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The Angiosperm Flora of Singapore Part 6 Caesalpiniaceae

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Major references: R.Br. in M. Flinders, Voy. Terra austral. 2 (1814) 550; R.S. Cowan in Polhill & Raven (eds.) 1(1981) 57–64; L. Watson & Dallwitz, Gen. Leg. — Caesalpinioideae (1983) 95 pp.; Ding Hou, K. Larsen & S.S. Larsen, Fl. Males. 1:12 (1996) 409–730.

Caesalpinioideae Kunth

Trees, lianas or herbs to shrubs; evergreen or deciduous, armed (*Caesalpinia*) or not, rarely tendrilled (*Bauhinia*); sometimes buttressed (*Koompassia*, *Intsia*). *Leaves* simple, pinnate or bipinnate; alternate; petiolate; pinna and pinnules usually stalked, stipleless; extrafloral glands sometimes present on leaves (*Intsia*) or leaf-axes (*Chamaecrista*, *Senna*); stipules paired, usually caducous. *Inflorescence* a raceme or panicle, singly or in fascicles; axillary, terminal on branches, or cauliflorous. *Flowers* usually bisexual, rarely unisexual (*Caesalpinia bonduc*), zygomorphic, usually 5-merous except for the gynoecium, perigynous; sepals (4-)5, usually free, rarely connate to form a calyx tube, usually imbricate; petals 5, sometimes reduced to (1–) 4 or absent (*Dialium*), imbricate, the adaxial petal overlapped by lateral petals (when these are present), often clawed, often unequal; stamens 10, or through reduction 9, 7–2, or in female flowers absent, filaments free or basally connate, anthers basi- or dorsi-fixed, often versatile, longitudinally dehiscent or by apical (and basal) pores; ovary 1-loculate, with 1or few to many anatropous ovules often superposed in 2 rows on either side of the adaxial suture, usually flattened, stipitate to sessile; style often recurved, short or long; stigma capitate or peltate, large to indistinct; hypanthium usually cupular, ± oblique, short. *Fruit* a legume, drupe (*Dialium*) or samara (*Koompassia*); legume compressed, oblong to linear, indehiscent or not, valves chartaceous, coriaceous or woody; drupes and samaras, indehiscent, rarely with pulp (*Dialium*), glabrous, pubescent to spinescent. *Seeds* 1–many per legume, varying in shape, often flattened, exendospermous; testa membraneous, coriaceous or crustose, rarely areolate (*Senna*), rarely arillate (*Sindora*); cotyledons fleshy or foliaceous, radicle straight.

Distribution — Predominantly tropical group of c. 160 genera with c. 2000 spp. (Hou *et al.*, 1996). In Singapore, there are 10 genera with 20 spp.

Ecology — Wide range of habitats including primary and secondary forest, coastal beach forest, mangrove, wasteland, abandoned villages and farmland.

Uses — See under species.

Notes — This family has traditionally been treated as a subfamily (Caesalpinioideae) of the family Leguminosae (e.g., Bentham (1865), Taubert (1894), Whitmore (1973) and Corner (1988) but here treated as a family in agreement with Cronquist (1981) and Hou *et al.* (1996). The primary reason is the distinction between three basic groups within the legumes *sensu lato* is clear. Moreover, in this treatment no emphasis is laid on the borderline Dimorphandra group *sensu* Polhill and Vidal (between Mimosaceae and Caesalpiniaceae) and tribe Swartzieae (between Caesalpiniaceae and Papilionaceae) as they are not found in Singapore.

Key to the Genera

1a. Leaves simple; lamina bilobed with an apical sinus a quarter to a third of the lamina length, venation palmate; tendrilled ..... ***Bauhinia***
1b. Leaves pinnately compound; pinna or pinnule lamina margins entire, venation pinnate; not tendrilled 2

2a. Leaves bipinnate 3
2b. Leaves pinnate 4

3a. Prickly climbers (rarely shrubs or trees). Lowermost sepal mostly cucullate. Stigma small, as wide as the style ..... ***Caesalpinia***
3b. Unarmed trees. Lowermost sepal unmodified. Stigma large, peltate ..... ***Peltophorum***

4a. Leaves imparipinnate 5
4b. Leaves paripinnate 6

5a. Midrib minutely puberulous above. Petals 5. Fruit a samara ..... ***Koompassia***
5b. Midrib glabrous above. Petals absent. Fruit a drupe ..... ***Dialium***

6a. Trees. Legumes oblong, orbicular or subglobose, 1–6-seeded 7
6b. Herbs to shrubs. Legumes long and narrow, >10-seeded 9

7a. Pinnae unequal, lowermost pair if present usually very much smaller. Petals (4-)5. Legume subglobose, deeply rugose ..... ***Cynometra***
7b. Pinnae ± equal, lowermost pair not markedly smaller than the others. Petal 1. Legume flattened, smooth or spinescent 8

8a. Pinnae with a thickened marginal nerve. Fertile stamens usually 9, basally connate into a hirsute sheath. Legume elliptic to orbicular. Seeds arillate ..... ***Sindora***
8b. Pinnae without a thickened marginal nerve. Fertile stamens 3(–4), free. Legume oblong. Seeds exarillate ..... ***Intsia***

9a. Pinnae linear or falciform, sessile. Anther-thecae ciliate along the sutures. Legume elastically dehiscent, valves coiling ..... ***Chamaecrista***
9b. Pinnae (oblong-)elliptic, ovate or obovate, stalked. Anther-thecae glabrous. Legume either indehiscent or dehiscent through 1 or both sutures, valves not coiling ..... ***Senna***

Bauhinia L.

Sp. pl. 1 (1753) 374; DC., Prodr. 2 (1825) 512; R.P.Wunderlin, K. Larsen & S.S. Larsen, Biol. Skr. danske Vidensk Selsk. 28 (1987) 18; Watson & Dallwitz, Gen. Leg. – Caesalpinioideae (1983) 12, 47.

Bauhinia subg. *Phanera* sect. *Phanera* (Lour.) Wunderlin, Larsen & Larsen

Phanera subg. *Phanera* sect. *Meganthera* de Wit

Tendrilled lianas; stem dbh ≤15 cm, young branches brownish pubescent, later glabrous. *Leaves* simple; lamina bilobed, palmately nerved, glabrous above, mucronate; petiole brownish pubescent; stipules ovate, falcate, puberulous, caducous. *Raceme* terminal or axillary, axis rusty brown to silvery pubescent. *Flowers* bisexual, zygomorphic, alternate; bracts lanceolate, early caducous; bracteoles linear, early caducous; calyx 5-lobed, sepals longer than the hypanthium, rusty brown or silky white pubescent outside; petals 5, shortly clawed, subequal, standard smaller with a hairier claw; stamens 3, staminodes 2–3, anthers dorsifixed and versatile, dehiscence

longitudinal; ovary densely pubescent, stipitate; style widened just before the peltate and capitate stigma; hypanthium long tubular with an orifice near the standard; flower buds oblong-apiculate. *Legume* tardily dehiscent, valves woody. *Seeds* ellipsoid to orbicular, flat with short funicular aril-lobes.

Distribution — *Bauhinia s. l.* has about 300 spp. all over the tropics with 69 spp. in Malesia and the section *Phanera sensu* Wunderlin, Larsen & Larsen has about 60 spp. in South and South-east Asia (Larsen and Larsen, 1996). In Singapore there is only one indigenous species.

Ecology — Lianas in primary and secondary forests, also in freshwater swamps; fringing the forests or along trails and streams.

Uses — Various *Bauhinia* spp. are used as ornamental trees (*B. purpurea* L., *B. variegata* L.), shrubs (*B. acuminata* L.) or climbers (*B. kockiana* Korth.).

Notes — In the past, some authors split *Bauhinia s. l.* into several distinct genera (e.g., de Wit (1956) who recognized 7 genera) as this large genus included a wide range of habits like lianas, shrubs or trees. More recently, Larsen & Larsen (1996) studied the genus throughout its distribution and found it to be a natural group with a reticulate pattern of variation. *Bauhinia ferruginea* var. *griffithiana* (*A.H.B. Loo & T.M. Leong ALoo 064*) was found near the Visitors' Centre of Bukit Timah Nature Reserve. Although it is not considered a native or naturalized species in Singapore, it regenerates within the vicinity of adult plants; so its distribution in Singapore should be monitored over time to see if this species becomes naturalized.

1. *B. semibifida* Roxb. ex Roxb. *var. semibifida*

Fl. Ind., ed Carey, 2 (1832) 330; Ridl., J. Straits Br. R. Asiat. Soc. 33 (1900) 75; Ridl., Fl. Malay Penins. 1 (1922) 627; de Wit , Reinwardtia 3 (1956) 465; H. Keng, Gdns' Bull., Singapore 27 (1974) 256; H. Keng, Concise Fl. Singapore (1990) 32; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 118; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 294; Ding Hou, K. Larsen & S.S. Larsen, Fl. Males. 1:12 (1996) 492.

Phanera semibifida (Roxb.) Benth.

Figure 1. ***Bauhinia semibifida*** **Roxb. ex Roxb. var.** ***semibifida.*** a. Inflorescence; b. Split legumes with valves open and separate showing seeds; c. Flower bud; d. Top view of flower; e. Left, leaf from a flowering branch (abaxial); right, leaf from a vegetative branch (adaxial); f. Left, complete half-flower; right - mature standard petal having turned yellow from white. (Each interval on scale bar equivalent to 1 mm). (A.H.B. Loo, A. Ibrahim, E.E.L. Seah & J. Lai A.Loo 084)

Young branches brownish pubescent. *Laminas* orbicular, 4–9 cm across, chartaceous, 11-nerved, brownish pubescent below, apical sinus a quarter to a third the lamina length, tips obtuse to subacute, base cordate; petiole 1–5 cm long, pubescent; stipules c. 2 by 1 mm. *Raceme* to 45 cm long, rusty tomentose. *Flowers* fragrant; sepals 5, reflexed, lanceolate, c. 2 cm long, caducous; petals 5, white turning yellow, oblanceolate with a short claw, 20–40 by 8–13 mm, claw and the base of the midrib puberulous; stamens 3, filaments white, 1–2.5 cm long, anthers dorsifixed, versatile, c. 1 cm long; staminodes to 1 cm long; ovary 2–4 cm long, silky tomentose, stipitate; stigma, white-green, c. 1 cm long; receptacle tubular; pedicel 2–5 cm long. *Legume* flat, oblong, c. 10 by 4 cm. *Seeds* 4–6 per legume, flat, hilum seven eighths the seed circumference.

Distribution — Singapore: fairly common; Botanic Gardens' Jungle, Bukit Kallang, Central Catchment Nature Reserve, Clementi Road; previously found in Bukit Mandai, Bukit Timah. Sumatra, Peninsular Malaysia, Borneo, Philippines, Celebes (Larsen and Larsen, 1996). The most widespread species of the genus.

Ecology — Forest edge and streams; flowering in June to July, October to December. Legumes reach maturity about one month after flowering. Ants are attracted to the secretions from the flowers and Lepidopteran larvae were observed on the peltate stigma which had a clear sticky secretion. Dispersal is by explosion and torsion of the legumes (Ridley, 1930).

Uses — Pounded roots are used as a treatment for veneral disease (de Wit, 1956).

Notes — There are five other varieties occurring in Malesia (four in Borneo and one in the Philippines). Throughout its distribution, var. *semibifida* is distinguished from the others in having a long tubular hypanthium dilated at the base (versus a short, uniformly wide hypanthium) , leaves on flowering shoots 4–11 cm across (versus leaves 11–18 cm across) and the apical sinus 1/4–1/2 the leaf length (versus a deep apical sinus more than 1/2 the leaf length).

Caesalpinia L.

Sp. pl. (1753) 380; Gen. pl. ed. 5 (1754) 178; Hattink, Reinwardtia 9 (1974) 1–69; Polhill and Vidal in Polhill and Raven (eds.), Adv. Leg. Syst. 1 (1981) 93.

Cinclidocarpus Zoll.
Guilandinia L.
Mezoneuron Desf.
Poinciana L.

Lianas or half-climbers, armed with recurved or straight prickles. *Leaves* bipinnate; rachis armed with paired prickles below the insertion of pinnae and pinnules with scattered ones in between; pinnae opposite; pinnules opposite, alternate or rarely subopposite, sessile or subsessile. *Inflorescence* a raceme or panicle (raceme of racemes); axillary, terminal or rarely supra-axillary; bracts mostly caducous; bracteoles absent. *Flowers* usually bisexual, sometimes unisexual, zygomorphic; sepals 5, free or connate, subequal, lower one usually cucullate; petals 5, yellow, orange, pink or rarely green, usually spathulate, clawed, unequal, standard differing in shape and size; stamens 10, free, equal or alternately narrow and wide, anthers dorsifixed and longitudinally dehiscent; ovary flat, sessile or subsessile; style ± curved upwards, slender; stigma usually as wide as the style; hypanthium oblique, cupular; pedicels sometimes articulated. *Legumes* usually smooth or sometimes armed with spines, winged along the dorsal suture or not, dehiscent or not. *Seeds* 1–8 per legume, orbicular to oblong, flat or globose.

Distribution — Pantropical genus with 18 indigenous species found all over Malesia (Hou, 1996a). Four indigenous species are found in Singapore.

Ecology — The Singapore species are found in beach forest and back-mangrove or further inland, in primary or secondary forests along trails or near streams.

Uses — See under individual species.

Notes — Recurved prickles may be set on top of woody triangular knobs in old stems for *C. crista* (Fig. 2) and *C. sumatrana*.

Key to Species

1a. Stipules pinnatifid, large, each lobe orbicular to 2.5 cm across; pinnae prolonged to a c. 5 mm long mucro. Branches pubescent, armed with straight and recurved prickles. Flowers unisexual (in male flowers, carpel rudimentary, 1–2 mm long; in female flowers anthers without

pollen); ovary densely spiny; petals green-yellow; style pubescent. Legumes densely spiny, pubescent, dehiscent. Seeds with lines concentric about the hilum ..... **1. *C. bonduc***

1b. Stipules simple and triangular, minute or absent, c. 1 by 1 mm; pinnae not prolonged into a mucro. Branches glabrous, armed only with recurved prickles. Flowers bisexual, ovary inermous; bracts inconspicuous or early caducous, 1–2 mm long, straight, not longer than bud; petals orange, pink or yellow; style glabrous or only sparsely puberulous basally. Legumes inermous, glabrous, indehiscent. Seeds without concentric lines 2

2a. Pinnules sessile, 2–6 mm wide, linear, base oblique and truncate, tapering to a point or a minute mucro on the distal side, in 12–30 pairs per pinna, membranous; rachis pubescent, 30–45(–70) cm long. Branchlets lenticellate. Petals orange. Legumes often twisted, base rounded. Seeds subglobose, c. 10 mm across ..... **4. *C. tortuosa***

2b. Pinnules with a 2–4 mm long stalk, 10–50 mm wide, elliptic or ovate-elliptic or oblong, base cuneate, not tapering on any side, in 1–6 pairs per pinna, subcoriaceous to coriaceous; rachis glabrous, 10–30 cm long. Branchlets without lenticels. Petals yellow or pink. Legumes not twisted, base cuneate. Seeds flat, c. 1–5 mm thick 3

3a. Pinnules alternate (but topmost pair often opposite), in 3–6 pairs per pinna, widely elliptic to oblong, dull above, sometimes puberulous below, apex retuse or rounded; pinnae in 4–8 pairs. Petals pink; sepals connate to a campaniform calyx tube. Legumes chartaceous, winged dorso-longitudinally (c. 1 cm wide), 10 cm long or more, apex rounded or hooked. Seeds 1–8 per legume, clearly outlined on the surface of the legume. Ovary glabrous, slightly falcate; filaments laterally compressed, alternately a narrow and wide one, glabrous or puberulous basally ..... **3. *C. sumatrana***

3b. Pinnules opposite, in 1-3 pairs pairs per pinna, elliptic to ovate elliptic, shiny above, glabrous on both surfaces, apex obtuse, acute or acuminate; pinnae in 2–4 pairs. Petals yellow; sepals free, not forming a calyx tube. Legumes woody, not winged, 7 cm long or less, apex beaked. Seeds 1(–2) per legume, not outlined on the surface of the legume. Ovary puberulous, straight; filaments terete, pubescent to above the middle ..... **2. *C. crista***

1. *C. bonduc* (L.) Roxb.

Fl. Ind., ed. Carey, 2 (1832) 362; L., Sp. pl., (1753) 381; Ridl., Fl. Malay

Penins. 1 (1922) 649; Hattink, Reinwardtia 9 (1974) 17; H. Keng, Gdns' Bull., Singapore 27 (1974) 256; K. Larsen, S.S. Larsen & J.E. Vidal, Fl. Thailand 4 (1984) 72; H. Keng, Concise Fl. Singapore (1990) 32; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 118; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 295.

