor). Widely cultivated as an ornamental tree.

Habitat & Ecology — Forest margins, open heath country by stream, secondary vegetation, roadsides; found at low altitudes; flowering and fruiting all year round.

Notes — 1. The collection *Nedi & Idjan 450* (L) from W Java is not annotated as cultivated.

2. The synonym *L. anisoptera* concerns a plant from Vietnam (not seen) with stronger developed ridges below the sinuses of the calyx lobes. Similar plants are also known

from S and W Thailand and Peninsular Malaysia, but they merge with the typical *L. floribunda* var. *floribunda*.

b. var. **cuspidata** Wall. ex C.B.Clarke

Lagerstroemia floribunda var. *cuspidata* Wall. ex C.B.Clarke in Hook.f., Fl. Brit. India 2 (1879) 577. — *Lagerstroemia cuspidata* (Wall. ex C.B.Clarke) Craib, Fl. Siam. 1 (1931) 721. — Type: *Wallich 2116* (holo K), Myanmar, Amherst.

Lagerstroemia siamica Gagnep., Notul. Syst. (Paris) (1918) 361; in Lecomte, Fl. Indo-Chine 2 (1921) 950, f. 102: 3; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 324, f. 53. — Type: *Pierre 819* (not found), Thailand, Mueang Pran.

Calyx tube with an auricle at each sinus between the calyx lobes.

Distribution — Myanmar, Thailand; in *Malesia*: northern Peninsular Malesia (Langkawi).

Habitat & Ecology — Disturbed flatland and roadsides; at low altitudes; fruiting specimens were collected in November and December.

5. Lagerstroemia indica L.

Lagerstroemia indica L., Syst. Nat., ed. 10 (1759) 1076; (1762) 734; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 940; Craib, Fl. Siam. 1 (1931) 724; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 256; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 190, f. 1; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 278; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 295: 1–2; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11 (2014) 565; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 121. — Lectotype (designated by Merr., Interpret. Rumph. Herb. Amb., 1917: 381): 'Tsjinkin' in Rumph., Herb. Amboin. (1755) 61, t. 28, f. 1, ('Habitat in China').

Lagerstroemia chinensis L., Syst. Nat., ed. 10 (1759) 1076. — Type: not indicated.

Velaga globosa Gaertn. (Sterculiaceae), Fruct. Sem. Pl. (1791) 246, t. 133. — Type: Gaertner (1791) t. 133, right hand drawing below.

Shrubs or small trees, to 3 m tall; bark smooth, flaky. *Leaves* (sub)sessile; lamina minutely hairy on both surfaces when young, glabrescent, 3–6(–10) cm long; lateral veins 5–7 on each side; intercostal venation reticulate. *Inflorescences* terminal, glabrous, lax, 5–20 cm long. *Flowers* c. 35 mm diam.; bud glabrous, globose, 5–6 mm diam., pseudopedicel 2–10 mm long; *calyx tube* glabrous, 3–4 mm long, not ridged or ridges faintly developed, narrow annulus in the throat present, auricles absent; *calyx lobes* (sepals) 6, glabrous within, 3–4 mm long; *petals* pink, lilac or white, blade suborbicular, 8–10 mm long, margin undulate and crispate, claw c. 10 mm long; *stamens* radially dimorphic (4 or 6 outer stamens longer than numerous inner ones), longer filaments pale purplish, shorter ones whitish, all anthers yellow; *ovary* glabrous, style c. 10 mm long. *Capsules* smooth (not shagreen), glabrous, subglobose, c. 10 mm long, 4–6-valved; *fruiting calyx* tube not ridged, lobes thin, persistent or caducous; fruiting pseudopedicel c. 8 mm long. — **Plate 2c.**

Distribution — Himalayan regions, China, Indochina, Japan, furthermore widely cultivated all over the world; in *Malesia*: introduced in many cultivars as an ornamental shrub or small tree.

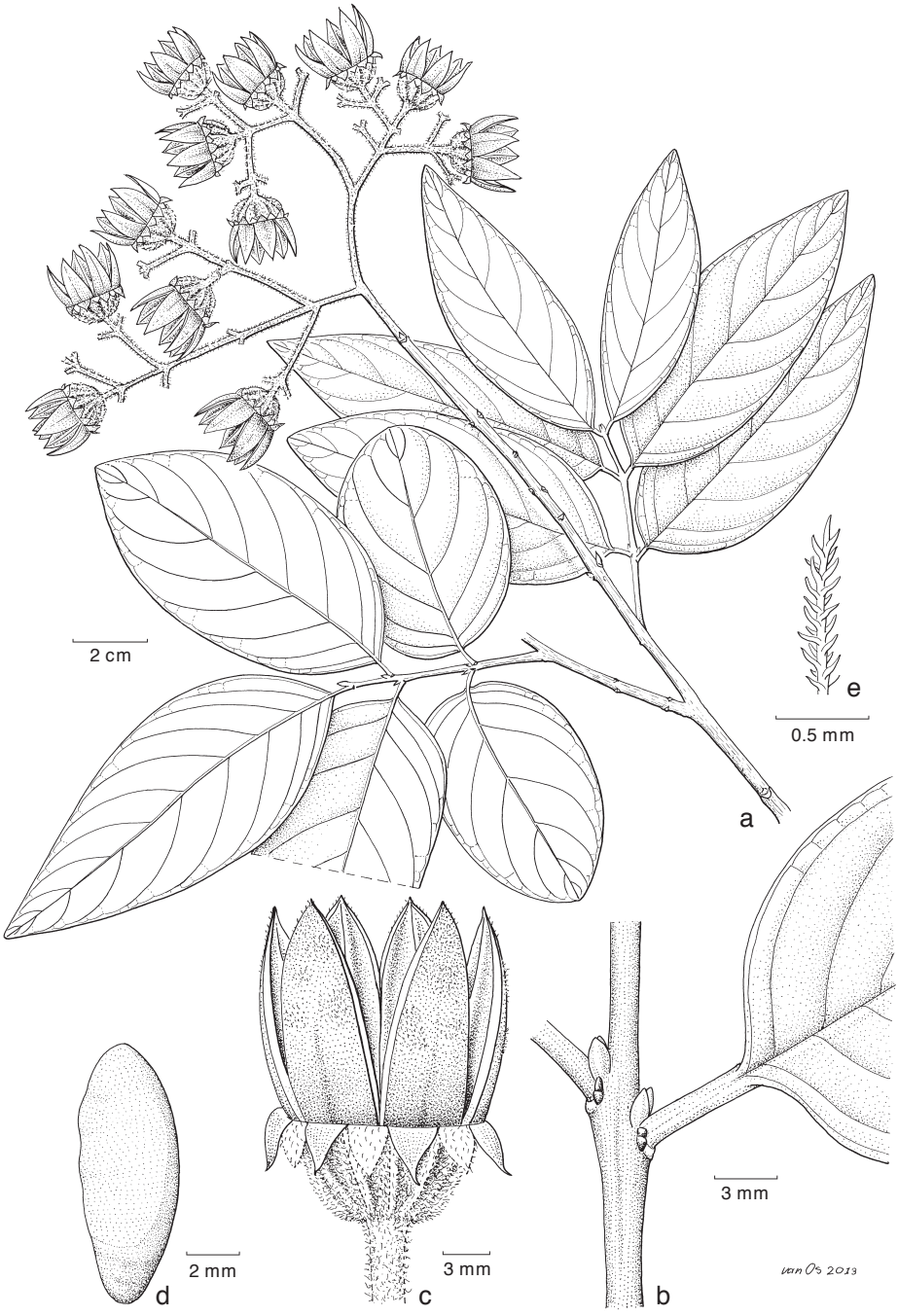

Fig. 13. *Lagerstroemia langkawiensis* Furtado & Srisuko. a. Branchlet with infructescence; b. node with subopposite leaves with axillary buds and lateral stipule-like appendices; c. fruiting calyx and fruit; d. seed; e. hair from fruiting calyx (*Van Balgooy 2322*; L).

6. Lagerstroemia langkawiensis Furtado & Srisuko

Lagerstroemia langkawiensis Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 327, f. 54; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 567, f. 6; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 117. — Type: *Henderson SF 29119* (holo SING; iso BO), Peninsular Malaysia, Langkawi, Pulau Timon.

Trees, 5–16 m tall; bark smooth, creamy pale brown, flaking in thin scales. *Leaves*: petiole c. 0.5 cm long; lamina glabrous, 7–12 cm long; lateral veins 6–8 on each side; intercostal venation reticulate. *Inflorescences* terminal, lax, c. 20 cm long, densely short-hairy, hairs stellate. *Flowers* c. 35 mm diam.; bud densely stellate-hairy, obovoid (obconical), flat at apex, c. 8 mm long, c. 1.5 mm nipplled, pseudopedicel 3–5 mm long; *calyx tube* c. 7 mm long, deep and sharply 12-ridged, with sepal-like auricles; *calyx lobes* (sepals) 6, glabrous within, c. 4 mm long; *petals* purple, blade broadly ovate, c. 15 mm long, margin subentire, undulate, claw c. 5 mm long; *stamens* asymmetrically dimorphic (outer 6–7 stamens longer than inner ones and directed towards a gap between the petals), longer filaments purple with blackish anthers, shorter ones whitish or pale pink with yellow anthers; *ovary* hairy. *Capsules* blackish, smooth or indistinctly wrinkled (not shagreen), hairy, especially at apex, 15–18 mm long, 6-valved; *fruiting calyx* densely stellate-hairy, sharply 12-ridged, calyx lobes thin, reflexed, glabrous within, with distinct auricles at the sinuses between the calyx lobes; fruiting pseudopedicel c. 5 mm long. — **Fig. 13**.

Distribution — Thailand; in *Malesia*: Peninsular Malaysia (Langkawi).

Habitat & Ecology — On limestone; at low altitudes; fruiting: November, December, and February.

7. Lagerstroemia loudonii Teijsm. & Binn.

Lagerstroemia loudonii Teijsm. & Binn., Natuurk. Tijdschr. Ned.-Indië (1863) 425 (‘*loudoni*’); Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 954; Craib, Fl. Siam. 1 (1931) 724; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 256; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 303, f. 43; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 27, f. 3669; S.Gardner et al., Field Guide Forest Trees Northern Thailand (2000) 202: 441; W.J.de Wilde & Duyfjes, Thai Forest Bull., Bot. 41 (2013) 98; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 569; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 121. — *Lagerstroemia tomentosa* C.Presl. var. *loudonii* (Teijsm. & Binn.) C.B.Clarke in Hook.f., Fl. Brit. India 2 (1979) 578. — Type: *Teijsmann 5938* (holo U; iso BO 3 sheets), Thailand, Petchaburi, Boekit Petjaboerie.

Trees, 4–10 m tall; bark light brown, thin, vertically cracked and flaking. *Leaves*: petiole c. 0.5 cm long; lamina shortly soft-hairy beneath, 4–20 cm long; lateral veins 8–13 on each side; intercostal venation scalariform. *Inflorescences* lateral (axillary), lax, 10–18(–25) cm long. *Flowers* c. 50 mm diam.; bud stellate-dendroid hairy, obovoid, 5–9 mm long, pseudopedicel 2(–7) mm long; *calyx tube* 3–4 mm long, nearly without ridges or faintly 12-ridged, without auricles; *calyx lobes* (sepals) 6(–7), hairy in upper half within, 3–4 mm long; *petals* (dark) purple, turning white with age, blade ovate or obovate, 15–20 mm long, margin irregularly serrate-fimbriate, especially so in upper half, claw c. 7 mm long; *stamens* asymmetrically dimorphic (outer 6–7 stamens longer than inner ones and directed towards a gap between the petals), longer

filaments purple with blackish anthers, shorter ones pale yellow with yellow anthers; *ovary* hairy. *Capsules* black, glossy, smooth, drying coarsely reticulate (not shagreen), glabrescent or often hairy at apex only, globose or broadly ellipsoid, (10–)12–18 mm long, 5–6-valved; *fruiting calyx* without distinct ridges; calyx lobes thin, hairy or with remnants of hairs within, reflexed; fruiting pseudopedicel 2–4(–7) mm long. — **Plate 2h.**

Distribution — *Lagerstroemia loudonii* is endemic in Thailand, where it is also cultivated as an ornamental tree; in *Malesia*: cultivated in W Java, but no collections seen except several from Bogor Botanical Garden (Kebun Raya).

Note — *Lagerstroemia loudonii* is readily recognised by the fimbriate (upper) margin of the petals.

8. Lagerstroemia ovalifolia Teijsm. & Binn.

Lagerstroemia ovalifolia Teijsm. & Binn., Natuurk. Tijdschr. Ned.-Indië 2 (1851) 306; Ned. Kruidk. Arch. 3 (1855) 410; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 945; Craib, Fl. Siam. 1 (1931) 725; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 256; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 210, p.p.; B.Everett & Whitmore, Tree Fl. Malaya 2 (1973) 280, f. 1; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 573; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 117, f. 2. — Type: *Teijsmann & Binnendijk s.n.* (holo BO; iso L, barcodes L2479644 & L2479645, U, Hort. bot 039040), W Java, Bantam.

