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A revision of *Jatropha* (*Euphorbiaceae*) in Malesia

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Key words

Euphorbiaceae
introduced species
invasive species
Jatropha
Malesia
revision

Abstract *Jatropha*, a widespread, species rich genus, ranges from the Americas and Caribbean to Africa and India. In Malesia five species occur, all of which were introduced and originated in Central and South America. The five species are revised and an identification key, nomenclature, descriptions, distributions, ecology, vernacular names, uses and notes are provided. Special attention is given to the uses of *J. curcas*, because it is steadily gaining popularity as a potential biofuel plant and, because of that, is being cultivated more often.

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INTRODUCTION

The genus *Jatropha* L. has recently gained increased interest of the general public due to one of its species, *J. curcas* L., of which the oil in the seeds is a new source of biofuel (e.g., Berchmans & Hirata 2008). *Jatropha* is a widely distributed genus, ranging from tropical America to Africa and India (Dehgan & Webster 1979). In Malesia the members of this genus are introduced and were formerly used for medicine and as hedgerows, nowadays they are mainly used as ornamentals (*J. gossypiifolia* L., *J. integerrima* Jacq., *J. multifida* L., *J. podagrica* Hook.) (label information, Burkill 1935, Heyne 1950), or for biofuel (*J. curcas*). Especially, *J. curcas* and *J. gossypiifolia* escaped from cultivation and established themselves over the whole of Malesia and have the potential to be damaging, invasive species (Sweet et al., unpubl. ms.). *Jatropha gossypiifolia* is already considered a medium impact invasive weed in Australia (Thorpe & Lynch 2000) and species for its biological control are evaluated (Heard et al. 2002).

Webster (1994, 2014) and Radcliffe-Smith (2001) classify *Jatropha* in the subfamily *Crotonoideae* tribe *Jatropheae*. In the skeleton phylogeny of the *Euphorbiaceae* by Wurdack et al. (2005) *Jatropha* is part of clade C1 (their f. 4), together with members of tribe *Crotoneae* (sensu Webster 1994, 2014, Radcliffe-Smith 2001).

Müller Argoviensis (1866) provided a first infrageneric classification, based on work of Baillon (1864), recognizing three sections of which two were subdivided into two subsections. He still included *Cnidoscolus* as the third section, now regarded as a distinct genus (e.g., McVaugh 1944, Radcliffe-Smith 2001, Webster 2014). Pax (1910) made a much more elaborate division with subgenera, sections and subsections, but also included *Cnidoscolus*. The most recent infrageneric classification is by Dehgan & Webster (1979), which was more or less confirmed by a phenetic (and less by an, on morphological characters based, phylogenetic) analysis by Dehgan & Schutzman (1994). Dehgan & Webster (1979) based themselves on Pax (1910) and also used subgenera, sections and subsections (but excluded *Cnidoscolus*). Of the Malesian species only *J. curcas* is part of subg. *Curcas* (Adans.) Pax sect. *Curcas* (Adans.) Griseb. The other four species are classified in subg. *Jatropha*. Within the latter subgenus *J. gossypiifolia* is part of sect. *Jatropha* subsect. *Adenophorae* Pax ex Dehgan & G.L.Webster (nom. inval., must be subsect. *Jatropha*); *J. integrifolia* is part of sect. *Polymorpha* Pax subsect. *Polymorphae* (Pax) Dehgan & G.L.Webster, and, finally, *J. multifida* and *J. podagrica* are placed in sect. *Peltatae* (Pax) Dehgan & G.L.Webster.

A first attempt to circumscribe Malesia as a region was made by Zollinger (1857; see also Lam 1937, Raes & Van Welzen 2009). Van Steenis (1948, 1950) was the first to provide proof that Malesia is a phytogeographical region, which was confirmed by Van Welzen et al. (2005). In 1951 Van Steenis launched his ambitious international project to revise all plant genera in Malesia, the 'Flora Malesiana' project, that, to date, is still running. The present revision is a contribution to this project.

Characters

The character states mentioned in this chapter only pertain to the Malesian taxa. An elaborate and excellent discussion of the morphology of *Jatropha* can be found in Dehgan & Webster (1979).

Habit

Dehgan & Webster (1979) describe *J. gossypiifolia* as a 'facultatively annual, herbaceous subshrub with woody stem' as the plant more or less dies back every year in greenhouses. Outside greenhouses, under tropical conditions, the species is truly perennial and just like *J. integerrima* a shrub. *Jatropha podagrica* is characterized by Dehgan & Webster (1979) as an 'erect fleshy subshrub with woody-succulent, above-ground caudex and branches', this species typically has a broad, succulent flask-like stem-base apically tapering into a far more slender upper stem part with a terminal tuft of leaves and inflorescences. *Jatropha curcas* and *J. multifida* can become higher shrubs to small trees up to 10 m high.

Indumentum

Most of the species are glabrous or have in various parts an indumentum of mainly simple hairs. Only *J. gossypiifolia* has long and very distinct glandular trichomes all over the plant,

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which come in two types, branching trichomes with an elongated glandular head or mushroom-like, non-branching ones with a broad, horizontal glandular, capitate head.

Leaf morphology

The stipules are ovate or triangular in *J. curcas* and *J. integerrima*, and can be early caducous. In *J. multifida* and *J. podagrica* the stipules are branched into narrow lobes, in *J. gossypiifolia* the stipules are dissected and resemble the branching glandular trichomes.

All the species have simple, alternate leaves that are lobed (3–13 lobes), but sometimes the lobes are not obvious (*J. integerrima*). *Jatropha integerrima* and *J. multifida* have small side-lobes, *J. integerrima* mainly at the base of the blade, and *J. multifida* alternately along the lobes. The margins are generally entire, with *J. gossypiifolia* and *J. multifida* being exceptions to that. *Jatropha gossypiifolia* has a finely serrate margin with simple and glandular, unbranched hairs, and *J. multifida* has one or more side-lobes. The species are basally palmately veined, the secondary veins along the midrib (of the central lobe) loop and anastomose near the margin, the higher order of veins are reticulate.

Inflorescences

The inflorescences are usually subterminal and cymose, often corymbiform, consisting of usually compound cymes or variations with reductions. Typical for the genus is that every primary branch ends with a pistillate flower, the lateral flowers in the cymes are generally staminate.

The basal bract is by far the largest and often they have similar hairs or glandular hairs as the normal leaves, sometimes they also have stipule-like lateral structures. Upwards the bracts decrease in size.

Staminate and pistillate flowers

The flowers are 5-merous and actinomorphic. The sepals of the staminate flowers are connate into a calyx in all species except *J. gossypiifolia*; those of the pistillate flowers are also connate in all species except *J. podagrica*. The sepals can have entire or serrate margins with glandular hairs. The petal margins are entire. The disc is 5-lobed. *Jatropha curcas* and *J. integerrima* have 10 stamens (two whorls of 5), the other species have 8 (outer, basal whorl 5, inner, upper 3), especially the inner ones can be united into an androphore, but the stamens are free in *J. multifida* and *J. podagrica*. The anthers are (dorsi)basifixed and open through a lengthwise slit per theca, either latrorse or extrorse. There are two thecae, which are often basally divaricate. The staminate flowers lack a pistillode. The pistillate flowers are generally (2–)3(–4)-locular, with a single ovule per locule, and the style is short and the three stigmas usually have a lower, narrow, unreceptive part and a broadened and largely split, upper receptive part.

Fruits and seeds

The fruits are all ellipsoid, smooth capsules (regmas), usually slightly 3-lobed and often with three grooves along the septa and three slight grooves (or thickenings) over the locules. The walls are thin, at most 1 mm thick. Fruit dehiscence is loculicidal in *J. curcas*, septicidal and partly loculicidal in *J. gossypiifolia* and *J. podagrica*, and only septicidal in *J. integerrima* and *J. multifida*. The expulsion of the seeds from the locule is performed explosively in some species by twisting the locule wall, aided by a thickening of the radial wall, also called a callus. The globose to ellipsoid seeds are glabrous and possess an apical, often multilobate caruncle.

TAXONOMIC TREATMENT

Jatropha L.

Jatropha L. (1753) 1006; (1754) 437; A.Juss (1824) 37; Baill. (1858) 294; Miq. (1859) 391; Müll.Arg. (1866) 1076; Kurz (1877) 402; Benth. (1880) 290; Hook.f. (1887) 382; Pax (1910) 21; Gagnep. (1926) 323; Pax & K.Hoffm. (1931) 160; McVaugh (1945) 271; Backer & Bakh.f. (1963) 494; Airy Shaw (1972) 283; (1975) 137; Dehgan & G.L.Webster (1979) 1; Airy Shaw (1982) 25; Grierson & D.G.Long (1987) 790; Radcl.-Sm. (1987) 343; G.L.Webster (1994) 103; Philcox (1997) 83; Govaerts et al. (2000) 1017; Radcl.-Sm. (2001) 288; Chantharaprasong & Welzen (2007) 343; Li Bingtao & M.G.Gilbert (2008) 268; G.L.Webster (2014) 125; Fern.Casas (2016) 2. — *Jatropha* L. subg. *Jatropha* subsect. *Jatropha*: Dehgan & G.L.Webster (1979) 39. — Conserved type (Wiersema et al. 2015: 238): *Jatropha gossypiifolia* L.

Curcas Adans. (1763) 356; Baill. (1858) 313; Britton & Millsp. (1920) 224. — *Curcas* Adans. sect. *Eucurcas* Baill. (1858) 314, nom. inval. — Type: *Jatropha curcas* L. (Adanson did not provide a species name, the combination *Curcas adansonii* Endl. ex Heynh. was made later).

Castiglionia Ruiz & Pav. (1794) 139. — Type: *Castiglionia lobata* Ruiz & Pav. [= *Jatropha curcas* L.]

Mozinna Ortega (1798) 104; A.Juss. (1824) 35; Hook. (1841) t. 357. — *Curcas* Adans. sect. *Mozinna* (Ortega) Baill. (1858) 315. — Type: *Mozinna spathulata* Ortega [= *Jatropha dioica* Sessé].

Loureira Cav. (1799) 17. — Lectotype (designated by Dehgan & Webster 1979: 47): *Loureira glandulifera* Cav. [= *Mozinna cordata* Ortega = *Jatropha cordata* (Ortega) Müll.Arg.].

