

## BURSERACEAE

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A.W. Bennett in Hooker *f.*, Fl. Brit. Ind. 1 (1875) 527; King, J. As. Soc. Beng. 62, 2 (1893) 235; Merrill, EB (1921) 316, PEB (1929) 116; Ridley, FMP 1 (1922) 368; H.J. Lam, Bull. Jard. Bot. Botg. 3, 12 (1932) 281; Masamune, EPB (1942) 362; Browne, FTSB (1955) 70; Leenhouts, FM 1, 5 (1956) 208, FM 1, 6 (1972) 917, FM 1, 7 (1976) 820; Backer & Bakhuizen *f.*, FJ 2 (1965) 112; Smythies, CST (1965) 30; Burgess, TBS (1966) 60; Kochummen, TFM 1 (1972) 121; Cockburn, TS 1 (1976) 34; Anderson, CLTS (1980) 155; Wong, DMT (1982) 30; Corner, WSTM 2 (1988) 199; Whitmore, Tantra & Sutisna, CLK 1 (1989) 34; Ng, Mal. For. Rec. 34, 1 (1991) 35.

Medium-sized to large buttressed trees, rarely shrubs; dioecious or occasionally monoecious; *crushed living parts with strong resinous smell*. **Bark** pale grey to brown, smooth or scaly, often lenticellate, *surface sometimes with black or white resinous gum; inner bark pinkish, or creamy, laminated or mottled, with droplets of clear or white resinous gum, with strong resinous smell* in most species (especially those of *Canarium* and *Triomma*). **Sapwood** often whitish, shiny, sometimes pinkish or yellowish brown, vessels usually visible to the unaided eye. Pith of twigs, petioles and petiolules often with vascular strands and resin ducts. **Leaves** spiral, usually crowded at the tips of twigs, *pinnately compound with opposite leaflets and a terminal leaflet, rarely trifoliolate; petiolules of leaflets with distinct swellings at both ends in most species* (leaflets sessile in *Garuga*); margin entire except in some *Canarium* and *Garuga* species. Stipules present in all species of *Garuga* and in most species of *Canarium*. **Inflorescences** usually axillary or terminal panicles, sometimes spikes, racemes or thyrses. **Flowers** unisexual (except in *Garuga*), *male and female on different trees*, 3- or 5-merous, usually greenish to cream, the remains of the other sex persisting; sepals valvate, mostly united; petals valvate, free; stamens usually twice as many as petals, filaments free or united, sometimes fused to the disc, anthers dehiscing inwards; disc intrastaminal (except in *Triomma*), nectariferous, brightly coloured; ovary superior, with 3-5 cells; each cell with 2 ovules; style simple, stigma globular, often slightly lobed. **Fruit** a drupe with a fleshy or leathery resinous rind and a more-or-less woody stone (pyrene) or in *Triomma* a woody capsule; stone 3-celled or less. **Seed** one; cotyledons fleshy, variously folded, rolled and convoluted; endosperm absent; germination epigeal or hypogeal, mostly rapid; cotyledons divided into 3, 5 or more lobes (entire in *Scutinanthe*). **Seedling** with first 2 leaves opposite or alternate, subsequent leaves alternate, spiral, simple for several nodes, then pinnate (in some *Santiria* the leaves are pinnate from start); sapling leaflets thinner, with long drawn-out tips, longer petioles and more distantly spaced when compared to the adult leaves.

**Distribution.** 16 genera and about 550 species; tropics and subtropics. In Sabah and Sarawak, 8 genera and 59 species are known.

**Ecology.** Burseraceae are common constituents of the main storey of mixed dipterocarp and *kerangas* forests; they also occur in submontane forests to 1800 m. The drupaceous fruits are dispersed by animals. In *Triomma* the winged seeds are dispersed by wind.

**Timber.** The standard Malaysian name for the timber of Burseraceae is *kedondong* (Malay). It is a very homogeneous group except for slight colour differences, and a light hardwood, moderately hard and moderately heavy; in strength Class 'C', strong; working quality variable, some easy, others difficult and blunting tools excessively. Not durable in tropical conditions. Moderately susceptible to powder post-beetles. Difficult to treat with preservatives. Seasoning without serious degrade, with low shrinkage. Sapwood pale, not sharply defined; heartwood yellow-brown, pink-brown or red-brown, only slightly darkening on exposure, surface mostly glossy, without figure; grain interlocked. Texture moderately fine and even. Most species of *Dacryodes*, *Santiria* and *Scutinanthe* have siliceous timbers while *Canarium* (except *C. apertum*) and *Triomma* have no silica in the timber.

**Uses.** Timber suitable for general building construction and carpentry work, plywood and weather boarding. The family abounds in fragrant balsams and resins (e.g., balsam from *Commiphora opobalsamum*; frankincense from *Boswellia* species especially *B. sacra*; myrrh from *Commiphora myrra*). The resins are used in traditional medicine in Peninsular Malaysia. The resin from *Canarium luzonicum*, the "Manila-elemi" is used in pharmacy in ointments and plasters. The oil from the kernel is used locally. Commercial quantities of the oil are now being produced in the Solomon Islands from *Canarium* species for industrial use in the manufacture of skin- and hair-care products under the trade name "Solomon Nut Oil". The seeds of *Canarium album*, *Canarium indicum* (*ngali-nut*; Solomon Islands), *C. ovatum* and *C. vulgare* (*kenari*, Indonesian) are eaten. Certain species, e.g., *C. album*, *C. ovatum* and *C. vulgare*, are planted as avenue trees, or for wind-breaks and also as shade-trees for nutmeg plantations.

**Taxonomy.** Although the Burseraceae is taxonomically closely related to the Meliaceae and Simaroubaceae it is liable to be confused with the pinnate-leaved species of the Anacardiaceae. The sole distinguishing character is the number of ovules per cell which is two in every cell in the Burseraceae and one in the Anacardiaceae. Vegetatively, the swollen petiolule is a good diagnostic feature for most members of the Burseraceae. The family is divided into 3 tribes. Except for *Triomma* which belongs to tribe *Bursereae* with capsular fruit, all the genera in Borneo belong to the tribe *Canarieae* with a drupaceous fruit. *Triomma* retains a capsular fruit which must be the primitive fruit of the family and which is perhaps to be regarded as an ancient relic character.

**Key to genera**

- 1. Flowers 4-5-merous. Fruit with 1 or more pyrenes.....2
- Flowers 3-merous. Fruit with 1 pyrene.....5
- 2. Flowers bisexual. Stipellae present. Leaflet margin toothed.....3. **Garuga**
- Flowers unisexual. Stipellae absent. Leaflet margin entire or occasionally toothed.....3
- 3. Stamens 5; disc extrastaminal. Fruit a 3-winged capsule. Leaflets withering yellow, with pink veins.....8. **Triomma**

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- 4. Recepta  
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Stamens 8 or 10; disc intrastaminal. Fruit a globular or ellipsoid drupe. Leaflets not so.....4

4. Receptacle of flower cup-shaped; ovary 3-celled.....7. **Scutinanthe**  
Receptacle flat; ovary 4-5-celled.....5. **Protium**

5. Fruit thick-walled, bony, seated on enlarged calyx. Leaves often stipulate, leaflet margin often toothed.....1. **Canarium**  
Fruit thin-walled, calyx not enlarged in fruit. Leaves without stipules, leaflet margin entire.....6

6. Remains of stigma on the fruit always distinctly off-centre. Fruit surface smooth when dry.....6. **Santiria**  
Remains of stigma on the fruit not off-centre. Fruit smooth or coarsely wrinkled when dry.....7

7. Dry fruits smooth. Cotyledons entire. Inflorescences axillary, to 10 cm long...4. **Haplolobus**  
Dry fruits coarsely wrinkled. Cotyledons divided. Inflorescences axillary and terminal, much longer.....2. **Dacryodes**

## 1. CANARIUM Stickman

(from the Moluccan name *kenari*)

*kedondong* (Malay)

Herb. Amb. (1754) 10 (erroneously *Cenarium*); King *l.c.* 236; Ridley *l.c.* (1922) 369; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 422; Burkill, EPMP 1 (1935) 424; Browne *l.c.* 70; Leenhouts *l.c.* (1956) 249, *l.c.* (1972) 92, Blumea 9 (1959) 275; Backer & Bakhuizen *f. l.c.* 114; Kochummen *l.c.* (1972) 126, Sandakania 5 (1994) 73; Cockburn *l.c.* 37; Anderson *l.c.* 155; Corner *l.c.* 200; Wong *l.c.* 30; Whitmore, Tantra & Sutisna *l.c.* 34; Ng *l.c.* 37.