Lagerstroemia ovalifolia Teijsm. & Binn. var. *exapiculata* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 213, f. 7: B^1–B^6, 8. — Type: *Burkill & Haniff SING 17179* (holo SING), Peninsular Malaysia, Pahang, Kuala Lipis.

Lagerstroemia ovalifolia Teijsm. & Binn. var. *ruptilis* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 215, f. 7: D^1–D^3. — Type: *Lakshnakara 836* (holo BM; iso K), Thailand, Narathiwat, To Mo.

Lagerstroemia ovalifolia Teijsm. & Binn. var. *minor* Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 216, f. 7: C. — Type: *Boden-Kloss SF 12300* (holo SING; iso BM, UC n.v.), Sumatra, Mentawai Archipelago, Siberut.

Trees, (4–)10–30 m tall; bark smooth or with pustules, pale grey when young but roughly blackish and fissured when older. *Leaves*: petiole 0.2–0.4 cm long; lamina glabrous except minutely simple-hairy on veins below, 6–11 cm long; lateral veins 5–9 on each side; intercostal venation subscalariform or reticulate. *Inflorescences* terminal, lax, 15–25 cm long, wholly densely extremely short-hairy, hairs simple. *Flowers* c. 30 mm diam.; bud extremely short-hairy, obovoid, 10–15 mm long, shortly nippled at apex, pseudopedicel c. 1 mm long; *calyx tube* distinctly (6–)7–9-ridged, ridges 0.5–1.5 mm high, at apex confluent into auricles, *calyx lobes* (sepals) (6–)7–9, minutely hairy in upper part within, 2–4 mm long; *petals* purple, blade broadly elliptic, 10–15 mm long, margin entire, somewhat undulate, claw 6–10 mm long; *stamens* radially dimorphic (6–7 outer stamens longer than numerous inner ones), filaments pale purplish, anthers yellow; *ovary* glabrous. *Capsule* brown, dull, shagreen, glabrous, 15–20 mm long, 5–6-valved; *fruiting calyx* distinctly (6–)7–9-ridged, ridges 0.5–1 mm high; calyx lobes thin, glabrous (glabrescent) within, patent, without or with small auricles at the sinuses between the calyx lobes; fruiting pseudopedicel (1–)2–3 mm long. — **Fig. 14; Plate 2e.**

Distribution — Thailand, Vietnam; in *Malesia*: Sumatra (Aceh, N Sumatra, Siberut), Peninsular Malaysia (Kedah, Perak, Pahang, Selangor, Johor), W Java.

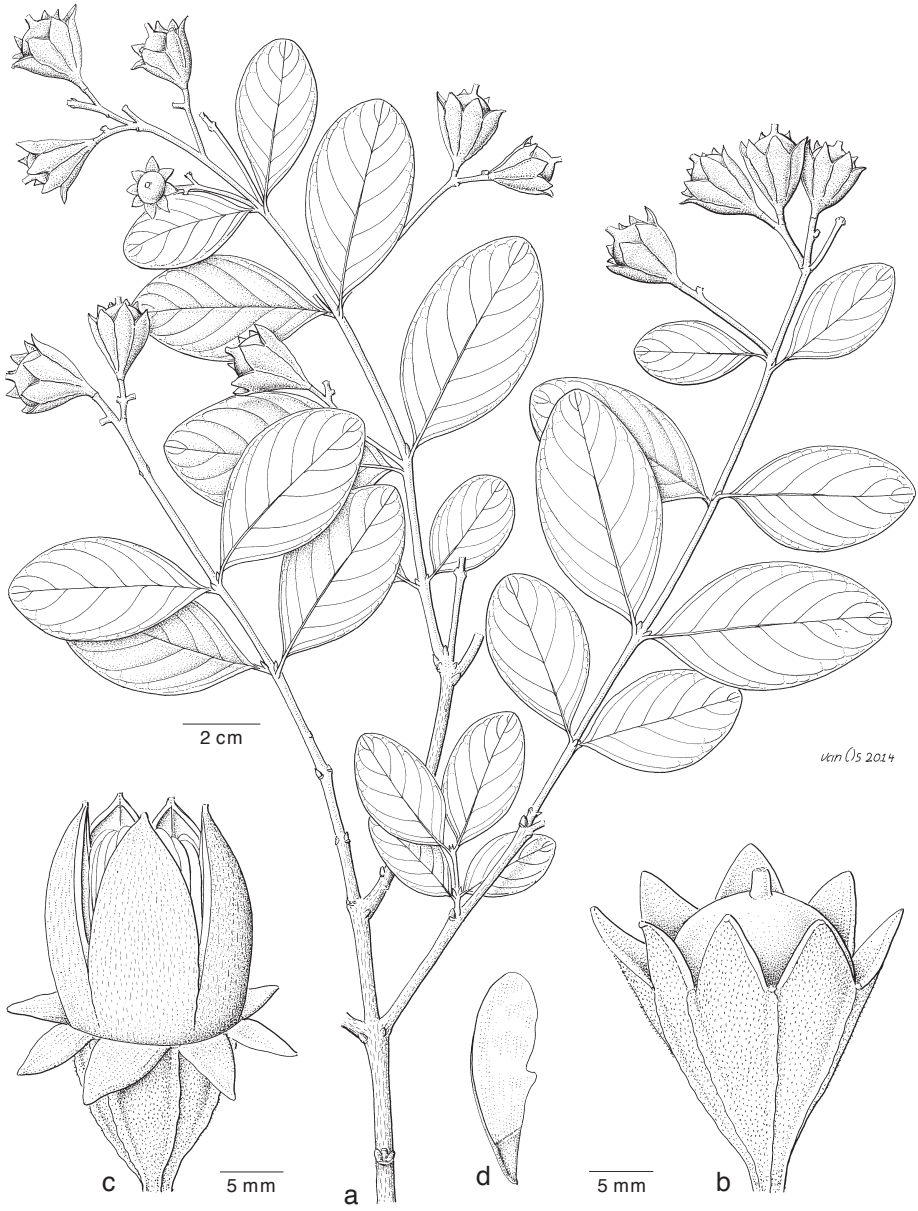

Fig. 14. *Lagerstroemia ovalifolia* Teijsm. & Binn. a. Habit of twig with half-grown fruit; b. half-grown fruit; c. fruit with persistent 8-lobed calyx; d. seed (a, b: *Phonsena*, *Duyfjes & de Wilde 7128*, c, d: *de Wilde & Duyfjes 20419*; all L).

Habitat & Ecology — Primary forest, primary marshy forest on flat land, roadsides by seasonal swamp in disturbed forest, river banks; greyish clay-mud soil; sea level to 650 m altitude; flowering March to July and in December; fruiting July to January.

Uses — Leaves and fruits are used for 'sakit toelang' or pain in the bones (Siberut).

Vernacular names — Sumatra: Boengoer, Goedo Goedo, Kaloe boengoer, Soesoe moeo.

Notes — 1. *Lagerstroemia ovalifolia* differs from all other Malesian species in having (6–)7–9 calyx lobes (sepals), 6 in other species.

2. Furtado & Srisuko (1969) had a different conception of *L. ovalifolia* as at present; part of it, namely var. *apiculata*, var. *riedeliana*, and var. *novoguineensis*, is conveyed to *L. celebica*.

3. In herbarium specimens the leaves below are sometimes conspicuously dark chocolate-coloured, contrasting with the upper surface.

9. Lagerstroemia paniculata (Turcz.) S.Vidal

Lagerstroemia paniculata (Turcz.) S.Vidal, Phan. Cuming. Philipp. (1885) 39, 115; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 268; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 228, f. 15; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 117. — *Pterocalymma paniculata* Turcz., Bull. Soc. Imp. Naturalistes Moscou 19 (1846) 508. — *Lagerstroemia calycina* Koehne, Bot. Jahrb. Syst. 4 (1883) 25, nom. superfl.; in Engl. & Prantl, Nat. Pflanzenfam. (1898) 14, f. 5: W, X. — Type: *Cuming 1188* (holo LE n.v.; iso E photo, K, L 2 sheets, SING), Philippines, Luzon (see note for the epithet *calycina*).

Trees, 15–18 m tall. *Leaves*: petiole 0.5–1 cm long; *lamina* glabrous on upper surface, lower surface glabrous but sometimes slightly hairy on midvein, 6–17 cm long; lateral veins 8–11 on each side; intercostal venation reticulate. *Inflorescences* terminal, lax, paniculate, many-flowered, 10–30 cm long, minutely hairy when young. *Flowers* c. 15 mm diam.; bud minutely hairy, obovoid (turbinate), 8–12 mm long, to 1 mm nippled, pseudopedicel 3–5 mm long; *calyx tube* 2–4 mm long, 6-ridged, ridges conspicuously winged and winged also along the calyx lobe sutures, wings single, auricles between the calyx lobes absent; *calyx lobes* (sepals) 6, glabrous within, c. 3 mm long; *petals* pinkish to violet, elliptic-oblong, c. 7 mm long (including c. 2 mm long claw), margin undulate; stamens ± radially dimorphic; ovary glabrous. *Capsules* unknown (but aspect likely shagreen).

Distribution — *Malesia*: Philippines (Luzon).

Habitat & Ecology — In secondary forestry plantation of Makiling Forest on low undulating country; c. 110 m altitude; flowering in February and April.

Uses — Wood used for general construction.

Notes — 1. The name *Lagerstroemia calycina* Koehne (1883) was according to its author based on *Pterocalymma calycina* Turcz. (1846), but the latter binomial is not extant in the place cited. As the type allegedly is the same as that of *L. paniculata* it should be regarded as a superfluous name. Furtado & Srisuko (1969) treated it as an isonym.

2. The species is known from 5 collections: the type, *Adduro FB 21959*, *Roso s.n.*, *Ahern's Collector FB 8127*, and *Sulit PNH 22870*. *Roso s.n.* and *Sulit PNH 22870* mention that these collections were taken from planted trees, but probably they concern original remnant trees.

10. Lagerstroemia pterosepala Furtado & Srisuko

Lagerstroemia pterosepala Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 230, f. 16; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 118. — Type: *Adduru FB 21959* (holo A photo; iso L photo seen but specimen not found), Philippines, Luzon.

Shrub or small tree (probably); young branches slightly winged along the edges. *Leaves*: petiole 0.1–0.3 cm long; *lamina* glabrous on both surfaces, but lower midvein somewhat hairy (hairs simple), (obovate to) elliptic, 5–8 cm long; lateral veins 5–7 on each side; intercostal venation reticulate. *Inflorescences* terminal, 3–6 cm long, 1–3(–5)-flowered, minutely grey-hairy. *Flowers* c. 20 mm diam.; bud sparsely or minutely hairy, obovoid (clavate), c. 10 mm long, not or slightly nippled, pseudopedicel indistinct, 1–3 mm long; *calyx tube* c. 10 mm long, with 6(–7) double winged ridges, wings chartaceous, crispate-undulate, c. 2 mm out, both continuing along the calyx lobe margins, auricles not obvious; *calyx lobes* (sepals) 6(–7), sutures in bud double winged, slightly hairy within, 4–5 mm long; *petals* rhombic, c. 10 mm long (including 1–2 mm long claw); stamens radially dimorphic (6–7 outer stamens longer than numerous inner ones); ovary glabrous, subglobose. *Capsules* not known with certainty (see note 2): 1–3 per infructescence, brown, glabrous, shagreen, broadly ellipsoid, 15–20 by 17–18 mm, apex broadly rounded, 4(–5)-valved; *fruiting calyx* glabrescent from minute hairs, broadly obturbinate, c. 10 by 20 mm, sharply 6(–7)-ridged, with 6(–7) reflexed lobes, ridges (1–)2 mm out, wings on ridges and calyx sutures not seen, presumably broken off; fruiting pseudopedicel 1–3 mm long.

Distribution — *Malesia*: Philippines (northern Luzon).

Habitat & Ecology — From *Ridsdale 1889*: Disturbed edge of forest on limestone; 450 m altitude, fruiting in April.

Notes — 1. The species is known from only three collections: the type, *Ridsdale 1889* (L), and *Clemens 15815* (UC n.v.).

2. *Lagerstroemia pterosepala* closely resembles *L. paniculata*, the latter is also from Luzon. Apart from differences in the flower, *L. pterosepala* is a shrub and possibly an ecologically (e.g., from poor soil) defined taxon.

3. The collection *Ridsdale 1889* (Luzon, Bulacan, environs Sibul Springs, N15°10' E121°04', 450 m altitude) with a large fruit, appeared difficult to identify. It clearly belongs to the group with the here variably conceived *L. celebica*, especially its most closely resembling species *L. ovalifolia*, but it cannot go with either of these. *Lagerstroemia ovalifolia* has 7–9 calyx lobes and 5–6 fruit valves, *L. celebica* usually has smaller fruits, with 6 valves and a distinct pseudopedicel. Provisionally it is assumed that it represents the fruit of *L. pterosepala* of which the fruit to date was unknown.