Adenoropium Pohl (1827) 12. — *Jatropha* L. sect. *Adenorhopium* (Pohl) Griseb (1859) 36; Müll.Arg. (1866) 1082; Benth. (1880) 291. — Lectotype (designated by Dehgan & Webster 1979: 39): *Adenoropium gossypiifolium* (L.) Pohl [= *Jatropha gossypiifolia* L.].

Zimapania Engl. & Pax (1891) 119. — Type: *Zimapania schiedeana* Engl. & Pax [= *Jatropha dioica* Sessé].

Collenucia Chiov. (1929) 177. — Type: *Collenucia paradoxa* Chiov. [= *Jatropha paradoxa* (Chiov.) Chiov.].

(Description based on Malesian species only) Large herbs to shrubs to treelets, monoecious, protogynous; taproot thick, long. *Indumentum* absent, of simple hairs or glandular. *Stipules* distinct or not, simple or split multiple times. *Leaves* simple, alternate, eglandular except sometimes for hairs; petioles not pulvinate; blades often palmately lobed to -partite with lobed segments, margin entire to undulate to finely serrate, with simple and glandular hairs on tips when serrate; venation at least basally palmate, bronchidodromous, anastomosing, veinlets reticulate. *Inflorescences* usually terminal, cymose, often corymbiform, with a pistillate flower ending every primary branch, more lateral flowers staminate; bracts elliptic or triangular, sometimes narrow, margin entire to serrate, becoming smaller upwards. *Flowers* unisexual, 5-merous, actinomorphic; sepals 5, often basally united, imbricate; petals 5, free or adnate, contort, glabrous, but in some species (partly) hairy inside; disc glands 5, alternating with the petals. *Staminate flowers*: sepal margin serrate to entire; petal margin entire; stamens 8 or 10 in two whorls, outer 5, inner 5 or 3, filaments free or partly united (especially inner whorl) in an androphore, anthers (narrowly) elliptical to triangular, (dorsi)basifixed, opening latrorse to extrorse via lengthwise slits, 2-thecate, these basally hardly to distinctly divaricate; pistillode absent. *Pistillate flowers*: sepals, petals and disc glands like in staminate flower, ovary (2–)3(–4)-locular, with a single ovule per locule; style short, stigmas 3, often resembling anthers and usually divided into a narrow unreceptive part (filament-like) and a receptive, almost completely split, broadened and thickened part (anther-like). *Fruits* globular to ellipsoid, capsular, slightly 3-lobed, dehiscing either only septicidally, only loculicidally or completely septicidally and partly loculicidally; wall thin, at most c. 1 mm thick. *Seeds* glabrous; caruncle 2- to multifid.

Distribution — According to Govaerts et al. (2000) a genus of c. 190 species in the tropical and subtropical regions of the Americas (incl. Caribbean), Africa (incl. Madagascar) up to

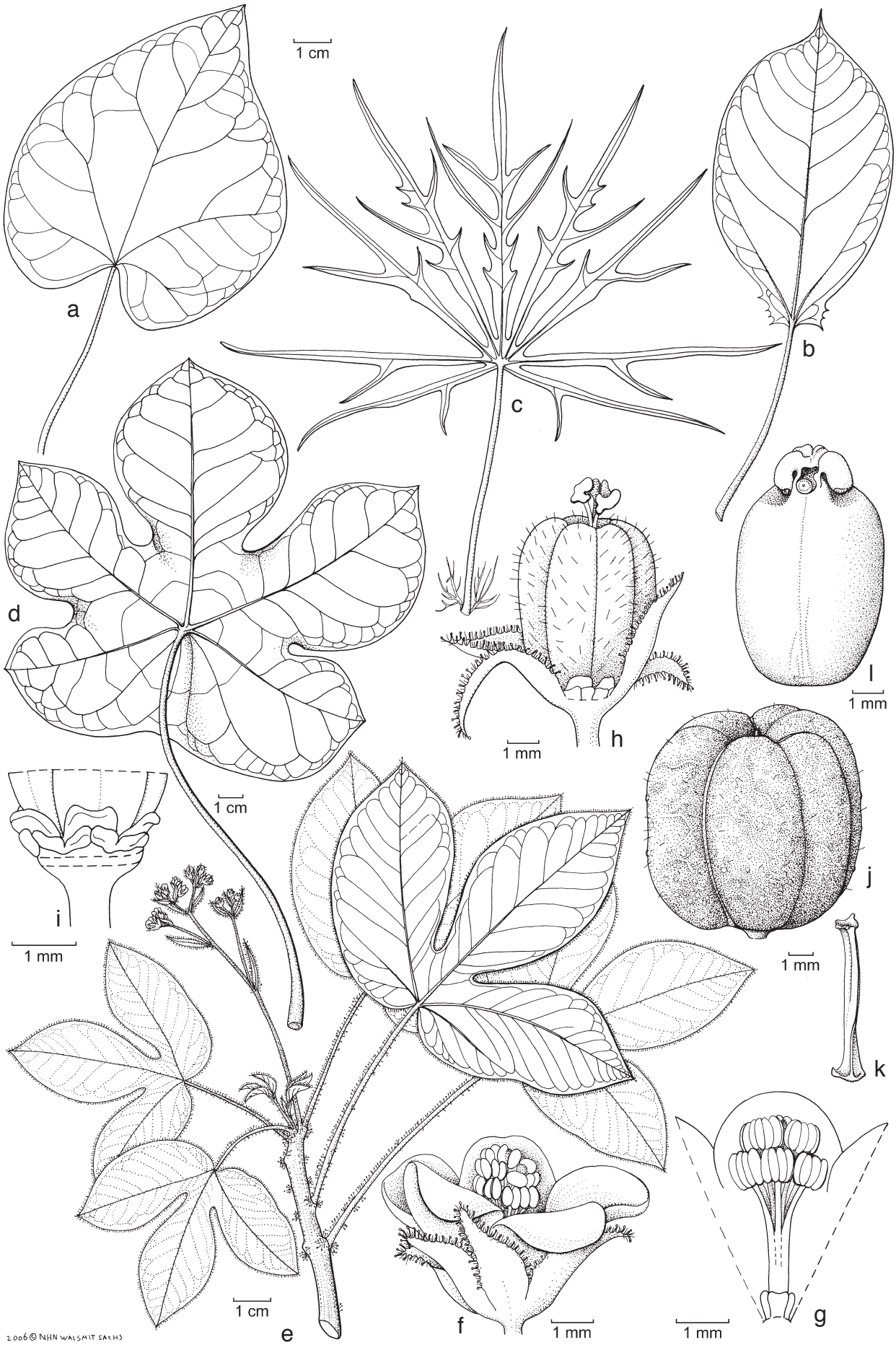


Fig. 1 Leaf shapes and flower details in Malesian *Jatropha* L. – *J. curcas* L.: a. Leaf. – *J. integerrima* Jacq.: b. Leaf. – *J. multifida* L.: c. Leaf. – *J. podagrica* Hook.: d. Leaf. – *J. gossypiifolia* L.: e. Habit; f. staminate flower; g. androecium with disc glands; h. pistillate flower; i. base of ovary with disc glands; j. fruit, k. columella; l. seed with apical caruncle (a: *Bullock 879*; b: *Noerkas 62*; c: *Anonymous s.n.*, barcode L 0034581; d. *M. Reekmans 7729*; e–g: *F.G. Dickason 8644*; h, i: *A.M. Huq & M.K. Mia 10498*; j–l: *A.H.M. Jayasuriya 1248*; all L). — Drawing: Anita Walsmit Sachs, 2006.

India. Several species are introduced throughout the tropics worldwide, five species cultivated in Malesia, often escaping and possibly invasive.

KEY TO THE SPECIES

1. Branches, petioles and leaf blades with branching and unbranched glandular hairs . . . . . 2. *J. gossypiifolia*
1. Branches, petioles and leaf blades without glandular hairs 2
2. Leaf blade peltate . . . . . 5. *J. podagrica*
2. Leaf not peltate, petiole basally attached to blade 3
3. Petiole hairy (use magnification); blades not lobed or with small, short basal lobes . . . . . 3. *J. integerrima*
3. Petiole glabrous; blades 3–13-lobed 4
4. Stipules very early caducous, broadly ovate, entire, densely hairy. Leaves 3- or 5–(7-)palmatilobed lobes joined up to halfway . . . . . 1. *J. curcas*
4. Stipules persistent, dissected into many flagelliform, glabrous filaments. Leaves (6–)9–11(–13)-palmatifid, lobes only basally joined . . . . . 4. *J. multifida*

1. *Jatropha curcas* L. — Fig. 1a, 2; Map 1

Jatropha curcas L. (1753) 1006; Blanco (1837) 759; (1845) 522; Miq. (1859) 392; Müll.Arg. (1866) 1080; Kurz (1877) 403; Blanco (1879) 160, t. 384; Hook.f. (1887) 383; Thell. (1908) 784; Pax (1910) 77, f. 30; Merr. (1917) 324; (1918) 229; (1923) 449; Gagnep. (1926) 324; McVaugh (1945) 283, f. 7, 8, 23; Corner (1951) 259, pl. 59; Backer & Bakh.f. (1963) 494; Airy Shaw (1972) 283; (1975) 137; (1982) 25; Mabb. (1983) 87; (1984) 442; Radcl.-Sm. (1987) 356; Grierson & D.G.Long (1987) 790; Philcox (1997) 85; Chantharaprasong & Welzen (2007) 344, f. 11A; Li Bingtao & M.G.Gilbert (2008) 268; Fern.Casas (2016) 5, f. 1–4, map 1. — *Manihot curcas* (L.) Crantz (1766) 167. — *Jatropha acerifolia* Salisb. (1796) 389, nom. superfl. — *Castiglionia lobata* Ruiz & Pav. (1798) 277, nom. superfl. — *Curcas adansonii* Endl. ex Heynh. (1846) 176 (see also Mabb. 1984: 435). — *Curcas indica* A.Rich. (1850) 208, pro nom. nov., nom. superfl. — *Curcas curcas* (L.) Britton & Millsp. (1920) 225, nom. inval. — *Curcas lobata* (Ruiz & Pav.) Splitg. ex Lanj. (1931) 154, nom. superfl., comb. inval., in synon. — Lectotype (designated by Radcliffe-Smith 1987): Linnaeus, Hort. cliff. (1737, published 1738) 445: *Jatropha* no. 3, Surinama, Jamaica, Brasilia. (Representative specimen in BM: http://data.nhm.ac.uk/dataset/collection-specimens/resource/05ff2255-c38a-40c9-b657-4ccb55ab2feb/record/1565052).