Half-climbers to 15 m long. *Leaves*: rachis 15–80 cm long; pinnae in 3–9 pairs, 8–18 cm long; pinnules in 5–10 pairs per pinna, opposite or rarely subopposite, elliptic-oblong, 2–5.5 by 1–2 cm, pubescent to glabrous, apex mucronate, stalk 1–2 mm long. *Panicle* supra-axillary or terminal, 12–60 cm long, pubescent. *Flowers*: sepals ovate, equal or rarely subequal, 7–9 by 3–4 mm, pubescent; standard petal: limb reflexed, with red patches, 4–5 by 3–4 mm, claw 3–4 by 1–2 mm, other 4 petals: spathulate, 8–10 by 3–4 mm (including c. 2 mm long, woolly claw); stamens 6–10 mm long (in female flowers 5–6 mm long staminodes), lower half woolly, anthers c. 1 mm long; ovary c. 3 by 2 mm; style 3–4 mm long; stigma ciliate; pedicel 4–5 mm long, articulated. *Legume* oblong, 6.5–9 by 3.5–4.5 cm, stipitate to 6 mm long, remnant style c. 10 mm long. *Seeds* 1–2 per legume, grey, globular, 1.5–2 cm across.

Distribution — Singapore: only two plants known; Pulau Sakijang Pelepah (extreme South), Pulau Semakau (North-west). Previously found in East Coast Park beach, Pulau Senang (South-east side). Pantropical; in Malesia all parts, but distinctly scarce in the rain forests of Sumatra, Borneo, the Philippines and western New Guinea (Hattink, 1974).

Ecology — Coastal, beach forest and back-mangrove to inland, in secondary forests. Flowers and fruits can occur together without periodicity. Legumes dispersed by floating in the sea (Ridley, 1930).

Uses — The seeds are used as an anthelminthic, vermifuge, chewed for coughs or eaten for stomach trouble as well as for curing gout (Burkill, 1935). The attractive, hard seeds are used ornamentally as beads in necklaces, rosaries and also used as marbles (Rudd, 1991), hence the name "grey knicker" which refers to the game of marbles played by children. In Somoa and Tonga, the prickly stems, attached to a stick are used to snare fruit bats (Whistler, 1992).

2. *C. crista* L.

Sp. pl. (1753) 380; Ridl., J. Straits Br. R. Asiat. Soc. 33 (1900) 75; Ridl., Fl.

Figure 2. ***Caesalpinia crista* L.** Stem showing characteristic recurved prickles set on top of corky knobs.

Malay Penins. 1 (1922) 650; Sinclair, Gdns'. Bull., Singapore 14 (1953) 32; Backer & Bakh. *f.*, Fl. Java 1 (1964) 545; Hattink, Reinwardtia 9 (1974) 20; H. Keng, Gdns' Bull., Singapore 27 (1974) 256; K. Larsen, S.S. Larsen & J.E. Vidal, Fl. Thailand 4 (1984) 70; H. Keng, Concise Fl. Singapore (1990) 32; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 118; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 295.

Caesalpinia nuga (L) Ait.f.

Lianas to 15 m long; branchlets glossy. *Leaves*: rachis 10–30 cm long; pinnae 3.5–9 cm long; pinnules opposite or rarely subopposite, 2–12.5 by 1–5 cm, subcoriaceous, base cuneate or rounded; petiolules 2–4 mm long; stipules, triangular, c. 1 by 1 mm, caducous. *Panicle* axillary or terminal, 15–40 cm long; bracts c. 1mm long, caducous. *Flowers*: sepals unequal, 7–8 by 2–3 mm (lowest one cucullate); standard petal: limb reflexed, orbicular, c. 5 mm across, claw c. 5 by 2 mm, pubescent, other 4 petals: obovate, 8–10 by 5–6 mm (including c. 2 mm long pubescent claw); stamens 10–14 mm long, anthers c. 1 mm long; ovary c. 5 by 2 mm; style c. 8 mm long, glabrous; stigma ciliate; pedicel 5–15 mm long, articulated c. 1 mm below

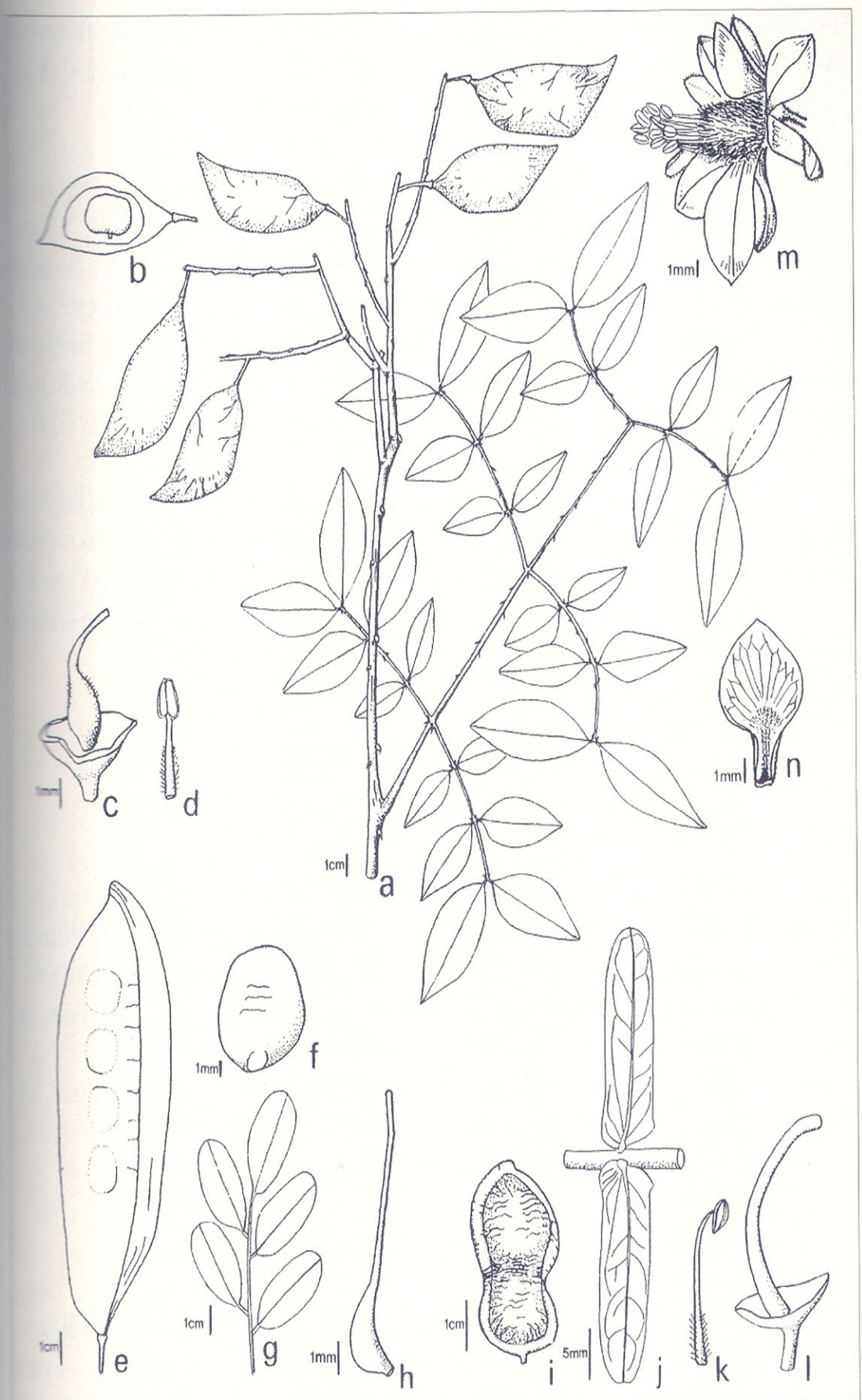

Figure 3. ***Caesalpinia crista*** **L.** a. Fruiting branch; b. Legume with one side removed to show seed (Tanaka, Chen & Boo A.Loo 005); c. Isolated carpel on hypanthium; d. Isolated stamen (SING 078418); m. Side view of flower; n. Standard petal (After Verdcourt, 1979). *Caesalpinia sumatrana* Roxb. e. Winged legume; f. Seed; g. Alternate pinnules of a pinna (H. N. Ridley 2105); h. Isolated falcate ovary (Mat 6028). *Caesalpinia tortuosa* Roxb. i. Legume; j. One pair of sessile pinnules; k. Isolated stamen; l. Isolated carpel on hypanthium. (King's Collector L10014).

the flower. *Legume* green turning brown, subelliptic or rhombic, flat, 4–7 by 3–4 cm, smooth, veined. *Seeds* brown, orbicular to reniform, 2–2.5 by 1.5–2 by 0.5–1 cm.

Distribution — Singapore: fairly common; Pulau Sakijang Pelepah, Pulau Semakau (West), Pulau Tekong, Pulau Tekong Kechil, Pulau Terkukor, Sembawang Road end, Sungei Buloh Nature Park, Sungei Mandai Kechil (Kampong Fatimah), Western Catchment Area; previously collected in Jurong, Kranji. Coastal parts of South-east Asia from India to the Ryuku Islands, Australia (Queensland), Palau Island, New Caledonia; all over Malesia except East Sumatra and East Borneo (Hattink, 1974).

Ecology — River banks, sandy beaches, in back-mangrove and its fringes. Mature plants may have stems to c. 10 cm thick that are covered by triangular woody knobs with recurved prickles set at the tip (Fig. 2). Periodicity for flowering and fruiting not found (Hattink, 1974). Legumes dispersed by floating (Ridley, 1930).

Uses — As for *C. bonduc*.

3. *C. sumatrana* Roxb.

Fl. Ind., ed. Carey 2 (1832) 366; Baker in J.D. Hook., Fl. Brit. India 2 (1879) 259; Ridl., J. Straits Br. R. Asiat. Soc. 33 (1900) 75; Ridl., Fl. Malay Penins. 1 (1922) 647; Backer & Bakh. *f.*, Fl. Java 1 (1964) 546; Hattink, Reinwardtia 9 (1974) 55; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; H. Keng, Gdns' Bull., Singapore 27 (1974) 262; H. Keng, Concise Fl. Singapore (1991) 36; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 118; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 295; Ding Hou, Fl. Males. 1:12 (1996) 553.

Mezoneuron sumatranum (Roxb.) W. & A. ex Miq.

Climbers to 20 m long; branchlets glossy. *Leaves*: rachis 16–20 cm long; pinnae 6–15 cm long; pinnules 2–7 by 1–5.5 cm, subcoriaceous, apex sometimes shortly mucronate, base cuneate to rounded; petiolules 2–4 mm long. *Panicle* supra-axillary or terminal, 30–80 cm long; bracts c. 1 by 0.5 mm, caducous. *Flowers*: calyx tube red, c. 1.3 by 0.5 cm, circumscissle above the hypanthium and falling off with the corolla and stamens, calyx lobes half-orbicular, 3–10 mm long, lowest one cucullate; petals spathulate, subequal, 12–30 mm long, limb 8–12 mm wide, basal part 2–3 mm wide; filaments pale pink, 10–29 mm long, anthers 1.5–3 mm long; ovary falcate,

4–15 by 1–2 mm; style 6–15 by 0.5 mm; stigma ciliate; pedicel 5–20 mm long. *Legume* wine-red, oblong, 10–17 by 3–6 cm (including the c. 1 cm wide wing). *Seeds* brown, broadly elliptic, 9–11 by 7 by 1 mm, smooth, margins nerved.

Distribution — Singapore: rare, Bukit Timah Nature Reserve (along the Rock Path and Cave Path); previously collected in Kranji, Sungei Jurong. Possibly collected in India. Malesia: Sumatra (West Coast Bengkulu), Peninsular Malaysia, West and East Java, Borneo (near Sandakan); New Guinea, Solomons (Guadalcanal) (Hattink, 1974).

Ecology — Forest fringes, along forest trails and in late secondary forests. Like *C. crista*, mature climbers of *C. sumatrana* also have thick stems with recurved prickles set on top of woody knobs. The knobs of this species are more closely set than in *C. crista*.

Uses — None known.

4. *C. tortuosa* Roxb.

Fl. Ind. ed. Carey 2 (1832) 365; Baker in J.D. Hook., Fl. Brit. India 2 (1879) 256, 257; Ridl., J. Straits Br. R. Asiat. Soc. 33 (1900) 75; Ridl., Fl. Malay Penins. 1 (1922) 651; Hattink, Reinwardtia 9 (1974) 57; H. Keng, Gdns' Bull., Singapore 27 (1974) 256; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; H. Keng, Concise Fl. Singapore (1991) 32; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 118; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 295.

Lianas, shrubs or small trees to 10 m tall. *Leaves*: pinnae in 7–20 pairs, 6–10.5 cm long; pinnules 10–13(–22) by 2–6 mm, glabrous or sparsely puberulous below, apex rounded to obtuse; stipules absent. *Panicle* axillary, terminal or rarely supra-axillary, 20–60 cm long; bracts 2 by 1 mm, pubescent. *Flowers*: sepals ovate, unequal, 8–10 by 4–6 mm, ciliate (lowest deeply cucullate); petals unequal, standard: limb reflexed, orbicular, c. 5 mm in diam., claw 5–8 by 2 mm, hirsute above, other 4 petals: limb orbicular to reniform, 7–10 by 6–12 mm, claw 1–3 by 1 mm, hirsute or glabrous; stamens slightly exserted, filaments 10–15 mm long, woolly halfway, anthers 2.5–3 by 1 mm; ovary subsessile, 3–5 by 1–1.5 mm, hairy or glabrous; style 8–12 mm, sparsely puberulous basally; stigma c. 1 mm across; pedicel 8–15 mm long, pubescent. *Legumes* black when dry, oblong, 3.5–9 by 2–3.5 cm, sutures thickened, constricted between the seeds, apex obtuse, shortly beaked. *Seeds* 1–5(–7) per legume.

Distribution — Singapore: now extinct; previously collected in Changi (Loyang). India (Assam), Hong Kong, Burma; Malesia: West and East Sumatra, Peninsular Malaysia (Johore, Penang), West and East Java, Kalimantan (Hattink, 1974).

Ecology — Primary and secondary forests, forest fringes, along rivers.

Uses — None known.

Chamaecrista Moench

Methodus (1794) 272; de Wit, Webbia 11 (1955) 278; Irwin and Barneby in Polhill and Raven (eds.) Adv. Leg. Syst. 1 (1981) 106, Mem. N. Y. bot. Gdn 35 (1982) 636.

Cassia subg. *Lasiorhegma* Vogel ex Benth.

Herbs with a woody base; stem erect or decumbent, pubescent. *Leaves* paripinnate; rachis with longitudinal ridges above, produced to a short mucro beyond the terminal pairs of pinnae; pinnae asymmetrical, sessile, apex ± mucronate, margins sparsely ciliate, base truncate; petiole with 1(–2) subsessile glands adaxially; stipules linear, apex acute, margins ciliate, intrastipular trichomes present. *Raceme* supra-axillary, few-flowered, bracts and bracteoles similar to the stipules but smaller. *Flowers*: sepals 5, unequal, membranous and thicker in the median undersurface, puberulous; petals 5, yellow, unequal, membranous, with darker reticulate veins visible, claw short; stamens 10, filaments straight, short, anthers basifixed, straight or ± curved, of ± two length classes, opening by two apical pores, thecae ciliate along the sutures. *Legume* strap-shaped, flat, transversely grooved between seeds, elastically dehiscent, valves twisting spirally. *Seeds* many per legume, seedcoat ± pitted, glossy.

Distribution — About 240 spp. are indigenous to the Americas with few indigenous to Tropical Asia (Larsen and Hou, 1996a). In Singapore, two exotic species. are naturalized (Corlett, 1988).

Ecology — Mainly found in open places, wasteland and reclaimed land. Roots have nodules.

Uses — Used mainly as green manure. See under species.

Notes — In the past, species in *Chamaecrista* and *Senna* were considered as subgenera under *Cassia* L. *s. l.* (e.g., de Wit, 1955). They are now recognized as separate genera following the work of Irwin and Barneby (1982) who raised the genus *Cassia s.l.* to the level of subtribe and elevated the previous subgenera to generic rank alongside *Cassia s.s.*. The circumscription of the genera follows that of Irwin and Barneby (1982) but the delimitation of species follows that of Larsen and Hou (1996a) who have found that Asian species justify the maintenance of both *C. leschenaultiana* and *C. mimosoides*.

Key to the Species

1a. Leaf rachis with 2 evenly high longitudinal ridges parallel to each other on the adaxial surface; pinnae falciform, 2–3 mm wide; subsessile discoid gland 1–1.5 mm below the lowest pair of pinnae. Ovary and legume with long, thin, non-appressed hairs; legume with a ± hooked mucro. Seeds 10–15 per legume ..... **1. *C. leschenaultiana***

1b. Leaf rachis with only one unevenly high longitudinal ridge in the form of an adaxial series of semicircular flaps between the nodes; pinnae linear, 0.5–1 mm wide; sessile discoid gland immediately below the lowest pair of pinnae. Ovary and legume with stiff, appressed hairs; legume with a ± straight mucro. Seeds 20–25 per legume..... ..... **2. *C. mimosoides***

1. *C. leschenaultiana* (DC.) O.Deg.