11. Lagerstroemia pustulata Furtado & Srisuko

Lagerstroemia pustulata Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 222, f. 12; Yii in Soepadmo et al., Tree Fl. Sabah & Sarawak 2 (1996) 228; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 119. — Type: *Muin Chai SAN 26006* (holo SING; iso K, L, SAN n.v., SAR n.v.), Borneo, Sabah, Lahad Datu.

Trees, to 15 m tall; bark smooth, whitish or orangey brown. *Leaves*: petiole c. 1 cm long; *lamina* glabrous on both surfaces, elliptic, 12–17 cm long; lateral veins 10–12

on each side; intercostal venation scalariform. *Inflorescences* terminal, lax, to 35 cm long, loosely-flowered, minutely hairy, glabrescent. *Flowers* c. 35 mm diam.; bud finely hairy, ± obovoid, c. 10 mm long, c. 7 mm diam., c. 1 mm nippled, sutures slightly thickened, pseudopedicel 2–7 mm long; *calyx tube* 5–7 mm long, 6-ridged, the ridges slightly winged and somewhat decurrent into the pseudopedicel; *calyx lobes* (sepals) 6, glabrous within, long-triangular, erect, 5–6 mm long, seemingly constricted (i.e. curved outwards) in the basal part (see note 1), margin ± thickened, auricles absent; *petals* pale purple, broadly elliptic, 15–20 mm long (including 5–10 mm long claw), margin gnawed; *stamens* dimorphic, becoming asymmetrical with age, shorter than the petals, longer filaments purplish, shorter ones pale pink, anthers yellow; *ovary* glabrous, ovate. *Capsules* shagreen, glabrous, oblong or subglobose, 20–25 mm long, c. 2 mm beaked at apex; *fruiting calyx* 6-ridged, ridges somewhat winged and decurrent into the pseudopedicel; calyx lobes 6, 5–8 mm long, glabrous within; fruiting pseudopedicel 8–12 mm long. — **Plate 2f.**

Distribution — *Malesia*: Borneo (Sabah, Kalimantan).

Habitat & Ecology — Primary forest, river bank; at low altitude; flowering in August and October; fruiting in August.

Notes — 1. The species is only known from 2 collections: the type, Sabah (Lahad Datu) and *Lee et al. 539*, Kalimantan (E Kutai; BO, SING). *Lagerstroemia pustulata* is distinguished by the relative long calyx lobes (sepals), glabrous within, when in flower looking constricted because of retroflexed margins (this latter character can be observed in dry material, the photos of living flowers do not show the constricted sepals), the long leaves, 12–17 cm long, and the large fruit, to 25 mm long.

2. The fruits (SING) seem to split into 3 valves.

3. The leaves and flower buds are described (Furtado & Srisuko 1969) as 'pustulate', but it is not clear what is actually meant.

12. Lagerstroemia speciosa (L.) Pers.

Lagerstroemia speciosa (L.) Pers., Syn. Pl. 2, 1 (1807) 72; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 264, f. 29A; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 25, f. 3662; Yii in Soepadmo et al., Tree Fl. Sabah & Sarawak 2 (1996) 230; S.Gardner et al., Field Guide Forest Trees Northern Thailand (2000) 206: 450; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 574; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 119. — *Munchausia speciosa* L. in Münchh., Hausvater 5 (1770) 357, t. 2. — Lectotype (designated by Dar in Nasir & Ali, Fl. W. Pakistan 78, 1975: 3): Herb. Linn. No. 939.1 (LINN), 'Habitat in Java, China'.

Adambea glabra Lam., Encycl. 1 (1783) 39. — Type: Rheede, Hort. Malab. 4 (1683) t. 20, 21, India.

Lagerstroemia flos-reginae Retz., Observ. Bot. (1789) 25; C.B.Clarke in Hook.f., Fl. Brit. India 2 (1879) 577; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 256. — Type: not indicated.

Lagerstroemia reginae Roxb., Pl. Coromandel 1 (1796) 46, pl. 65; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 261, f. 29B. — Lectotype (designated by De Wilde & Duyfjes 2014): *Roxburgh s.n.* (holo K, barcode K000729731, right hand specimen), northern India, Circars.

?*Lagerstroemia punctata* Blume, Mus. Bot. 2 (1856) 126. — Type: not found, 'Archipelago indico'.

Trees, 5–30 m tall; bark light brown, black when old, coarsely vertically cracked and slightly flaking. *Leaves*: petiole 0.5–1 cm long; lamina glabrous, dull, elliptic or obovate, 10–20(–30) cm long; lateral veins (6–)8–14 on each side; intercostal venation

reticulate or reticulate-scalariform. *Inflorescences* terminal, lax or elongate, 15–25(–30) cm long, young densely short stellate-hairy, glabrescent. *Flowers* c. 50 mm diam.; bud finely farinose, grey or brown, subglobose, 7–8 mm diam., not nippled or 0.5(–1) mm nippled at apex, pseudopedicel 3–8 mm long; *calyx tube* 6–8 mm long, distinctly 12-ridged, the ridges low; *calyx lobes* (sepals) 6, glabrous within, to 5 mm long, auricles between the sinuses absent or as minute warts; *petals* purple, blade obovate, c. 20 mm long, upper part of margin irregularly undulate, claw c. 5 mm long; *stamens* monomorphic (all about the same length), filaments purple, anthers yellow; *ovary* glabrous. *Capsules* brown or black, dull, smooth (not shagreen), glabrous, 15–25 mm long, 6-valved; *fruiting calyx* 12-ridged, the ridges not winged; calyx lobes glabrous within, ± thin, often reflexed, without auricles; fruiting pseudopedicel 5–10(–12) mm long.

Distribution — India, Myanmar, China (Yunnan), Thailand, Cambodia, Laos, Vietnam (probably only cultivated); in *Malesia*: Sumatra, Peninsular Malaysia (Kedah, Perak, Terengganu, Pahang, Selangor), Borneo (Kalimantan, Sarawak, Sabah), Java (also Pulau Bawean and Pulau Kangean), Philippines (Palawan, Luzon, Samar, Mindanao), Sulawesi, Lesser Sunda Islands (Bali, Lombok, Sumbawa, Flores, Timor), Moluccas (Aru), Papua (Digoel River), Papua New Guinea (Western). Widely cultivated as an ornamental tree. — **Plate 2g.**

Habitat & Ecology — In primary and secondary forest at river banks and in seasonal swamp, behind the shore on sand and coral rock; deep clayey soil, brown soil, sand, also on limestone; from sea level to 500 m altitude (one collection from Sumbawa 900 m); flowering and fruiting all year round.

Uses — Commonly cultivated as an ornamental. The wood is employed as timber.

Vernacular names — Philippines: Banaba. Sulawesi: Lobani, Tjopeng.

Note — The collection *Van Balgooy 6724*, from Aru Isl., links up with e.g. *Versteegh BW 4857* and *Brass 8160* from S New Guinea. The latter two are separately discussed by Furtado & Srisuko (1969) as having a deviating distribution under *L. reginae* Roxb. These collections deviate in rather pronounced ridges on the calyx tube and thickenings of the calyx lobes along the sutures in the bud. However, they easily fall within the overall variation of the widespread *L. speciosa*.

13. Lagerstroemia subcostata Koehne

Lagerstroemia subcostata Koehne, Bot. Jahrb. Syst. 4 (1883) 20; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 255; Furtado & Srisuko, Gard. Bull. Singapore 24 (1969) 281, f. 35a, 35b: a; T.C.Huang in T.C.Huang, Fl. Taiwan, ed. 2 (1993) 876, pl. 435; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 281; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 300: 1–5; W.J.de Wilde & Duyfjes, Blumea 59 (2014) 121. — Lectotype (designated by De Wilde & Duyfjes 2014): *Oldham 119/2* (holo GH, barcode GH00099295, photo), China, Taiwan.

Notes — 1. A species description of *L. subcostata* is omitted. It is indigenous in China and Taiwan, and was included in Flora of Java (Backer 1964) as locally cultivated, but we think it is only sporadically grown in botanic gardens. The flowers are recorded as fragrant. From Java we have seen *Schuurman 134* (L, flowers), cultivated in the botanic garden at Bogor, and *Backer 26423* (BO, flowers) also cultivated; from the Philippines *Steiner PNH 40084* (= *Steiner 1811-A*) (L, fruit), cultivated in Los Baños.

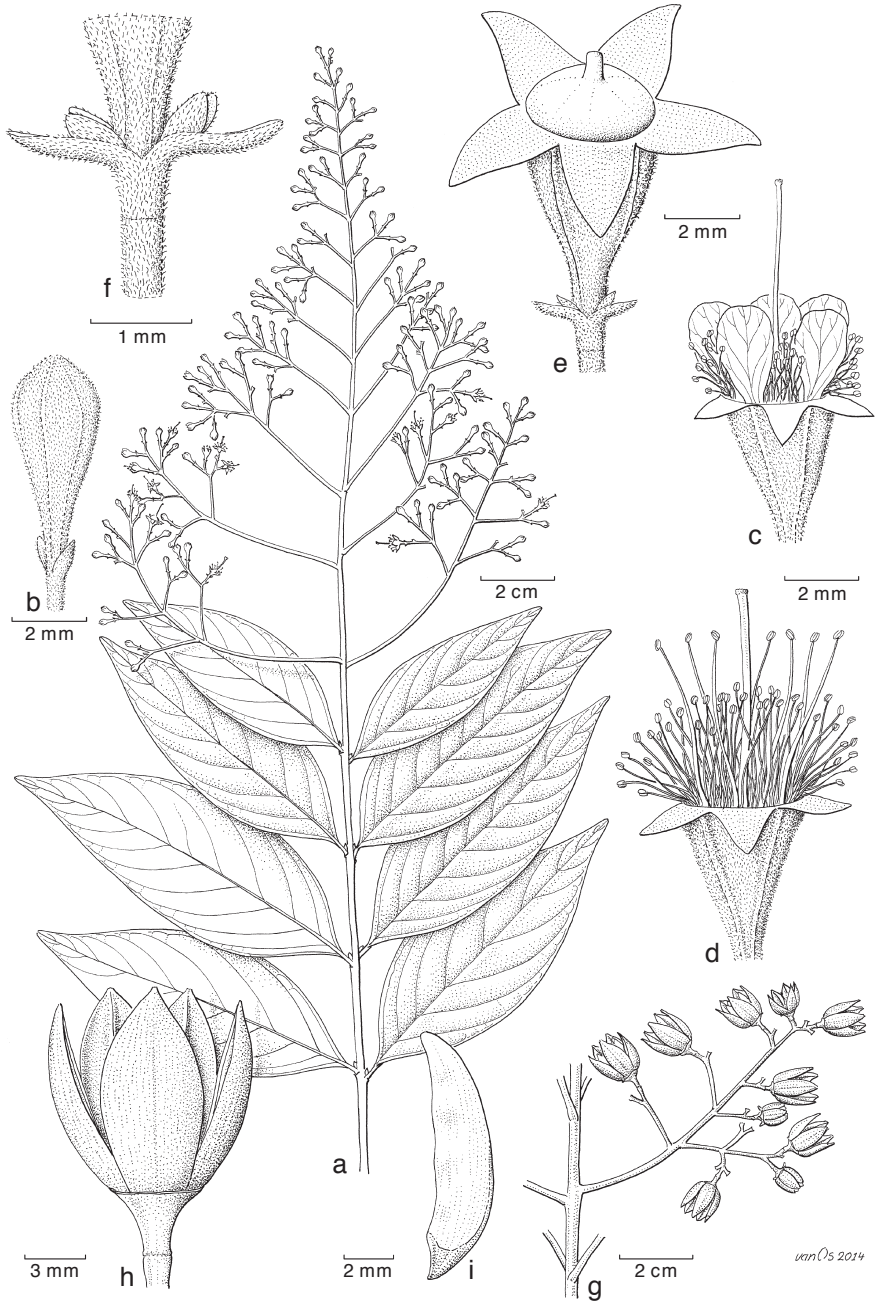

Fig. 15. *Lagerstroemia vanosii* W.J.de Wilde & Duyfjes. a. Habit of flowering twig; b. flower bud; c. flower; d. ditto, in a later stage, petals dropped off; e. ditto, petals and stamens dropped off, showing developing fruit; f. basal part of flower bud and pedicel, note 'bracteoles' with minute axillary buds; g. part of infructescence; h. old fruit, calyx withered away; i. seed (a–f: *Koorders 39478*, g–i: *Koorders 20043*; all L).

2. Both *L. subcostata* and *L. indica* have a narrow annulus in the throat of the calyx tube within, a character shared with some more Chinese species.

14. Lagerstroemia vanosii W.J.de Wilde & Duyfjes

Lagerstroemia vanosii W.J.de Wilde & Duyfjes, Thai Forest Bull., Bot. 41 (2013) 96; Blumea 59 (2014) 121, f. 3. — Type: *Koorders 39478* (holo L; iso BO, not found), Java, Banjoemas Prov.