Ricinus americanus [Rumph. (1743) 95, nom. inval.;] Mill. (1768) under *Ricinus*. — Type: not indicated (See Thellung 1908: 784 for synonymy).

Ricinoides americana Garsault [(1764) t. 67, nom. nud.;] (1767) 51. — Type: Not indicated.

Curcas purgans Medik. (1787) 119. — Type: Not indicated.

Jatropha edulis Sessé (1794) 3. — Type: *M. Sessé Lacasta*, *J.M. Mociño*, *J.D. del Castillo & J.M. Maldonado 4233* (holo MA; iso F, US), Mexico.

Ricinus jarak Thunb. (1825) 23. — Type: Not indicated.

[*Curcas drastica* Mart. in Schrank & Mart. (1829) 50, nom. nud.] See Mabberley (1984) 442 for synonymy.

[*Jatropha moluccana* Wall. (non L.) (1847) nr. 7799E, nom. nud.].

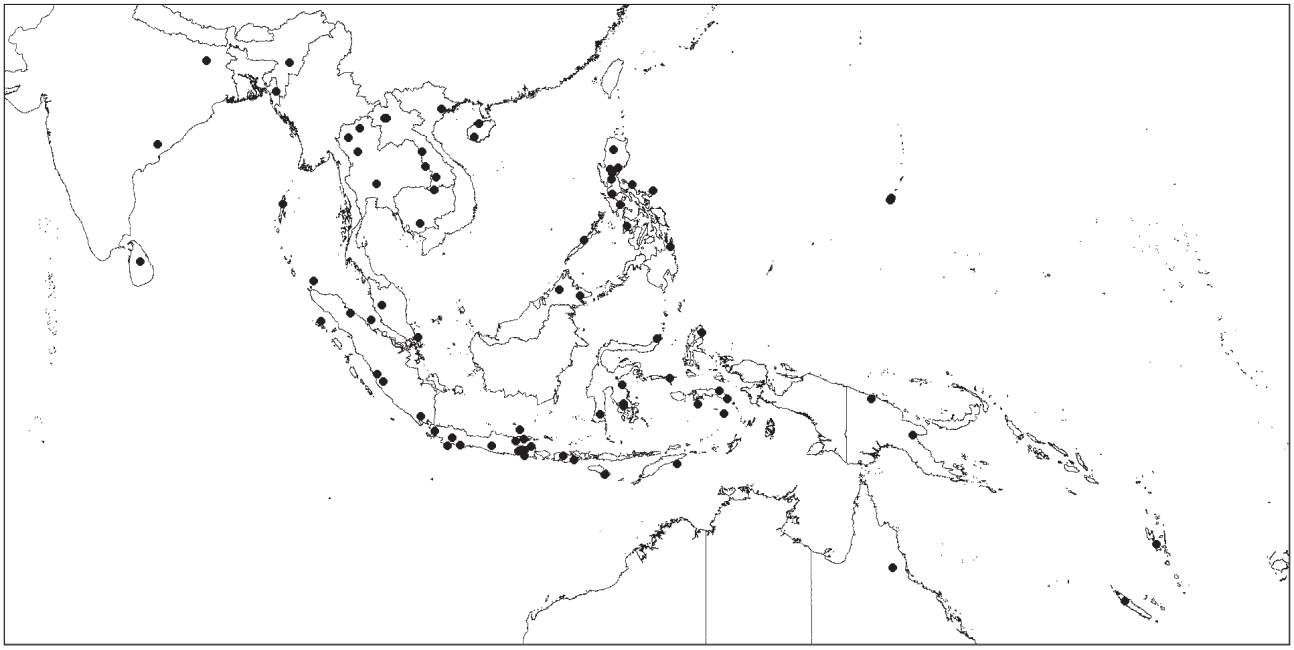
[*Jatropha condor* Wall. (1847) nr. 7799F, nom. nud.].

Jatropha tuberosa Elliot (1859) 85. — Type: Not indicated, grown in a garden. See Mabberley (1983) 87 for synonymy.

Jatropha yucatanensis Briq. (1900) 230; Pax (1910) 77. — Type: *Linden s.n.*, 1840 (holo G; iso F), Mexico, Yucatan.

Jatropha afrocurcas Pax (1909) 83; (1910) 79. — Type: *P. Jaeger 342* (B? †), Deutsch-Ostafrika (Tanzania), Sseke.

Shrubs to treelets, up to 7 m high, stem up to 15(–28) cm diam, many-branched; flowering twigs 4–15 mm diam, ridged when dried, snapping easily, epidermis easily peeling, tan-coloured. *Outer bark* greyish green to grey, very rough; under bark green; inner bark light greenish cream to straw; exudate (whitish) pale translucent, watery to somewhat sticky sap; sapwood pink, white later; heartwood pulpy. *Indumentum* of simple, long villous or arachnoid hairs on various parts. *Stipules* very indistinct, extremely early caducous, broadly ovate, c. 1 by 1.5 mm, densely villous hairy. *Leaves*: petiole 6.5–23 cm long, diam 0.5–5 mm, basally slightly thickened and triangular, above flat or glabrous to somewhat hairy; blade ovate to 3- or 5–(7-)palmatilobed, widest ± in middle, 7–17 by 6–16.5 cm, 0.7–1.5 times longer than wide, glossy, smooth, base emarginate to cordate, margin entire, often somewhat undulate, somewhat revolute, apex of central lobe acute to acuminate; lobes short, at most till half of leaf blade, ± triangular; upper surface dull to shiny dark green, usually glabrous, sometimes hairs along veins when young, leaving white dots as scars, lower surface dull light green, glabrous to more hairy than upper surface; venation palmate, 7 veins originating from base, basal 2 weakest developed, up to c. 7 veins along midrib, higher order veins reticulate. *Inflorescences* axillary compound cymes, often several per node, erecto-patent to patent, green, flowers at end of main axes pistillate, others staminate; peduncle 3.5–4.5 cm long, c. 1 mm wide; rachis 5–20 mm long, (sub)glabrous to villous to arachnoid; bracts elliptic, basal one up to 13 by 1.3 mm, becoming smaller towards top of inflorescence, margin entire, apex acute, (sub)glabrous to villous to arachnoid on both sides.



Map 1 Distribution in Malesia of *Jatropha curcas* L.

Fig. 2 *Jatropha curcas* L. a. Terminal branchlet; b. abaxial surface leaf tip; c. detail of inflorescence; d. staminate flower; e. pistillate flower; f. fruit; g. seed, ventral side; h. seed, dorsal side; i. seed, lateral side (a, b: *A. Ibáñez 2024*; c–e: *E.L. Ekman H-8156*; f–i: *M. Nee 41135*; all MA). — Drawing: José María Pizarro Domínguez, 2006.

Flowers cup-shaped, pale green to yellow to white, fragrant; pedicels up to 9 mm long, (sub)glabrous to villous to arachnoid, with an abscission zone, often subapical; calyx lobes basally connate, outside (sub)glabrous to hairy, inside glabrous; petals with margin entire, apex emarginate, outside glabrous, inside villous. *Staminate flowers* c. 9 mm diam; sepals ovate to elliptic-oblong, 4–5 by 2–3 mm, margin entire, apex obtuse to acute; petals obovate-oblong, 7–8 by 2.5–3 mm, apex rounded; disc lobes vertically tongue-like, 1–1.2 by 0.4–0.5 mm, glabrous; stamens 10, outer 5 almost free or adnate to inner united 5, androphore up to 5 mm long, light green, free filaments up to 4 mm long, light green, anthers narrowly triangular, 1.6–1.7 by c. 0.5 mm, basally cleft, basifixed, extrorse opening with length slits, light yellow. *Pistillate flowers* c. 6 mm diam; calyx lobes ovate, 3.2–5 by 1.5–2.5 mm, margin entire, apex acute; petals long ovate, 6.2–7 by 2–3 mm, apex rounded; disc glands obtrapezoid, 0.9–1 by 0.8–1 mm; ovary ovoid, 2–3 by 1.7–2 mm, light green; style c. 0.5 mm long, green; stigmas green, filament-like, non-receptive part c. 0.5 mm long, anther-like, receptive part basi-dorsifixed, c. 1 mm long, apically split till halfway. *Fruits* long-ovoid, 2.3–3 by 1.8–2.5 cm, 6-grooved, surface rugged, glabrous, yellow when ripe, black when dried; wall up to 1 mm thick, opening loculicidally only; columella T-shaped, up to 2.2 cm long. *Seeds* ellipsoid but somewhat flattened dorsiventrally, with a slight sharp ridge on the inside, 16–19 by 10–12 by 8.5–9.5 mm, when dry dark wall bursting with small white dot- to stripe-like, mainly transverse openings; caruncle vestigial or poorly developed in a fold over the hilum.

Distribution — Central and South America, Caribbean, widely introduced in Malesia.

Habitat & Ecology — A culture follower, found near villages, on and along roads, in cultivated areas and grounds, in gardens, at landfills, near rivers in the shade, secondary/open grassland, open plains, in and around primary, disturbed and secondary forest, near the coast and on limestone hills; soil often sandy, clay-loam, loam, river beds with gravel and sand; once reported from rhyolite bedrock. Altitude: sea-level up to 800(–1200) m. Flowering and fruiting: throughout the year.

Vernacular names — Malay Peninsula (Corner 1951): Jarak, Jarak belanda, Jarak pagar (Malay). Sumatra: Djarak, Djira. Java: Jarak pagar (Malay). Borneo: Jarak (Malay); Tangan-tangan (Brunei); Brunei: Jarigan-tangan. Philippines (mainly after Merrill 1923): Galúmbang (Pampángan); Kásla (Bisáya); Kirisól, Taba-tabá, Tañgan-tañgan-túba, Túbang-bakód (Tagálog); Tuban miyalad (Ifugao); Tuban bakod (Tagbanua); Tubang bakod (Tagkawayan); Tagumbáu, Tagumbau-na-puráu, Tauuá (Illóko); Takumbau (Sambáli); Taua-tauá (Igorot, Ilóko), Túba (Bíkol, Igorot, Tagálog). Sulawesi: Jarah. Moluccas: Kadatao (Halmahera Island); Kai doean (Seram Island). Purgeernoot (Dutch); Physic nut (English).