Medium-sized to large buttressed trees, rarely shrubs. **Bark** grey-fawn or light yellow-brown, smooth, scaly or dippled, with many small lenticels; *inner bark pinkish or reddish, laminated*, soft, aromatic, with clear sticky exudate, rarely with non-sticky exudate, which becomes dark brown on exposure. **Sapwood** whitish, darkening inwards. Twigs usually round, *the pith nearly always with vascular strands*. **Leaves** often with stipules of various shapes and sizes, at base of rachis or on it, soon falling off; leaflets generally with pointed tips, *the margin entire, dentate, or serrate*, basal pair of leaflets usually smaller; petiole rounded, flattened or channelled especially towards base, often swollen at base. **Inflorescences** axillary or terminal panicles, spikes, racemes, or thyrses, female ones often reduced and smaller. **Flowers** unisexual, male and female on separate trees, *3-merous*; receptacle flat or concave; calyx cup-shaped, *lobes deltoid*, outside glabrous or hairy, *inside always densely silky-hairy*; petals 3, creamy, free, usually overlapping in bud, nearly always ovoid-oblong, *the tip inflexed, fleshy and thick* with thin margins, outside hairy in the centre, inside usually glabrous; stamens 6 in one whorl, rarely only 3, free to entirely connate, sometimes adnate to the disc, in female flowers sterile and often less-developed, filaments flattened,

anthers opening by a longitudinal slit; disc inside to the stamens (intrastaminal), 6-lobed, strongly developed in male flowers; ovary in female flowers stalked if receptacle is concave, ovoid to ellipsoid, style cylindrical, stigma globular, slightly 3-lobed; in the male much reduced, often fused to disc. **Fruit** a drupe seated on persistent enlarged calyx, with apical stigma, blue black when ripe (rarely ivory white or red), hairy especially near base and apex, or glabrous; pericarp fleshy or fibrous, wrinkled when dry; stone hard, woody, round or triangular in cross-section, with 3 cells, often reduced to 2 or 1, containing woody intrusions of the placenta, penetrating between cells as wings, often visible as surface ribs. **Seed** 1 per cell; testa brown; without endosperm; cotyledons oily, 3-lobed in most species but 5-lobed in *C. megalanthum*.

**Distribution.** c. 100 species; tropical W and E Africa, Madagascar, Mauritius, Sri Lanka, SE Asia from S Deccan to S China and Hainan, Malesia, NE Australia and Melanesia; 23 species in Sabah and Sarawak.

**Ecology.** Common in the lowland mixed dipterocarp forests, rare in submontane forests to 1800 m.

**Uses.** *Canarium* species produce general utility timber. Burkill (*l.c.*) documents some of the uses. *C. pimela* is cultivated in SE China as an ornamental and as a fruit tree. The fruits are highly esteemed by the Chinese. *C. indicum*, *C. ovatum* and *C. vulgare* are planted for their nuts. They are an important constituent of the diet in the Solomon Islands. In Malaysia and China they are a valued titbit. In Sarawak *C. odontophyllum* is widely cultivated for the edible fruits. *C. pseudodecumanum* has edible fruits; the oil pressed out of the seeds is locally used. The resin is used in pharmacy in ointments and plasters, mainly from *C. luzonicum*, the "Manila-elemi". It is also a constituent of cellulose lacquers. The shell of the nut is used as fuel substitute in the Solomon Islands. Very little is known about the economic value of the other species.

**Taxonomy.** The genus can be subdivided into 3 subgenera: subgenus *Canarium* consisting of sections *Canarium* and *Pimela* is centred in Malesia, subgenus *Africanarium* in W Africa, and subgenus *Canariellum* restricted to E Queensland and New Caledonia. In Sabah and Sarwak, section *Canarium* can be recognised by its foliaceous or pectinate (comb-like) stipules, its leaflets which dry brown, its stamens that are free or adnate to the disc, the usually glabrous disc and pistil, and the larger fruit (5-7 cm long) with frequently tomentose calyx. In contrast, section *Pimela* has lanceolate or narrow stipules, leaflets which dry greyish green, stamens that are often partly or entirely connate, a disc and pistil that are mostly pilose, and smaller fruit (often 2.5-3.5 cm long) with usually glabrous calyx.

### Key to *Canarium* species

1. Leaflets glabrous.....2
- Leaflets hairy.....16
2. Leaflet margin toothed.....3
- Leaflet margin entire.....6

3. Leaflet:  
Leaflet:
4. Stipule:  
Stipule:
5. Stipule:  
Stipule:
6. Leaflet:  
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Leaflet:
7. Plants \  
Plants \
8. Lateral  
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9. Twigs \  
Twigs \
10. Stipule:  
Stipule:
11. Rachis  
Rachis
12. Leaflet  
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13. Leaves  
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| 3. Leaflets distinctly whitish below.....   | 13. <i>C. littorale</i>            |
| Leaflets not so, rarely faintly whitish below.....                                      | 4                                  |
| 4. Stipules absent. Leaflet base rounded, margin faintly toothed.....                   | 20. <i>C. pseudodecumanum</i>      |
| Stipules present. Leaflet base not rounded, margin distinctly toothed.....              | 5                                  |
| 5. Stipules deeply irregularly lobed. Rachis yellowish.....                             | 5. <i>C. denticulatum</i>          |
| Stipules suborbicular, not lobed. Rachis brownish.....                                  | 10. <i>C. kinabaluensis</i>        |
| 6. Leaflets sessile, lateral veins perpendicular to midrib. Trees with stilt-roots..... | 4. <i>C. decumanum</i>             |
| Leaflets stalked, lateral veins not so. Trees without stilt-roots.....                  | 7                                  |
| 7. Plants without stipules.....   | 8                                  |
| Plants with stipules.....   | 10                                 |
| 8. Lateral veins 5–7 pairs. Leaflet apex with 1–2-cm-long tip.....                      | 22. <i>C. pseudopimela</i>         |
| Lateral veins 7–14 pairs. Leaflet apex without such long tips.....                      | 9                                  |
| 9. Twigs with prominent leaf-scars. Petals clawed.....                                  | 21. <i>C. pseudopatentinervium</i> |
| Twigs without prominent leaf-scars. Petals not clawed.....                              | 19. <i>C. pilosum</i>              |
| 10. Stipules needle-like.....   | 11                                 |
| Stipules broad and flat.....  | 13                                 |
| 11. Rachis black. Flowers reddish when fresh.....                                       | 6. <i>C. dichotomum</i>            |
| Rachis not black. Flowers not reddish when fresh.....                                   | 12                                 |
| 12. Leaflet stalk about 5 mm long; lateral veins 15–18 pairs.....                       | 11. <i>C. kostermansii</i>         |
| Leaflet stalk longer, to 20 mm long; lateral veins 6–11 pairs.....                      | 2. <i>C. asperum</i>               |
| 13. Leaves faintly glaucous below.....  | 14. <i>C. littorale</i>            |
| Leaves not glaucous below.....  | 14                                 |
| 14. Lateral veins and reticulations invisible.....                                      | 18. <i>C. patentinervium</i>       |
| Lateral veins and reticulations visible.....  | 15                                 |
| 15. Lateral veins prominently raised above; leaflet base usually rounded.....           | 7. <i>C. divergens</i>             |
| Lateral veins not raised; leaflet base cuneate.....                                     | 3. <i>C. caudatum</i>              |
| 16. Leaflet margin toothed.....   | 17                                 |
| Leaflet margin entire.....  | 24                                 |
| 17. Leaflets sessile, margin minutely toothed.....                                      | 20. <i>C. pseudodecumanum</i>      |
| Leaflets stalked, margin coarsely and distinctly toothed.....                           | 18                                 |
| 18. Stipules absent.....  | 19                                 |
| Stipules present.....   | 21                                 |