Treelets. *Twigs* (below inflorescence) subterete, c. 2.5 mm diam. *Leaves*: petiole 0.3–0.6 cm long; lamina glabrous on both surfaces, drying grey-green or dark chocolate-coloured below, elliptic, 6–10 cm long; lateral veins 5–6(–7) on each side, intercostal venation finely reticulate. *Inflorescences* terminal, broadly paniculate, 15–20 cm long, densely minutely grey hairy, hairs simple. *Flowers* c. 8 mm diam.; bud minutely hairy, obovoid (obconical), with broadly rounded apex, 3–3.5 by c. 3 mm, pseudopedicel 1–1.5 mm long; *calyx tube* c. 2.5 mm long, tube and pseudopedicel distinctly (5–)6-ridged (not winged), auricles absent; *calyx lobes* (sepals) 6, glabrous within, triangular, c. 1.5 mm long, auricles in the sinuses absent; *petals* white, (narrowly) elliptic, c. 3 mm long (including c. 0.5 mm long claw), margin entire; *stamens* radially dimorphic (the outer 5–6 longer than the numerous inner ones); *ovary* glabrous. *Capsules* glabrous, outer surface drying shagreen, broadly ovoid, 10–12 mm long, (4–)5-valved; *fruiting calyx* c. 3 mm long, 5–6-ridged (not winged), calyx lobes glabrous within, somewhat reflexed, auricles absent; fruiting pseudopedicel c. 2 mm long. — **Fig. 15.**

Distribution — C Java, SW of Banyumas, Nusa Kambangan ('Banjoemas Province').

Habitat & Ecology — Forest at low altitudes, possibly on limestone; flowering in March; fruiting in September and October.

Notes — 1. *Lagerstroemia vanosii* somewhat resembles *L. ovalifolia*, of which the petals, including the claw, are 15–20 mm long, while those of *L. vanosii* are among the smallest known in *Lagerstroemia*, including claw their length is c. 3 mm.

2. *Lagerstroemia vanosii* was recently described from old material (*Koorders 20043*, *Koorders 24643*, and *Koorders 26924*) and it was never collected again. The specimens concerned were neglected in Backer & Bakhuizen van den Brink Jr.'s Flora of Java. It is an endemic lowland species, apparently restricted to limestone.

5. LAWSONIA

Lawsonia L., Sp. Pl. (1753) 349, emend. Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 270, f. 59; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 240. — Type: *Lawsonia inermis* L.

Shrubs, lateral twiglets spiny or not, 1.5–6 m tall, glabrous. *Leaves* opposite, short petioled. *Inflorescences* small terminal (or axillary) leafy panicles. *Flowers* 4-merous, actinomorphic; bracteoles 2, minute; *calyx tube* (floral tube) short obconical, less than twice as long as broad, deeply divided, lobes (sepals) 4, ovate, epicalyx appendages absent; small crenate disc inside at base of calyx tube present; *petals* 4, reniform, crumpled, very shortly clawed, longer than calyx lobes, yellow or red; *stamens* usually 8, in 4 pairs, inserted near base of the calyx lobes; *ovary* superior, free, sessile, subglobose, (2–)4-celled, ovules numerous, placentas axillary, style slender, slightly longer than

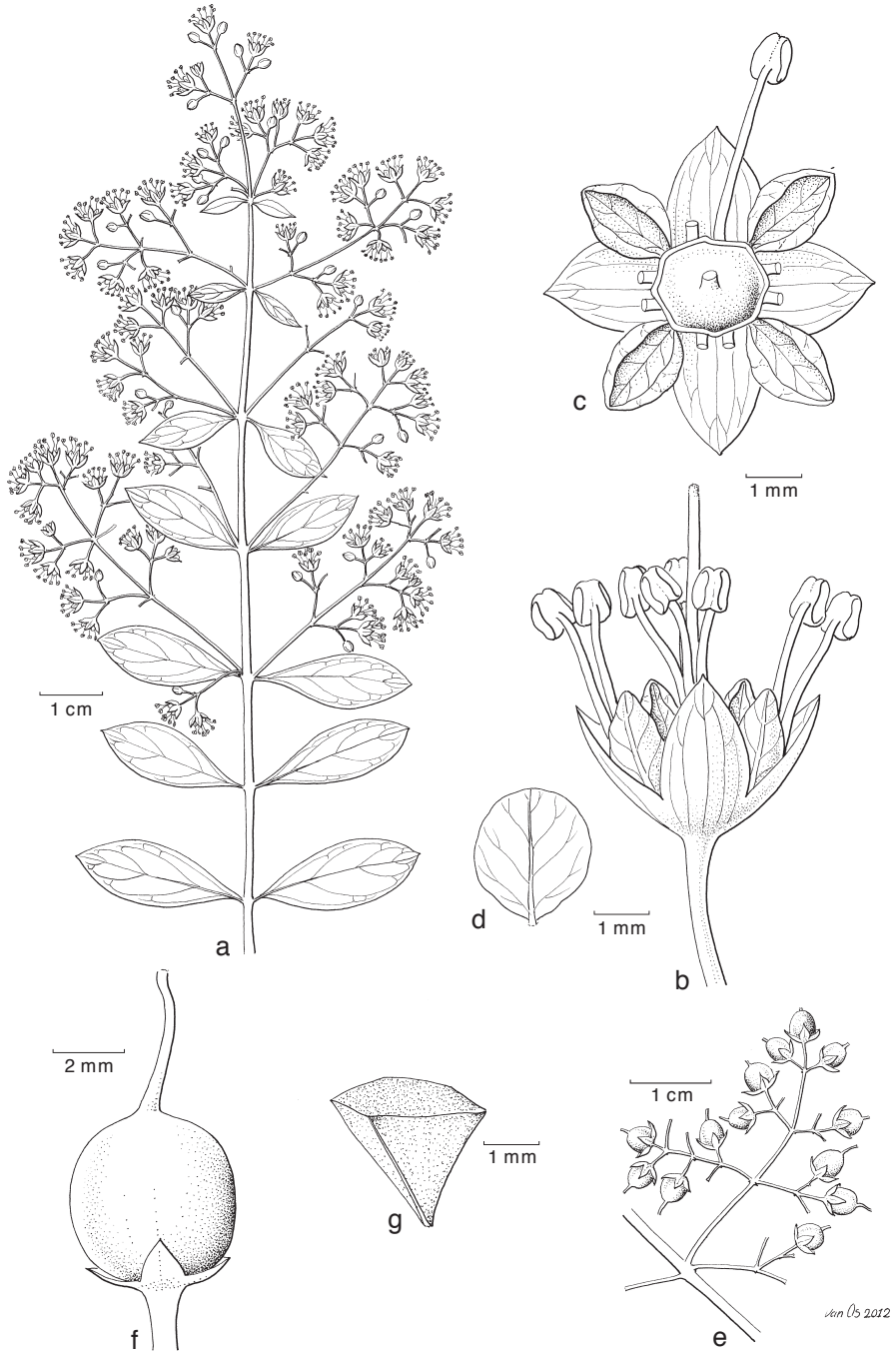

Fig. 16. *Lawsonia inermis* L. a. Flowering branch; b, c. flower, lateral and apical view, respectively; d. petal; e. portion of infructescence; f. fruit; g. seed (d: *Van Ooststroom 12491*, e–g: *Teo & Pachiappan KL 3081*; all L).

stamens, stigma punctiform. *Capsule* (depressed) globose, sessile in calyx tube, much exserted, indehiscent, many-seeded. *Seeds* numerous, obpyramidal, unwinged, without sarcotesta; cotyledons flat, equal in size.

One species. Probably native to E Africa and SW Asia.

1. Lawsonia inermis L.

Lawsonia inermis L., Sp. Pl. 1 (1753) 349; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 962, f. 104: 1–5; Craib, Fl. Siam. 1 (1931) 718; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 256; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) 294: 3–5. — *Lawsonia* ('*Lausonia*') *alba* Lam., Encycl. 3, 2 (1792) 106, nom. superfl., combines *L. inermis* and *L. spinosa*. — Lectotype (designated by S.A.Graham, Harvard Pap. Bot. 9, 2005: 302): *Herb. Hermann 135* (BM photo), 'Habitat in India, Aegypto'.

Lawsonia spinosa L., Sp. Pl. 1 (1753) 349. — Lectotype (designated by S.A.Graham, Harvard Pap. Bot. 9, 2005: 302): *Herb. Hermann 134* (BM photo) 'Habitat in India'.

Shrubs, often much branched, with spiny short shoots or not spiny, young branchlets sharply angular (winged), old ones almost terete. *Leaves*: petiole 0.2–0.5 cm long; lamina membranous, glabrous, elliptic, oblong or subovate, 1.5–5 by 1–2(–3) cm, base acute, apex acute-short acuminate. *Panicles* often collected into an up to 20 cm long compound inflorescence. *Flowers* fragrant; *calyx tube* (floral tube) c. 1.5 mm long, lobes (sepals) acute, 2–2.5 mm long; *petals* at first light yellow, turning red or not, longer than the sepals, c. 3 by 4 mm; *stamens* patent, about twice as long as calyx lobes, falling off after anthesis, anthers small. *Capsule* 5–8 mm diam., crowned by the style or short style base remnant. *Seeds* with testa apically thickened, spongy, thinner and hard towards the base. — **Fig. 16.**

Distribution — As the genus; in *Malesia*: cultivated.

Uses — *Lawsonia inermis* is cultivated as an ornamental or for the leaves providing the red-brown henna dye used for colouring nails or hair.

6. PEMPHIS

Pemphis J.R.Forst. & G.Forst., Char. Gen. Pl., ed. 2 (1776) [67], no. 34; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 185; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 241. — Type: *Pemphis acidula* J.R.Forst. & G.Forst.

Shrubs or small trees, coastal; all parts appressedly grey hairy. *Leaves* opposite, (sub)-sessile. *Flowers* axillary, solitary (or paired), 6-merous, actinomorphic, distylic; *calyx tube* (narrowly) campanulate, less than twice as long as broad; *calyx lobes* (sepals) short; epicalyx appendages about half as long as calyx lobes; *petals* white; *stamens* 12, ± biseriate, inserted somewhat above base of calyx tube; *ovary* superior, globose, 1-locular with central basal placentation. *Capsule* dry, opening operculate, slightly exserted from calyx. *Seeds* numerous, irregularly obpyramidal, not winged, without sarcotesta; cotyledons equal in size.

A single coastal species, in E Africa, and in S and SE Asia east to the Marshall Islands in the Pacific Ocean, north to Japan (Ryukyu Islands).

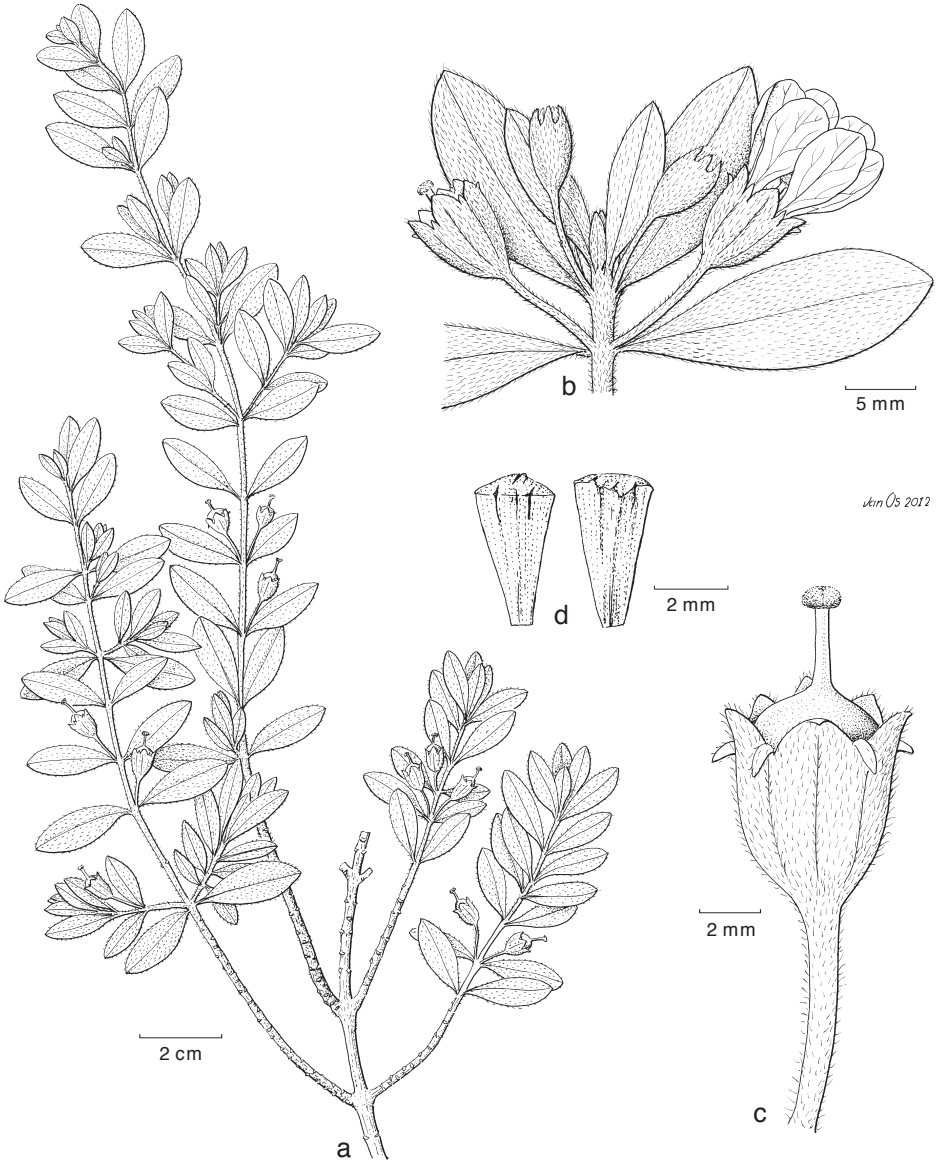

Fig. 17. *Pemphis acidula* J.R.Forst. & G.Forst. a. Branch with fruits; b. twig apex with flowers; c. fruit in persistent perianth; d. seeds (a, c, d: *Sinclair s.n.*, Feb. 1949; b: *Kerr 2094*; all L).