Traditional uses (partly after Burkill 1935, Heyne 1950) — Traditionally, *J. curcas* has many uses. The ***complete plant*** and almost every part of the plant has been found useful. The shrub is often an ornamental, usually used as hedges, but also as firewood. It is also planted to reforest hills and seasides, and in one part of Africa it is planted on graves. The ***bark*** is applied to snake-bites and bites of other animals as an antidote. The ***stem*** juice has piscicidal properties and is used to kill or stupefy fish. The juice is also used for the production of blue and red dye and medicinally it is applied against sprue (Malaysia, Perak), dropped in wounds and even used by children to blow bubbles. The ***leaves*** are applied to wounds, are used to get rid of itches, and can be applied to bruises after being cooked. Also, rubbing them on the abdomen of children stimulates the intestines and a decoction of the leaves forms a cure for diarrhea, a remedy for coughs and a lotion for eczema and ulcers. While the mature leaves are toxic in larger quantities, the young leaves are sometimes eaten or used as flavouring in cooking. The ***seeds*** are used as a medicinal purgative and mashed they are applied to wounds as a styptic. In Guam (Marianas) the seeds are eaten in small quantities. In the USA they are also used for criminal poisoning. The seeds, when a wick is applied, are burned as lamps, just as the pressed oil, the latter is also used in soap production and can be used in wool spinning. It is said that rubbing the seed oil on your scalp stimulates hair growth, and energetic rubbing of the oil on a female abdomen will produce abortion. Philippines labels indicate that the plant (not which part) is used as a pain reliever and for fractures.

Modern uses and possible future uses (after Pandey et al. 2012) — *Jatropha curcas* has recently caught wide attention as a biofuel plant. This is because the seeds have an oil content of around 30–40 %, the plant can grow on wasteland and marginal land unsuitable for food crops and is not a food crop itself. Also important is that the *Jatropha* bio-diesel is as good as petro-diesel. The fruit-hulls that are left can be used as bioactive compost. The cultivation for bio-diesel produces a seed cake as a by-product. This seed cake can be used as manure, but can also be used for biogas production through anaerobic digestion. The cultivation of *J. curcas* also has environmental benefits. It is a potential phytoremediator for polluted soil and a sequester of atmospheric carbon (to store it in the soil). It can also help to control soil erosion because it develops a deep taproot that can stabilize the soil. Also, new medical uses for *J. curcas*, which range from HIV- and tumor-suppressing properties of the water extract of the branches, to using the leaves against syphilis, have been found. The downside is that the species often escapes cultivation and can become an invasive species. In Malesia specimens are collected on all major islands, but there are no reports of negative aspects of invasiveness.

2. *Jatropha gossypiifolia* L. — Fig. 1e–l, 3; Map 2

Jatropha gossypiifolia L. (1753) 1006 ('*gossypifolia*'); Müll.Arg. (1866) 1086; Hook.f. (1887) 383 ('*gossypifolia*'); Pax (1910) 26; Merr. (1923) 449; Gagnep (1926) 326; McVaugh (1945) 281, f. 13, 18; Corner (1951) 260, text-fig. 83; Backer & Bakh.f. (1963) 494; Airy Shaw (1972) 283; (1975) 137; (1982) 25; Radcl.-Sm. (1987) 354; Philcox (1997) 83; Chantharaprasong & Welzen (2007) 346, f. 11E–L; Fern.Casas (2016) 18, f. 5–8, map 2. — *Manihot gossypiifolia* (L.) Crantz (1766) 167 ('*gossypifolia*'). — *Adenoropium gossypiifolium* (L.) Pohl (1827) 16 ('*gossypifolium*'). — Conserved type (Wiersema et al. 2015: 395): Linnean Herbarium no. 1141.1 (LINN).

Jatropha staphysagriifolia Mill. (1768) under *Jatropha*, no. 9 ('*staphysagrifolia*'). — *Jatropha gossypiifolia* L. var. *staphysagriifolia* (Mill.) Müll.Arg. (1866) 1087 ('*staphysagriaefolia*'), nom. illeg. (autonym rule). — Type: Not indicated.

Adenoropium elegans Pohl (1827) 15. — *Jatropha elegans* (Pohl) Klotzsch (1853) 102. — *Jatropha gossypiifolia* L. var. *elegans* (Pohl) Müll.Arg. (1866) 1087; Pax (1910) 26; Backer & Bakh.f. (1963) 494; Philcox (1997) 83. — Type: *Von Martius s.n.* (holo M; iso L, barcode L 0034540), Brasilia, Villam dos Ilhéos, Capitaniae Bahiae.

Adenoropium jacquinii Pohl (1827) 15. — *Jatropha jacquinii* (Pohl) Baill. (1864) 268. — Type: Not indicated.

Jatropha glandulifera auct. non Roxb.: Kurz (1877) 403.

See www.ipni.org or www.theplantlist.org for more infraspecific names synonymous with var. *gossypiifolia*.

(Herbs to) shrubs to treelets, at least up to 5 m high, up to 12 cm diam, branching, succulent; flowering branches 1.5–8 mm diam, round, with branching glandular hairs, especially when young, often dark maroon. *Outer bark* thin, finely pustular-lenticellate to smooth, grey; sap thin, greyish or whitish. *Indumentum* of simple, white, long hirsute hairs and branching glandular trichomes with elongated heads and non-branching glandular mushroom-shaped trichomes, glandular hairs with dark maroon stalk and yellow head. *Stipules* dissected and appearing as a band of branching glandular trichomes (a similar band is also present with the bracts). *Leaves*: petiole 2–15.5 cm long, 1–2 mm diam, basally thickened, round but above flat to grooved,

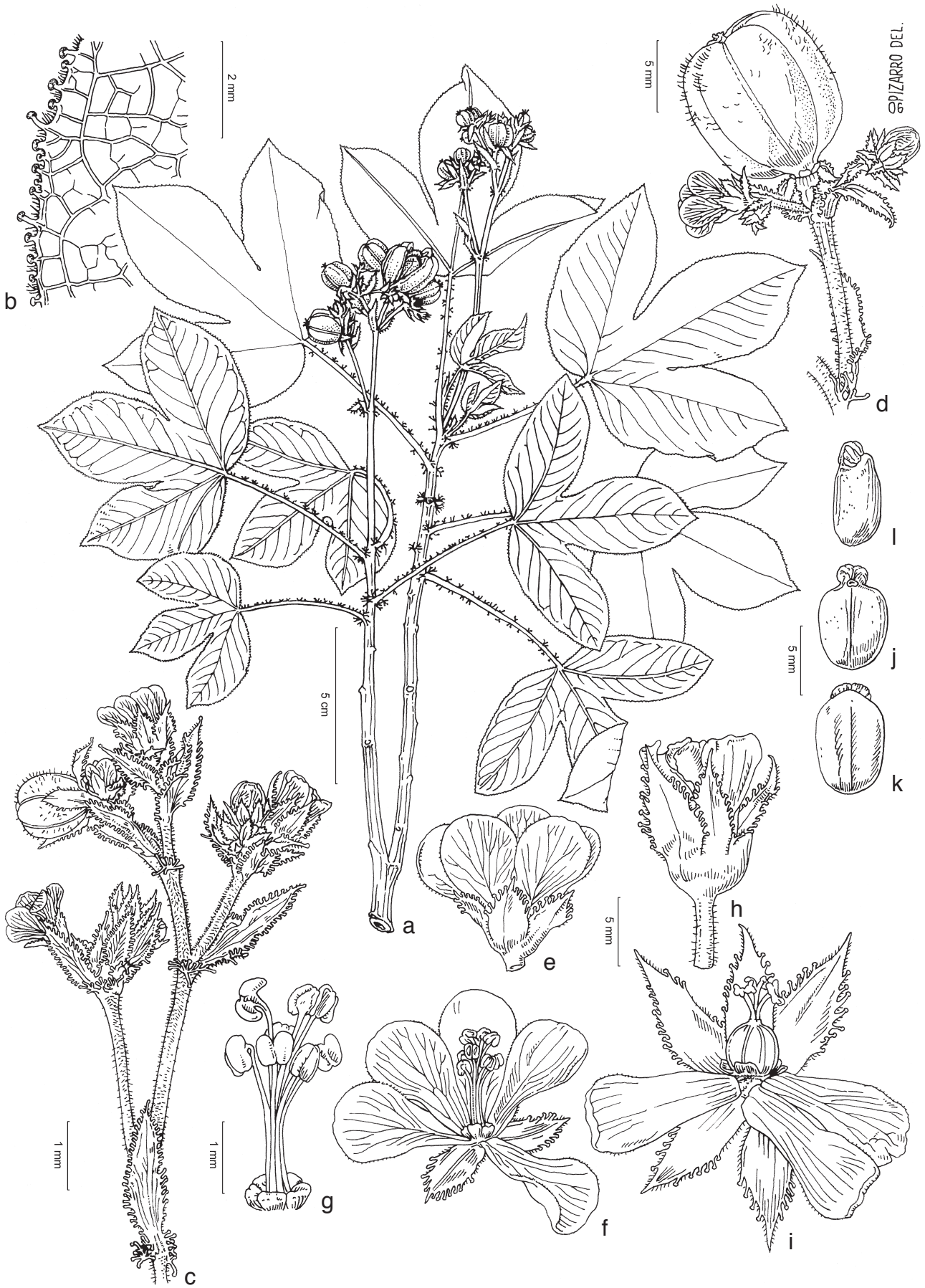
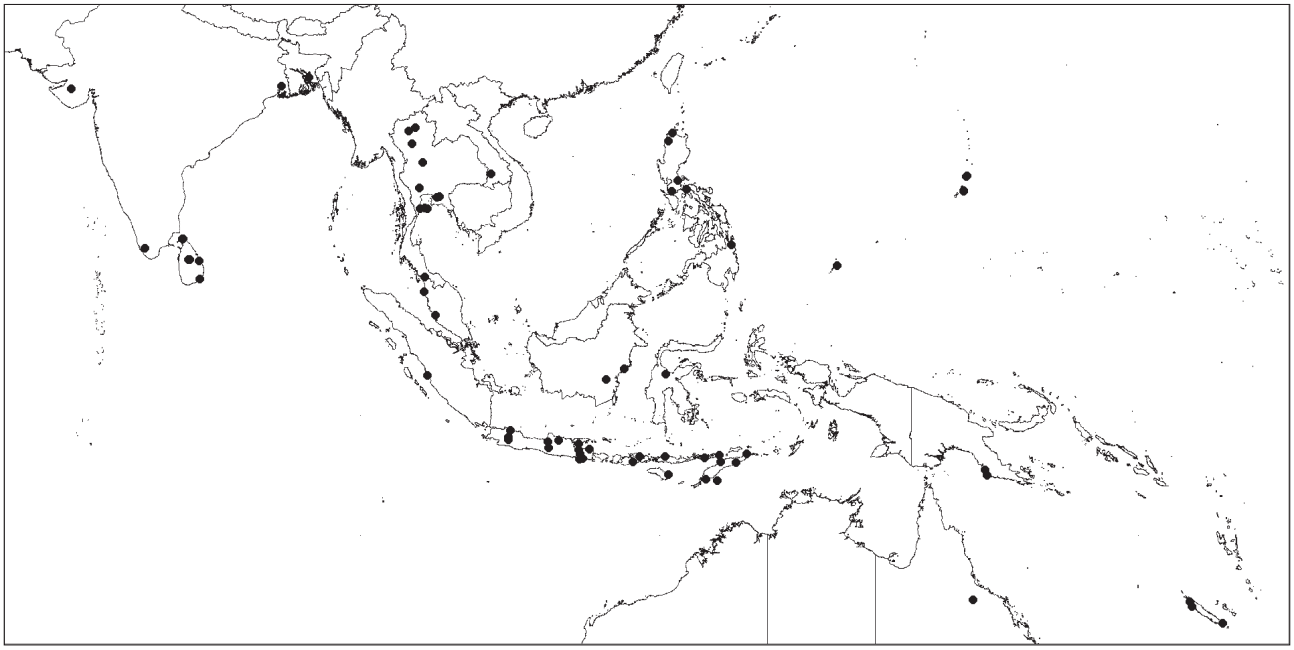