Fl. Haw. Fam. 169b. (1934); DC., Mem. Soc. Phys. Hist. Nat. Geneve 2 (1824) 132; Ridl., J. Straits Br. R. Asiat. Soc. 33 (1900) 74; Ridl., Fl. Malay Penins. 1 (1922) 619; de Wit, Webbia 11 (1955) 280; Rudd, Rev. Handb. Fl. Ceylon (1991) 88; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 119; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 297; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 566.

Cassia leschenaultiana DC.
Chamaecrista nictitans (L.) Moench

Subshrubs to 1.5 m tall; stem erect or decumbent, pubescent. *Leaves*: rachis 4–9 cm long, produced to a short mucro to 4 mm long; pinnae in 10–30 pairs, asymmetrical, 5–20 by 2–3 mm, apex truncate, mucro 0.5 mm long or more, margins sparsely ciliate, base truncate; petiole 5–7 mm long with

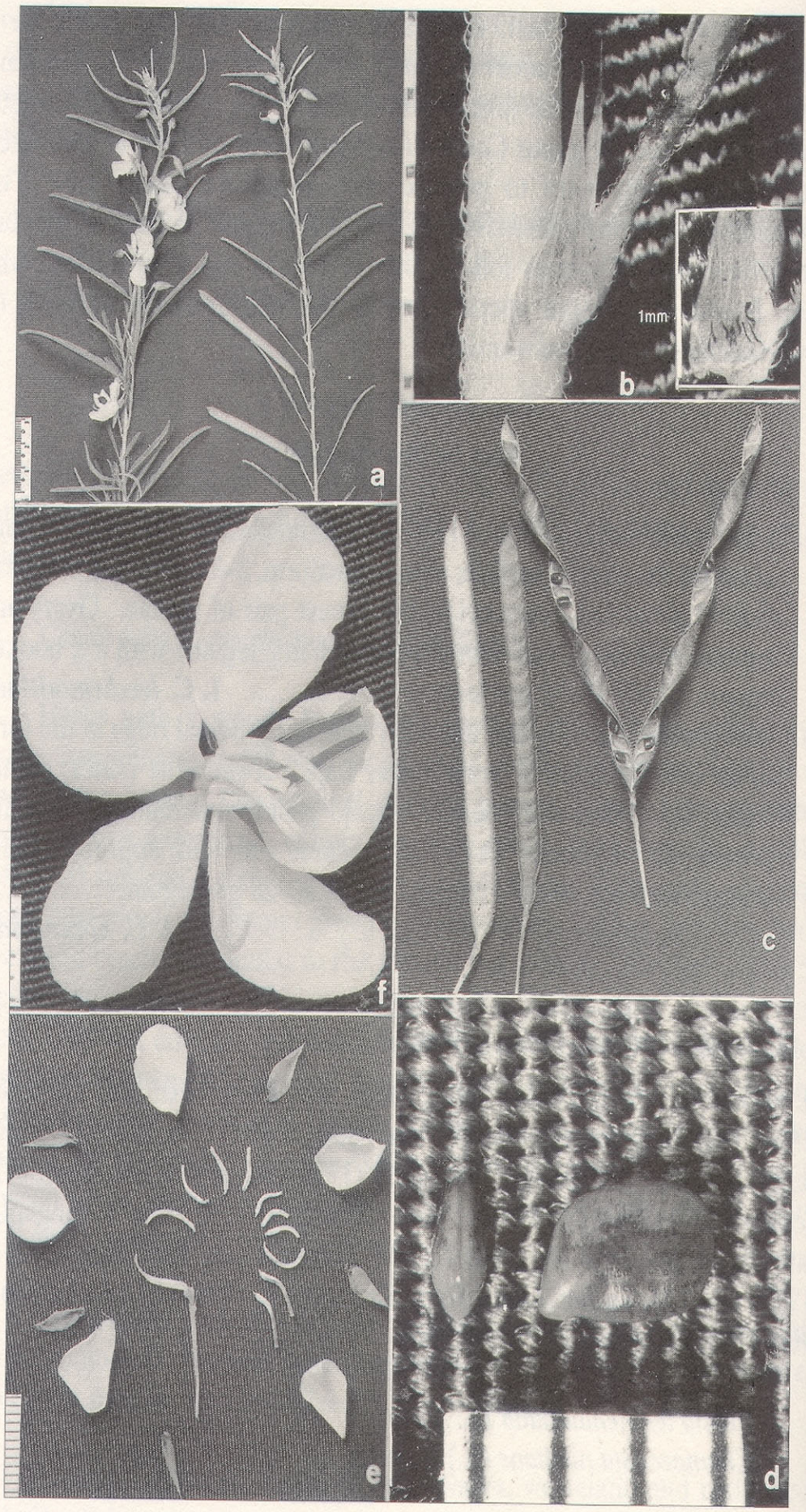

Figure 4. ***Chamaecrista mimosoides*** **(L.) Greene.** a. Left, flowering branch; right, fruiting branch; b. Paired stipules and petiolar gland, inset, intrastipular trichomes. c. From left, unripe, ripe and split legume showing spirally twisted valves; d. Hilar view and side view of seed; e. Exploded flower; f. Anterior view of flower. (Each interval on scale bar equivalent to 1mm). (A.H.B. Loo A.Loo 085).

1(–2) glands (c. 1 mm in diam.); stipules 10–17 mm long. *Raceme* 1–4-flowered. *Flowers*: sepals ovate to long-acute, 7–8 by 1–3 mm; petals orbicular to obovate, c. 7–8 by 3–6 mm; filaments short, c. 1 mm long, anthers slightly curved, unequal, 2–6 mm long; ovary c. 5 by 1 mm, sessile; style recurved, c. 2 mm long, glabrous; stigma flat, ciliate. *Legume* green turning brown, strap-shaped, 3–5 by 0.5 cm. *Seeds* dark brown, oblong, flat, c. 4 by 3 mm.

Distribution — Singapore: fairly common but less common than *C. mimosoides*; Pulau Tekong, Pulau Ubin (Western tip). South-east Asia, widespread in Malesia (Larsen and Hou, 1996a).

Ecology — Found in waste or reclaimed land; in Pulau Ubin growing in rock crevices near the sea. It has been observed to form nodules (Allen & Allen, 1981).

Uses — As green manure (Burkill, 1935).

2. *C. mimosoides* (L.) Greene

Pittonia 4 (1899) 27; L., Sp. pl. (1753) 379; Baker in J. D. Hook., Fl. Brit. India 2 (1879) 266; Ridl., Fl. Malay Penins. 1 (1922) 619; de Wit, Webbia 11 (1955) 283; M.R. Hend, Mal. Wild. Fl. Dic. (1959) 97; H. Keng, Gdns' Bull., Singapore 27 (1974) 258; R.T. Corlett, J. Biogeog. 15 (1988) 657–663; J.B. Hacker, A guide to herbaceous and shrub legumes of Queensland (1990) 94; H. Keng, Concise Fl. Singapore (1990) 33; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 119; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 297; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 567.

Cassia mimosoides L.

Subshrubs to 1.2 m tall; stem erect or decumbent, appressed pubescent. *Leaves*: rachis 3–5 cm long, produced to a short mucro to 3 mm long; pinnae in 40–60 pairs, asymmetrical, 3–6 by 0.5–1 mm, apex acute, mucro less than 0.5 mm long, margins sparsely ciliate, base truncate; petiole 2–3 mm long with 1 adaxial gland (c. 0.5 mm in diam.); stipules 3–5 mm long. *Raceme* 1–3-flowered; bracts and bracteoles like stipules but smaller. *Flowers*: sepals ovate to long acute, 8–10 by 2–5 mm; petals orbicular to obovate, 9–13 by 8–10 mm; filaments 1–2 mm long, anthers straight to slightly curved, 4–8 mm long, 2 adaxial ones turning reddish; ovary 6–9 by 1 mm, sessile; style 3–4 mm long, glabrous; stigma flat, ciliate. *Legume*

green turning brown, strap–shaped, 4–6 by 0.5 cm. *Seeds* dark brown, oblong, flat, c. 2.5 by 1.5 mm.

Distribution — Singapore: fairly common; Old Upper Thomson Road, Pulau Tekong, Yishun Ave 6. Regarded as introduced in the Malesian area and Africa; common all over tropical Asia (Larsen and Hou, 1996a).

Ecology — A short-lived weed of 1–2 years found in waste- or reclaimed land and which flowers and fruits year-round. The leaves are more sensitive than those of *C. leschenaultiana* and are thigmonastic and photoblastic, folding up during the hottest hours of the day and at night. The Singapore specimens have been observed to have root nodules. In Malesia this is a polymorphic species with many ecotypes (Larsen and Hou, 1996a).

Uses — As green manure; the roots are used for spasms in the stomach and tea is made from the leaves by the Japanese (Burkill, 1935).

Notes — Like *C. leschenaultiana*, a line of hairs can be observed on the inner surface of the stipules near the point of insertion (Fig. 4b, inset).

Cynometra L.

Sp. pl. (1753) 382, Gen. pl. ed. 5 (1754) 179; Meeuwen, Blumea 18 (1970) 1–52; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981)124; Watson & Dallwitz, Gen. Leg. — Caesalpinioideae (1983) 22.

Trees to 26 m tall; vegetative buds small, scaly. *Leaves* when new in bright pink tassles, when mature, paripinnate, 1–2-jugate; pinnae opposite, asymmetrical, chartaceous with an acroscopic midrib, glabrous; stipules early caducous. *Raceme* sessile, 1(–2) per axil or when cauliflorous, in groups of 3–5, densely-flowered, ± spherical in outline; rachis short, pubescent to glabrous. *Flowers* bisexual, zygomorphic; bracts scale-like, apressed hairy, lower ones reniform, decreasing in width up the raceme and becoming acute; bracteoles obovate, ciliate, caducous; sepals 4(–5), reflexed at anthesis, imbricate; petals 5(–4), narrow, glabrous; stamens 10 (-11), ± equal, filaments glabrous, anthers sagittate basally and apiculate at the apex, connective introrse, medi-dorsifixed, often cleft below the insertion of the filament, longitudinally dehiscent; ovary with 1(–2) ovules, densely pilose, shortly stipitate; style sparsely puberulous to halfway; receptacle shortly campanulate, circumscissle under the ripening fruit. *Fruit* indehiscent, rugose, brown scurfy, patently hairy, woody on a thickened

pedicel. *Seeds* 1(–2) per legume.

Distribution — About 70 spp., pantropical, in the West Pacific found eastwards as far as Micronesia, the Solomons and Fiji. and 14 spp. (13 indigenous and one cultivated) occurring in Malesia (Hou, 1996b). In Singapore there is only one indigenous sp.

Ecology — Mainly confined to the back-mangrove but also found inland.

Uses — As commercial timber (as the medium hardwood *kekatong* as classified by the Malaysian Timber Board). See under spp. *Cynometra cauliflora* L. (*nam nam*) is a cultivated sp. which was commonly planted for its fruits which can be eaten raw or cooked.

1. *C. ramiflora* L. var. *ramiflora*

Sp. pl. (1753) 382; Backer & Bakh. *f.*, Fl. Java 1 (1964) 526; Meeuwen, Blumea 18 (1970) 23; Whitmore, Tree fl. Malaya 1 (1972) 254; H. Keng, Gdns' Bull. Singapore 27 (1974) 259; Corner, Ways. Trees, 3rd ed. (1988) 434; H. Keng, Concise. Fl. Singapore (1990) 34; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 119; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 299.

Cynometra ramiflora subsp. *bijuga* Prain

Trees 4–26 m tall. *Leaves* 1–2-jugate; pinnae oblong, elliptic, obovate–lanceolate, base cuneate, lower pair much smaller, 1.1–5.5 by 0.5–2.6 cm with an acute apex, upper pair 4.5–14 by 1.6–5.6 cm with an acute to acuminate apex, petiolules indistinct; rachis 0.8–1.3 cm, canaliculate; petiole 3–15 mm, canaliculate. *Raceme*: rachis 13–25 mm long. *Flowers*: bracteoles 3–4 mm long; sepals lanceolate, 3–6 by 1–1.5 mm long, ciliate marginally and apically to glabrous; petals lanceolate to spathulate, 3–8 mm long, sometimes shortly mucronate; filaments 4–7 mm long, anthers orbicular, 0.5–1 mm long; ovary slightly excentrically inserted, rhomboid, flattened, 1–2 by 0.5–1 mm; style 3.5–5.5 mm long; gynophore 0.5–1 mm long; hypanthium 1–1.25 mm deep; pedicel 7–15 mm long. *Fruit* ovate or elliptic, the tip pointing up, 2.3–3.8 by 1.5–3 cm. *Seeds* c. 1.2 by 1 cm.

Distribution — Singapore: now probably extinct; previously collected in Kranji and Sungei Jurong. From India throughout South-east Asia and Malesia to the Pacific but not in Sri Lanka and Australia (Hou, 1996b).

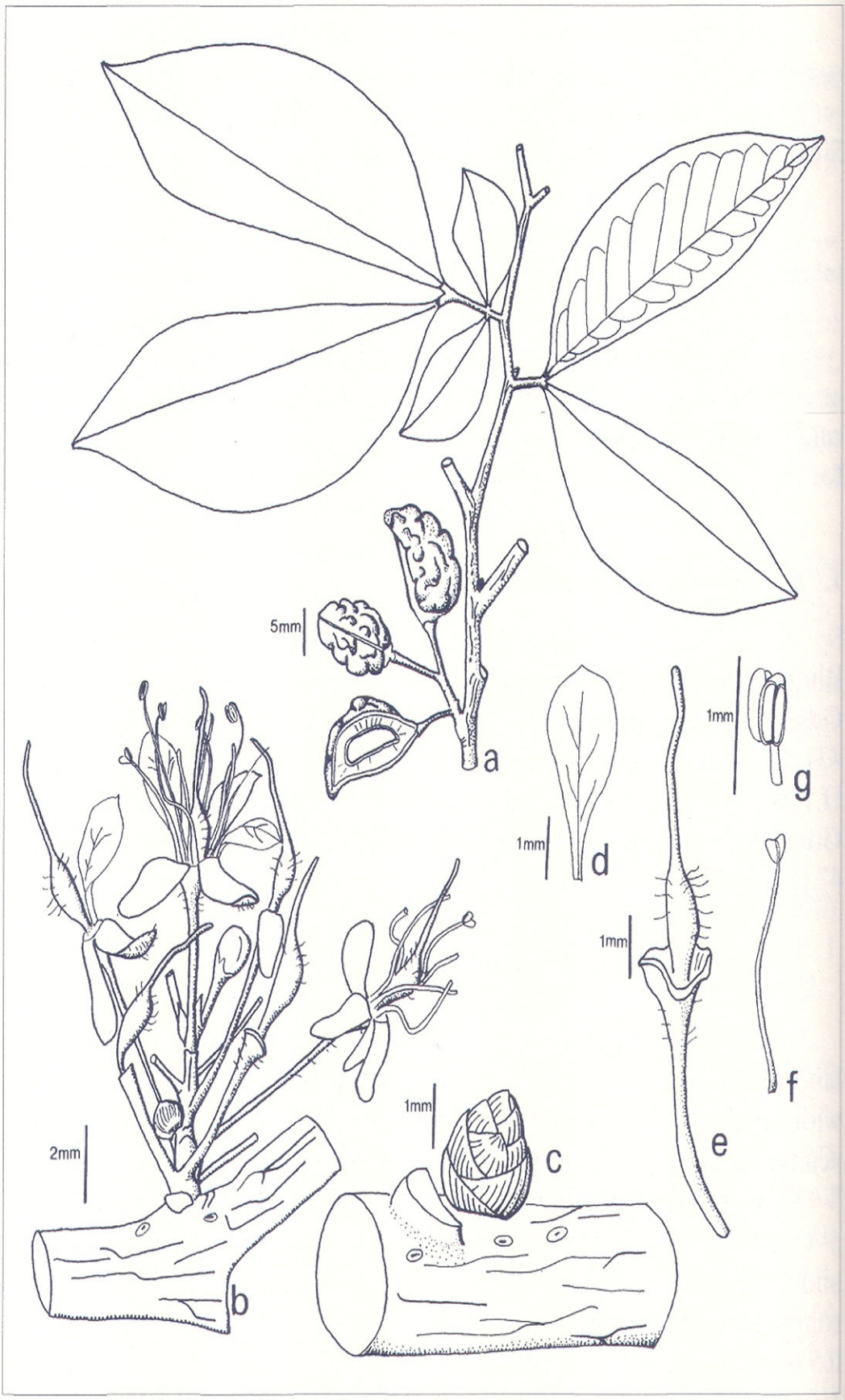

Figure 5. ***Cynometra ramiflora*** **L. var.** ***ramiflora*** a. Fruiting branch with one fruit longitudinally halved. (J. Sinclair SF 40957); b. Inflorescence; c. Scaly axillary bud; d. Isolated petal; e. Isolated carpel on hypanthium and pedicel; f. Back view of a stamen with cleft introrsed anther; g. Front view of an uncleft anther and top portion of filament. (Balara 3662).