*C. apertum*  
.....20

*andifolium*  
*awakanum*

*C. pilosum*  
.....22

*itophyllum*  
.....23

*C. littorale*  
*stipulatum*

*galanthum*  
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*C. hirsutum*  
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**Ecology.** In lowland mixed dipterocarp forests to 500 m, on clay-rich and yellow sandy soils and alluvium. Flowers collected in January and April and fruits in May and October.

## 2. *Canarium asperum* Benth.

(Latin, *asper* = rough, uneven; possibly the rough-hairy inflorescence)

in Hooker, Lond. J. Bot. 2 (1843) 215; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 461; Masamune *l.c.* 362; Leenhouts *l.c.* (1956) 293, *l.c.* (1959) 439; Backer & Bakhuizen *f. l.c.* 115; Whitmore, Tantra & Sutisna *l.c.* 34. **Type:** *Hinds, s.n.*, New Guinea (K).

subsp. *asperum* var. *asperum*

**Synonyms:** *Canariopsis aspera* (Benth.) Miq., Fl. Ind. Bat. 1, 2 (1859) 653; *Canarium villosum* Benth. & Hook. *f. ex F.-Vill.*, Nov. App. (1880) 40; *C. molle* Engl. in DC. *l.c.* 109 (for a complete list of synonyms, *cf.* Leenhouts *l.c.* (1956).

Small to medium-sized tree to 30 m tall, 50 cm diameter. **Bark** pale brown, scaly with large flakes; inner bark dull brown with white sticky exudate. **Sapwood** cream. *Stipules* needle-like, inserted near the base of petiole. **Leaves** with up to 6 pairs of leaflets; rachis glabrous, rarely hairy; petiolules of lateral leaflets 0.5–2 cm long, swollen towards apex (only 2 mm long on collections from Pulau Gaya), rarely hairy; blade elliptic to lanceolate, 7.5–16 x 4–6.5 cm; base rounded to broadly cuneate, slightly unequal, *margin entire*, apex pointed; midrib raised above; lateral veins 6–11 pairs, raised below, faintly raised above; intercostal veins scalariform-reticulate, raised below, faint above. **Flowers** in axillary spikes or racemes. **Fruits** ovoid to subglobose, 9–14 x 4–11 mm.

**Distribution.** E Java, Borneo, Lesser Sunda Islands, Philippines, Celebes, Moluccas, New Guinea and the Solomon Islands. In Sabah uncommon, recorded only from Pulau Selipol, P. Gaya, P. Banggi, Lahad Datu and Kudat. Not yet recorded from Sarawak. Also known from Kalimantan.

**Ecology.** Rocky coasts and inland lowland mixed dipterocarp forests.

Leenhouts *l.c.* (1956 & 1959) recognised two subspecies, *viz.* subsp. *asperum* and *papuanum*, of which only subsp. *asperum* occurs in Sabah and Sarawak. Of subsp. *asperum*, he distinguished two varieties, namely var. *asperum* and var. *clementis* with the latter endemic to the Philippines.

## 3. *Canarium caudatum* King

(Latin, *caudatus* = tailed; the gradually tapering leaflet apex)

*l.c.* 240; Ridley *l.c.* (1922) 370, Kew Bull. (1930) 81; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 443; Masamune *l.c.* 362; Leenhouts *l.c.* (1956) 259, *l.c.* (1959) 343; Kochummen *l.c.* (1972) 129. **Type:** *King's collector 10227*, Perak (holotype CAL; isotypes A, BM, G, L).

Medium-sized to large tree to 36 m tall, 40 cm diameter. **Bark** grey, cracking and scaly; *inner bark with strong resinous smell*. Stipule usually falling off early, kidney-shaped.

**Leaves** with 2–4 pairs of leaflets; petiolules of lateral leaflets *c.* 1 cm long, swollen at both ends; blade elliptic or ovate, 5.5–16.5 x 3–8 cm; base rounded or broadly cuneate, margin entire, apex pointed, tip *c.* 1 cm long; midrib raised above; lateral veins 8–11 pairs, distinct on both surfaces; intercostal veins reticulate, visible on both sides. **Flowers** in terminal thyrsoïd inflorescences; *stamens 3 in male flowers and 6 in female flowers*. **Fruits** spindle-shaped, 5.5–8 x 2–3.5 cm, with saucer-shaped persistent calyx.

**Key to forms**

Stipules small, kidney-shaped, inserted partly on the twig.....

forma **caudatum**

Synonym: *C. pauciflorum* Ridl. *l.c.* (1930) 80.

Sumatra, Peninsular Malaysia and Borneo. Of scattered distribution in Sabah and Sarawak.

Stipules auricle-shaped, inserted on the petiole.....

forma **auriculiferum** Leenh.

Blumea 8 (1955) 181. Type: *Haviland 2877*, Sarawak (holotype SING; isotype BM, K, L, SAR).

Sumatra, Peninsular Malaysia, and Borneo. In Borneo uncommon, known by a few collections from Sabah (*SAN 33828*), Sarawak (e.g., *S. 5840*, *S. 12032* and *S. 46003*), and Kalimantan.

**Ecology.** Lowland mixed dipterocarp and *kerangas* forests to 230 m.

**4. *Canarium decumanum* Gaertn.**

(Latin, *decumanus* = the largest or greatest; the size of the fruit and tree)

Fruct. 2 (1791) 99; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 435; Leenhouts *l.c.* (1956) 276, *l.c.* (1959) 389; Burgess *l.c.* 60; Cockburn *l.c.* 39; Whitmore, Tantra & Sutisna *l.c.* 34. **Type:** *Hort. Bot. Bog. VIE 5* (= Pl. Bog. Exsicc. 116), Moluccas (neotype L; isoneotypes B, BO, BRSL, G, K, L, NY).

Very large tree to 54 m tall, 150 cm diameter; buttresses to 5 m tall, *stilt-roots present*. **Bark** grey, smooth to scaly or dippled; inner bark orange-red, granular, with strong mango smell, exudate brownish and sticky. **Sapwood** white. Twigs pale white with prominent leaf-scars. *Stipules inconspicuous*. **Leaves** closely spirally arranged, with 4–5 pairs of *almost sessile leaflets*; rachis powdery yellowish hairy; blade oblong, elliptic or ovate, 6–15.5 x 3–7 cm; base rounded or subcordate, *margin entire*, apex pointed; midrib flattened above; *lateral veins 12–23 pairs, almost perpendicular to midrib, forking and forming reticulations a few millimeters away from margin*, visible on both surfaces; intercostal veins scalariform-reticulate, very faint; *petiole flattened above with sharp edges*. **Flowers** hairy, in axillary thyrsoïd inflorescences. **Fruits** ellipsoid, 7–8.5 x 4.5–6 cm, rough hairy.