1. **Pemphis acidula** J.R.Forst. & G.Forst.

Pemphis acidula J.R.Forst. & G.Forst., Char. Gen. Pl., ed. 2 (1776) 68, t. 34; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 966, f. 104: 6–8; Craib, Fl. Siam. 1 (1931) 717; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 255; Hewson in A.S.George, Fl. Austral. 18 (1990) 105; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 30, f. 3679; T.C.Huang in T.C.Huang, Fl. Taiwan, ed. 2, 3 (1993) 878, pl. 436; Nicolson & Fosberg, Regnum Veg. 139 (2004) 483; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven,

Fl. China 13 (2007) 282; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 583. — *Lythrum pemphis* L.f., Suppl. Pl. (1782) 249, nom. superfl. — Lectotype (designated by Nicolson & Fosberg 2004): *Anonymous s.n.*, s.d. (S, S-G-4659, photo), Teutea (= Takaroa in the Tuamotus, French Polynesia).

Pemphis acidula J.R.Forst. & G.Forst. var. *crassifolia* Ridl., J. Straits Branch Roy. Asiat. Soc. 45 (1906) 196. — Type: *Ridley 47* (holo SING), Christmas island.

Shrubs or densely branched trees (0.5–)1–5 m tall, base of trunk to 10 cm diam. *Leaves* decussate; petiole to 0.2 cm long; lamina grey hairy, thick, succulent, narrowly elliptic to lanceolate, 1–3 by 0.3–1.5 cm, base attenuate, apex acute or obtuse, often terminating in a minute hydathode. *Flowers* axillary; bracteoles 2, minute, at base of pedicel 5–15 mm long; calyx tube 4–6 mm long, finely 12-ridged, thick-walled; *calyx lobes* short, about 1/4 as long as calyx tube; epicalyx appendages c. half as long; *petals* elliptic, or (ob)ovate or suborbicular, 5–8 by 3–5 mm, crumpled in bud; *stamens* 12, scarcely biseriate, 6 exserted in short-styled flowers, or all included in long-styled flowers; *ovary* globose, *style* long-exserted or included, stigma broad capitate. *Capsule* 1-locular (incompletely 3-locular), subglobose or obovoid, 6–9 mm long, some-

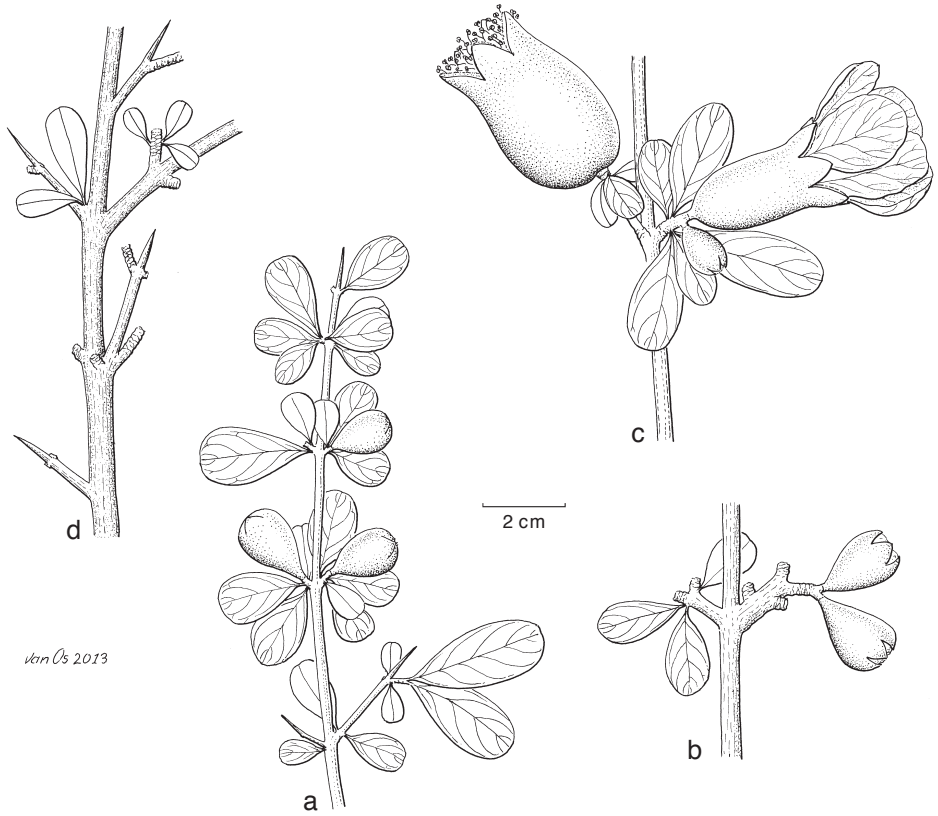

Fig. 18. *Punica granatum* L. a. Portion of twig with flower buds; b. detail; c. portion of flowering buds, petals of left flower removed; d. portion of twig showing spines (a, c: *Hennipman et al. 1037*, b, d: *Duyfjes et al. 278*; all L)

what exserted at maturity. *Seeds* c. 20, with one thickish margin, not winged, 2–3 mm long. — **Fig. 17.**

Distribution — As the genus.

Ecology — Coastal shrub on or behind (coral) beaches and on coastal limestone rocks, at low altitudes; flowering and fruiting all year round.

7. PUNICA

Punica L., Sp. Pl. 1 (1753) 472; Backer in Steenis, Fl. Males., Ser. 1, 4 (1951) 227; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 283; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 242; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 583. — Type: *Punica granatum* L.

For the treatment of *Punica*, formerly in family Punicaceae, see Backer (1951). — *Punica* contains 2 species, of which one (cultivated) in *Malesia*: *P. granatum* L. — **Fig. 18.**

8. ROTALA

Rotala L., Mant. (1771) 143, 175; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 24, f. 2; S.G.Panigrahi, Bull. Bot. Surv. India 18 ('1976', publ. 1979) 178; C.D.K.Cook, Boissiera 29 (1979) 1; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 275; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 242, f. 86; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 586. — Type: *Rotala verticillaris* L.

Sellowia Roth in Roem. & Schult., Syst. Veg. 5 (1819) 407. — Type: *Sellowia uliginosa* Roth.

Ammannia L. subg. *Ditheca* Wight & Arn., Prodr. Fl. Ind. Orient. (1834) 304, p.p. — *Ditheca* (Wight & Arn.) Miq., Fl. Ned. Ind. 1[1], 4 (1856) 615, p.p. — Lectotype (designated by Cook 1979): *Ditheca densiflora* (Roth) Miq. (= *Rotala densiflora* (Roth) Koehne).

Hydrolythrum Hook.f. in Benth. & Hook.f., Gen. Pl. 1 (1867) 777. — Type: *Hydrolythrum wallichii* Hook.f.

Annual or perennial herbs, amphibious or terrestrial, glabrous; *stems* erect, ascending, or floating. *Leaves* decussate, whorled or rarely alternate, sessile or shortly petiolate. *Bracts* leaf-like or scale-like; bracteoles 2 or absent. *Flowers* sometimes heterostylous, (sub)sessile, solitary in the axils of bracts along the main axis or in lateral or terminal racemes; *calyx tube* campanulate, enclosing the ovary, less than twice as long as broad; *calyx lobes* 3–6, valvate, persistent, tooth-like *calyx appendages* or small folds sometimes present between the calyx lobes; nectaries sometimes present at the base of the calyx tube (*R. wallichii*); *petals* 0–6, absent, minute or larger (0.5–2.5 mm long) and showy, usually crumpled in bud; *stamens* 1–6, episepalous, inserted in the calyx tube in the lower half, anthers dorsifixed, introrse; *ovary* superior, 2–4-locular, placentation axile, becoming free-central at maturity, stigma capitate (or 2-lobed, India). *Fruit* a septicidally dehiscent capsule, less than 5 mm long, opening by 2–4 valves (*R. hexandra* excepted), the valves with microscopic horizontal striations; one valve crowned by the persistent style. *Seeds* numerous or few, semi-ovoid or ellipsoid, with mucilaginous hairs, without sarcotesta; cotyledons equal in size.

Distribution — World-wide 44 species, mainly (sub)tropical, 24 species in Asia, 1 in Australia, 8 species in *Malesia*.

Note — The horizontal striations on the fruit valves were discovered by Koehne (1903); these striations, seen in *R. cordata*, appear to exist on the inner surface of the valves, probably caused by fine microscopic horizontal wrinkling of the surface (own observations).

KEY TO THE SPECIES

1a. Leaves (at least partly) whorled 2
b. Leaves decussate 3
2a. Petals absent . . . . . **5. R. mexicana**
b. Petals present . . . . . **8. R. wallichii**
3a. (Aerial) leaves or leaf-like bracts at base narrowly long-attenuate (appearing petiolate). Calyx lobes 4. Stamens 4. Capsule opening by (3–)4 valves **6. R. ramosior**
b. (Aerial) leaves at base cuneate, rounded, obtuse or cordate. Calyx lobes 4–6. Stamens 4–6. Capsule opening by 2–3 valves 4
4a. Calyx lobes, petals, and stamens 6. Stipule-like outgrowths present on the nodes . . . . . **3. R. hexandra**
b. Calyx lobes, petals, and stamens (3–)4–5. Stipule-like outgrowths on the nodes absent 5
5a. Calyx appendages between the calyx lobes present. Calyx lobes, petals, and stamens (4–)5. Capsule opening by 3 valves 6
b. Calyx appendages between the lobes absent. Calyx lobes, petals, and stamens 4. Capsule opening by 2–3 valves 7
6a. Bracteoles longer than calyx tube, provided with a midvein. Style at least 0.5 mm long . . . . . **2. R. densiflora**
b. Bracteoles equal to or ± shorter than calyx tube, without a midvein. Style less than 0.25 mm long . . . . . **7. R. rosea**
7a. Capsule opening by 3 valves. Leaves without a cartilaginous margin **1. R. cordata**
b. Capsule opening by 2 valves. Leaves with a narrow cartilaginous margin . . . . . **4. R. indica**

1. **Rotala cordata** Koehne

Rotala cordata Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 172; C.D.K.Cook, Boissiera 29 (1979) 93, f. 20: A–E, map 12; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 32, f. 3683; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 285; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 302: 5–7; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 587. — Type: *Hooker & Thomson s.n.* (holo G, G00227467, right hand specimen, photo), India ('India or.: Bengal reg. trop.!').

Rotala diversifolia Koehne, Bot. Jahrb. Syst. 41, 2 (1907) 77; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 974; Craib, Fl. Siam. 1 (1931) 715; Leeuwen, Blumea 19 (1971) 54. — Type: *Hosseus 275* (holo M photo; iso K, L), Thailand, Chiang Mai, Doi Suthep.