Ecology — A constituent of the back-mangrove. The corky pericarp contains many air pockets which give buoyancy to the fruit which is dispersed by water (Meeuwen, 1970).

Uses — The hard, dark brown timber is only available in small quantities and is used for making doorposts; the roots purge and the leaves and oil from the seeds are used to treat skin diseases (Burkill, 1935).

Notes — The other var., var. *bifoliata* (Merr.) Meeuwen, has distinct petiolules 5–8 mm long but is only found in the Philippines (Luzon, Mindanao) (Meeuwen, 1970).

Dialium L.

Mant. 1 (1767) 3; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101; K. Larsen, S. S. Larsen & J. E. Vidal, Fl. Thailand 4:1 (1984) 85; J. P. Rojo, Fl. Males. 1:12 (1996) 608.

Trees; young stems lenticellate, pubescent. *Leaves* imparipinnate, rachis and petiole pubescent to glabrous, eglandular; pinnae alternate to subopposite, glabrous above, glabrous to pubsecent below, lamina margins entire, petiolules short, 2–6 mm long; stipules small, 1–1.5 mm wide, caducous. *Panicle* terminal, bractless, pubescent, lower branches usually subtended by leaves. *Flowers* bisexual, zygomorphic, small; sepals 5, reflexed at maturity, pubescent all over but minutely so inside; petals 0; stamens 2, filaments slender to stout, anthers basifixed, longitudinally dehiscent, connective puberulous; ovary sessile, centrally or excentrically inserted, subglobose, densely pubescent, ovules 1(–2); style short, straight to sharply curved; stigma small, slightly swollen; hypanthium flat or concave; pedicels pubescent. *Drupe* subglobose to obovoid, ± compressed, hairy or velvety, 1(–2)-seeded, exocarp crustaceous, endocarp pulpy, enveloping the seeds. *Seeds* 1(–2) per drupe, squarish, roundish or reniform, flat, smooth, longitudinally striate.

Distribution — Pantropical genus of 27 spp., not in Australia and the Pacific Islands (Rojo, 1996). In Malesia absent from the islands east of Borneo and Java. In Singapore there are two indigenous spp., one with two vars.

Ecology — In primary and late secondary forests.

Uses — The heartwood gives a good general-purpose timber, known

as *keranji* (Rojo & Alonzo, 1993). The pulpy endocarp of the fruits are edible but of slight economic importance (Rojo, 1996).

Notes — For the Singapore spp., *D. patens* has been reduced to *D. indum* var. *indum* and *D. maingayi* reduced to *D. platysepalum*, respectively following a revision by J. P. Rojo (unpubl. thesis, 1982). The spp. of *Dialium* are best separated with floral characters, in particular, the anthers (v-channeled or not), the depth of the hypanthium and the insertion of the ovary and stamens (centrally or excentrically).

Key to the Species

1a. Flower buds triulate, dark rusty pubescent; anthers v-channeled, triangular; filaments stout and flattened; style sharply recurved at the top; receptacle concave and wide; ovary and stamens excentrically inserted. Lamina of pinna chartaceous to thinly coriaceous, veins indistinct and not clearly raised on both surfaces, sometimes obscured by a golden indumentum below. Drupe velvety ..... **2. *D. platysepalum***

1b. Flower buds elliptic or rarely, ovate, white or whitish pubescent; anthers not v-channelled, oblong; filaments narrow and subulate; style straight to slightly recurved at the top; receptacle shallow and narrow, ovary and stamens ± centrally inserted. Lamina of pinna subcoriaceous to stiffly coriaceous, veins and reticulations distinct and slightly to prominently raised on both surfaces, not obscured by a golden indumentum on the lower surface at all times. Drupe hairy but not velvety ..... **1. *D. indum***

1. *D. indum* L.

Mant. 1 (1767) 24; Baker in J.D. Hook., Fl. Brit. India 2 (1878) 269, 270; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1990) 74; Ridl., Fl. Malay Penins. 1 (1922) 622; de Wit, Blumea 7 (1953) 320, 321; Whitmore, Tree Fl. Malaya 1 (1972) 260; H. Keng, Gdns' Bull., Singapore 27 (1974) 260; K. Larsen, S.S. Larsen & J.E. Vidal, Fl. Thailand 4:1 (1984) 87; H. Keng, Concise Fl. Singapore (1990) 35; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I. M. Turner, Gdns' Bull., Singapore 45 (1993) 121; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 302; J. P. Rojo, Fl. Males. 1:12 (1996) 609–612.

Dialium laurinum Baker
Dialium marginatum de Wit
Dialium patens Baker

Trees to 40 m tall; dbh to 1 m, twigs grey to dark brown pubescent. *Leaves*: petiole and rachis (4–)10–15(–20) cm long; pinnae 5, 7 or 9, lamina surfaces concolourous to darker above, ovate-oblong, ovate-lanceolate to broadly elliptic, (4–)6–10(–17) by (2.5–)3–5(–7.5) cm, veins in 8–10(–14) pairs, puberulous to glabrous below, apex rounded to long acute, base cuneate to obtuse, petiolules 3–6 mm. *Panicle* rachis 6–20 cm long. *Flowers*: sepals elliptic or ovate-elliptic, to 5 by 2.5 mm, white pubescent outside; filaments 0.5–2 mm long, anthers 2.5–4 by 1.5 mm; ovary to 2 mm long, white to golden-brown pubescent; style to 2 mm long; pedicels 2–6 mm long. *Drupe* brown, globose to ovoid, 1.5–2.5 by 1–1.5 cm, exocarp brittle. *Seeds* 1(–2) per drupe, brown, squarish to reniform, 7–12 by 5 mm.

Distribution — Singapore: rare; confined mainly to the Nature Reserves; previously collected in Kranji, MacRitchie Reservoir (South) and Mandai Road. Southernmost Thailand and in Malesia: Sumatra, Peninsular Malaysia, Borneo, Java (Rojo, 1996).

Ecology — Primary and late secondary forest.

Notes — There are two vars. that can be distinguished fairly accurately based on their pinnae. There are, however, intermediates. The type specimen of *Dialium laurinum* (Lectotype: *Maingay 1625* (residing in K), Peninsular Malaysia) is intermediate between the two vars. Ridley believed that the Singapore district, Kranji may have taken its name from this sp. which was previously abundant there (Keng, 1990). *Dialium indum* var. *indum* was not included in Singapore for its distribution area by Rojo (1996) in his revision of the Malesian spp. of *Dialium*. However *D. patens* which was sunk into this var., was already included in the flora of Singapore (Turner *et al.*, 1990; Turner, 1993) and collections made in Singapore were found in SING (specimen Corner 37721; J. Sinclair, SF 40957).

Key to Varieties

1a. Pinnae broadly elliptic to broadly lanceolate, stiffly coriaceous, apex obtuse to abruptly acuminate; veins and reticulations prominently raised above and below ..... var. ***bursa***

1b. Pinnae ovate-oblong to ovate-lanceolate, subcoriaceous, apex long acuminate to shortly cuspidate; veins and reticulations distinct but only slightly raised below ..... var. ***indum***

2. *D. platysepalum* Baker

In J.D. Hook. Fl. Brit. India 2 (1878) 270; Prain, J. Asiat. Soc. Beng. 66, ii (1897) 173, 174; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1990) 74; Ridl., Fl. Malay Penins. 1 (1922) 622, 623; Whitmore, Tree fl. Malaya 1 (1972) 259–261; H. Keng, Gdns' Bull., (1974) 260, 261; K. Larsen, S.S. Larsen & J.E. Vidal, Fl. Thailand 4:1 (1984) 88; H. Keng, Concise Fl. Singapore (1990) 35; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I. M. Turner, Gdns' Bull., Singapore 45 (1993) 121; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 302; J. P. Rojo, Fl. Males. 1:12 (1996) 612.

Dialium kingii Prain
Dialium maingayi Baker
Dialium wallichii (Baker) Prain

Trees to 45 m tall; dbh 90–120 cm; twigs greyish to rusty brown pubescent. *Leaves*: petiole and rachis (5–)10–18(–28) cm long; pinnae less the terminal one, in (5–)7–9(–13) pairs, lanceolate to oblong-elliptic, (4–)6–10(–15) by (1.5–)2–4(–7) cm, veins in 10–12(–15) pairs, lamina upper surface grey to dark brown when dry, lower surface milky brown or golden pubescent, puberulous to glabrescent or with a golden indumentum below, apex abruptly or long acuminate to cuspidate, base rounded to cuneate, petiolule 2–6 mm long. *Panicle* rachis 7–18 cm long, dark brown pubescent. *Flowers*: sepals ovate-triangular, to 6 by 4 mm, rusty to golden brown pubescent outside; style to 3 mm long; pedicel 2–4 mm long. *Drupe* dark brown, subglobose to obovoid, 1.5–3 long, sometimes with stipe to 2 mm long, pericarp firm. *Seeds* 1(–2) per drupe, brown, subglobose, 0.3–1.7 by 0.9–1 cm.

Distribution — Singapore: rare; Bukit Timah Nature Reserve (Jungle Falls); previously collected in Botanic Gardens' Jungle; Bukit Timah Nature Reserve (Rock Path and Ginger Walk), Jurong (Kim Teck Road), MacRitchie Nature Reserve (South). Malesia: Peninsular Malaysia, Sumatra, Borneo (Rojo, 1996).

Ecology — In primary forests and late secondary forest. In Malesia, also occurring in freshwater swamp forest. Flowers year-round, with peaks in Dececember to March and May to September, and fruiting most in July to October (Rojo, 1996).

Uses — As timber (*keranji*); pulpy endocarp of the fruits is edible (Burkill, 1935).

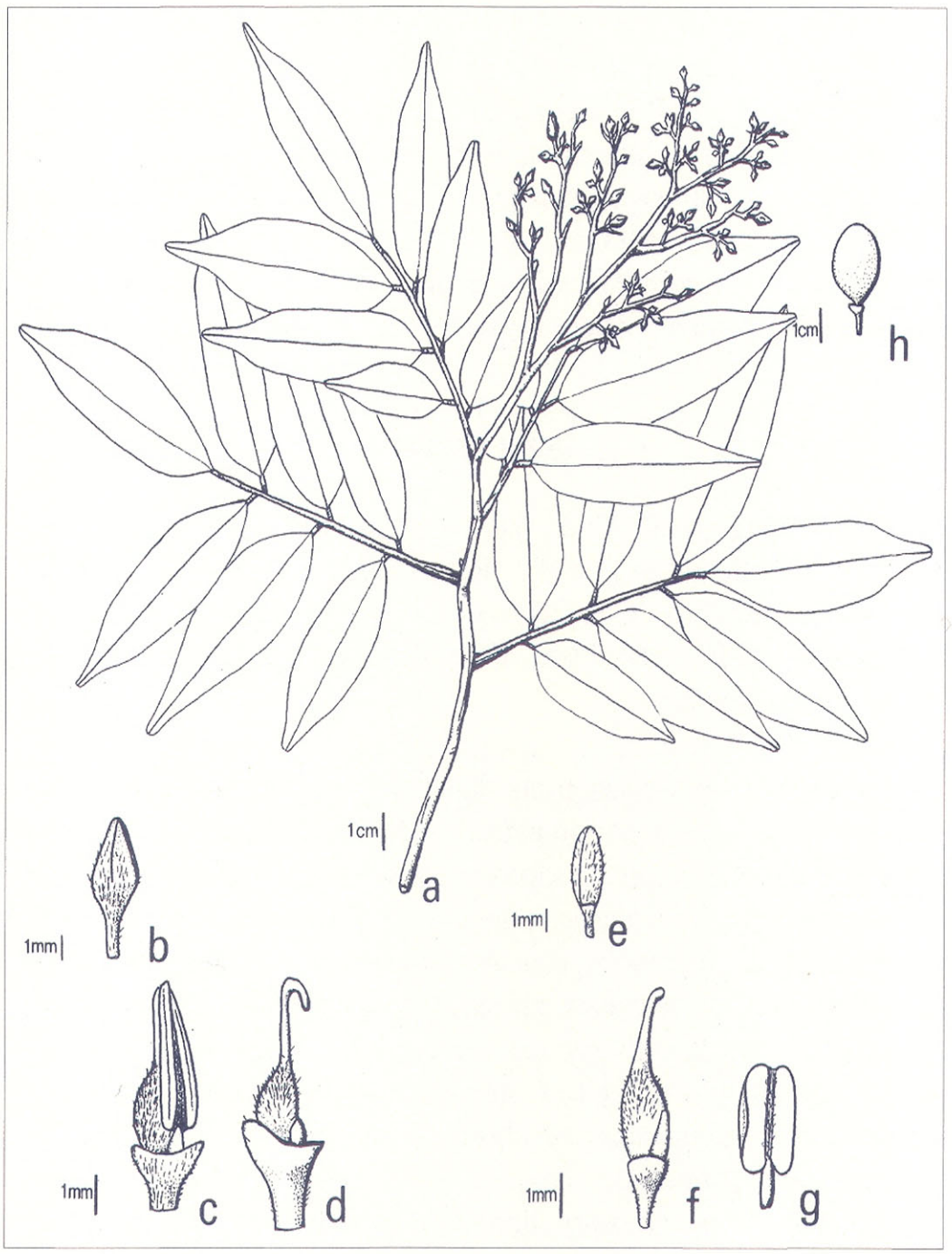

Figure 6. ***Dialium platysepalum*** **Baker.** a. Flowering branch; b. Triulate flower bud; c. Position of a v-channelled stamen; d. Isolated carpel on hypanthium and tip of pedicel (Ngadiman 3621); h. Drupe. (H. Keng S.N.) – *Dialium indum* L. e. (Ovate)-elliptic flower bud; f. Isolated carpel on hypanthium and tip of pedicel; g. Isolated stamen. (Kostermans 6562).

Notes — Based on the classification of Rojo (1996) there are 3 discrete 'groups' that can be distinguished in Singapore based on the size of the pinnae and colour and quality of their indumentum on their undersurface. The '*wallichii*' group is the most distinct group and is characterised in having lanceolate pinnae not exceeding 7 by 2 cm; the lower surface is also covered with a golden indumentum that often obscures the veins below and the upper surface is often greyish. The '*maingayi*' and '*platysepalum*' group are more difficult to separate; the '*maingayi*' group having a whitish to slightly golden indumentum below with indistinct veins and the '*platysepalum*' group having pinnae that are often tinged golden beneath. These 'groups' along with the '*kingii*' and '*triste*' groups are not given any nomenclatural or taxonomic status as the differences between them are slight and they form a gradient with intermediate specimens.

Intsia Thouars

Gen. Nov. Madg. (1806) 22; de Wit, Bull. Jard. bot. Buitenz.. 3:17 (1941) 139; Cowan & Polhill in Polhill & Raven (eds.) Adv. Leg Syst. 1 (1981) 128; Watson & Dallwitz, Gen. Leg. – Caesalpinioideae (1983) 35; K. Larsen, S.S. Larsen & J.E. Vidal, Flora of Thailand 4:1 (1984) 124; Ding Hou, Blumea 38 (1994) 322.

Trees often buttressed; trunk sometimes crooked, bark in brown and grey patches. *Leaves* paripinnate, (1–)2(–3)-jugate, laminas ovate to suborbiculate, chartaceous to subcoriaceous, usually with 1–2 small (≤ 0.5 mm across) crateriform glands at the base on the lower surface, petiolules twisted; stipules intrapetiolar, connate. *Inflorescence* a fascicle or a raceme of racemes, terminal or axillary, pubescent to glabrescent. *Flowers* bisexual, zygomorphic; bracts early caducous; calyx lobes 4, subequal, pubescent; petals: only one fully developed, limb flabellate, lower half narrowed into a claw, others rudimentary or absent; stamens 3(–4), staminodes 4–7, filaments and staminodes connate at the base, anthers dorsifixed, longitudinally dehiscent; ovary stipitate, stipe pubescent and adnate to the hypanthium except at the apical part; style coiled and slender; stigma capitulate, small. *Legumes* oblong, straight to slightly falcate, flattened, glabrous, valves leathery to slightly woody. *Seeds* 3–6 per legume, oblong, ovoid or discoid, flattened, scurfy.

Distribution — Two or more spp. from Madagascar, islands of the Indian Ocean, Tropical Asia, through Malesia to Northern Australia, Melanesia and Micronesia (Hou, 1994). In Malesia two spp. occur. In Singapore only one sp. is indigenous.

Ecology — *Intsia* spp. are long-lived spp. and are confined mainly to the coastal habitats, near mangroves and on sandy beaches (Hou, 1994).

Uses — As timber under the trade name *merbau*; *Intsia* timber is hard, very strong and durable and also termite-resistant; it has a wide range of uses both in- and outdoors from heavy construction to flooring, doors, posts, poles, and sleepers (Hou, 1994).