**Vernacular name.** Sabah—*pamatudon* (Malay, Dusun).

**Distribution.** Borneo, Moluccas, New Guinea. In Sabah uncommon, recorded from Lahad Datu and Sandakan; not yet reported from Sarawak; also known in Kalimantan.

**Ecology.** Lowland forests.

**5. *Canarium***  
(Latin, *denti*)

Bijdr. (1826)  
*l.c.* (1956) 27  
(1972) 129; (lectotype).

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**6. *Canarium***  
(Latin, *dicho*)

*l.c.* (1859) 648  
*l.c.* 363; Leen  
Tantra & Suti  
**Type:** *Kortha*  
Bot. Btzg. 42 (

### 5. *Canarium denticulatum* Blume

(Latin, *denticulatus* = with very small teeth; the leaflet margin)

Bijdr. (1826) 1162; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 521; Masamune *l.c.* 362; Leenhouts *l.c.* (1956) 272, *l.c.* (1959) 367; Backer & Bakhuizen *f. l.c.* 115; Burgess *l.c.* 60; Kochummen *l.c.* (1972) 129; Cockburn *l.c.* 41; Whitmore, Tantra & Sutisna *l.c.* 34. **Type:** *Blume* 743, Java (L, lectotype).

Medium-sized tree to 30 m tall, 50 cm diameter; buttresses short. **Bark** grey-white, smooth; middle bark green; inner bark pinkish. **Sapwood** white. Twig pale whitish. *Stipules persistent, yellowish, inserted on petiole, deeply irregularly lobed.* **Leaves** with 2–6 pairs of leaflets; *rachis pale yellow*; petiolules of lateral leaflets 8–15 mm long, yellowish (rachis hairy in saplings); blade elliptic or oblong, 6–23.5 x 3–9 cm; *base unequal*, rounded or cuneate, margin faintly toothed towards apex, apex pointed; midrib raised above; lateral veins 9–13 pairs, curving and joining near margin, visible on both surfaces; intercostal veins reticulate, faintly visible on both surfaces; glabrous or reddish brown-hairy on the lower side. **Flowers** white, hairy, in an axillary thyrsoid inflorescence. **Fruits** ellipsoid, 2.5–3 x 1.5 cm.

#### Key to subspecies

Leaflets reddish brown-hairy below, margin toothed.....

subsp. **kostermansii** Leenh.

*Blumea* 8 (1955) 181. **Type:** *Kostermans* 5226, E Borneo, Sg. Menubar region (holotype L; isotypes BM, BO, K).

Endemic to Borneo. Uncommon, in Sabah only known from several collections, all from the east coast districts; also in Kalimantan.

Leaflets glabrous, margin entire or faintly toothed.....

subsp. **denticulatum**

Synonyms: *C. fissistipulum* Miq., Fl. Ind. Bat. Suppl. (1861) 521; *C. kunstleri* King *l.c.* 184; *C. laciniatum* Elmer, Leafl. Philip. Bot. 3 (1911) 1084.

Andamans, Burma, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sabah reported from Ranau, Kalabakan, Kinabatangan, Lahad Datu, Sandakan, Tawau. In Sarawak known from Batu Laga, Bt. Mersing, Ulu Tinjar, Bt. Raya, Ulu Rajang, Segam FR, Lambir NP and Marudi; also known in Kalimantan. Common in the lowlands, rarely to 750 m, in mixed dipterocarp forest on friable fertile soils, particularly on basic volcanic rocks.

### 6. *Canarium dichotomum* (Blume) Miq.

(Latin, *dichotomus* = having divisions always in pairs; branching of the inflorescence)

*l.c.* (1859) 648; Merrill *l.c.* (1929) 116; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 447; Masamune *l.c.* 363; Leenhouts *l.c.* (1956) 283, *l.c.* (1959) 423; Burgess *l.c.* 60; Anderson *l.c.* 155; Whitmore, Tantra & Sutisna *l.c.* 34. **Basionym:** *Pimela dichotoma* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 222. **Type:** *Korthals* 957, Sumatra (holotype L; isotype U). **Synonym:** *C. endertii* H.J. Lam, Ann. Jard. Bot. Btzg. 42 (1932) 210.



Medium-sized tree to 27 m tall, 25 cm diameter. **Bark** brownish to reddish, smooth to scaly; inner bark reddish brown. **Sapwood** pale white. Twigs 0.5–2(–2.5) cm thick, grey or dark brown to blackish, powdery brown-hairy when young. **Stipules** linear, hairy, on the base of rachis, *persistent*. **Leaves** with 1–4 (rarely 6–8) pairs of leaflets; rachis black, powdery brown-hairy; petiolules of lateral leaflets 0.5–2 cm long, hairy; blade elliptic to lanceolate or oblong, 8–20 x 4–9.5 cm, sparsely hairy below or glabrous; base broadly cuneate, unequal, margin entire, apex pointed, tip *c.* 1 cm long; midrib raised above; lateral veins 9–15 pairs, raised below, distinct above; intercostal veins reticulate, faintly visible on both surfaces. **Flowers** in terminal and axillary thyrsoïd inflorescences, main branches in male inflorescences repeatedly dichotomously branched, axis reddish. **Fruits** oblong, 3–4 x 1.2–1.5 cm, triangular; calyx funnel-shaped.

**Distribution.** Sumatra, Borneo. Of scattered distribution in Sabah and Sarawak. Also known in Kalimantan.

**Ecology.** Lowland forest, rarely in submontane forest to 1200 m.

### 7. *Canarium divergens* Engl.

(Latin, *divergium* = going different ways; the laxly branched inflorescence)

in DC. *l.c.* 143; Merrill *l.c.* (1921) 316; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 503; Masamune *l.c.* 363; Leenhouts *l.c.* (1956) 260, *l.c.* (1959) 346; Anderson *l.c.* 155. **Type:** *Beccari PB 2237*, Sarawak, Matang (holotype P; isotypes FI, K).

Medium-sized tree to 30 m tall, 45 cm diameter; buttresses short. **Bark** grey-white, lenticellate, scaly. Twigs brownish, glabrous. **Stipules** deciduous. **Leaves** with 2–4 pairs of leaflets; petiolules of lateral leaflets 7–15 mm long; blade elliptic, ovate or obovate, 7–18 x 3.5–9.5 cm, glabrous; base cuneate to rounded, margin entire to faintly toothed, apex pointed, tip *c.* 1 cm long; midrib raised above; lateral veins 7–13 pairs, raised below, faint above, curving and joining near margin; intercostal veins scalariform-reticulate, raised below, faint above. **Inflorescences** thyrsoïd, terminal and axillary; male to 37 cm long, hairy. **Fruits** yellowish green when fresh, ellipsoid, 6–8.5 x 2.5–3.5 cm; calyx funnel-shaped with wavy margin.

**Distribution.** Endemic to Borneo. Uncommon in Sabah, known by a single collection *SAN 50076* from Beaufort; more common in Sarawak, (Semengoh, G. Buri, Matang, Lambir National Park, Bintulu and Ulu Anap); also recorded from Brunei.