Annual herbs, to 50 cm long, amphibious or terrestrial; s*tems* erect, rooting at base, branched or simple, with 4 distinct white wings running into the leaf or bract margins; nodes without stipule-like outgrowths. *Leaves* decussate, sessile; lamina lanceolate, ovate, or oblong, to 2.5 cm long, base cordate, margin not cartilagenous, apex subob-

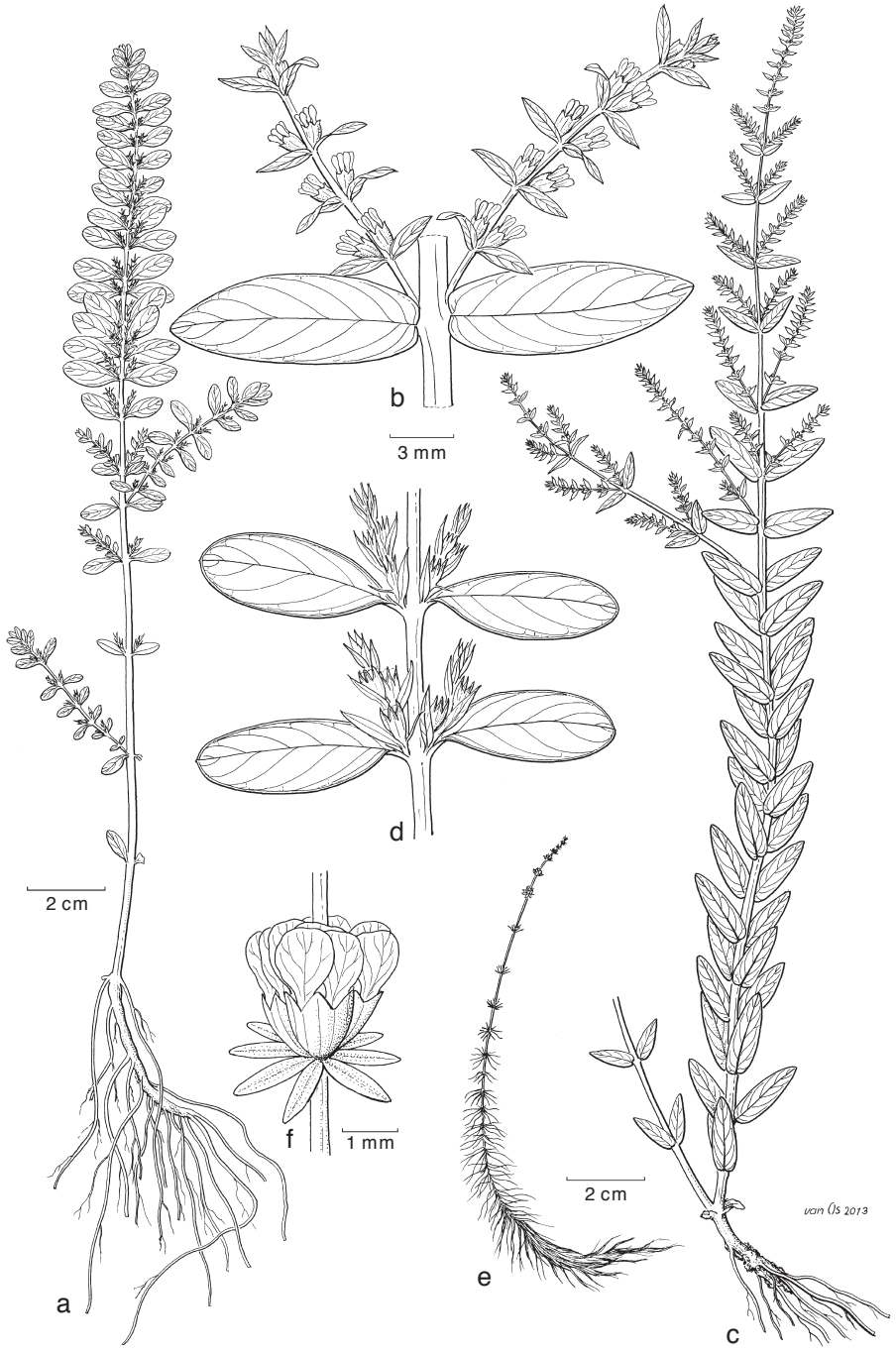

Fig. 19. Species of *Rotala*. a, b. *Rotala cordata* Koehne. — c, d. *Rotala indica* (Willd.) Koehne, note hyaline leaf margin. — e, f. *Rotala wallichii* (Hook.f.) Koehne, note several flowers crowded at a node (a, b: *Kerr 2260*, c, d: *Maxwell 88-1355*, e, f: *Maxwell 85-1167*; all L).

tuse. *Bracts* on main stem leaf-like, bracts on lateral inflorescence branches lanceolate or oblong, spreading or recurved, 2–3 times as long as subtended flower, base cordate; bracteoles 2, c. 0.2 mm long. *Flowers* subsessile, usually borne on contracted lateral branches or occasionally on the main stem; *calyx tube* campanulate, becoming subglobose in fruit, 1–1.5 mm long; *calyx lobes* 4, triangular, c. 0.5 mm long, margin usually minutely toothed, apex acuminate; *calyx appendages* absent; *petals* 4, pink or purple, obovate, equalling or up to 2 times as long as calyx lobes; *stamens* 4, inserted at 1/3 of the calyx tube, anthers level or slightly exceeding the tips of the calyx lobes; *ovary* globose, style 1–1.5 mm long, exserted. *Capsule* globose, 1–1.5 mm diam., included within the calyx tube, opening by 3 valves. *Seeds* subovoid, c. 0.5 mm long. — **Fig. 19a, b.**

Distribution — NE India to Vietnam; in *Malesia*: Sumatra (Samosir), Sulawesi, Papua.

Ecology — Swamps, open wet spots in loamy pools and ditches, and wet meadows; 500–1100 m altitude; flowering and fruiting from July to November.

Note — *Rotala cordata* resembles *R. indica*, but the latter differs in having smaller petals, a less broad leaf base, and a cartilaginous edge of the leaves.

2. **Rotala densiflora** (Roth) Koehne

Rotala densiflora (Roth) Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 164; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 253; Leeuwen, Blumea 19 (1971) 55; C.D.K.Cook, Boissiera 29 (1979) 82, f. 17. — *Ammannia densiflora* Roth in Roem. & Schult., Syst. Veg. ed. 15, bis 3 (1818) 304; Nov. Pl. Sp. (1821) 99; DC., Prodr. 3 (1828) 79. — *Ditheca densiflora* (Roth) Miq., Fl. Ned. Ind. 1[1] (1856) 615. — Type: *Heyne s.n.* (iso L 2 sheets, barcodes L0010070, L0010071), 'Indiae orientalis'.

Sellowia uliginosa Roth in Roem. & Schult., Syst. Veg. ed. 15, bis 5 (1819) 407; Nov. Pl. Sp. (1821) 163. — *Winterlia uliginosa* (Roth) Spreng., Syst. Veg. ed. 16, 1 (1824) 788, nom. superfl. — Type: *Heyne s.n.* (iso L, L0010072), 'Indiae orientalis uliginosis'.

Annual herbs, to 40 cm tall, amphibious or terrestrial; *stems* erect, 4-angular, usually winged, simple or branched; nodes without stipule-like outgrowths; upper branches slender, usually opposite, spreading, usually fertile with leaf-like bracts much shorter than leaf lamina. *Leaves* decussate; *lamina* linear-lanceolate, oblong or ovate, 0.2–3.5 cm long, base cordate or obtuse, apex obtuse, acute or acuminate. *Bracts* on main stem or on lower branches leaf-like, on the upper lateral branches much shorter and (broadly) ovate; bracteoles with a midvein, (narrowly) ovate, longer than the calyx, apex attenuate. *Flowers* in the axil of bracts; *calyx tube* campanulate, becoming subglobose in fruit, 1–1.5 mm long; *calyx lobes* 5, (shallowly) triangular, c. 0.5 mm long, acute or acuminate, *calyx appendages* linear, as long as or twice as long as calyx lobes; *petals* 5, pink (or white), obovate, sometimes erose or 2-lobed at apex, 0.5–1 mm long; *stamens* 5, inserted just below the middle of the calyx tube, anthers level with calyx lobes; *ovary* globose, style 0.5–1 mm long, exserted. *Capsule* (sub)globose, c. 1.5 mm long, opening by 3 valves. *Seeds* half-ovoid, c. 0.5 mm long.

Distribution — Western Himalayas (Tadzjik), Uzbekistan, N Pakistan, NE and Peninsular India, Sri Lanka, Australia (E Queensland); introduced in N Italy; in *Malesia* (according to Cook 1979): Sabah, only *Clemens 9766* (K not found).

Habitat & Ecology — Rice fields; flowering in October (Sabah).

Note — Australian material seen by Cook (1979) has 3 stamens. Material outside Malesia may have shortened internodes and thus leaves appearing as in whorls of 4.

3. **Rotala hexandra** Wall. ex Koehne

Rotala hexandra Wall. ex Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 167; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 252; Leeuwen, Blumea 19 (1971) 54; C.D.K.Cook, Boissiera 29 (1979) 47, f. 8: A–D; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 285. — (*Ammannia hexandra* Wall., Cat. No. 2103, nom. nud.) — Type: *Wallich 2103* (holo K-W; iso K), Myanmar, Sagaing.

Annual (or perennial?) herbs, to 40 cm tall, amphibious (or terrestrial); *stems* creeping and rooting, ascendant, 4-angular or winged. *Leaves* decussate; lamina lanceolate or oblong, 1–3 cm long, base of submerged or lower lamina cuneate or cordate, base of aerial or upper lamina cordate or auriculate, apex obtuse; *stipule-like outgrowths* on the nodes subulate, to 2 mm long, caducous (not to be confused with bracteoles). *Bracts* leaf-like, base auriculate, associated stipule-like outgrowths present; bracteoles scareous, linear, 1 mm long. *Flowers* monomorphic (?), (sub)sessile, often cleistogamous and flowering under water; *calyx tube* campanulate, c. 2 mm long, nerved between the calyx lobes; *calyx lobes* 6, (shallowly) triangular, c. 0.5 mm long, *calyx appendages* absent; *petals* 6, obovate or oblanceolate, c. 1 mm long, margin somewhat erose; *stamens* 6, inserted near base of calyx tube; anthers exserted; *ovary* globose, style c. 2 mm long, exserted. *Capsule* subglobose, c. 2.5 mm long, apparently breaking up when mature, but with characteristic fine *Rotala* stripes present. *Seeds* unknown.

Distribution — Myanmar, China (Hainan); in *Malesia*: W Java (Bogor), Philippines (Central Luzon).

Habitat & Ecology — Marshy places; flowering in April, July and December.

Notes — 1. Despite its rather wide distribution *R. hexandra* is only known from a limited number of collections, and is as yet not completely known.

2. The stipule-like outgrowths on the nodes are characteristic for *R. hexandra* and apparently unique in the family Lythraceae (Cook 1979).

4. **Rotala indica** (Willd.) Koehne

Rotala indica (Willd.) Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 172; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 973; Craib, Fl. Siam. 1 (1931) 716; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 252; Leeuwen, Blumea 19 (1971) 54; C.D.K.Cook, Boissiera 29 (1979) 108, f. 24, map 14; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 32, f. 3685; T.C.Huang in T.C.Huang, Fl. Taiwan, ed. 2, 3 (1993) 878, pl. 437; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 285; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 302: 1–4; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 587. — *Peplis indica* Willd., Sp. Pl. 2, 1 (1799) 244. — Type: *Klein 847* (holo B, B-W 07001-010 photo), India, Trankenbar (not *Klein 546* as stated by Cook 1979).

Ameletia acutidens Miq., Fl. Ned. Ind. 1[1] (1856) 617. — Type: *Horsfield s.n.* (holo U, barcode U0074669; iso K, barcode K000729612, photo), Java.

Annual herbs, amphibious or terrestrial, erect or decumbent and rooting at the nodes, latter without stipule-like outgrowths, usually branched; *stems* 4–40(–80) cm long, weakly 4-angled or terete. *Leaves* decussate, (sub)sessile, stipule-like outgrowths on the nodes absent; lamina obovate or subspathulate-oblong, or narrowly oblong, 0.4–2 cm long, base cuneate (or obtuse or somewhat cordate), margin cartilaginous (distinct on dried leaves), apex acute or obtuse. *Bracts* leaf-like or on spike-like lateral inflores-

cences smaller than foliage leaves, lanceolate; bracteoles linear, 1–2 mm long, about as long as the calyx tube. *Flowers* (sub)sessile, solitary in axils of bracts, either on main axis or on short, spike-like, lateral inflorescences; *calyx tube* 1.5–2.5 mm long, campanulate, angled on the nerves; *calyx lobes* 4, (acutely) triangular, 0.5–1.5 mm long, with cartilaginous margin; *calyx appendages* absent; *petals* 4, pinkish or white, persistent, linear or narrowly ovate, less than half as long as the calyx lobes; *stamens* 4, filaments inserted about half-way the calyx tube; anthers appearing just above the calyx lobe sinuses; *ovary* ellipsoid, c. 1.5 mm long, style 0.5–1 mm long, stigma level at or above the calyx lobes. *Capsule* red, ellipsoid, c. 2 mm long, opening by 2 valves. *Seeds* almost hemispherical, 0.3–0.4 mm long. — **Fig. 19c, d.**

Distribution — A widespread species: Iran, former USSR, Afghanistan, Pakistan, India, Andaman Islands, Sri Lanka, Nepal, Bhutan, Bangladesh, China, through Indochina east to N Korea, Japan; in *Malesia*: Sumatra, Peninsular Malaysia, Java, Philippines, Sulawesi, Lesser Sunda Islands (Lombok); also introduced in various places in Europe, Africa, and North America.

Habitat & Ecology — On moist places, open grassy places, fallow rice fields; also on limestone; from sea level to 950 m altitude; flowering and fruiting from March to December.

Note — *Rotala indica* resembles *R. cordata*, but the latter differs in having larger petals, a narrow leaf base, and in lacking the cartilaginous edge of the leaves.