1. *I. bijuga* (Colebr.) Kuntze

Rev. Gen. pl. 1 (1891) 192; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1900) 75; Ridl., Fl. Malay Penins. 1 (1922) 639; Whitmore, Tree fl. Malaya 1 (1972) 262; H. Keng, Gdns' Bull., Singapore 27 (1974) 262; K. Larsen, S. S. Larsen & J. E. Vidal, Flora of Thailand 4:1 (1984) 125; Corner, Ways. Trees, 3rd ed. (1988) 438; H. Keng, Concise Fl. Singapore (1990) 36; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 122; Ding Hou, Blumea 38 (1994) 324, ; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 304.

Afzelia bijuga A. Gray
Afzelia retusa Kurz

Trees to 40 m tall; dbh to 1 m but usually smaller. *Leaves*: rachis 1.5–3.5 cm long; pinnae laminas ovate to broadly elliptic or suborbiculate, (2–)4–15 by 1.5–8.5 cm, abaxial midrib pubescent in the lower half, apex broadly acuminate, retuse or rounded, base cuneate to obtuse, petiolules 2–7 mm long; petiole 2.5–5.5 cm long; stipules c. 1 by 1 mm. *Raceme* 5–10 cm long. *Flowers*: calyx lobes ovate to obovate, 1–1.2 by 0.6–0.8 cm; petal white turning pink, red or purple, limb 1.2–1.5 by 1.5 cm, claw c. 0.5 by 0.1 cm, puberulous adaxially; filaments red or purple, 3–3.5 cm long, puberulous basally, anthers 2–2.5 by 0.5–1 mm, staminodes to 10 mm long; ovary 4–7.5 by 1.5 mm; style red or purple, 3–4 cm long; stigma c. 1 mm long; hypanthium 5–12 by 2–3 mm; pedicel 5–15 mm. *Legume* green turning purple to black, 7.5–20 by 5–6 cm. *Seeds* black, c. 2 by 2.5 cm.

Distribution — Singapore: rare; Pulau Tekong Kechil, Sungei Buloh Nature Park, Western Catchment Area; previously found in Bukit Timah Nature Reserve, Changi, Kranji Nature Reserve, Lim Chu Kang (Sarimbun), Pulau Jong, Pulau Ubin, Seletar, Tuas. Madagascar, islands of the Indian ocean, Tropical Asia, through Malesia to Northern Australia, Melanesia and Micronesia (Hou, 1994).

Figure 7. ***Intsia bijuga* (Colebr.) Kuntze.** a. Fruiting branch; b. Inflorescence; c. Seed; d. Lower surface of pinna showing crateriform glands (g); e. Adaxial view of twisted petiolule (A.H.B. Loo, A. Ibrahim, E.E.L. Seah & H.T.W. Tan A.Loo 037; f. Side view of a flower. (Rao & Jumali K6662).

Ecology — Along sea coasts, in beach forest or the back-mangrove, edges of rivers, in tidal or temporarily inundated places with (salty) water; also found in primary forests. A treelet c. 2 m tall growing from a rock crevice was observed to be in fruit in Pulau Tekong Kechil. The roots are reported to nodulate with a typical cowpea-type strain in Tully, Queensland, Australia (Allen and Allen 1981).

Uses — *I. bijuga* is a major tropical logwood and sawnwood sp. imported and exported under the trade name *merbau* (ITTO, 1996).

Koompassia Maingay ex Benth.

In Hooker's Icon. Pl. 12 (1873) 58, t. 1164; de Wit, Bull. Jard. bot. Buitenz. 3:17 (1947) 309; Irwin & Barneby in Polhill & Raven (eds.) Adv. Leg. Syst. 1 (1981) 101; Watson and Dallwitz, Gen. Leg. – Caesalpinioideae (1983) 37.

Trees, deciduous, gigantic; buttresses steep, thick and plank-like. *Leaves* imparipinnate; rachis and petiole ferruginous pubescent to glabrescent; pinnae alternate to subopposite, 5–14, laminas elliptic to ovate, subcoriaceous to coriaceous, pubescent below, midrib sunken and puberulous above, prominent below, lateral veins many, obscure on the upper surface, petiolules pubescent; stipules broadly ovate, small, early caducous. *Panicle* densely flowered, terminal or axillary, ferruginous pubescent. *Flowers* small; bracts and bracteoles lanceolate, small, caducous; calyx 5-lobed, lobes subequal, imbricate, pubescent outside; petals 5, subequal, with a prominent midvein, glabrous; stamens 5, alternating with the petals, filaments very short, glabrous, anthers basifixed, opening by apical and basal pores, both pores connected by a subdehiscent longitudinal rim; ovary sessile or sometimes, subsessile, 1-ovuled, pubescent; style very short; stigma indistinct; pedicels pubescent. *Samara* strongly compressed laterally, twisted 180°C at the base, pubescent, centre thickened and prominently veined, wing broad, circumferential, broadened apically, chartaceous. *Seed* 1 per legume, irregularly oblong, strongly compressed laterally.

Distribution — A small genus comprising three spp. in Malesia: Sumatra, Peninsular Malaysia, Borneo, Philippines and New Guinea (Hou, 1996c). In Singapore only one sp. is indigenous.

Ecology — In primary and late secondary forest; also in freshwater swamp forest.

Uses — All three spp. in Malesia have timber that are suitable for structural usage.

1. *K. malaccensis* Benth.

In Hooker's Icon. Pl. 3:2 (1876) 58, t. 1164; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1900) 74; Merr. Phillip. J. Sc. Bot 10 (1915) 12; Ridl., Fl. Malay Penins. 1 (1922) 620; de Wit, Bull. Jard. bot. Buitenz. 3:17 (1947) 317; Whitmore, Tree fl. Malaya 1 (1972) 265; H. Keng, Gdns' Bull., Singapore 27 (1974) 262; K. Larsen, S. S. Larsen & J. E. Vidal, Flora of Thailand 4:1 (1984) 84; Corner, Ways. Trees, 3rd ed. (1988) 439; H. Keng, Concise Fl. Singapore (1990) 36; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 122; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 304; Ding Hou, Fl. Males. 1:12 (1996) 634.

Trees to 45(–60) m tall; dbh 64(–120) cm; buttresses to 3(–6) m high. *Leaves*: rachis 6.2–19 cm long; pinnae 5–9(–14), laminas elliptic, ovate, oblong–ovate to elliptic-lanceolate, 3.5–10.4(–12.5) by 1.6–3.7 cm, finely areolate above, apex acuminate, slightly notched, base usually rounded, petiolules 4–9 mm long; petiole 1.4–3.9 cm long; stipules 2–2.5 mm wide. *Panicle* to 12 cm long. *Flowers*: bracts fleshy, c. 1 mm long, bracteoles subalternate, 0.5–1 mm long; calyx lobes ovate-lanceolate, 2–3 by 1 mm; petals orbicular to obovate, c. 2–3 by 1–1.5 mm, base fleshy; filaments abruptly broadened basally, 0.5–1 mm long; anthers heart-shaped, c. 1 by 0.5 mm; ovary c. 1 mm long; style < 0.5 mm long; pedicel 0.5–5 mm long. *Samara* green turning brown, oblong, 8.7–15 by 2.7–4.5 cm (including wing). *Seed* beige, to 3.5 by 1.5 cm, shallowly rugose.

Distribution — Singapore: vulnerable; Botanic Gardens' Jungle, the Nature Reserves; previously common all over Singapore (Keng, 1990). Malesia: Sumatra, Riau Archipelago, Bangka, Biliton, throughout Peninsular Malaysia, Borneo (Hou, 1996c).

Ecology — In primary and late secondary forest and freshwater swamp forest; sometimes occurring in groups near rivulets. Flowering and fruiting occurs year round. Seedlings can be found abundantly near the parent tree. Dispersal is by rapid spinning of the samaras sometimes to a distance of 50 m or more (Ridley, 1930). J. F. Maxwell (specimen J. F. Maxwell 81-225, in 1981), reported that the seeds were eaten by the long-tailed macaque, *Macaca fascicularis*, which bent the wings over the seed to expose it.

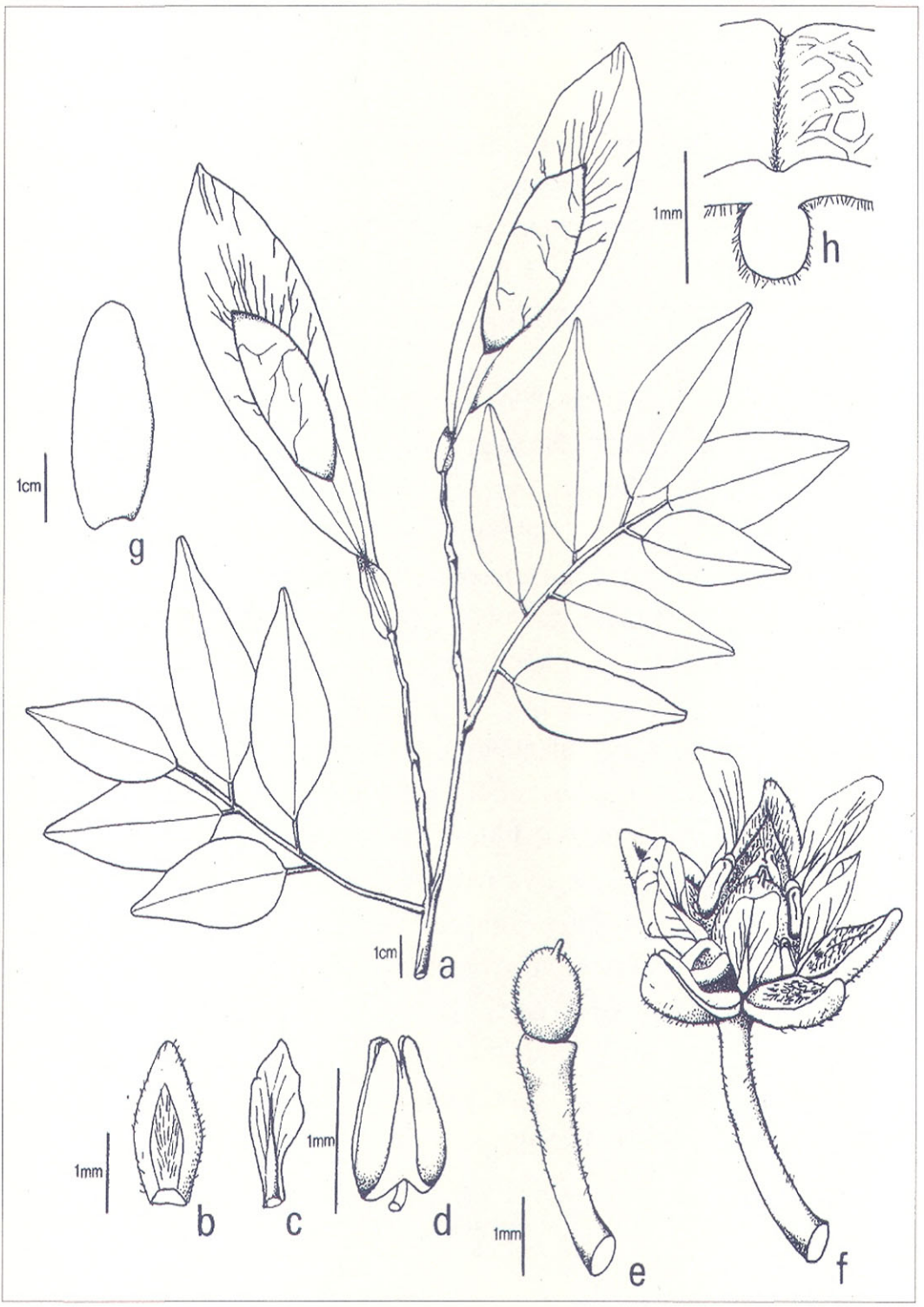

Figure 8. ***Koompassia malaccensis*** **Benth.** a. Fruiting branch (Kostermans 6682); b. Isolated sepal; c. Isolated petal; d. Isolated stamen; e. Isolated carpel on pedicel; f. Side view of a flower; g. Seed; h. Cross-section of pinnae showing pubescence on adaxial midrib and and abaxial surface of pinna. (J.F. Maxwell 81-225).

Uses — This sp. yields a coarse and hard, reddish heartwood which is known as *kempas*. The timber is strong but not popular as it is readily attacked by termites and has limited durability when exposed; it gives excellent charcoal and the buttresses are used as table tops (de Wit, 1947). *K. malaccensis* is a major tropical logwood and sawnwood sp. imported and exported under the trade name *kempas* (ITTO, 1996).

Peltophorum (Vogel) Benth.

J. Bot. 2 (1840) 75, *nom. cons.*;Vogel, Linnaea 11 (1837) 406; Taubert, PflFam. 3:3 (1892) 176; Polhill & J. E. Vidal in Polhill & Raven (eds.) Adv. Leg. Syst. 1 (1981) 90; Watson & Dallwitz, Gen. Leg. – Caesalpinioideae (1983) 47.

Deciduous trees, young shoots ferrugineous pubescent or glabrescent. *Leaves* twice-paripinnate; rachis and petiole ferruginous pubescent, grooved adaxially; pinnules numerous, opposite, small, venation finely reticulate, puberulous all over, sessile; stipules small, caducous. *Inflorescence* a raceme of racemes, terminal and axillary, ferrugineous pubescent. *Flowers* bisexual, zygomorphic; bracts minute, caducous; sepals 5, imbricate, reflexed, yellow-green, triangular, subequal, pubescent outside; petals 5, yellow, subequal, ferruginous woolly towards the short claw, venation finely reticulate; stamens 10, free, subequal, filaments slender, basally flattened and pilose, anthers brown, oblong, equal, dorsifixed and versatile, longitudinally dehiscent; ovary stipitate; style filiform, incurled; stigma broadly peltate; receptacle short, obscure. *Legume* indehiscent with a firm wing-like margin, oblong-lanceolate, strongly compressed laterally, woody, smooth, longitudinally striate, apex acute, base cuneate, slightly constricted between the seeds. *Seeds* lenticular to narrowly oblong, irregularly compressed.

Distribution — A pantropical genus of about 15 spp., three occurring in Malesia (Hou, 1996d). In Singapore, one sp. is indigenous.

Ecology — Coastal, along beaches and in the back-mangrove.

Uses — See under sp.

1. *P. pterocarpum* (DC.) K. Heyne

Nutt. Pl. Ned.–Ind., ed. 2 (1927) 755; DC., Prodr. 2 (1825) 441; Backer & Bakh. *f.*, Fl. Java 1 (1964) 547; Whitmore, Tree fl. Malaya 1 (1972) 268; H. Keng, Gdns' Bull. Singapore 27 (1974) 263; Hattink, Reinwardtia 9 (1974)

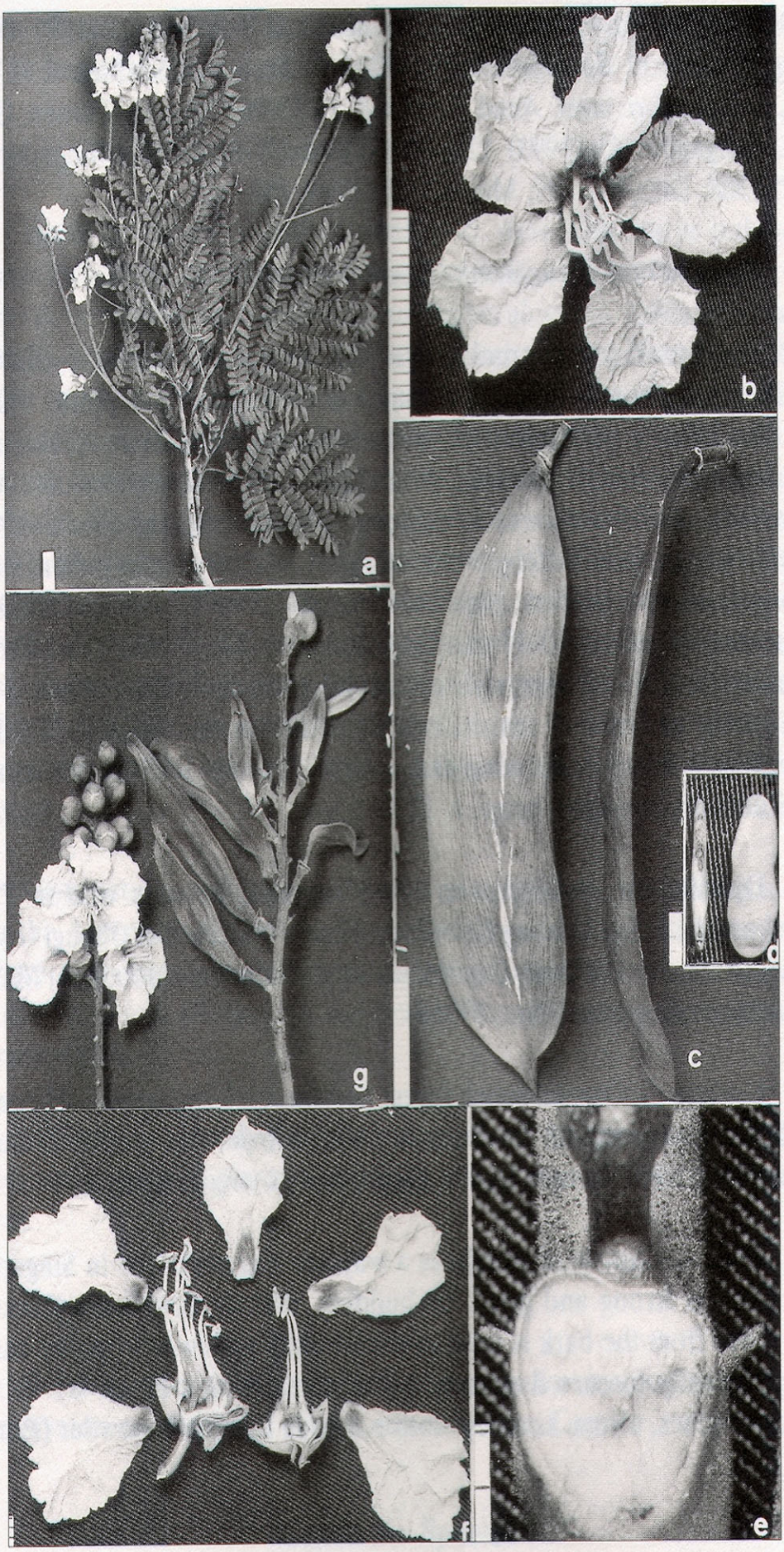

Figure 9. ***Peltophorum pterocarpum*** **(DC.) K. Heyne.** a. Flowering branch; b. Anterior view of flower; c. Side views of legume; d. Hilar view and side view of seed; e. Petiole cross-sectioned to show paired stipules (s); f. Exploded flower; g. Left - flowers and buds in a raceme, right - young legumes in a raceme. (Each interval on scale bar equivalent to 1mm). (A.H.B.Loo A.Loo 086).