Fig. 3 *Jatropha gossypiifolia* L. a. Terminal branchlet; b. leaf venation, abaxial surface, with mushroom-like glandular hairs along margin; c. detail of inflorescence; d. infructescence with mature fruit; e, f. staminate flowers; g. disc and androecium; h, i. pistillate flowers; j. seed, ventral view; k. seed, dorsal view; l. seed, lateral view (a – c, e – l: *G.G. Hatschbach 64656*; d: *P.L. Krieger 10422*; all MA). — Drawing: José María Pizarro Domínguez, 2006.



Map 2 Distribution in Malesia of *Jatropha gossypiifolia* L.

upper surface with hirsute hairs and along ridges branched glandular hairs, maroon; blade ovate, 3–5-palmatifid, 2–12.5 by 2.5–16 cm, 0.6–0.9 times as long as wide, base rounded to slightly emarginate, margin subentire to finely, shallowly serrate, teeth ending in unbranched glandular trichomes, ciliate with hirsute hairs, apex of central lobe obtuse to acuminate, lobes usually obovate, basally united, surfaces often showing small glands (hydatodes?), upper surface glossy dark green to brownish, often, especially when young, with hirsute hairs along major veins, lower surface light green to completely red when young, glabrous; venation palmate, with 7 basal veins of which central 3 or 5 more developed, nerves in central lobe 8–14 pairs, anastomosing and looped near margin except for basal one which ends in sinus between lobes. *Inflorescences* compound subterminal cymes, erect to erecto-patent, up to 16.5 cm long, laxly hirsute, green to maroon; peduncle 2.5–20 cm long, 1–3 mm wide; rachis 0.9–7 cm long; cymes with central flowers pistillate, staminate flowers along branches; bracts elliptic, basal ones 10–19 by 2–4 mm, indument and basal structures like leaves and stipules, respectively. *Flowers* cup-shaped; pedicel 2–10 mm long, with simple hairs, subapical abscission zone; sepals free, ovate to elliptic to obovate, green to maroon, margin serrate with simple hairs and teeth ending in a glandular hair, apex cuspidate; petals obovate, apex rounded, maroon with light green to yellow basal part. *Staminate flowers* c. 6 mm diam; sepals c. 4 by 1.2 mm; petals c. 4.5 by 2.5 mm; disc lobes obtrapezoid, convex, c. 0.5 by 0.5 mm; stamens 8, 5 in outer whorl, 3 united in inner whorl, outer almost free, with free filament part c. 1.2 mm long, yellow-red, androphore c. 2.5 mm long, light green, anthers triangular, 0.5–0.6 by 0.5–0.6 mm, orange-red, especially inner ones basally divaricating, dorsibasifixed, latrorse opening. *Pistillate flowers* 4.5–6 mm diam; sepals 4.5–6 by 2–2.5 mm; petals c. 5 by 3 mm, caducous; disc lobes ± rectangular, c. 1 by 0.5 mm, thick; ovary ovoid 1.5–3 by 1.3–3 mm, 6-ribbed, green, few hairs, style absent to very short, c. 0.1 mm long; stigmas light green, with unreceptive lower part c. 1 mm long, apically receptive part thickened, split, U-shaped, 0.6–0.8 mm long. *Fruits* oblong, slightly 3-lobed, 8–12 by 7–11.5 mm, pendant, sparingly hirsute to subglabrous, dehiscing completely septicidally and partly loculicidally, shiny green when immature; wall c. 0.5 mm thick; columella 6.3–8.5 mm long, narrowly T-shaped, very slender. *Seeds* somewhat dorsiventrally compressed-ellipsoid, 8–8.5 by 4.5–5 by 3–4 mm; caruncle multifid, exceeding the seed apex.

Distribution — Mexico to N South America and Caribbean Islands, introduced and established throughout Malesia.

Habitat & Ecology — Wet areas like swamps, coast, littoral and sublittoral, gradually sloping reef flats, and damaged mangrove ecotone, but also secondary forest, lowland savannah, grassy plains, wasteland, road sides, usually open areas in general. Soil: sandy loam, (white-)sand, loam, clay, rocky clay loam, often siltish; bedrock: granite, limestone. Altitude: sea-level up to 750 m. Flowering and fruiting: throughout the year.

Vernacular names — Malay Peninsula (mainly after Corner 1951): Jarak, Jarak beremah, Jarak hitam, Jarak kling, Jarak merah (Malay). Java: Djarak, Djarak kosta, Djarak tjina. Philippines (mainly after Merrill 1923): Balautandoiong, Tagumbau-a-nalabága, Taua-tauá (Ilóko); Bongalon (Tagbanua); Lansi-laninaan (Tagálog); Túba-sa-buáia (Bíkol); Tuba-túba (Panay Bisáya, Cebu Bisáya). Lesser Sunda Islands: Flores: Waru-wégé (Takatunga, Ngadha); Timor: Damar merah; Pauk op na (Dawan); Alor: Arangfai, Iwang bawiw, Train kenanagar. Cotton-leaved physic-nut (English).

Uses (after Burkill 1935, Heyne 1950) — Ornamental plant, planted in hedges. Medicinally used against diarrhea. A swallowing of a decoction of 7–21 leaves works as a remedy for dry belly-ache. Seeds are used criminally as a poison, but also as a purgative; seed oil used as lamp oil, useful in treating leprosy.

Note — If a subdivision of this somewhat variable species is desirable, then the specimens in Malesia are generally regarded as belonging to var. *elegans*.

3. *Jatropha integerrima* Jacq. — Fig. 1b, 4; Map 3

Jatropha integerrima Jacq. (1760) 32; (1763) 256, t. 183, f. 47; Pax (1910) 50; McVaugh (1945) 274, f. 5, 6, 12, 16, 21, 22; Airy Shaw (1972) 284; (1982) 25; Radcl.-Sm. (1987) 353; Chantharaprasong & Welzen (2007) 347, f. 11B, pl. XIX-2; Fern.Casas (2016) 28, f. 9–13, map 3. — *Adenoropium integerrimum* (Jacq.) Pohl (1827) 14. — *Jatropha diversifolia* A.Rich. (1850) 207, nom. superfl.; Müll.Arg. in DC. (1866) 1094. — Type: Not indicated.

Jatropha hastata Jacq. (1760) 32; (1763) 256, t. 173, f. 54; Pax (1910) 51; Backer & Bakh.f. (1963) 494. — *Adenoropium hastatum* (Jacq.) Britton & P.Wilson (1924) 485. — *Jatropha integerrima* Jacq. var. *hastata* (Jacq.) Fosberg (1976) 102. — Lectotype (designated here): *Jacquin s.n.* (BM).