5. Rotala mexicana Cham. & Schltdl.

Rotala mexicana Cham. & Schltdl., Linnaea 5 (1830) 567; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 972; Craib, Fl. Siam. 1 (1931) 716; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 253; Leeuwen, Blumea 19 (1971) 54; C.D.K.Cook, Boissiera 29 (1979) 33, f. 4, map 3; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 33, f. 3687; T.C.Huang in T.C.Huang, Fl. Taiwan, ed. 2. 3 (1993) 881, pl. 440; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 284; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 302: 18; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 589. — Type: *Schiede & Deppe 566* (holo HAL n.v.; iso MO, barcode MO2151195, photo), Mexico, Hacienda de la Laguna.

Ammannia pygmaea Kurz, J. Bot. 5 (1867) 376. — *Rotala pygmaea* (Kurz) Rajagopal & Ramayya, Kew Bull. 23 (1969) 465. — Type: *Kurz s.n.* (holo CAL?), India, Calcutta, Botanic Garden (not found).

Annual herbs, to 10 cm tall, terrestrial (or aquatic or amphibious); *stems* (branched or) simple, ascending or erect, often turf-forming. *Leaves* decussate or in whorls of 3–8; lamina linear (submerged leaves linear), 1 cm long or less. *Bracts* linear or (sub)ovate; bracteoles linear, about as long as the calyx tube. *Flowers* sessile, solitary; *calyx tube* pinkish, subglobose, 0.5–0.8 mm long, *calyx lobes* 3–5, but usually 4, broadly triangular, 0.25–0.5 mm long, *calyx appendages* and interjected folds absent; *petals* absent; *stamens* 1–4, usually included within the calyx tube; *ovary* globose, style very short or rarely up to 0.3 mm long. *Capsule* purplish, globose, 0.5–0.8 mm diam., opening by 3 valves. *Seeds* subovoid, c. 0.3 mm long.

Distribution — A very widespread species in the warmer parts of the world; in *Malesia*: Java, Philippines (Mindanao), New Guinea.

Ecology — Wet soil around pools in savanna forest, damp patches along tracks, dry and soggy sawahs; from sea-level to 550 m; flowering and fruiting from February to October.

Note — As pointed out by Cook (1979) *R. mexicana* is annual, self-compatible and has a world-wide distribution, therefore it exhibits a large variety of phenotypic as well as genotypic differentiation in growth forms and in separate plant parts, corroborated by plants grown in culture. Growth forms comprise largely submerged plants, as well as erect or prostrate land forms, including turf-forming facies.

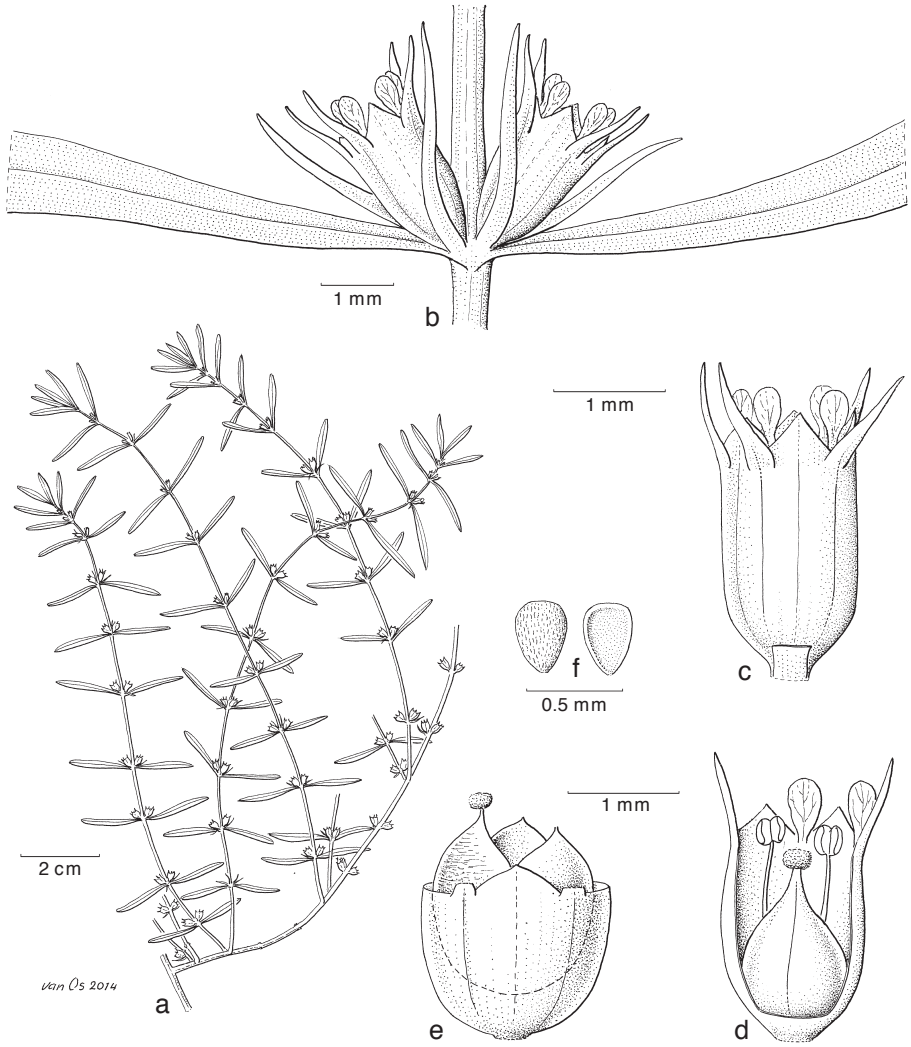

Fig. 20. *Rotala ramosior* (L.) Koehne. a. Habit; b. node with flower; c. ditto, lengthwise opened; e. calyx containing fruit (the latter drawn somewhat exserted to show finely transversely lined fruit valves; f. seeds (*Merrill Species Blancoanae 752*; L).

6. **Rotala ramosior** (L.) Koehne

Rotala ramosior (L.) Koehne in Mart., Fl. Bras. 13, 2 (1877) 194; Merr., Sp. Blancoan. (1918) 280; C.D.K.Cook, Boissiera 29 (1979) 74, f. 15, map 9. — *Ammannia ramosior* L., Sp. Pl. 1 (1753) 120. — Type: *Clayton 774* (holo BM photo), North America, Virginia.

Ammannia catholica Cham. & Schltdl., Linnaea 2 (1827) 378. — *Rotala catholica* (Cham. & Schltdl.) Leeuwen, Blumea 19 (1971) 54. — Lectotype (designated by Leeuwen 1971): *Chamisso s.n.* (holo LE n.v.; iso G, barcode G00227389, photo), Philippines, Luzon.

Ammannia monoflora Blanco, Fl. Filip. (1837) 64; Merr., Sp. Blancoan. (1918) 280. — Neotype (designated here): *Merrill 426* (holo L), Luzon, Manila.

Ammannia pentandra auct. non Roxb.: Llanos, Fragm. Pl. Filip. (1851) 49 (see Merr., Sp. Blancoan., 1918: 280).

Annual herbs, 10–25 cm tall, terrestrial or amphibious, glabrous, branched, erect or usually ascending; *stems* 1–2 mm diam., weakly 4-angled. *Leaves* and bracts decussate, subsessile; lamina oblong or narrowly elliptic, 1–4 by 0.3–0.6 cm, base long and narrowly attenuate, petiole-like, apex subacute or obtuse. *Bracts* leaf-like; bracteoles 1–6 by 0.3–1 mm, larger bracteoles leaf-like. *Flowers* monomorphic; *calyx tube* greenish white, red-tinged, urceolate, 2–4.5 mm long, globose in fruit; *calyx lobes* 4, triangular, c. 0.5 mm long, acute or apiculate; *calyx appendages* 4, spreading in bud, triangular, 0.5–1(–2) mm long; *petals* usually absent, when present white or pink, 0.5 mm long; *stamens* 4, filaments inserted near base of calyx tube, anthers white, included; *ovary* globose, style less than 0.5 mm long. *Capsule* globose, enclosed within the calyx, 2–4.5 mm long, opening by (3–)4 valves. *Seeds* dark red or brown, half-obovoid, c. 0.4 mm long. — **Fig. 20.**

Distribution — Widely distributed in North, Middle and South America; in *Malesia*: Philippines (Luzon) where naturalized (see Merrill 1918 and Cook 1979); also naturalized in Italy and Taiwan.

Habitat & Ecology — In inundated areas like rice fields, ponds, and shallow streams; flowering from October to March.

Note — According to Cook (1979) the Luzon specimens agree with a local race of *R. ramosior* occurring in Mexico; this race has variably long bracteoles and middle-long calyx appendages.

7. **Rotala rosea** (Poir.) C.D.K.Cook ex H.Hara

Rotala rosea (Poir.) C.D.K.Cook ex H.Hara, Enum. Fl. Pl. Nepal 2 (June 1979) 173; C.D.K.Cook, Boissiera 29 (July 1979) 86, f. 18: A–H; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 33, f. 3686; T.C.Huang in T.C.Huang, Fl. Taiwan, ed. 2. 3 (1993) 881; Verdc. in Dassan. et al., Revis. Handb. Fl. Ceylon 9 (1995) 225; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 286; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 302: 15–17; W.J.deWilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 590. — *Ammannia rosea* Poir. in Lam., Encycl. Suppl. 1 (1810) 329. — Type: *Desfontaines s.n.* (holo FT n.v.), 'Indes orientales'.

Ammannia leptopetala Blume, Mus. Bot. 2 (1856) 134. — *Rotala leptopetala* (Blume) Koehne, Bot. Jahrb. Syst. 1, 2 (1880) 162; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 253. — Type: *Blume s.n.* (holo L, barcode L0010078; iso L, barcodes L0010079, L2487716, L00248717), Java.

Rotala leptopetala (Blume) Koehne var. *pentamera* Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 35; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 971; Craib, Fl. Siam. 1 (1931) 716. — Type: not indicated.

Rotala pentandra auct. non (Roxb.) Blatt. & Hallb.: Leeuwen, Blumea 19 (1971) 55, p.p.

Annual herbs, 5–25 cm tall, terrestrial (or amphibious), *stems* procumbent at base, or erect, rooting at base, simple or branched mostly from lower part; nodes without stipule-like outgrowths. *Leaves* decussate, sessile; lamina linear-lanceolate or ovate, 0.5–1.5 by 0.1–0.4 cm, base obtuse or cuneate, apex obtuse or acute. *Bracts* leaf-like, smaller than foliage leaves but always longer than the flowers, base obtuse; bracteoles without a midvein, linear, 0.5–1 mm long, not exceeding the calyx tube. *Flowers* sessile; *calyx tube* campanulate, becoming semi-globose in fruit; *calyx lobes* (4–)5, triangular, c. 0.3 mm long; *calyx appendages* subulate, spreading in bud, about as long as the calyx lobes, rarely rudimentary or absent; *petals* (4–)5, rarely rudimentary, not persisting in fruit, c. 0.3 mm long; *stamens* (4–)5; filaments inserted below the middle of the calyx tube; anthers included, level with the apex of the calyx tube; *ovary* globose, style short, absent or to 0.3 mm long. *Capsule* usually red in upper part, globose, c. 2 times as long as the calyx tube, to 2 mm diam., opening by 3 valves. *Seeds* straw coloured, half-ovoid, c. 0.3 mm long.

Distribution — India, Indochina, S China, Korea, Japan; in *Malesia*: Sumatra, Peninsular Malaysia, Java, Philippines (Mindanao, Luzon), Papua.

Habitat & Ecology — In muddy sawahs, wet spots in grassy swamps and on forest slopes; from sea-level to 900 m; flowering and fruiting all year round.

Note — Both Cook (1979) and Verdcourt (1995) erroneously considered the name *Ammannia leptopetala* Blume as illegitimate; the name is, however, valid and a synonym of *R. rosea*.

8. Rotala wallichii (Hook.f.) Koehne

Rotala wallichii (Hook.f.) Koehne, Bot. Jahrb. Syst. 1 (1880) 154; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 972; C.D.K.Cook, Boissiera 29 (1979) 29, f. 2: C, D, map 1; P.H.Hô, Ill. Fl. Vietnam 2, 1 (1992) 34, f. 3688a; T.C.Huang in T.C.Huang, Fl. Taiwan, ed. 2. 3 (1993) 883, pl. 440; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 284; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 292: 10; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 591. — *Hydrolythrum wallichii* Hook.f. in Benth. & Hook.f., Gen. Pl. 1 (Sept. 1867) 777; Ic. Pl. 11 (or Ser. 3, 1) (Nov. 1867) 5, t. 1007. — Type: *Gomez s.n.*, Wallich Cat. 9059 (holo K-W, K000729665; iso K-W 3 sheets), Myanmar (Tavoy).