59; Verdc., Manual New Guinea Legumes., Lae Bot. Bull. 11 (1979) 16; H. Keng, Concise Fl. Singapore (1990) 37; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 73; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 123; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 308; Ding Hou, Fl. Males. 1:12 (1996) 651.

Peltophorum ferrugineum (Decne.) Benth.

Trees to 35 m tall; trunk beige, dbh 0.7–1.0 m. *Leaves*: rachis 9–14 cm long; pinnae in 4–13 pairs; pinnules in 15–18 pairs per pinna, oblong, 10–18 by 5–7 mm, puberulous all over, sessile, apex rounded to emarginate, base unequal, acute or rounded; petiole 2.5–4 cm long; stipules deltoid, 3–5 mm long. *Inflorescence* to 40 cm long. *Flowers* fragrant; bracts deltoid, c. 5 mm long; sepals 7–10 by 5 mm; topmost two sometimes puberulous in the upper median portion; petals obovate, 2–2.5 by 1.2–1.8 cm, wrinkled; filaments pale yellow, 10–13 mm long, anthers c. 2 by 1 mm; ovary densely pubescent, 5–7 by 1–2 mm; style c. 1 cm long, stigma white green, c. 2 by 2 mm, sticky; pedicel 5–7 mm. *Legume* reddish brown, 6–14 by 2–3.5 cm (including 4–5 mm wide wing-like margin). *Seeds* 1–3(–4) per legume, longitudinally arranged, beige, c. 12 by 5 mm.

Distribution — Singapore: almost extinct; possibly wild in Pulau Semakau and Pulau Tekong Kechil; previously collected in Changi (coast), Tuas. Sri Lanka, Thailand, Cambodia, South Vietnam; throughout Malesia to Northern Australia (Hou, 1996d).

Ecology — Coastal beach forest and the back-mangrove. Flowering and fruiting year round. Nodules are absent from this species (Allen & Allen, 1981). The flowers have a slightly sweet, musky scent.

Uses — Cultivated widely as a wayside and park tree in Singapore. The wood is strong and good for building, making boats and planks; in Java a dye from the bark is used to colour batik yellow-brown; the bark is used internally to cure dysentery and externally as a lotion for sprains, muscular aches, ulcers, as an eye-lotion, gargle and tooth-powder (Burkill, 1935).

Senna Mill.

Gdnr's. Dict., abr. ed. 4 (1754); Irwin and Barneby in Polhill and Raven (eds.), Adv. Leg. Syst. 1 (1981) 105; Mem. N. Y. bot. Gdn 35 (1982) 64;

Benth., Trans. Linn. Soc. Lond. 27 (1871) 513; de Wit, Webbia 11 (1956) 228; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 673.

Cassia subg. *Senna* (Miller) Benth.

Herbs to shrubs, foetid or weakly so; stem glabrous to pubescent. *Leaves*: rachis and petiole eglandular or with 1(–2) glands adaxially, both grooved or widely and shallowly so, puberulous to pubescent, rachis abaxially produced to a short mucro beyond the uppermost petiolules; pinnae opposite, elliptic, oblong-elliptic, ovate or obovate, increasing in size distally, apex obtuse to acuminate, pubescent to glabrescent, base subequal, petiolules to 5 mm long; stipules paired. *Raceme* axillary and/or terminal. *Flowers* ebracteolate; sepals 5, ovate to orbicular, subequal; petals 5, obovate to orbicular, subequal, shortly clawed; stamens (6–)7, in 2 sizes, staminodes 0–3(–4), filaments straight, anthers basifixed, mostly beaked or produced, larger ones usually curved, opening by two apical pores, thecae not ciliate along the sutures. *Legume* indehiscent or inertly dehiscent through one or both sutures, in the latter case not coiling, transversly septate between seeds, many-seeded. *Seeds* and funicles variable.

Distribution — Pantropical genus of c. 260 spp., originating mainly from the Americas. There are 17 relatively common spp. in Malesia and of these probably only three spp. are indigenous (including *Senna tora*) (Larsen and Hou, 1996b). In Singapore, five exotic spp. are naturalized (Corlett, 1988).

Ecology — Mostly found in abandoned kampongs or farmland, occasionally in open places and along railway lines. Root nodules are absent.

Uses — See under spp.

Notes — See notes under *Chamaecrista* for reasons to recognize *Chamaecrista* and *Senna* as genera separate from *Cassia*

Key to the Species

1a. Shrubs; stem to 3–7 cm thick, marked with persistent stipules and conspicuous leaf scars. Petiole and rachis eglandular; rachis 30–56 cm long; pinnae in 8–20 pairs, margins orange, apex and base obtuse,

lowermost pair much smaller than the rest, recurved and set further apart from the rest (i.e., 1st internode the longest); stipules deltoid, stiff, persistent. Raceme densely 30–50-flowered. Bracts orange, petaloid, enveloping bud; sepals orange-yellow, incurled. Legume tetragonal, winged. Seeds olive-green, quadrangular ..... **1. *S. alata***

1b. Herbs or undershrubs; stem to 1.5 cm thick, not marked with persistent stipules or conspicuous leaf scars. Petiole or rachis with glands present; rachis 1.5–17 cm long; pinnae in 3–5(–7) pairs, margins green, apex rounded, acute or acuminate, base cuneate to rounded, lowermost pair not much smaller than the rest or recurved and not set further apart from the rest (i.e., all internodes subequal); stipules linear, membranous, caducous. Raceme loosely 2–5(–8)-flowered. Bracts green, linear, not enveloping bud; sepals green, flat or slightly incurved. Legume flattened or terete, wingless. Seeds brown, ovoid to orbicular 2

2a. Petiole base with glands; rachis eglandular, 5–17 cm long; pinnae in 3–5(–7) pairs, ovate or elliptic, apex acute or acuminate. Stigma subapical or lateral. Legume ± straight. Seeds dull 3

2b. Petiole eglandular; rachis with glands between the lowest pair or lowest two pairs of pinnae, 1.5–3 cm long; pinnae in 3 pairs, obovate, apex rounded or obtuse. Stigma apical. Legume falcate. Seeds glossy ... 4

3a. Plant foetid, pubescent all over. Pinnae pubescent on both surfaces; petiolar gland subulate, c. 1.5 mm long. Inflorescence a leafy raceme. Lowest part of the androecium a stamen with a narrow anther; ovary woolly. Legume hirsute, angular. Seeds obovoid, without an areole ..... **2. *S. hirsuta***

3b. Plant not foetid to slightly so, ± glabrous. Pinnae glabrous above, glabrescent below; petiolar gland globose, c. 3 mm across. Inflorescence in ± leafless raceme. Lowest part of the androecium a filamentous staminode with a petaloid anther; ovary shortly pubescent. Legume glabrous to glabrescent, sub-terete. Seeds orbicular, brown with a paler areole ..... **4. *S. occidentalis***

4a. A gland between the lowest pair of pinnae only. Pedicel of flower usually 1–3.5 cm long, of legume 2–4.5 cm long. 3 largest anthers bottle-necked below the apex. Areole of seed 0.3–0.5 mm wide, covering little of the seed surface. Plant weakly foetid ..... **3. *S. obtusifolia***

4b. A gland between the lowest 2 pairs of pinnae. Pedicel of flower usually 0.5–1 cm long, of legume 1–1.5 cm long. 3 largest anthers

abruptly rounded at the apex. Areole of seed 1.5–2 mm wide, covering much of the seed surface. Plant strongly foetid ..... **5. *S. tora***

1. *S. alata* (L.) Roxb

Fl. Ind. ed. 2, 2 (1832) 349; Sp. pl. (1753) 378; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1900) 74; Ridl., Fl. Malay Penins. 1 (1922) 619; de Wit, Webbia 11 (1956) 231; H. Keng, Gdns' Bull., Singapore 27 (1974) 257; Irwin & Barneby, Mem. N. Y. bot. Gdn 35 (1982) 460; R.T. Corlett, J. Biogeog. 15 (1988) 657–663; Corner, Ways. Trees, 3rd ed. (1988) 429; J.B. Hacker, A guide to herbaceous and shrub legumes of Queensland (1990) 86; H. Keng, Concise Fl. Singapore (1990) 33; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 124; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 309; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 675.

Cassia alata L.

Shrubs, 1–2(–5) m tall. *Leaves*: rachis orange and widely grooved above; pinnae in 8–20 pairs, oblong-elliptic but distal pairs obovate, 5–15 by 3–8 cm , veins pubescent below, petiolules c. 5 mm long; petiole 2–3 cm long; stipules brownish-red. *Raceme* 25–80 by 4–6 cm. *Flowers*: bracts 2.5–3 by 1.5–2 cm; sepals obovate, 1.5–1.8 by 0.7–1 cm; petals clawed, limb ovate to oblong, rarely obovate, 1.8–2.5 by 1–1.6 cm (including 2–4 mm long claw); stamens 7, unequal, largest 2: filaments laterally compressed, 5–6 by 2 x 1 mm, anthers swollen, curved, 12–13 mm long, central 4: filaments and anthers 3–4 mm long, lowest one: filament 0.5–1 mm long, anther 4–5 mm long, staminodes 3; ovary green, falcate with grooved sides, 15–20 by 2 mm, minute pubescent, style c. 7 mm long, stigma small, pedicel 4–5 mm long. *Legume* green turning black, tetragonal, 10–15 by 1.5–2 cm (including 4–8 mm wide wings). *Seeds* c. 50, quadrangular, flat, 7–8 by 5–8 mm.

Distribution — Singapore: common in abandoned kampongs; Island Club Road, Rochester Park, Old Upper Thomson Road (end of Kallang River), Pulau Tekong (South), Sungei Mandai Kechil (Kampong Fatimah), Yishun Ave 6; previously collected in Ang Mo Kio and Choa Chu Kang. It is probably native in the rivers of the Guianas and periphery of the Orinoco and Amazon basins in Brazil, Colombia and Venezuela. It became fully established in Java by the middle of the 17th century (Irwin and Barneby, 1982).

Ecology — Found near riverbanks or margins of ponds and ditches in abandoned kampongs, often in groups or scattered. It may be branched or not, commonly procumbent, establishing itself over a small area by leaning and producing erect shoots. The leaves are thigmonastic and photonastic, turning up during the hottest and sunniest hours of the day, in rainy weather and in the evenings. The legumes rattle when shaken.

Uses — This species has been used as an effective remedy for ringworm and other cutaneous diseases (Burkill, 1935). The leaves are also taken internally as a laxative, astringent, expectorant, purgative taenifuge, tonic and mixed with lime juice as an anthelmintic, the flowers are taken internally as a tonic for skin diseases, the seeds are taken internally for skin diseases, the bark contains tanning material, the roots used in West Africa for tattooing or tribal markings and the leaves contain chrysophanic acid (2.2%) and are used as an antiparasitic (Duke, Reed & Weder, 1981a). Burkill (1935) also mentioned that the roots are used internally for constipation and externally for ringworm and that the toasted leaves along with beans of *Glycine max*, are sometimes made into a drink similar to coffee. The plant may poison stock, and is sometimes a weed in pastures as it may rapidly reduce the area available for grazing as livestock will not eat the plant (Verdcourt, 1979).

2. *S. hirsuta* (L.) Irwin & Barneby var. *hirsuta*

Phytologia 44 (1979) 499; Sp. pl. (1753) 378; Ridl., J. Straits Branch Asiat. Soc. 33 (1900) 74; Ridl., Fl. Malay Penins. 1 (1922) 618; de Wit, Webbia 11 (1955) 250, 251; M.R. Hend., Mal. Wild. Fl. Dic. (1959) 96; H. Keng, Gdns' Bull., Singapore 27 (1974) 258; Irwin & Barneby, Mem. N. Y. bot. Gdn 35 (1982) 434; R.T. Corlett, J. Biogeog. 15 (1988) 657–663; Randell, J. Adelaide Bot. Gard. 11 (1988) 42; H. Keng, Concise Fl. Singapore (1990) 33; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 124; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 309; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 679.

Cassia hirsuta L.

Herbs to 2 m tall; hirsute all over. *Leaves*: rachis 5–17 cm long; pinnae in 3–5(–7) pairs, laminas ovate-elliptic, 2–12 by 1–3.5 cm, apex acute to acuminate, petiolules c. 2 mm long; petiole 3–6 cm long; stipules 7–15 x 1 mm. *Raceme* 2–5(–8)-flowered. *Flowers*: bracts 3–5 mm long;

sepals unequal, outer 2: ovate, 3–7 by 3–4 mm, villose outside; inner 3: obovate, 7–10 by 4–6 mm; petals 9–17 by 7–11 mm (including 1–2 mm long claw), limb obovate to orbicular; stamens 7, largest 2: filaments winged, 4–6 mm long, anthers curved, 6 mm long, beaked; central 4: similar but half as long, lowest 1: as long as the largest; ovary ± falcate, 5–8 mm long; style 1.5–2.5 mm long; stigma subapical, ciliate; pedicel 1–2 cm long. *Legume* grey brown, ± straight, flattened, sides grooved, 10–14 by 0.3–0.5 cm, hirsute. *Seeds* 50–100 per legume, 2–3 by 1 mm.

Distribution — Singapore: rare; previously collected in Geylang, Pasir Panjang, Yio Chu Kang. Origin in tropical South America; long naturalized in the Old World wet tropics (Irwin and Barneby, 1982).

Ecology — Along roadsides, railways, in old kampongs or abandoned plantations and farmland.

Uses — This species is used as green manure and to treat herpes (Heyne, 1927). The leaves are eaten steamed (Ochse, 1931).

Notes — Two varieties, var. *puberula* and var. *hirsuta*, are recognized in the Malesian area (Larsen and Hou, 1996b); the former found only in the Phillipines, has arched legumes and in the revision of de Wit (1955) is synonymous with *Cassia leptocarpa* Benth. In the use of the keys given by Larsen and Hou (1996b) to distinguish the varieties, it is important to examine mature legumes as immature ones are ± arched as in var. *puberula*.

3. *S. obtusifolia* (L.) Irwin & Barneby

Mem. N. Y. bot. Gdn 35 (1982) 252; Sp. pl. (1753) 377; Ridl., J. Straits Branch Asiat. Soc. 33 (1900) 74; Ridl., Fl. Malay Penins. 1 (1922) 618; de Wit, Webbia 11 (1955) 254; Brenan, Kew Bull (1958) 248; H. Keng, Gdns' Bull., Singapore 27 (1974) 258; R.T. Corlett, J. Biogeog. 15 (1988) 657–663; Randell, J. Adelaide Bot. Gard. 11 (1988) 45; J.B. Hacker, A guide to herbaceous and shrub legumes of Queensland (1990) 96; H. Keng, Concise Fl. Singapore (1990) 33; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 124; Turner, Gdns' Bull., Singapore 47 (1995) 309; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 681.

Cassia obtusifolia L.