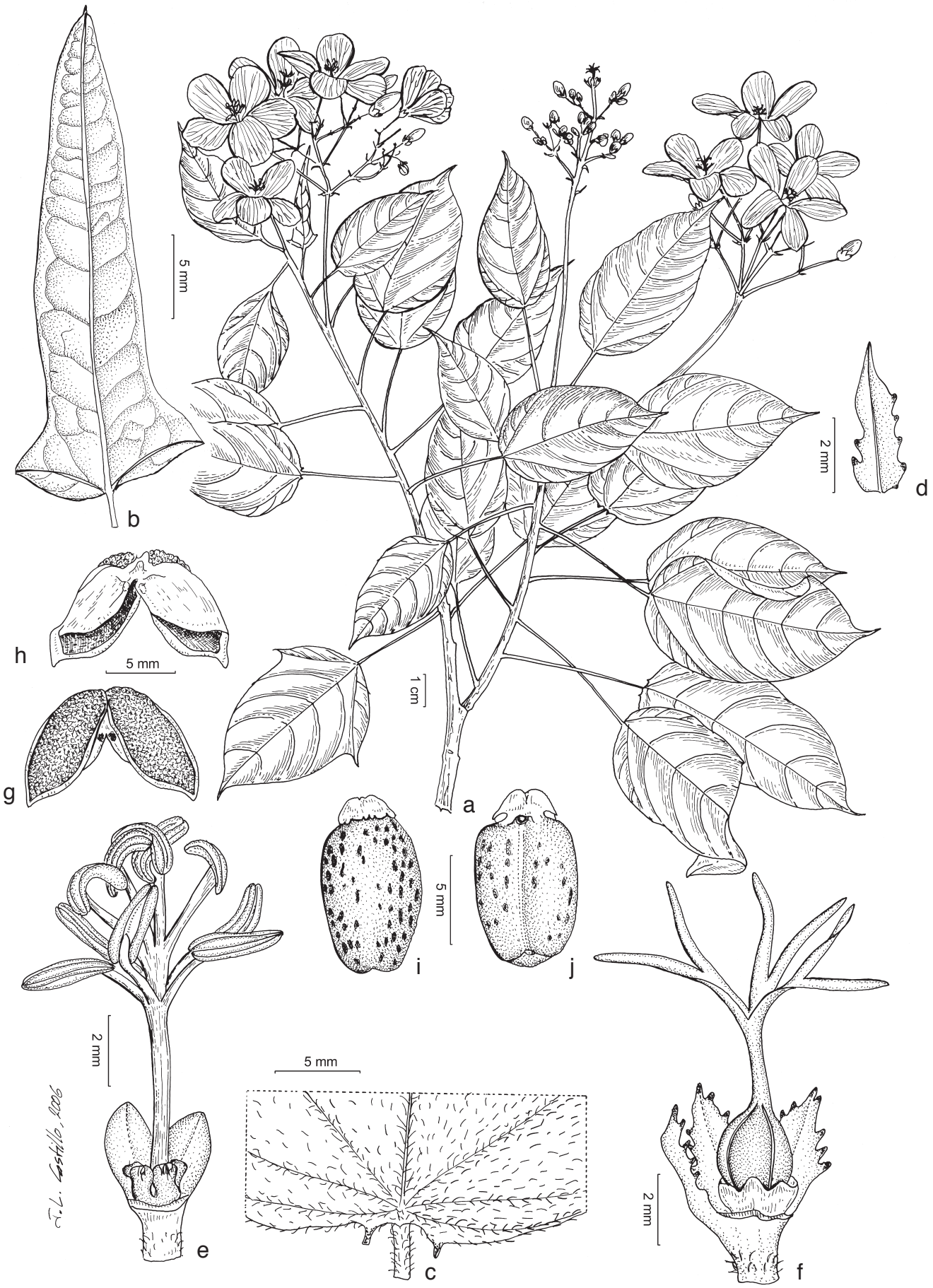


Fig. 4 *Jatropha integerrima* Jacq. a. Branches with inflorescences; b. leaf; c. leaf base with small lobes; d. bract; e. staminate flower showing disc and androecium; f. pistillate flower in section; g, h. partly loculicidally divided two-valved cocci, outside and inside, respectively; i. seed, dorsal view; j. seed, ventral view (a – d, f: *F.R. Fosberg 59690*; e: *E.L. Ekman 2369*; g – j: *E.L. Ekman H-4472*; all MA). — Drawing: Juan Luis Castillo Gorroño, 2006.

Jatropha acuminata Desr. (1797) 8; Vent. (1803) t. 52. — Type: *Herb. de Jussieu s.n.* (holo P-JU; IDC microfiche 6206, box 31, fiche 1194, no. 20), Saint Domingue (Santo Domingo).

Jatropha pandurifolia Andrews (1802) t. 267 ('*panduraefolia*'); Pax (1910) 49; Gagnep. (1926) 326. — *Adenoropium pandurifolium* (Andrews) Pohl (1827) 14. — *Jatropha diversifolia* A.Rich. var. *pandurifolia* (Andrews) M.Gómez (1894) 51. — Type: Andrews (1802) t. 267.

Jatropha coccinea Link (1822) 406. — *Adenoropium coccinea* (Link) Steud. (1840) 799, in synonymy ('*coccineum*'). — *Jatropha pandurifolia* Andrews var. *coccinea* (Link) Pax (1910) 50, f. 19b. — *Jatropha integerrima* Jacq. var. *coccinea* (Link) N.P.Balakr. (1980, publ. 1982) 176. — Type: Not indicated, Hort. Cels. (= Garden of J.M. Cels).

Jatropha pauciflora C.Wright ex Griseb. (1865) 170; Müll.Arg. (1866) 1095; Pax (1910) 51. — *Jatropha diversifolia* A.Rich. var. *pauciflora* (C.Wright ex Griseb.) M.Gómez (1894) 51. — Type: *C. Wright 1954* (holo GOET; iso BM, BREM s.n., G-DC, GH, HAC [3], K, MO, NY, P, US [2x], YU), Cuba.

Jatropha moluensis Sessé & Moc. (1894) 224. — Type: Not indicated (MA? n.v.), [Cuba,] Havana.

Jatropha pandurifolia Andrews var. *latifolia* Pax (1910) 50, f. 19a. — *Jatropha integerrima* Jacq. var. *latifolia* (Pax) N.P.Balakr. (1980, publ. 1982) 176. — Lectotype (designated here): *Pr. de la Sagra 595* (holo W), Cuba, cultivated in gardens in Havana.

Jatropha glaucovirens Pax (1910) 51. — Type: *A.H. Curtiss 458* (holo B? lost; iso A, BM, G [2x], GH, HAC, K, L, M), [Cuba,] Isla de Pinos, Nueva Gerona.

Shrubs to treelets, at least up to 8 m high, stem up to 10 cm diam, somewhat succulent; flowering branches 2–3 mm diam, hairy, glabrescent. *Outer bark* dark grey, fairly smooth; exudate white (one label). *Indumentum* of simple, pilose hairs, present on most parts. *Stipules* triangular, 1.3–1.5 by 0.5–0.7 mm, caducous, often with basal lobe, latter sometimes separate. *Leaves*: petiole 0.8–7.5 cm long, diam c. 1 mm, round in transverse section, but flat to slightly grooved above, especially hairy above, basally thickened, light green; lamina ovate to most often obovate, 5.2–12 by 3.4–7.5 cm, 1.3–2.6 times longer than wide, papyraceous, basally rounded to somewhat emarginate, often with two glandular extensions, margin entire except basally several triangular mini-lobes ending in a gland, apex acuminate to cuspate, dark green above, usually hairy on venation, dull green below, glabrous; venation basally 7-palmate, but midrib and next two veins strongest, latter ending over blade half, more terminally pinnate with 5–12 veins per side. *Inflorescences* compound dichasia with central flower(s) pistillate, erect, subterminal, up to 15 cm long; peduncle 4.5–12.7 cm long, diam c. 1.5 mm; basal bract elliptic, up to 8 by 1 mm, with stipule-like basal extensions, upper bracts usually triangular, c. 3 by 1 mm, becoming smaller upwards, margin serrate with gland on top of the teeth, apex acute. *Flowers*: pedicels 5–8 mm long, apically (and often also basally) an abscission zone; calyx lobes basally connate, lobes triangular to ovate, basally green, rest dark red, glabrous; petals free, obovate, dark red. *Staminate flowers* c. 16 mm diam, lobes ovate, 2–3 by 1.5–2 mm, margin entire, apex round; petals 9–24 by 5–10 mm, curved backwards, apex slightly emarginate to round, basally hairy inside, rest glabrous; disc lobes ± square, c. 0.5 by 0.5 mm; stamens 10, in 2 whorls of 5, glabrous, androphore 4.5–5 mm long; free part of filaments 2.3–4 mm long, anthers narrowly triangular, 2–2.5 by c. 0.7 mm, basally slightly divaricate, dorsibasifixed, opening latrorse, connective with appendix. *Pistillate flowers* c. 20 mm diam: lobes 1.5–3.7 by 1.1–2 mm, margin (entire to) serrate with glands, apex acute; petals 10–13 by 5–6 mm, apex emarginate to rounded, glabrous; disc lobes rectangular, c. 1 by 0.5 mm; ovary ellipsoid, 2.5–5 by 2–3 mm, glabrous, green, style 0.8–1 mm long; stigmas 4.2–5 mm long, red, bifid in upper 2.4–2.5 mm, flattened and in some broadened. *Fruits* oblong, c. 1 by 1 cm, dehiscing septicidally, smooth, green; wall c. 1 mm thick; columella T-shaped, c. 9 mm long. *Seeds* ellipsoid, c. 8 by 3 mm.

Distribution — Caribbean Islands (Cuba, Dominican Republic, Haiti), introduced in Malesia (Java, Philippines, Celebes).

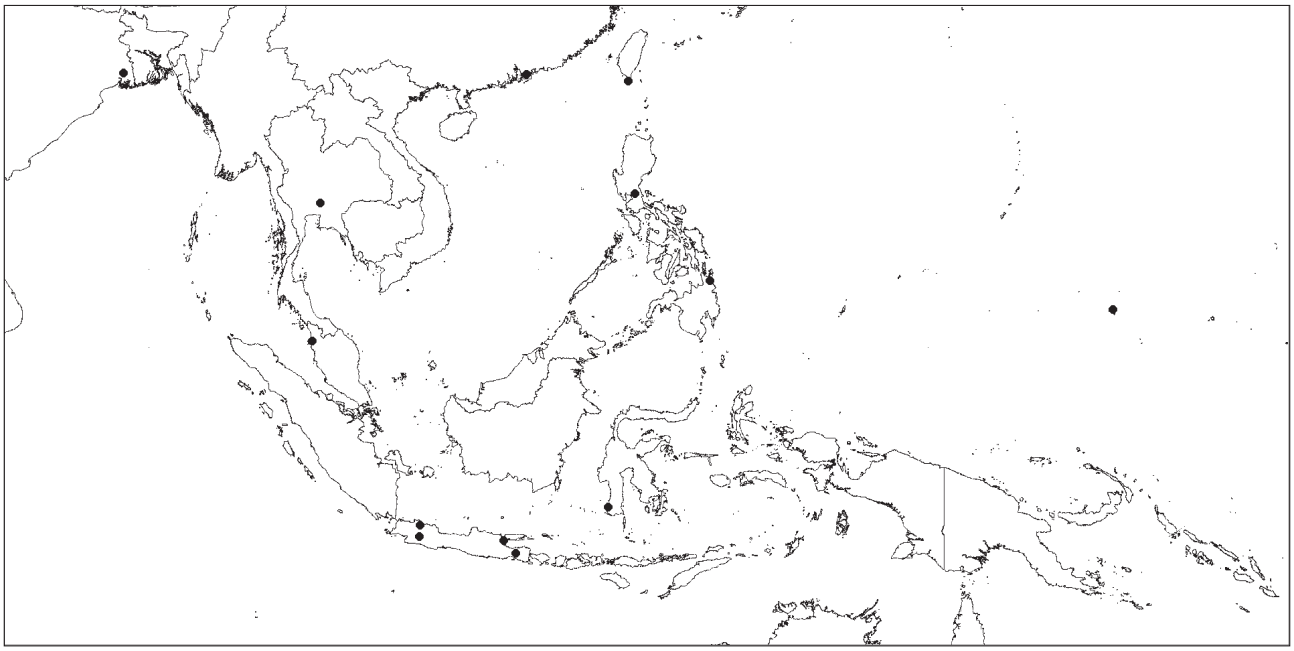
Habitat & Ecology — Secondary forest, along trail in lowland mixed forest; soil: brownish clay, clay-loam. Altitude: sea-level to 4 m. Flowering: January, February, April, May, August, December.