**Ecology.** Mixed dipterocarp forests on deep sandy humult ultisols, to 450 m.

### 8. *Canarium fusco-calycinum* Stapf ex Ridl.

(Latin, *fuscus* = dark or dark brown, *calycinus* = calyx; the colour of the calyx)

*l.c.* (1930) 82; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 499; Masamune *l.c.* 363; Leenhouts *l.c.* (1956) 283, *l.c.* (1959) 424; Anderson *l.c.* 155. **Type:** *Haviland 1981*, Sarawak, Kuching (holotype K; isotypes BM, SAR).

Medium-sized tree to 27 m tall, 25 cm diameter. Bark brownish to reddish, smooth to scaly; inner bark reddish brown. Sapwood pale white. Twigs 0.5–2(–2.5) cm thick, grey or dark brown to blackish, powdery brown-hairy when young. Stipules linear, hairy, on the base of rachis, persistent. Leaves with 1–4 (rarely 6–8) pairs of leaflets; rachis black, powdery brown-hairy; petiolules of lateral leaflets 0.5–2 cm long, hairy; blade elliptic to lanceolate or oblong, 8–20 x 4–9.5 cm, sparsely hairy below or glabrous; base broadly cuneate, unequal, margin entire, apex pointed, tip c. 1 cm long; midrib raised above; lateral veins 9–15 pairs, raised below, distinct above; intercostal veins reticulate, faintly visible on both surfaces. Flowers in terminal and axillary thyrsoïd inflorescences, main branches in male inflorescences repeatedly dichotomously branched, axis reddish. Fruits oblong, 3–4 x 1.2–1.5 cm, triangular; calyx funnel-shaped.

**Distribution:**

**Ecology.** Lc

### 9. *Canari*

(Latin, *gran*

Ann. Jard. Bot. Btzig. 3, 12 (1932) 503; Masamune *l.c.* 363; Leenhouts *l.c.* (1956) 260, *l.c.* (1959) 346; Anderson *l.c.* 155. **Type:** *Beccari PB 2237*, Sarawak, Matang (holotype P; isotypes FI, K).

Medium-sized tree to 30 m tall, 45 cm diameter; buttresses short. Bark grey-white, lenticellate, scaly. Twigs brownish, glabrous. Stipules deciduous. Leaves with 2–4 pairs of leaflets; petiolules of lateral leaflets 7–15 mm long; blade elliptic, ovate or obovate, 7–18 x 3.5–9.5 cm, glabrous; base cuneate to rounded, margin entire to faintly toothed, apex pointed, tip c. 1 cm long; midrib raised above; lateral veins 7–13 pairs, raised below, faint above, curving and joining near margin; intercostal veins scalariform-reticulate, raised below, faint above. Inflorescences thyrsoïd, terminal and axillary; male to 37 cm long, hairy. Fruits yellowish green when fresh, ellipsoid, 6–8.5 x 2.5–3.5 cm; calyx funnel-shaped with wavy margin.

**Distribution** known only

**Ecology.** Lo

### 10. *Canar*

(Latin, *hirsu*

Sp. Pl. 4 (1805) 103; Masamune *l.c.* 363; Leenhouts *l.c.* (1956) 283, *l.c.* (1959) 424; Anderson *l.c.* 155. **Type:** *Haviland 1981*, Sarawak, Kuching (holotype K; isotypes BM, SAR).

Medium-sized tree to 20 m tall, 50 cm diameter. *Twigs rusty brown-hairy*. Stipules linear, falling off early. **Leaves** with 2 pairs of leaflets; rachis hairy; petiolules of lateral leaflets 2–3 mm long, hairy; *blade hairy below*, ovate to oblong, 4.5–15 x 3–9 cm; base broadly cuneate, margin entire, incurled, apex pointed, tip *c.* 1 cm long; midrib raised above, hairy; lateral veins 12–17 pairs, raised below, visible above, curving and joining near margin; intercostal veins scalariform-reticulate, raised below, faint above. **Flowers** (male) in terminal thyrsoid inflorescences, hairy; stamens united. **Fruits** ellipsoid, 3–3.5 x 1.2–1.5 cm, triangular in cross-section; calyx red-brown hairy, with distinct lobes.

**Distribution.** Endemic to Sarawak. Uncommon, reported from the 1st, 4th and 7th Div.

**Ecology.** Lowland mixed dipterocarp forest.

### 9. *Canarium grandifolium* (Ridl.) H.J. Lam

(Latin, *grandis* = large; *folium* = leaf)

Ann. Jard. Bot. Btzig. 42 (1932) 215, Bull. Jard. Bot. Btzig. 3, 12 (1932) 527; Leenhouts *l.c.* (1956) 275, *l.c.* (1959) 386; Kochummen *l.c.* (1972) 129. **Basionym:** *Trigonochlamys grandifolia* Ridl., J. Str. Br. R. As. Soc. 54 (1916) 31, *l.c.* (1922) 381. **Type:** *Cantley's collector, s.n.*, Singapore (lectotype SING).

Medium-sized to large tree to 40 m tall, 60 cm diameter; buttresses tall. **Bark** greyish, diphled and scaly. Twigs densely fulvous tomentose. *Stipules absent*. **Leaves** with 5–7 pairs of leaflets, leaflet stalks glabrous to hairy; *blade elliptic to obovate*, 10–17 x 5–8 cm, *densely hairy beneath and on midrib above*; base cuneate to rounded, *margin recurved, minutely toothed to entire*, apex rounded with short tip; *midrib sunken above; lateral veins 9–14 pairs, prominently raised below; intercostal veins equally prominent, sunken above*. **Inflorescences** terminal, rarely lateral, densely red-tomentose; male thyrsoid, female racemose to spicate. **Flowers** pubescent; *petals clawed*; stamens free. **Fruits** ellipsoid, *c.* 5 x 3.5 cm, slightly hairy at apex.

**Distribution.** Peninsular Malaysia and Borneo. In Sabah and Sarawak very uncommon, known only from two collections (*SAN 44553* and *S. 36641*); also known from Brunei.

**Ecology.** Lowland mixed dipterocarp forest.

### 10. *Canarium hirsutum* Willd.

(Latin, *hirsutus* = covered with rough hairs; the fruit)

Sp. Pl. 4 (1805) 760; Ridley *l.c.* (1922) 374; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 466; Masamune *l.c.* 363; Leenhouts *l.c.* (1956) 287, *l.c.* (1959) 424; Backer & Bakhuizen *f. l.c.* 115; Burgess *l.c.* 60; Kochummen *l.c.* (1972) 130; Cockburn *l.c.* 42; Anderson *l.c.* 155; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *bb. 33772*, Moluccas (neotype L; isoneotypes A, BO, SING). **Synonyms:** *C. hispidum* Blume, Cat. (1823) 109; *C. subcordatum* Ridl. *l.c.* (1922) 374.

Medium-sized tree to 25 m tall, 60 cm diameter. *Twigs very stout, 1.5–3.5 cm thick, reddish brown-hairy near tip, pith large with many small vascular strands. Stipules present (except in two varieties), caducous, inserted on the petiole, subulate, 4–12 mm long. Leaves to 2 m long, with 4–13 pairs of leaflets; blade sessile except basal ones, glabrous or hairy, ovate to lanceolate, 5–45 x 2.5–15 cm; base rounded to cordate, margin entire, apex pointed; midrib raised above; lateral veins 12–30 pairs, visible on both surfaces; intercostal veins finely reticulate, visible; petiole to 2 cm thick near base with sharp edges. Inflorescences axillary, male thyrsoid, female subracemose. Flowers c. 1 cm long, shortly stalked. Fruits with irritant reddish brown hairs, oblong to ovoid, 2.8–3.5 x 2–2.5 cm.*

**Distribution.** Throughout Malesia (except Lesser Sunda Islands), Carolines and Solomon Islands. In Sabah rather common, but in Sarawak very uncommon and represented by a single collection (*S. 25192*). Also known in Kalimantan.