Herbs or subshrubs to 2 m tall. *Leaves*: rachis 1.5–3 cm long, adaxial

gland c. 2 mm long; pinnae in 3 pairs, laminas obovate, 1.5–5 by 0.7–3 cm, increasing in size distally, membranous, pubescent below, base cuneate, petiolule 1–2 mm; petiole 1.5–3 cm; stipules linear, 5–20 by 0.5–1 mm, setaceous. *Raceme* 1–2(–3)-flowered on a c. 2 mm long peduncle. *Flowers*: bracts linear, c. 5 mm long; sepals ovate, subequal, 0.6–0.9 byx 0.3–0.5, puberulous; petals subequal, 0.7–2 by 0.4–1.2 cm (including 0.5–1.5 mm long claw), limb obovate; stamens 7, filaments 1–2 mm long, anthers unequal, largest 3; 4–5 mm long, central 4; 2.5–3.5 mm long, staminodes 0–3; ovary falcate, 7–13 by 0.5–1 mm, pubescent; style 2–3 mm long; stigma truncate, ciliate; pedicel pubescent. *Legume* brown, falcate, flattened, 11–23 by 0.5 cm, puberulous. *Seeds* 20–30(–50) per legume, brown, rhombic to ovoid, 3–5 by 2 by 2 mm, smooth.

Distribution — Singapore: uncommon; previously collected in Bukit Kallang and Tanglin. Probably native to the Americas and rare in Malesia (Larsen and Hou, 1996b).

Ecology — In old kampungs or abandoned plantations and farmland.

Uses — The leaves used as a vegetable, treatment for skin problems and as a cure for vomitting and stomach-ache while the roots are used for constipation (Burkill, 1935).

Notes — This species is closely related to *Senna tora* such that some authors regarded them as conspecific (e.g., Bentham, 1871). However, de Wit (1955) separated them into distinct taxa based mainly on foliar glands, pedicel length and scent. Brenan (1958) further distinguished the two species on differences in the width of the areoles of their seeds and emphasized the difference in the stamens.

4. *S. occidentalis* (L.) Link

Handb. 2 (1831) 140; Sp. pl. (1753) 377; Ridl., J. Straits Branch Asiat. Soc. 33 (1900) 74; Ridl., Fl. Malay Penins. 1 (1922) 618; de Wit, Webbia 11 (1955) 256; M.R. Hend., Mal. Wild. Fl. Dic. (1959) 99; H. Keng, Gdns' Bull. Singapore 27 (1974) 258; Irwin & Barneby, Mem. N. Y. bot. Gdn 35 (1982) 436; R.T. Corlett, J. Biogeog. 15 (1988) 657–663; Randell, J. Adelaide Bot. Gard. 11 (1988) 41; Hacker, A guide to herbaceous and shrub legumes of Queensland (1990) 97; H. Keng, Concise Fl. Singapore, (1990) 33; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull. Singapore 45 (1993) 124; Turner, Gdns' Bull., Singapore 47 (1995) 309; K. Larsen & Ding Hou, Fl. Males.

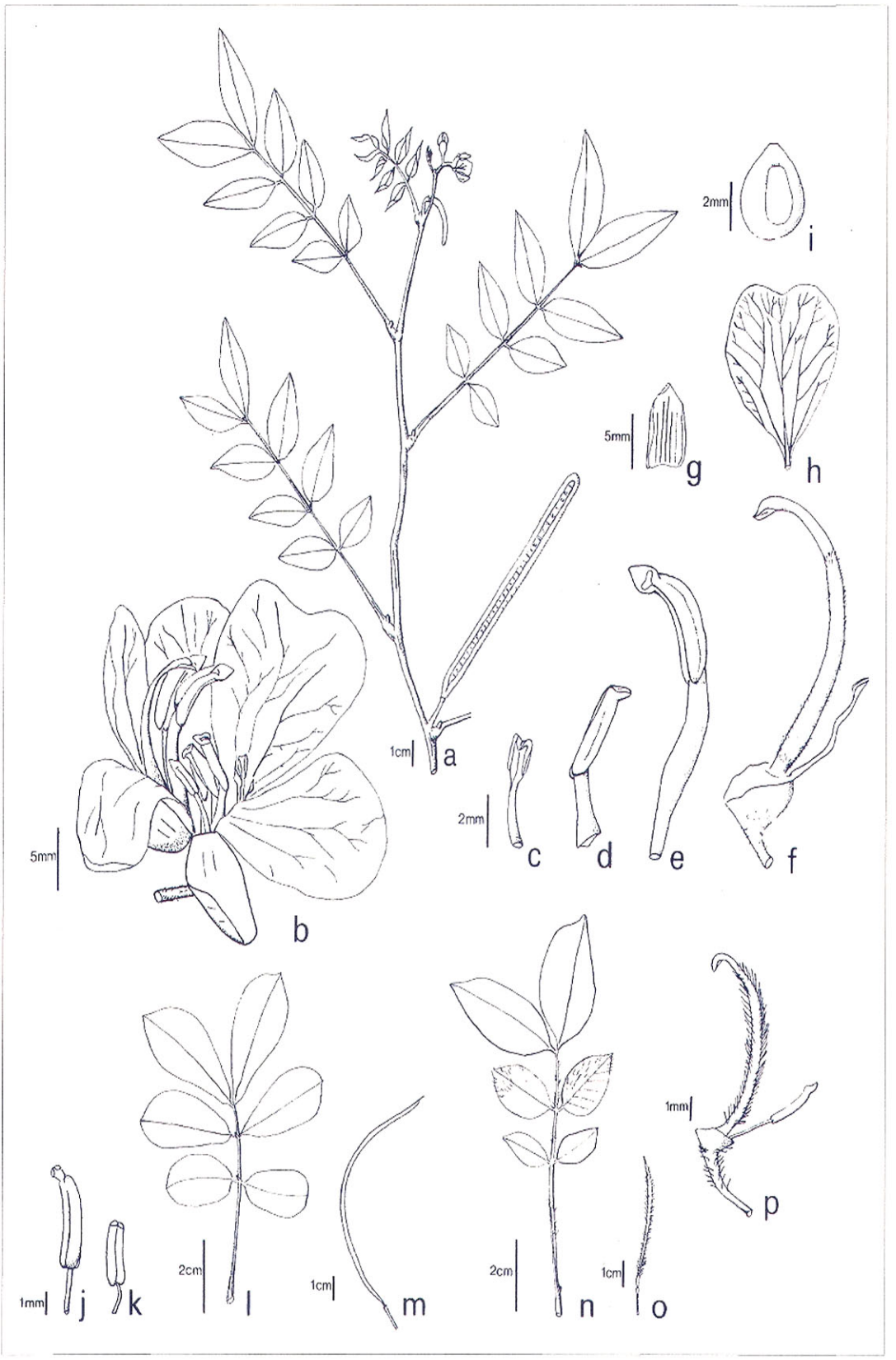

Figure 10. ***Senna occidentalis* (L.) Link.** a. Flowering and fruiting branch; b. Side view of flower; c. Isolated staminode; d. One of four middle stamens; e. One of three upper stamens; f. Isolated carpel on hypanthium with lowermost staminode attached on hypanthium and tip of pedicel; g. Isolated sepal; h. Isolated standard petal A.H.B. Loo, A.Loo 070); i. Seed. (Abu Kassim s.n.). ***Senna obtusifolia* (L.) Irwin & Barneby. j.** One of three largest stamens showing bottle-neck below apex. (R. W. Hullett S. N.). ***Senna tora* (L.) Roxb.** k. One of three largest stamens showing abruptly rounded apex; l. Leaf; m. Falcate legume. (P. W. Wong 2717). – ***Senna hirsuta* (L.) Irwin & Barneby var. *hirsuta*.** n. Leaf; o. Young legume; p. Isolated carpel with lowermost anther attached on hypanthium and pedicel. (Abu Kassim s.n.)

1:12 (1996) 681.

Cassia occidentalis L.

Herbs to subshrubs, 0.5–2 m tall. *Leaves*: rachis 7–10 cm long, with a puberulous groove; pinnae in 3–5(–6) pairs, laminas ovate-elliptic, 3–10.5 by 2–3.5 cm, petiolules 3–4 mm; petiole 3–6 cm long, gland glossy purple; stipules 3–20 by 2–3 mm. *Raceme* 2–4-flowered on a 2–5 mm long peduncle. *Flowers*: bracts 8 by 3–4 mm; sepals unequal, 2 ovate, 6–8 by 4–6 mm, 3 obovate to orbicular, 6–11 by 6–7 mm; petals unequal, 3 orbicular to widely obovate, 12–15 by 10–15 mm, 2 obovate, c. 12–17 by 7–9 mm, all excluding 1–2 mm long claw; stamens 6, largest 2: filaments 6–9 mm long, anthers 5–6 mm long, central 4: filaments 3–4 mm long, anthers 3–5 mm long, staminodes 4; ovary green, 1–2 cm long, pubescent; style 4–5 mm long; stigma lateral, ciliate; pedicel c. 1 cm long. *Legume* brown with pale margins, ± straight, 10–12 by 0.5–1 cm, glabrous to glabrescent. *Seeds* 30–50 per legume, flat, 3–4 mm in diam., smooth.

Distribution — Singapore: uncommon; East Coast Road, School of Biological Sciences Garden, the National University of Singapore; previously collected in Changi, Geylang and Jalan Bahar. This sp. is of South American origin and probably naturalized in the Malesian area (Larsen and Hou, 1996b).

Ecology — In old kampongs and abandoned farmland and plantations and along roads or near houses.

Uses — The seeds may be used as a substitute for coffee, the young leaves and legumes are eaten with rice usually as medicine, the leaves are used to cure headache and toothache and alcoholic infusions are slightly insecticidal (Burkill, 1935). The plant is used as green manure, as a purgative, febrifuge with diuretic and sudorific properties, the roots and leaves used as a substitute for quinine and the seeds and leaves used externally to treat skin diseases and as an antiperiodic, and the roots are used for snakebite and as an antidote for poisons (Duke, Reed & Weder, 1981b). In Senegal, the leaves are used to protect cowpea seeds (*Vigna unguiculata*) against *Callosobruchus maculatus* (Coleoptera: Bruchidae) (Liennard *et al.*, 1993).

5. *S. tora* (L.) Roxb.

Fl. Ind. ed. 2, 2 (1832) 340; Sp. pl. (1753) 376; Prain, J. As. Soc. Beng. 66, ii

(1897) 158, 475; Ridl., Fl. Malay Penins. 1 (1922) 618; de Wit, Webbia 11 (1955) 276; Brenan, Kew Bull (1958) 248; M.R. Hend., Mal. Wild. Fl. Dic. (1959) 99; H. Keng, Gdns' Bull., Singapore 27 (1974) 258; R.T. Corlett, J. Biogeog. 15 (1988) 657-663; Randell, J. Adelaide Bot. Gard. 11 (1988) 45; J.B. Hacker, A guide to herbaceous and shrub legumes of Queensland (1990) 102; H. Keng, Concise Fl. Singapore (1990) 33; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 72; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 124; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 309; K. Larsen & Ding Hou, Fl. Males. 1:12 (1996) 689.

Cassia tora L.

Erect herbs to subshrubs up to 1.5 m tall; puberulous to pubescent all over. *Leaves*: rachis 1.5–2.5 cm long, glands c. 2 mm long; pinnae in 3 pairs, laminas obovate, 2–4.5 by 1–2.5 cm, membranous, pubescent below, apex rounded or obtuse, base cuneate to rounded, subequal, petiolule 2 mm long; petiole 1.5–4 cm long; stipules 5–11 by 1 mm. *Raceme* axillary, 2-flowered on a 2–5 mm long peduncle. *Flowers*: bracts 2–5 mm long; sepals ovate, subequal, 4–7 by 2–4 mm, puberulous below; petals obovate, unequal, 8–10 by 5–6 mm; stamens 7, filaments 2–3 mm long, anthers unequal: largest 3, c. 3 mm long, central 4: c. 1.5–2 mm long, staminodes 0–3; ovary green, falcate, c. 7 mm long, densely pubescent; style c. 2 mm long; stigma ciliate; pedicel pubescent. *Legume* light brown, falcate, flattened, 10–15.5 by 0.2–0.5 cm, puberulous. *Seeds* 20–30 per legume, glossy light brown, rhomboidal, 4–5 by 2.5 by 2 mm.

Distribution — Singapore: uncommon; previously found in Pulau Ubin, Tanglin. Its origin is uncertain but is strictly palaeotropic in occurrence. It is common throughout Malesia at lower altitudes (Larsen and Hou, 1996b).

Ecology — In old kampongs or abandoned plantations and farmland.

Uses — Its leaves are used as a purgative, cure for coughs and against ringworm, the young leaves are eaten as a vegetable, the seeds contain emodin and are applied for itching, used for boils and as an internal and external medicine for eye diseases and the seeds are also used as a substitute for coffee (Burkill, 1935).

Sindora Miq.

Fl. Ind. Bat. Suppl. (1861) 287; de Wit, Bull. Jard. bot. Buitenz., 3:18 (1949) 5; Watson & Dallwitz, Gen. Leg. — Caesalpinioideae (1983) 53; Cowan & Polhill in Polhill & Raven (eds.) Adv. Leg. Syst. 1 (1981) 132.

Trees. *Leaves* paripinnate, 2–4-jugate; pinna laminas elliptic to obovate, coriaceous, rarely subcoriaceous, midrib slightly grooved above, secondary veins many, emerging at 60° or more from the midrib measured from the apex, anastomosing to a thickened marginal vein, tertiary veins finely reticulate, petiolules short; stipules foliaceous, caducous. *Panicle* axillary or terminal. *Flowers* bisexual, zygomorphic; bracts and bracteoles small, caducous; sepals narrowly overlapping, 4, spinescent or not, strigose inside, pubescent outside; petal 1, fleshy; androecium of 9 connate stamens and staminodes and 1 uppermost free staminode, the lower 9 filaments shortly, obliquely and basally connate into a hirsute sheath, the 2 uppermost ones of the 9 with elongated filaments and dorsifixed and longitudinally dehiscent anthers, the other 7 lower filaments shorter with or without small, imperfect anthers; ovary subsessile, 2–5-ovuled, pubescent; style filiform, recurved; stigma small; pedicel short, pubescent. *Legume* elliptic to orbicular, flat, woody, armed or not, dehiscent, beak curved. *Seeds* 1–3 per legume, black, shiny, each set on a large fleshy aril; cotyledons split, funicle curving.

Distribution — A genus of 18–20 spp. in West Africa and South-east Asia and 15 spp. occur in Malesia (Hou, 1996e). In Singapore there are two indigenous species.

Ecology — Coastal beach forest to further inland in primary forest.

Uses — Mainly as timber. See under species.

Key to the Species

1a. Lower surface of pinna glossy, glabrous except at the midrib; rachis and petiole both glabrous. Sepals inermous outside; ovary inermous. Legume unarmed ..... **1. *S. coriacea***

1b. Lower surface of pinna dull, puberulous to pubescent all over; rachis and petiole pubescent to puberulous. Sepals with spiny outgrowths on the upper half outside; ovary shortly spinescent. Legume densely armed with spines to 4 mm long ..... **2. *S. wallichii***

1. *S. coriacea* (Baker) Prain

J. Asiat.. Soc. Beng. 66 ii (1897) 206, 482; Baker in J. D. Hook., Fl. Brit. India 2 (1878) 275; Ridl., Fl. Malay Penins. 1 (1922) 639; Whitmore, Tree fl. Malaya 1 (1972) 271; de Wit, Bull. Jard. bot. Buitenz.. 3:18 (1949) 30; K. Larsen, S.S. Larsen & J.E. Vidal in Fl. Thailand 4 (1984) 98; I.M. Turner, Gdns' Bull., Singapore 47 (1995) 310; Ding Hou, Fl. Males. 1:12 (1996) 697.

Trees 18–33 m tall; trunk cylindric, dbh 31–95 cm, buttresses to 60 cm high. *Leaves*: rachis 5.5–12(–14) cm long; pinna laminas elliptic or ovate, rarely obovate, (3.5–)5–10(–15) by (2.5–)3–5(–7.5) cm, glossy above, apex acute to acuminate, rarely shortly-acuminate, base acute to obtuse; petiolules c. 5 mm long; petiole 2.5–4 cm long. *Panicle* 20–30 cm long, lateral branches to 7 cm long, ± zig-zagging. *Flowers*: bracts and bracteoles ovate-lanceolate, 1.5–3 mm long; sepals yellow, elliptic or lanceolate, 6.5–7.5 by 2.5–3 mm; petal yellow to red, obovate to oblong, 5–7.5 by 2–4 mm, pubescent outside, margins villous; stamens basally connate to c. 3 mm high, free filaments and staminode to 12 mm long, 2 largest anthers ellipsoid, 2.5–3.5 by 1.5 mm long, the rest to 1.5 mm long; ovary ± ellipsoid, 3–4 by 2 mm, woolly along the suture, 4–5-ovuled; style to 11 mm long, glabrous; pedicel 1–2.5 mm long. *Legume* ellipsoid or rarely broadly ellipsoid, 7–10 by 4–6 cm, beak to c. 1 cm long. *Seeds* 2-3 per legume, black, compressed, suborbicular, c. 2 by 2 cm, aril c. 2 by 2 cm.