Subperennial herbs, to 30 cm long, aquatic or amphibious; *stems* floating or creeping, rooting and branched in basal part, or when erect little branched or unbranched. *Leaves* in whorls of 4 or more; submerged laminas linear or capillary, thin, translucent, tinged with red, to 2 cm long, apex more or less bifid; aerial leaves usually in whorls of 3–12 (less than submersed leaves), rarely decussate, linear or oblong, rarely more than 0.5 cm long, apex obtuse or bifid. *Bracts* like aerial leaves, 1.5–3 mm long; bracteoles linear, to 0.5 mm long. *Flowers* solitary, several at each node; pedicel adnate to bract, to 1 mm long; *calyx tube* campanulate, membranous, translucent, c. 1.5 mm long; *calyx lobes* 4, triangular, c. 0.5 mm long; *calyx appendages* absent; *petals* 4, pink, showy, obovate, c. 2.5 mm long; *stamens* 4, inserted below the middle of the calyx tube; anthers level with the top of the calyx lobes; nectar scales bi-lobed; *ovary* globose, style c. 0.5 mm long. *Capsule* only seen immature (Cook 1979), globose, c. 1 mm diam., opening by 2 valves. *Seeds* subovoid, c. 0.7 mm long. — **Fig. 19e, f.**

Distribution — NE India, Myanmar, Laos, Vietnam, S China (Kwantung), Taiwan; in *Malesia*: Peninsular Malaysia (Kedah, Johor).

Habitat & Ecology — In primary forest, gregarious in shallow streams, also on sandbanks.

Uses — Decorative aquarium plant.

Note — *Rotala wallichii* can develop dense floating masses. The terrestrial form is moss-like with shorter, harder leaves.

9. SONNERATIA

Sonneratia L.f., Suppl. Pl. (1782) 38, 252., nom. cons.; Backer & Steenis in Steenis, Fl. Males., Ser. 1, 4 (1951) 280; V.C.Vu in Aubrév. & Tardieu, Fl. Cambodge, Laos & Vietnam 4 (1965) 194; Steenis, Fl. Males., Ser. 1, 6 (1972) 973; Santisuk in Smitinand & K.Larsen, Fl. Thailand 5, 4 (1992) 436; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 286; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 243, f. 78. — Type: *Sonneratia acida* L.f.

For the treatment of *Sonneratia*, formerly in family Sonneratiaceae, see Backer & Steenis (1951). — In *Malesia* 4 species: *S. alba* Sm., *S. caseolaris* (L.) Engl., *S. griffithii* Kurz, and *S. ovata* Backer; *S. apetala* Buch.-Ham. can be expected. — **Plate 1b.**

10. TRAPA

Trapa L., Sp. Pl. 1 (1753) 120; Gen. Pl. 5 (1754) 56; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 982; Steenis, Fl. Males., Ser. 1, 4 (1949) 43; V.C.Vu & J.E.Vidal in Aubrév. & J.-F.Leroy, Fl. Cambodge, Laos & Vietnam 14 (1973) 40; C.F.Hsieh in T.C.Huang, Fl. Taiwan 3 (1993) 968; S.A.Graham in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 243, f. 87; C.J.Chen et al. in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 290; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 593. — Type: *Trapa natans* L.

For the treatment of *Trapa*, formerly in the family Hydrocaryaceae, see Steenis (1949).

Trapa occurs in temperate and (sub)tropical Africa, Asia, and Europa; introduced elsewhere; in *Malesia* 2 species (Steenis 1949): *T. bicornis* Osbeck var. *cochinchinensis* (Lour.) Glück ex Steenis (= *Trapa natans* L. var. *bicornis* (Osbeck) Makino), and *T. maximowiczii* Korsh. — **Plate 1c.**

11. WOODFORDIA

Woodfordia Salisb., Parad. Lond. 1, 2 (1806) t. 42; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 78; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 252; S.A.Graham, Syst. Bot. 20 (1995) 482; in Kubitzki, Fam. Gen. Vasc. Pl. 9 (2007) 244. — Type: *Woodfordia floribunda* Salisb., nom. superfl. (= *Woodfordia fruticosa* (L.) Kurz).

Shrubs or small trees, irregularly branching. *Leaves* opposite (decussate), (sub)sessile, whitish short hairy, lower surface glandular black-punctate; stipules absent (some hairs present only). *Inflorescences* condensed, in axils of leaves or fallen leaves, (branched) racemes to 3 cm long, bracts minute. *Flowers* 5- or 6-merous, slightly zygomorphic; bracteoles 2, minute; *calyx tube* elongate, more than 2 times longer than broad, slightly constricted at level of stamen insertion; sepals short, alternating at sinus with minute

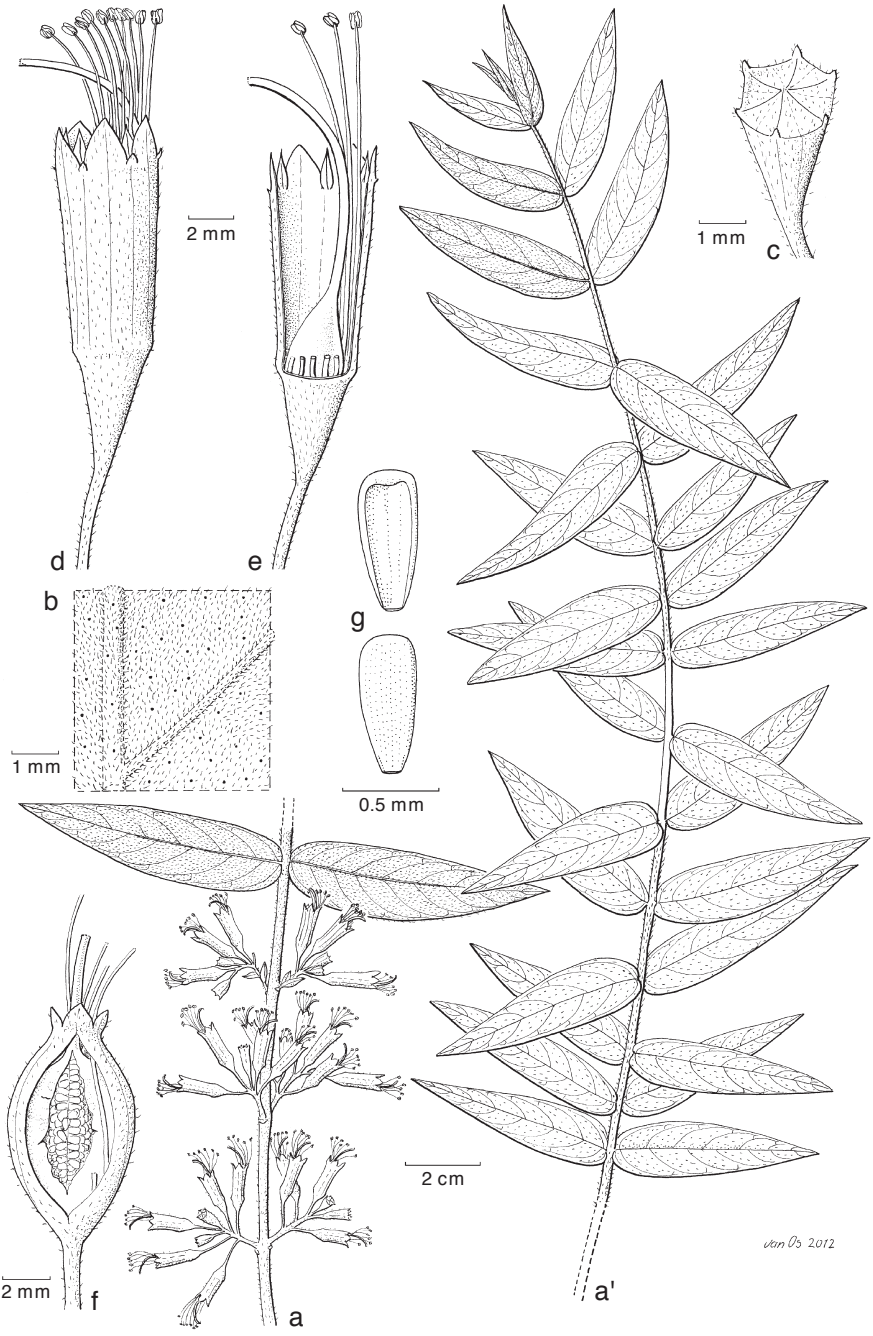

Fig. 21. *Woodfordia fruticosa* (L.) Kurz. a, a'. Apex of twig; b. detail of lower leaf surface showing blackish glandular dots; c. flower bud; d, e. flower, from outside and calyx tube, petals and stamens partly removed, respectively; f. lacerated persistent calyx with enclosed fruit, opened, showing seeds; g. seeds (a–e: *Read 2263*, f, g: *Malhotra BSI 26753*; all L).

epicalyx processes; *petals* red, small, persistent; *stamens* 12, in two whorls, alternating in length, inserted deeply in the tube; *ovary* superior, ellipsoid, (sub)sessile, nearly 2-locular; style thicker and longer than staminal filaments, ultimately together with the stamens long exserted and curved towards one side; stigma punctiform; placenta appearing as central. *Capsules* thin-walled, translucent at maturity, irregularly (or loculicidally) dehiscent. *Seeds* many, narrowly obpyramidal, small; cotyledons equal in size.

Two species, one in Africa and the Arabian Peninsula, one species occurring naturally in Madagascar and SE Asia.

1. Woodfordia fruticosa (L.) Kurz

Woodfordia fruticosa (L.) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 40 (1871) 56; Koehne in Engl., Pflanzenr. 17.IV.216 (1903) 78, f. 12: A; Gagnep. in Lecomte, Fl. Indo-Chine 2 (1921) 964; Craib, Fl. Siam. 1 (1931)717; R.A.Howard & Jayaw., Baileya 10 (1962) 15; Backer in Backer & Bakh.f., Fl. Java 1 (1964) 254; H.N.Qin & S.A.Graham in Wu Zhengyi & P.H.Raven, Fl. China 13 (2007) 288; H.N.Qin et al. in Wu Zhengyi & P.H.Raven, Fl. China Ill. 13 (2008) f. 305: 1–3; W.J.de Wilde et al. in Santisuk & Balslev, Fl. Thailand 11, 4 (2014) 597. — *Lythrum fruticosum* L., Syst. Nat., ed. 10, 2 (1759) 1045. — *Grislea tomentosa* Roxb., Pl. Coromandel 1 (1795) 29, t. 31, nom. superfl. — *Woodfordia floribunda* Salisb., Parad. Lond. (1806) t. 42, nom. superfl.; C.B.Clarke in Hook.f., Fl. Brit. India 2 (1879) 572. — Lectotype (designated by Dar in Nasir & Ali, Fl. W. Pakistan 78, 1975: 6): Herb. Linn. No. 626.4 (LINN), China.

(*Lythrum punctatum* Span., Linnaea 15 (1841) 202, nom. nud.)

Shrubs or treelets, 1–6 m tall, stems and branches elongate, bark whitish, membranous-flaky, young twigs pubescent, glabrescent. *Leaves*: petiole c. 0.1 cm long; lamina sparsely or densely hairy above, subglabrous or especially on nerves short-hairy beneath, blackish glandular punctate beneath, lanceolate or ovate-lanceolate, 3–14 by 0.5–4 cm, base rounded or subcordate, apex long acuminate. *Inflorescences* with 2–15 flowers, pedicels short. *Flowers*: *calyx tube* (orange-)red, greenish towards base, 9–15 mm long; *calyx lobes* oblong-ovate or triangular, 2–3 mm long, epicalyx appendages minute; *petals* 6, lanceolate, long acuminate, 2(–5) mm, about as long as the sepals; *stamens* 12, somewhat unequal in length, inserted above the base of the ovary, long exserted towards one side; *ovary* ellipsoid, to 10 mm long; style c. 8 mm long. *Capsules* ellipsoid, 5–10 mm long, sometimes lacerating the calyx. *Seeds* reddish brown, 1–1.5 mm long. — **Fig. 21; Plate 1d.**

Distribution — Madagascar, Pakistan, India, Nepal, Bhutan, S China, Myanmar, Thailand, Laos, Vietnam; in *Malesia*: Java, Madura, Philippines (1 collection), Sulawesi (1 collection), Lesser Sunda Islands (Bali, Sumbawa, Sumba, Timor (most collections)).

Habitat & Ecology — Shrub vegetation in areas with a (long) dry period, in (semi) dry forest on rocky ridges; on very dry lava soil, also on limestone; 50–1550 m altitude; flowering from May to November; fruiting from August to November.

Uses — The flowers are used as a dye (India and elsewhere).

Vernacular name — Lesser Sunda Islands: Silu (Timor).

Notes — 1. *Woodfordia fruticosa* is a rare plant, mostly only few specimens are found on a collecting site, often sterile, rarely flowering.

2. Schmutz (*Schmutz 2248*, Timor) saw one plant on a large stone in a streambed and noted it as a real rheophyte; Coert (*Coert 3583*, E Java) regarded it to be a kremnophyte.

INDEX TO SCIENTIFIC PLANT NAMES

Numbers refer to page numbers. Infrageneric epithets have been entered directly under the generic name to which they belong, preceded by the indication of their rank (subg., sect., etc.). Infraspecific epithets have been entered under the specific name to which they belong, preceded by the indication of their rank (subsp., var., etc.).

Synonyms (including nomina nuda) have been printed in *italics*. Page numbers in **bold** type denote main treatment.