**Ecology.** Mixed dipterocarp forest, rarely to 1800 m.

Two subspecies and a few varieties are recognised for this species. In Sabah and Sarawak only subspecies *hirsutum* is present with its variety *hirsutum* and forma *scabrum* (Blume) Leenh.

### 11. *Canarium kinabaluensis* Leenh.

(of Mt. Kinabalu)

*l.c.* (1955) 182, *l.c.* (1956) 260, *l.c.* (1959) 346; Burgess *l.c.* 60; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *Ramos 1698*, North Borneo, Sandakan (holotype L; isotypes A, BO, BM, K, P).

Medium-sized tree to 25 m tall, 50 cm diameter; buttresses steep, to 1 m high. **Bark** grey, smooth; inner bark orange with strong resinous smell. **Sapwood** white. Twigs blackish. Stipules suborbicular, inserted on the base of the petiole. **Leaves** with 2–4 pairs of leaflets; rachis black, cracking; petiolule black on drying; blade drying to reddish brown, thickly leathery, elliptic-ovate or lanceolate, 8–20 x 3.5–10 cm; base broadly cuneate, margin very faintly toothed, apex pointed; midrib raised above, sharply keeled below; lateral veins 11–13 pairs, raised below; intercostal veins scalariform. Inflorescences and flowers unknown. **Fruits** spindle-shaped, green drying brown, strongly wrinkled, 6–8 x 2–4 cm. **Seeds** one.

**Distribution.** Endemic to Borneo. Uncommon, collected from Papar, Sandakan and Mt. Kinabalu in Sabah; also known from Kalimantan.

**Ecology.** Lowland to submontane forests at 300–1500 m.

### 12. *Canarium kostermansii* Leenh.

(A.J.G.H. Kostermans, 1907–1994, botanist at the Forest Research Institute Bogor and the Herbarium Bogoriense, Indonesia)

*l.c.* (1955) 191, *l.c.* (1956) 281, *l.c.* (1959) 398; Burgess *l.c.* 61; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *Kostermans 5315*, E Borneo (holotype L; isotypes BM, K).

Medium-size  
Twigs slender  
subulate, ca  
lanceolate, 1  
midrib raised  
above; interc  
racemose. F

**Distribution**  
Kalimantan.

**Ecology.** Lo

### 13. *Canarium* (Latin, *latus*)

*l.c.* (1930) 81;  
(1956) 258, *l.*  
Sarawak, Kuc

Small to me  
persistent, *rc*  
pairs of leaf  
hairy; *blade*  
cm; base bro  
above; latera  
veins scalari  
thyrsoid infl  
funnel-shape

**Distribution**  
known only t

**Ecology.** Lov

### 14. *Canarium* (Latin, *littorale*)

*l.c.* (1826) 1;  
Masamune *l.c.*  
Burgess *l.c.* 6;  
& Sutisna *l.c.*

Medium-size  
bark orange-  
dropping off

Medium-sized to large tree reaching 35 m tall, 60 cm diameter. **Bark** brown, smooth. Twigs slender, to 1 cm thick, pith with 2 concentric cylinders of vascular strands. Stipules subulate, caducous. **Leaves** with 4–7 pairs of leaflets; leaflet stalk about 0.5 cm long; blade lanceolate, 10–22 x 3–7 cm; base unequal, broadly cuneate, margin entire, apex pointed; midrib raised above; lateral veins 15–18 pairs, faintly curving towards the margin, raised above; intercostal veins reticulate, distinct on both surfaces. **Inflorescences** (female) axillary, racemose. **Fruits** spindle-shaped, 3 x 1–1.5 cm, glabrous; calyx funnel-shaped.

**Distribution.** Endemic to Borneo. Uncommon in Sabah and Sarawak; also found in Kalimantan.

**Ecology.** Lowlands and hill forests to 900 m.

### 13. *Canarium latistipulatum* Ridl.

(Latin, *latus* = broad, wide, *stipula* = stipule)

*l.c.* (1930) 81; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 508; Masamune *l.c.* 364; Leenhouts *l.c.* (1956) 258, *l.c.* (1959) 341; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *Haviland & Hose 2245*, Sarawak, Kuching (holotype K; isotype SAR).

Small to medium-sized tree to 27 m tall. *Young twigs powdery brown-hairy*. Stipules subpersistent, rounded to ovate, 1–2 x 1–1.7 cm, inserted on the base of petiole. **Leaves** with 3 pairs of leaflets; rachis powdery brown-hairy; petiolule of lateral leaflets 5–10 mm long, hairy; blade sparsely hairy below, drying reddish brown, oblong or elliptic, 6–15 x 3.5–6 cm; base broadly cuneate, margin toothed, apex pointed, tip *c.* 1.5 cm long; midrib raised above; lateral veins 7–10 pairs, raised below, curving and joining near margin; intercostal veins scalariform-reticulate, distinct below, faint above. **Flowers** (male) hairy, in terminal thyrsoid inflorescences. **Fruits** oblong, 6.2–7.2 x 2.2–3 cm, with tapered base; calyx funnel-shaped, powdery brown-hairy.

**Distribution.** Endemic to Borneo. Common in Sabah but uncommon in Sarawak and known only by 2 other collections (*S. 3458* & *S. 52998*) beside the type.

**Ecology.** Lowland forests.

### 14. *Canarium littorale* Blume

(Latin, *littoralis* = of the seashore; its main habitat)

*l.c.* (1826) 1164; Merrill *l.c.* (1929) 116; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 498; Masamune *l.c.* 364; Leenhouts *l.c.* (1956) 256, *l.c.* (1959) 337; Backer & Bakhuizen *f. l.c.* 115; Burgess *l.c.* 61; Kochummen *l.c.* (1972) 130; Cockburn *l.c.* 42; Anderson *l.c.* 155; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *Blume 1736*, Java, Nusa Kambangan (holotype L; isotypes BO, MEL, U).

Medium-sized to large tree to 40 m tall, 60 cm diameter. **Bark** grey, smooth to scaly; inner bark orange-red or brownish. **Sapwood** pale white. Twigs glabrous or hairy. Stipules dropping off early or semi-persistent, kidney-shaped with wavy to deeply lobed margins.

**Leaves** with 2–6 pairs of leaflets; rachis glabrous or softly hairy; petiolules of lateral leaflets 1–2 cm long, glabrous or hairy, often swollen at both ends; *blade* ovate to oblong or lanceolate, 3–25 x 2–9 cm, glabrous or sparsely to densely hairy below, *sometimes white waxy below*; base cuneate to subcordate, margin entire to faintly or prominently toothed, apex pointed; midrib raised above; lateral veins 9–20 pairs, sometimes curving and joining near margin, raised below, faint or sunken above; intercostal veins scalariform-reticulate or reticulate, distinct below, faint above, rarely sunken above. **Flowers** usually in terminal thyrsoid (male) or subracemose (female) inflorescences. **Fruits** ellipsoid or ovoid, 4.5–7 x 1.5–3 cm, sparsely hairy or glabrous with rugose and wrinkled surface when dried.

An extremely variable species in vegetative and floral characters. Leenhouts (*l.c.* 1959) recognises 5 forms (*littorale*, *pruinorum*, *purpurascens*, *rufum*, and *tomentosum*), of which 3 occur in Sabah and Sarawak.