Uses — Ornamental because of relative large orange-red flowers in red inflorescences.

Note — This species is very variable in the shape of the leaf blade. The form most encountered is obovate to somewhat panduriform, but in the Philippines the blades are ovate.

4. *Jatropha multifida* L. — Fig. 1c, 5, 6; Map 4

Jatropha multifida L. (1753) 1006; Miq. (1859) 392; Müll.Arg. (1866) 1089; Kurz (1877) 403; Hook.f. (1887) 383; Pax (1910) 40, f. 13; Merr. (1923) 449; Gagnep. (1926) 325; McVaugh (1945) 277; Backer & Bakh.f. (1963) 494; Airy Shaw (1972) 284; Radcl.-Sm. (1987) 354; Grierson & D.G.Long (1987) 790; Chantharaprasong & Welzen (2007) 347, f. 11C; Li Bingtao & M.G.Gilbert (2008) 269; Fern.Casas (2016) 37, f. 14–17, map 4. — *Manihot multifida* (L.) Crantz (1766) 167. — *Adenoropium multifidum* (L.) Pohl (1827) 16. — Lectotype (designated by Radcliffe-Smith 1987): t. 173 (f. 213), opposite p. 218 in Dillenius, Hortus Elthamensis (1732), America meridionali (S America).



Map 3 Distribution in Malesia of *Jatropha integerrima* Jacq.

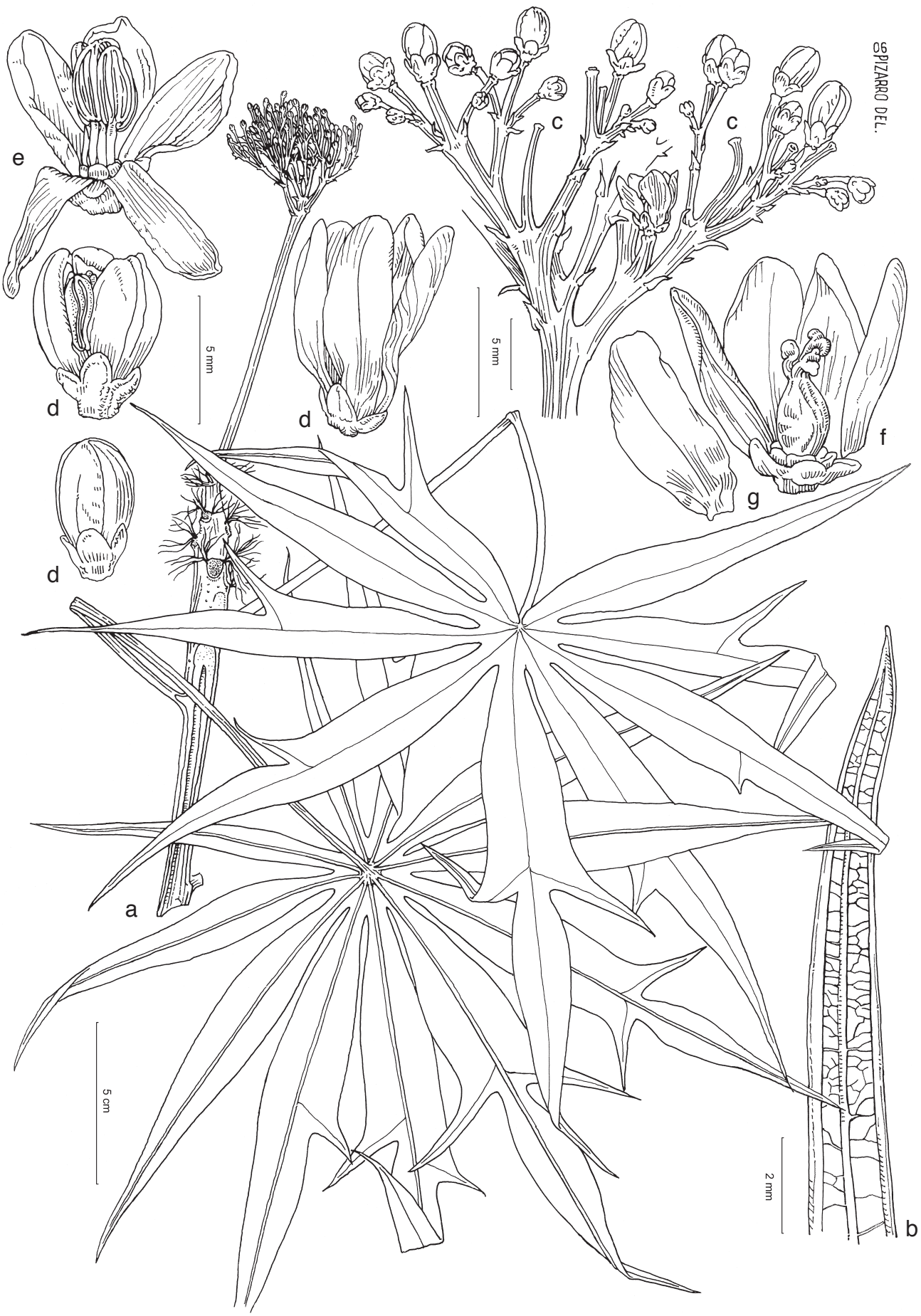


Fig. 5 *Jatropha multifida* L. a. Terminal branchlet; b. apex of leaf lobe, abaxial surface; c. staminate bud; d. young staminate flower; e. adult staminate flower; f. pistillate flower; g. pistillate petal (all: *F. Melville 156*, MA). — Drawing: José María Pizarro Domínguez, 2006.

Jatropha janipha Blanco (non L., non Lour.) (1837) 758; (1845) 521; (1879) 159, t. 342; Merr. (1918) 229. — Neotype (designated here after Merrill 1918): *Merrill Species Blancoanae 625* (holo L), Philippines, Luzon, Manila.

Shrubs, at least up to 2.5 m tall, branches somewhat succulent; flowering branches 5–9 mm diam. *Outer bark* greyish with green-brown lenticels. *Indumentum* absent. *Stipules* dissected in many flagelliform parts of 15–20 by 0.1–0.2 mm. *Leaves* palmatisect; petiole 4–27 cm long, 1–5 mm diam, round but flattened to somewhat grooved above, basally thickened; blade almost circular in circumference, 14–34 by 12–30 cm, base cordate; lobes (6–)9–11(–13), elliptic, 4.5–17 by 0.7–8 cm, margin entire but with 1 or more small, triangular, alternate side-lobes, slightly constricted above side-lobes, apex gradually acute; palmately nerved, with along midrib up to 21 pairs of nerves. *Inflorescences* subterminal, cymose, corymbiform, erect, up to 30 cm long; peduncle up to 26 cm long, 2–3 mm wide; rachis 4–21 mm long; central flower pistillate, others staminate; bracts narrowly triangular, 2–4 by 0.5–1 mm, often folded lengthwise, margin usually with a few side-lobe-like initiations, apex acuminate, upwards becoming smaller. *Flowers* c. 6 mm diam, all parts red or orange; pedicels 3–7 mm long; calyx c. 3 mm wide and long, margin entire; petals obovate, contort, apex emarginate to obtuse. *Staminate flowers*: calyx lobes c. 1 by 1–1.2 mm, apex emarginate to rounded; petals 4–5.8 by 2.5–3 mm; disc glands ± square, c. 0.4 by 0.4 mm; stamens 8, 5 in outer and 3 in inner whorl, free, filaments 2.5–3 mm long, anthers with parallel thecae, 2–2.5 by 0.4–0.7 mm, basifixed, opening extrorse. *Pistillate flowers*: calyx lobes triangular, c. 2 by 1 mm, apex acute; petals c. 4 by 2.5 mm; disc glands present; ovary ovoid, style short to absent, stigmas short and thick. *Fruits* irregularly shaped, shape dependent on number of developed seeds, c. 3 by 2 cm, containing 1–3 seeds, dehiscence septicidal, yellow; wall c. 0.5 mm thick; columella not seen. *Seeds* sub-ellipsoid, 17.5–20 by 15–17 by 12–13.5 mm.

Distribution — S North America, central and N South America, introduced in Malesia (Malay Peninsula, Sumatra, Java, Philippines).

Habitat & Ecology — Hill slopes, cultivated within human settlements. Altitude: up to 700 m. Flowering: March, April, May; fruiting: April.

Vernacular names — Malay Peninsula: Hubiq (Semelai). Philippines (Merrill 1923): Apio (Visaya); Tubang-amerikáno (Bíkol); Maná (Spanish). Dutch: Koraalboom (coral tree).

Uses (after Burkill 1935, Heyne 1950) — Ornamental plant of which the young leaves and tubers can be eaten after roasting; older leaves can act as purgative. Seeds are medicinally used as purgative and criminal poisoning due to cathartic properties; oil used as lamp oil.

5. *Jatropha podagrica* Hook. — Fig. 1d, 7, 8; Map 4

Jatropha podagrica Hook. (1848) t. 4376; Müll.Arg. (1866) 1093; Pax (1910) 44; Merr. (1923) 450; McVaugh (1945) 277; Backer & Bakh.f. (1963) 494; Airy Shaw (1972) 284; Radcl.-Sm. (1987) 355; Chantharaprasong & Welzen (2007) 348, f. 11D; Li Bingtao & M.G.Gilbert (2008) 268; Fern.Casas (2016) 49, f. 18–22, map 5. — Type (see Radcliffe-Smith 1987): *Seemann s.n.* (BM n.v.), Panama, Santa Marta.