Distribution — Singapore: rare; Bukit Kallang, Bukit Timah, Nee Soon Swamp Forest. Peninsular Thailand; Malesia: Sumatra (East coast), Peninsular Malaysia (widespread), Borneo (Sabah, Kalimantan) (Hou, 1996e).

Ecology — Primary rain forest or in fresh water swamp forest.

Uses — This species considered the best timber in the genus along with *Sindora velutina* (Whitmore, 1973). The wood oil collected from the tree is used for medicinal purposes (Burkill, 1935).

Notes — This species is a new record for the flora of Singapore. It was first discovered in 1994 by Ali bin Ibrahim in Nee Soon Swamp Forest.

2. *S. wallichii* Benth.

In Hook., Icon. Pl. 11 (1867) sub t. 1018 excl. t. 1017; Baker in J.D. Hook., Fl. Brit. India 2 (1879) 268; Prain., J. Asiat. Soc. Bengal 66, ii (1897) 203, 204, 481, 482; Ridl., J. Straits Brch R. Asiat. Soc. 33 (1900) 75; Ridl., Fl.

Malay Penins. 1 (1922) 637, 638; Symington, Kew Bull. (1938) 75, 77; de Wit, Bull. Jard. bot. Buitenz., 3:18 (1949) 76; Whitmore, Tree fl. Malaya 1 (1972) 273; Corner, Ways. Trees, 3rd ed. (1988) 445; H. Keng, Concise Fl. Singapore (1990) 39; I.M. Turner, K.S. Chua & H.T.W. Tan, J. Singapore natn. Acad. Sci. 18 & 19 (1990) 73; I.M. Turner, Gdns' Bull., Singapore 45 (1993) 124; Turner, Gdns' Bull., Singapore 47 (1995) 310; Ding Hou, Fl. Males. 1:12 (1996) 708.

Sindora intermedia (Baker) Prain

Trees to 30 m tall; trunk cylindric, dbh (0.7–)1–2 m. *Leaves*: rachis (2–)4–6.5 cm long, pinna laminas elliptic to ovate or obovate, 3.3–9 by 2–5.2 cm, upper surface sometimes puberulous, glossy, apex rounded to broadly acuminate, base rounded; petiolules c. 4 mm long; petiole 1.5–2.5 cm long; stipules falcate, 10–17 by 4–8 mm. *Panicle* 6–25 cm long, lateral branches to 5 cm long, zig-zagging. *Flowers*: bracts and bracteoles lanceolate, to 4 mm long; sepals yellow-green, lanceolate, c. 10 by 3–4 mm; petal elliptic, c. 8 by 3 mm, outside hirsute; stamens unequal, 2 largest: filaments c. 1.5 cm long, anthers 3.5 by 2 mm, 7 others: 0.5–0.7 cm long, anthers c. 3 by 2 mm, staminode 1; ovary rhomboid, c. 5 by 4 mm; style c. 1.5 cm long; stigma capitate; pedicel to 5 mm long. *Legume* green turning black, orbicular to irregularly elliptic, 4–9.5 cm across, beak to 9 mm long. *Seeds* 1–3 per legume, surface with concentric lines, compressed, suborbicular, 1–1.5 by 0.7 cm, aril yellow turning dark brown, c. 2 by 2 cm.

Distribution — Singapore: rare; Botanic Gardens' Jungle, Bukit Timah Nature Reserve (Jungle Falls), Changi Point, Fort Canning Hill, Pulau Sakijang Pelepah, Upper Pierce Reservoir; previously found in Bukit Timah Road. Sumatra (East Coast, Jambi, Palembang, Riau Archipelago), Peninsular Malaysia, Borneo (Sabah, Kalimantan) (Hou, 1996e).

Ecology — Coastal beach forest to further inland in primary forest, sometimes near streams, in groups or solitary. Seedlings can be found near the parent tree. The exudate from the spines of the legume has a strong citrus scent. The seeds are said to be dispersed by rodents which eat the fleshy aril (Ridley, 1930). The aril is fleshy in unripe legumes that have fallen to the ground but in ripe legumes the aril is dark brown and very hard.

Uses — The commercial timber is known as *sepetir* as classified by the Malaysian Timber Board; the pods are medicinal and the wood oil used as an illuminant (Burkill, 1935).

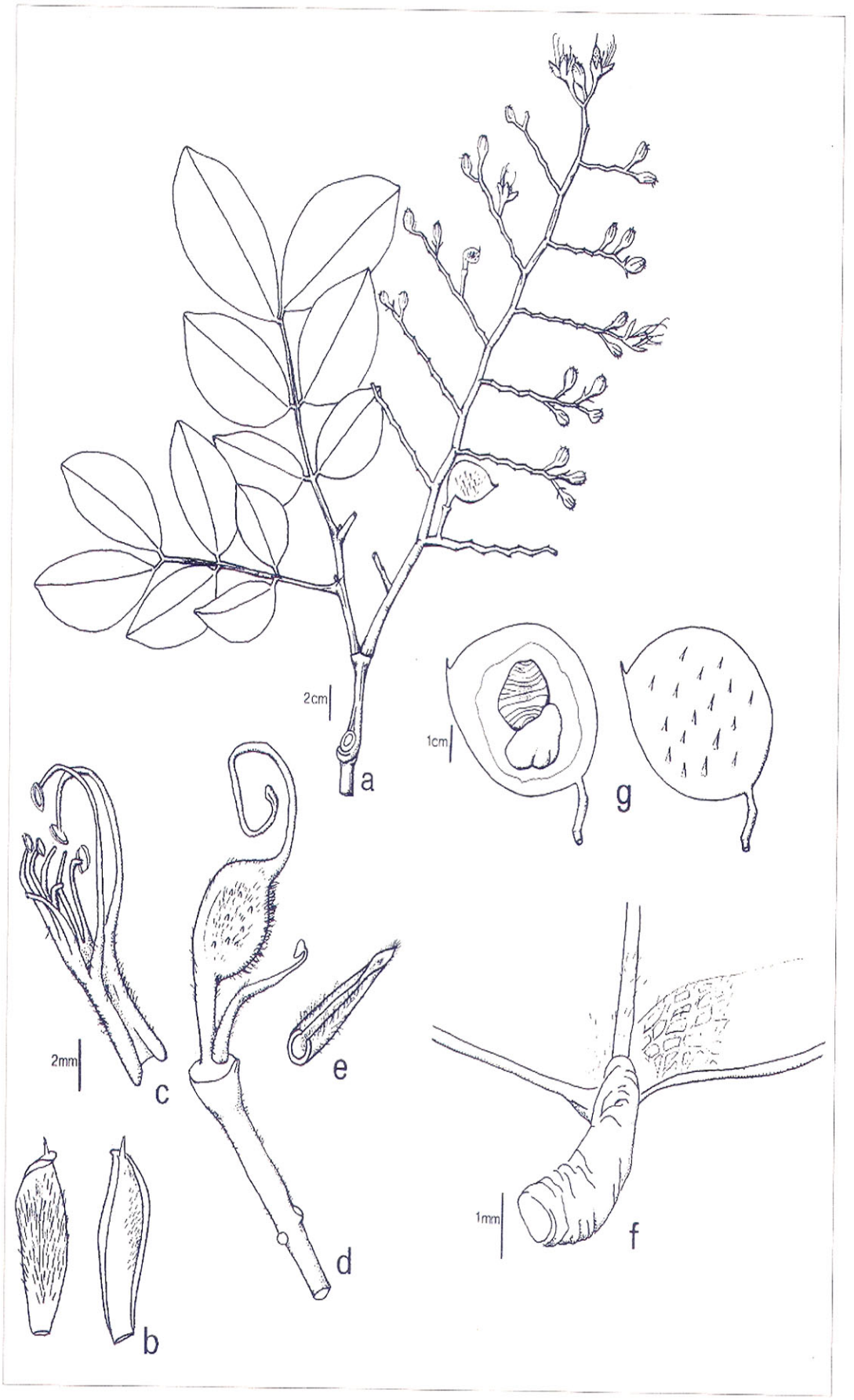

Figure 11. ***Sindora wallichii*** **Benth.** a. Flowering branch with some newly formed legumes; b. Left, inner surface of sepal, right - outer surface of sepal; c. 9 stamens basally connate into a hirsute sheath; d. Ovary on stipe with one free uppermost staminode; e. Isolated petal (adaxial); f. Abaxial view of pinna showing thickened marginal nerve and tertiary venation; g. Legume; left, one valve removed to show arillate seed; right; outer surface of valve. (J.F. Maxwell 78-51)

Notes — Corner (1988) believed that the famous tall tree that stood at Changi and served as a navigational landmark to pilots until 1942, belonged to this species.

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List of Caesalpiniaceae collected in the Republic of Singapore
(includes collector's/s' name, number, date of collection, location, state of specimen.)

Bauhinia semibifida Roxb. var. ***semibifida***

A.H.B. Loo, I.M. Turner, Eel Seah, ALoo 001, 6 July 1996;A.H.B. Loo, Eel Seah, ALoo 007,12 Jul 1996, Nee Soon Swamp Forest, flowering; A.H.B. Loo, C. Boo, J. Yong, L. Chen, I.M. Turner, Eel Seah, ALoo 017(flower buds), 018 (fruiting), 019 (stem), Nee Soon Firing Range; T. M. Leong, ALoo 039, 15 Aug 1996, Rifle Range Road, seedling; B.Y.H. Lee, ALoo 071, Sep 1996, Macritchie Reservoir, flowering; A.H.B. Loo, B.Y.H. Lee, ALoo 078, 11 Oct 1996, Upper Pierce Reservoir (Resam Path), flower buds; A.H.B. Loo, Ali Ibrahim, Eel Seah, Joseph Lai, ALoo 084, 29 Oct 1996, Rifle Range Road (Near Bukit Kallang), flowering.

Caesalpinia bonduc (L.) Roxb.

A. H. B. Loo, Ali Ibrahim, Eel Seah, H. T. W. Tan, ALoo 044, 26 Aug 1996, Pulau Sakijang Pelepah, male flowers; A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 057, 3 Sep 1996, Pulau Sakijang Pelepah, male flowers; A.H.B. Loo, B.C. Soong, Ali Ibrahim, Eel Seah, H.T.W. Tan, S1019, 27 Sep 1996, Pulau Semakau (West), fruiting.

Caesalpinia crista L.

A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 049, 29 Aug 1996, Pulau Tekong (Kg. Salabin), fruiting; A.H.B. Loo, Eel Seah, H.T.W. Tan, ALoo 055, 3 Sep 1996, Pulau Sakijang Pelepah vegetative; N. Tanaka, L. Chen, C. Boo, ALoo 005, 009, Sungei Mandai Kechil, Kg. Fatimah; A.H.B. Loo, ALoo 010, 18 July 1996, Sembawang end, fruiting; A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 025 (stem), ALoo 026 (fruiting), ALoo 027 (seedling), 9 Aug 1996, Western Catchment Area; A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 028, 15 Aug 1996, Pulau Tekong (Kg. Unum), vegetative; A.H.B. Loo, Ali Ibrahim, Eel Seah, ALoo 048, 22 Aug 1996, Pulau Tekong Kechil, vegetative; A.H.B. Loo, Ali Ibrahim, B.C. Soong, Eel Seah, H.T.W. Tan, A.H.B. Loo, Ali Ibrahim, B.C. Soong, Eel Seah, H.T.W. Tan, ALoo 080, 22 Oct 1996, Pulau Terkukor, vegetative; ALoo 081, 22 Oct 1996, Pulau Terkukor, seedling.

Caesalpinia sumatrana Roxb.

A.H.B. Loo, J.A.C.P.L. Looi, ALoo 058, 9 Sep 1996, Bukit Timah Nature Reserve (Cave Path), sapling.

Chamaecrista leschenaultiana *(DC.)* Degener

N. Tanaka, C. Boo, L. Chen, ALoo 043, Jul 1996, Pulau Ubin, vegetative.

Chamaecrista mimosoides (L.) Greene

A.H.B. Loo, ALoo 011, 22 July 1996, Old Upper Thomson Road, flowering and fruiting; A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 034, 20 Aug 1996, Pulau Tekong, flowering and fruiting; A.H.B. Loo, ALoo 072, 11 Oct 1996, Yishun Ave 6, whole plant, nodules; A.H.B. Loo, ALoo 073, 11 Oct 1996, whole plant, nodules; A.H.B. Loo, ALoo 074, 07911 Oct 1996, Yishun Ave 6; A.H.B. Loo, ALoo 085, Nov 1996, Old Upper Thomson Road, flowering and fruiting.

Dialium platysepalum Baker

A.H.B. Loo, T.M. Leong, ALoo 060, 19 Sep 1996, Bukit Timah Nature Reserve (Jungle Falls), 'wallichii', vegetative.

Intsia bijuga (Colebr.) Kuntze

A.H.B. Loo, Eel Seah, D. Wee, Karen, ALoo 020, 1 Aug 1996, Sungei Buloh Nature Reserve, vegetative; A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 024, 9 Aug 1996, Western Catchment Area, fruiting; A.H.B. Loo, Ali Ibrahim, Eel Seah, ALoo 037, 22 Aug 1996, Pulau Tekong Kechil, fruiting, ALoo 038, vegetative.

Koompassia malaccensis Benth.

A.H.B. Loo, ALoo 059, Jul 1996, Botanic Gardens' Jungle, fruits picked up from the ground; A.H.B. Loo, T.M. Leong, ALoo 063, Bukit Timah Nature reserve (Jungle Falls), samaras and seedlings.

Peltophorum pterocarpum (DC.) K. Heyne

A.H.B. Loo, ALoo 003, 12 July, Mandai Road, fruiting; A.H.B. Loo, Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 015, 3 Aug 1996, Pulau Hantu, fruiting; Ali Ibrahim, Eel Seah, ALoo 016, 3 Aug 1996, West Coast Road, flowering; A.H.B. Loo, Eel Seah, ALoo 021, 6 Aug 1996, Pulau Sakijang Bendera, fruiting; A.H.B. Loo, ALoo 023, 7 Aug 1996, NUS Campus, flowering and fruiting; Ali Ibrahim, Eel Seah, ALoo 036, 22 Aug 1996, Pulau Tekong Kechil, vegetative, wild?; Ali Ibrahim, Eel Seah, H.T.W. Tan, ALoo 051, 29 Aug 1996, Pulau Tekong, flowering; A.H.B. Loo, Ali Ibrahim, B.C Soong, Eel Seah, H.T.W. Tan, S1010, 27 Sep 1996, Pulau Semakau (West), fruiting, wild?; A.H.B. Loo, B.C Soong, Eel Seah, H.T.W. Tan, S1023, 27 Sep 1996, Pulau Semakau (West), sapling; A.H.B. Loo, Ali Ibrahim, B.C Soong, Eel Seah, H.T.W. Tan, ALoo 067, 1 Oct 1996, Pulau Subar Darat, fruiting; ALoo 082, 22 Oct 1996, Pulau Terkukor, vegetative; A.H.B. Loo, ALoo 086, Nov 1996, NUS Campus, flowering and fruiting.

Senna alata (L.) Roxb.

N. Tanaka, L. Chen, C. Boo, ALoo 002, 13 July 1996, Sungei Mandai Kechil, fruiting; B.Y H. Lee, ALoo 032, 19 Aug 1996, North Bouna Vista Road, flowering, A.H.B. Loo, ALoo 033, 19 Aug 1996, North Bouna Vista Road, flowering; A.H.B. Loo, Ali Ibrahim, B.C Soong, Eel Seah, H.T.W. Tan, ALoo 035, 20 Aug 1996, Pulau Tekong, vegetative; A.H.B. Loo, ALoo 075, 076, 11 Oct 1996, Island Club Road, flowers and fruits; A.H.B. Loo, ALoo 077, 11 Oct 1996, Yishun Ave 6, fruiting.

Senna occidentalis (L.) Link

AH.B. Loo, ALoo 029, 030, 031, 16 Aug 1996, East Coast Road, flowering and fruiting; A.H.B. Loo, Ali Ibrahim, Eel Seah, ALoo 041, 22 Aug 1996, East Coast Road, flowering and fruiting; A.H.B. Loo, ALoo 070, 8 Oct 1996, School of Biologial Sciences Garden (NUS), flowering and fruiting.

Sindora coriacea (Baker) Prain

A.H.B. Loo, Ali Ibrahim, Eel Seah, Joeseph Lai, ALoo 083, 29 Oct 1996, Bukit Kallang (Summit), vegetative.

Sindora wallichii Benth.

A. H. B. Loo, Ali Ibrahim, Eel Seah, ALoo 054, 29 Aug 1996, Netheravon Road, fruiting; ALoo 063, 19 Sep 1996, Bukit Timah Nature Reserve (Jungle Falls), seedlings and fallen fruits.

The following species were not found in the field:

Caesalpinia tortuosa Roxb.
Cynometra ramiflora L. var. ***ramiflora;***
Dialium indum L.var. ***bursa*** (de Wit) Rojo
Dialium indum L. var. ***indum***
Senna hirsuta (L.) Irwin and Barneby var. ***hirsuta;***
Senna obtusifolia (L.) Irwin and Barneby
Senna tora (L.) Roxb.