**Key to forms**

1. Leaflets whitish beneath.....  
 forma **pruinorum** (Engl.) Leenh.  
*l.c.* (1956) 258. Basionym: *C. pruinorum* Engl. in DC. *l.c.* 106, Merrill *l.c.* (1921) 317, Masamune *l.c.* 365. Type: *Beccari PB 1970*, Sarawak (holotype K; isotype FI).  
 Confined to Sabah and Sarawak, common in secondary forest, especially on periodically flooded sandy alluvium.  
 Leaflets not whitish beneath.....2
2. Leaflets densely hairy below; margin prominently toothed; lateral veins sunken above.....  
 forma **rufum** (A.W. Benn.) Leenh.  
*l.c.* (1959) 339. Basionym: *C. rufum* A.W. Benn. in Hooker *f. l.c.* 533, Masamune *l.c.* 365. Type: *Maingay 1434*, Malacca (holotype K; isotypes CAL, L).  
 Widely distributed in Sabah, less common in Sarawak. Also in Indo-China, Sumatra, Peninsular Malaysia, and Java.  
 Leaflets glabrous below; margin faintly toothed; lateral veins not sunken above.....  
 forma **littorale**  
 Synonyms: *C. glaucum* Blume *l.c.* (1850) 219; *C. serricuspe* Miq. *l.c.* (1859) 649; *C. serrulatum* Miq. *l.c.* (1859) 646; *C. acutum* Engl. in DC. *l.c.* 113; *C. giganteum* Engl. in DC. *l.c.* 106; *C. flavum* Ridl. *l.c.* (1930) 81.  
 Sumatra, Peninsular Malaysia, Java and Borneo. In Sabah and Sarawak common in the lowland mixed dipterocarp to submontane forests to 1100 m. Also found in Kalimantan.

**15. *Canarium megalanthum* Merr.**  
 (Greek, *mega* = large, *anthos* = flower)

Philip. J. Sc. 30 (1926) 81; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 446; Masamune *l.c.* 324; Leenhouts *l.c.* (1956) 274, *l.c.* (1959) 370; Burgess *l.c.* 61; Kochummen *l.c.* (1972) 131; Anderson *l.c.* 155; Whitmore, Tantra & Sutisna *l.c.* 35. Type: *Wood 1213*, British North Borneo (holotype UC; isotypes A, K, L).

Emergent tr  
 dipped and  
 persistent, ir  
 rachis powde  
 blade powde  
 apex pointec  
 intercostal v  
 inflorescenc

**Distribution**  
 Also known

**Ecology.** Ri  
 May and Sep

**Uses.** In Bru  
 the genus.

**16. *Canar***  
 (E.D. Merrill

in Merrill *l.c.*  
 Leenhouts *l.c.*  
 Sutisna *l.c.* 3  
 BM, G, K, L,

Small to me  
 brownish. S;  
 inserted at b  
 petiolules of  
 to the touch  
 margin entir  
 14 pairs, cu  
 reticulate, d  
 inflorescence

**Distribution**  
 Kalimantan.

**Ecology.** Mi

**17. *Canar***  
 (Greek, *odor*

*l.c.* (1861) 52  
*l.c.* 364; Leen  
 156; Whitmor  
**Synonyms:** *C*  
 1754; *C. mult.*

Emergent tree to 35 m tall, 50 cm diameter; buttresses present. **Bark** grey, smooth to dappled and scaly; inner bark reddish brown. **Sapwood** yellowish white. **Stipules** sub-persistent, inserted on the petiole near base, 3-4-lobed. **Leaves** with 4-5 pairs of leaflets; rachis powdery yellowish hairy; petiolules of lateral leaflets 1-1.5 cm long, powdery hairy; blade powdery hairy, oblong to lanceolate, 8-17 x 4-7 cm; *base rounded*, margin entire, apex pointed; midrib flattened above; lateral veins 10-12 pairs, raised on both surfaces; intercostal veins scalariform-reticulate, visible below. **Flowers** hairy, in terminal thyrsoid inflorescences. **Fruits** ellipsoid, sparsely hairy, 5-7.5 x 2.8-4.5 cm.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo; uncommon in Sabah and Sarawak. Also known in Kalimantan.

**Ecology.** Ridges in mixed dipterocarp forest to 360 m. Flowering in May and fruiting in May and September.

**Uses.** In Brunei this species is cultivated for its edible fruits which are among the largest in the genus.

#### 16. *Canarium merrillii* H.J. Lam

(E.D. Merrill, 1876-1954, American botanist)

in Merrill *l.c.* (1929) 117; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 489; Masamune *l.c.* 364; Leenhouts *l.c.* (1956) 282, *l.c.* (1959) 402; Burgess *l.c.* 61; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *Elmer 20326*, British North Borneo, Sandakan (holotype PNH; isotypes A, BM, G, K, L, NY, P, SING, U, Z).

Small to medium-sized tree to 25 m tall, 30 cm diameter. **Bark** grey, scaly; inner bark brownish. **Sapwood** white. Twigs pale grey, rough hairy. **Stipules** linear, to 5 mm long, inserted at base of petiole, semi-persistent. **Leaves** with 4-5 pairs of leaflets; rachis hairy; petiolules of lateral leaflets 2-5 mm long, hairy; *blade rough hairy below* (like sandpaper to the touch), elliptic, oblong or obovate, 5.5-16 x 3-5.5 cm; base cuneate, unequal, margin entire, apex pointed, tip *c.* 1 cm long; midrib faintly sunken above; lateral veins 6-14 pairs, curving and joining near margin, raised below, visible above; intercostal veins reticulate, distinct below, faint above. **Flowers** yellow, in terminal or axillary thyrsoid inflorescences. **Fruits** ellipsoid, pointed, 3-4.2 x 1.2-1.5 cm.

**Distribution.** Endemic to Borneo. Of scattered distribution in Sabah, Sarawak and Kalimantan.

**Ecology.** Mixed dipterocarp to submontane forests to 1400 m.

#### 17. *Canarium odontophyllum* Miq.

(Greek, *odontos* = toothed, *phyllon* = leaf; the toothed leaflets)

*l.c.* (1861) 521; Merrill *l.c.* (1929) 118; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 519; Masamune *l.c.* 364; Leenhouts *l.c.* (1956) 271, *l.c.* (1959) 365; Burgess *l.c.* 60; Cockburn *l.c.* 43; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 35. **Type:** *Teijsmann HB 692*, Sumatra (holotype U; isotype L). **Synonyms:** *C. beccarii* Engl. in DC. *l.c.* 107; *C. palawanense* Elmer, Leaflet. Philip. Bot. 5 (1913) 1754; *C. multifidum* H.J. Lam, Ann. Jard. Bot. Btzig. 42 (1932) 215.

Fig. 1.