Shrubs, up to 70(–150) cm high, not or hardly branching, basal stem very thickened, succulent, flask-like, on top a more slender apical branch (or lower on basal part side-branches); flowering branches c. 1 cm diam. *Bark* grey and green; watery to slightly white sap. *Indumentum* absent. *Stipules* dissected in slip-like lobes of c. 4 mm wide. *Leaves*: petiole 16.5–35 cm long, c. 0.5 cm diam, round, hollow; blade ovate, c. 15–28

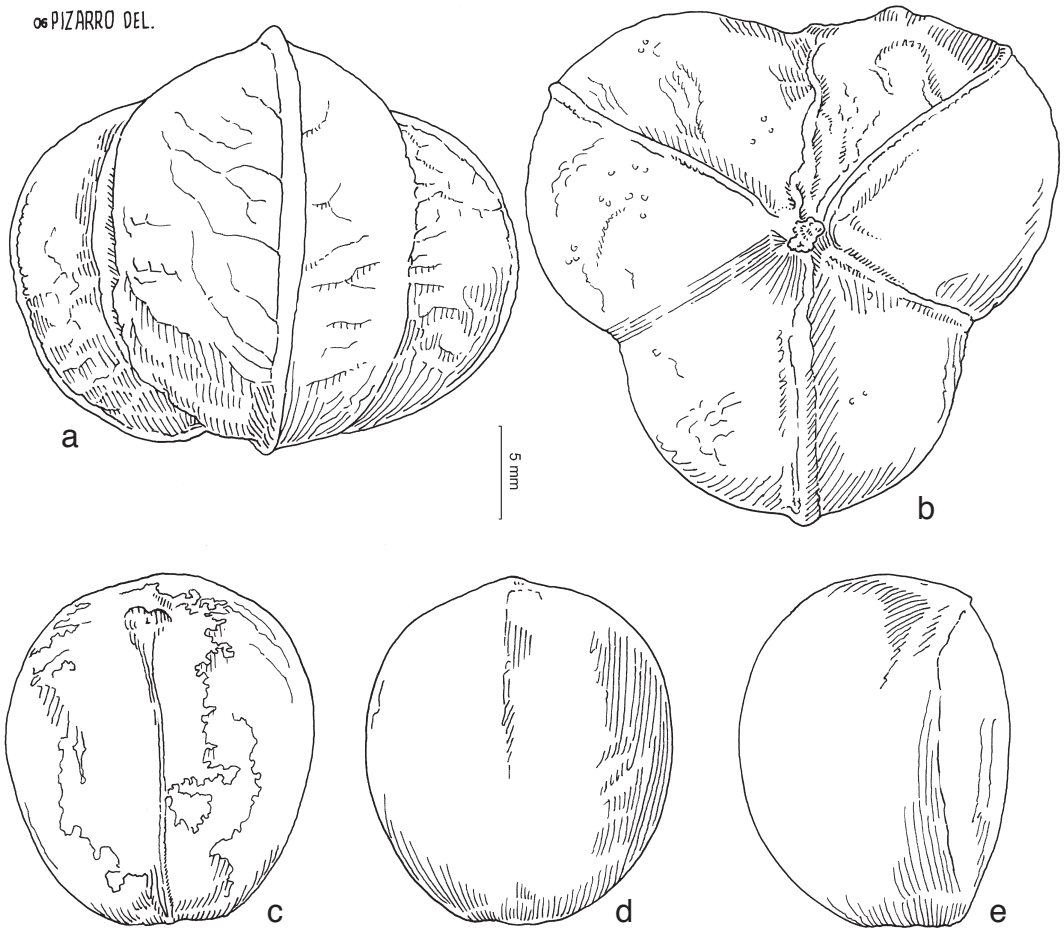
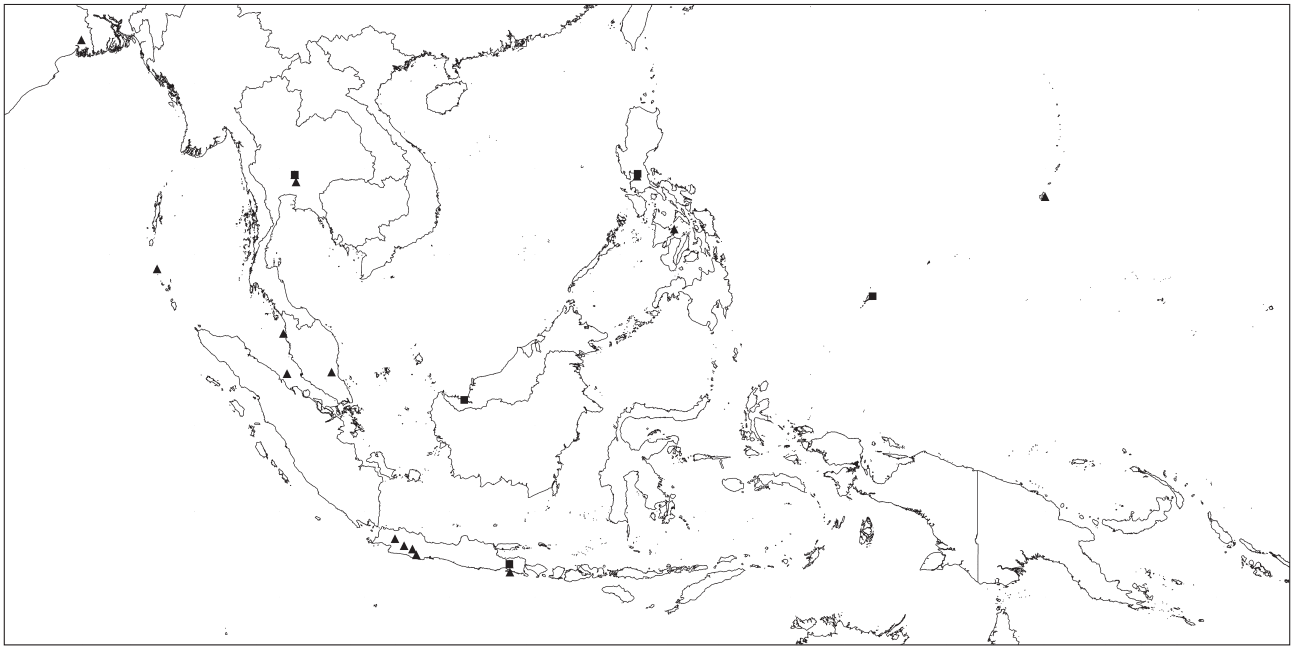


Fig. 6 *Jatropha multifida* L., fruits and seeds. a. Fruit, lateral view; b. fruit, apical view; c. seed, ventral view; d. seed, dorsal view; e. seed lateral view (all: *C.F. Baker 4*, MA). — Drawing: José María Pizarro Domínguez, 2006.

Fig. 7 *Jatropha podagrica* Hook. a. Terminal branchlet; b. abaxial leaf tip; c. detail of inflorescence; d. staminate flowers; e. pistillate flowers; f. pistillate petal; g. fruit (all: *J. Lau 2024*, MA). — Drawing: José María Pizarro Domínguez, 2006.

Fig. 8 *Jatropha podagrica* Hook. a. Habit of complete plant; b. branchlet tip; c. mature fruit; d. seed, ventral view; e. seed, dorsal view; f. seed lateral view (a, b: *D.A. Neill 217*; c–f: *W.D. Stevens 9142*; all MA). — Drawing: José María Pizarro Domínguez, 2006.



Map 4 Distribution in Malesia of *Jatropha multifida* L. (▲) and *J. podagrica* Hook. (■).

by 17–31 cm, 5-lobed, lobes less than 1/3rd of blade, base 4.5–7.5 cm peltate, margin entire, dark green above, pale light greenish greyish below; lobes obovate, apices broadly acute to acuminate; venation palmate, slightly raised on top, 7 veins originating from base, nerves 4–10 pairs per lobe. *Inflorescences* compound cymes, corymbiform; peduncle 34–43 cm long, red, cymes with basally the central flowers pistillate, on the branches staminate flowers; rachis 3–40 mm high; bracts ovate, 1–3 by 0.8–2 mm, apex acuminate, becoming smaller upwards. *Flowers*: pedicel with apically an abscission zone; sepals and petals red. *Staminate flowers*: pedicel 2–5 mm long; calyx lobes 1.4–1.5 by 0.8–1 mm, apex rounded; petals obovate, c. 6.5 by 1.6 mm, margin entire, apex rounded; disc glands thick, ± square, c. 0.3 by 0.3 mm; stamens 8, 5 in outer whorl, 3 in inner whorl, filaments free, c. 4 mm long, anthers with parallel thecae, c. 2.5 by 0.8 mm, basifixed, opening latro-extrorse, pollen orange. *Pistillate flowers* subsessile; sepals free, triangular, c. 1.5 by 1.5 mm, apex obtuse; petals early caducous, not seen; disc glands like staminate flowers; ovary ellipsoid, c. 5 by 3 mm, style nearly absent; stigmas: unreceptive basal part c. 1 mm long, receptive part c. 1.2 mm long, almost completely split, U-shaped. *Fruits* flattened, depressed globular, c. 11 by 7 mm, glabrous, opening septicidally and partly loculicidally; wall c. 0.3 mm thick; columella c. 10 mm long, apically thickened, not T-shaped. *Seeds* ellipsoid, c. 9 by 4 mm; caruncle c. 1.5 by 2 mm.

Distribution — Central America and Caribbean Islands. Introduced in Malesia as ornamental, occurring in the Philippines, naturalized in the Caroline Islands (Koror Island).

Habitat & Ecology — On the Caroline Islands common in thickets around houses, in the Philippines and Thailand only planted; granite bedrock. Altitude: sea-level up to 350 m. Flowering: February–April, July, August, October; fruiting: February, March, July, August, October.

Uses — Garden ornamental, potential to escape cultivation, not considered a dangerous invasive in the Caroline Islands. Young leaves and tubers can be eaten, but not raw.

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IDENTIFICATION LIST

1 = *J. curcas* L. 2 = *J. gossypiifolia* L. 3 = *J. integerrima* Jacq. 4 = *J. multifida* L. 5 = *J. podagrica* Hook.

A series 231: 1 – Achmad 1747: 1 – Anderson 108: 2; 566: 2 – Arnoldo 89a: 2; 98a: 4; 576: 1; 906: 2; 1951: 2 – Avé 116: 1.
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