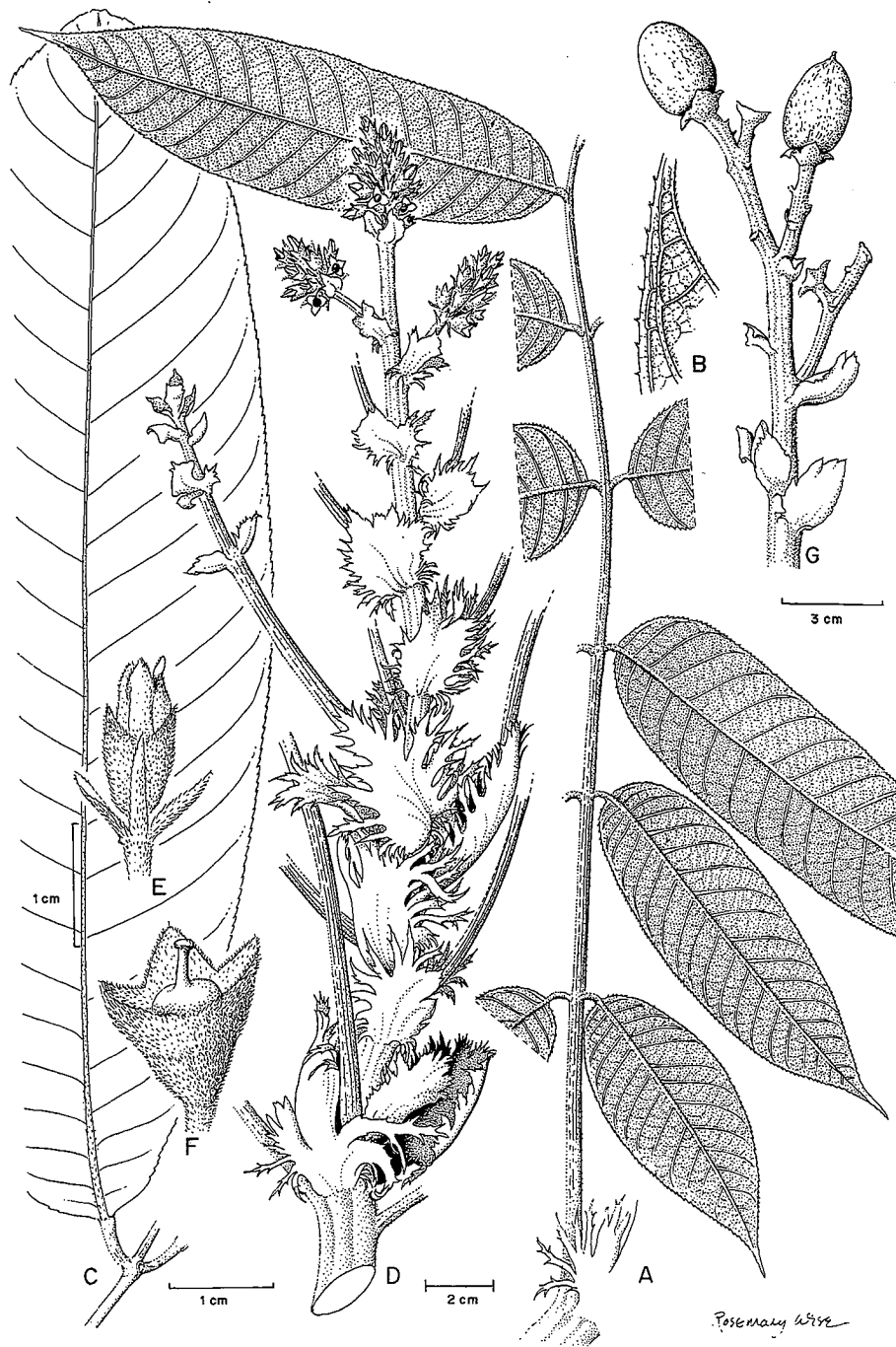


Fig. 1. *Canarium odontophyllum*. A, mature leaf; B, details of leaflet venation and margin; C, young leaflet; D, young shoot with stipules and inflorescences; E, flower bud; F, female flower; G, infructescence. (A, B from SAN 106079; C, D, E & F from SAN 37543; G from SAN 106079.)

Tree to 30 m t  
Twigs stout, w  
lobed, c. 6 x 2  
lateral leaflets  
lanceolate, 9.5  
pointed; midri  
above; interco  
hairy, in axilla  
cm.

**Distribution.**  
in Sarawak. A

**Ecology.** Mixe  
and November

**Uses.** Widely c

**18. *Canarium***  
(Latin, *patens*

*l.c.* (1861) 526;  
(1956) 258, *l.c.*  
Sutisna *l.c.* 36.  
*C. nitidum* A.W

Tree to 24 m ta  
falling off ear  
leaflets 1-1.5  
ovate to oblon  
flattened above  
and joining n  
sometimes inc  
ellipsoid, 6-6.

**Distribution.**  
Tawau and Tu  
found in Kalin

**Ecology.** Mixe  
forest, to 450 r

**19. *Canarium***  
(Latin, *pilosus*

in Hooker *f. l.c.*  
(1932) 472; M

Tree to 30 m tall, 30 cm diameter. **Bark** grey-brown; inner bark brownish. **Sapwood** pale. Twigs stout, whitish, 1.5–2 cm thick, rusty hairy. *Stipules persistent, irregularly toothed or lobed, c. 6 x 3 cm.* **Leaves** with 3–8 pairs of leaflets; rachis yellowish hairy; petiolules of lateral leaflets 3–10 mm long, hairy; *blade densely velvety hairy below, oblong to lanceolate, 9.5–28 x 4–11 cm; base broadly cuneate to rounded, margin toothed, apex pointed; midrib raised above, hairy; lateral veins 12–23 pairs, raised below, faint to sunken above; intercostal veins scalariform-reticulate, raised below, faint to sunken above.* **Flowers** hairy, in axillary or terminal thyrsoïd inflorescences. **Fruits** ovoid to ellipsoid, 3–4 x 2.5–3 cm.

**Distribution.** Sumatra, Borneo, and the Philippines. Widely distributed in Sabah, uncommon in Sarawak. Also known in Kalimantan.

**Ecology.** Mixed dipterocarp forests on fertile clay soils to 500 m. Flowering in May, June and November and fruiting in March and August.

**Uses.** Widely cultivated in Sarawak and Brunei for its fruits.

### 18. *Canarium patentinervium* Miq.

(Latin, *patens* = spreading, *nervus* = nerves; the leaflet venation)

*l.c.* (1861) 526; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 506; Masamune *l.c.* 365; Leenhouts *l.c.* (1956) 258, *l.c.* (1959) 342; Burgess *l.c.* 61; Kochummen *l.c.* (1972) 134; Whitmore, Tantra & Sutisna *l.c.* 36. **Type:** *Teijsmann HB 3736*, Sumatra, Palembang (holotype U; isotype L). **Synonyms:** *C. nitidum* A.W. Benn. in Hooker *f. l.c.* 533; *C. parvifolium* A.W. Benn. in Hooker *f. l.c.* 536.

Tree to 24 m tall, 25 cm diameter. **Bark** grey, smooth. Twigs brownish, lenticellate. *Stipules falling off early, kidney-shaped.* **Leaves** with 2–4 pairs of leaflets; petiolules of lateral leaflets 1–1.5 cm long, cracking; blade thickly leathery, glabrous, drying to dark brown, ovate to oblong, 7–12.5 x 2.5–6 cm; base cuneate, margin entire, apex pointed; midrib flattened above, rarely sunken; lateral veins 7–10 pairs, raised below, faint above, curving and joining near margin; intercostal veins reticulate, faintly visible on both surfaces, sometimes inconspicuous. **Flowers** hairy, usually in terminal thyrsoïd inflorescences. **Fruits** ellipsoid, 6–6.5 x 2.2–3 cm, apex pointed.

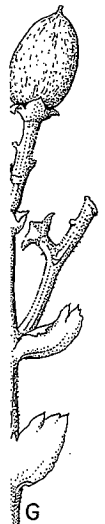
**Distribution.** Sumatra, Peninsular Malaysia, and Borneo. Widespread, collected from Tenom, Tawau and Tuaran in Sabah, and from Lundu, Semengoh to Bukit Lambir in Sarawak. Also found in Kalimantan.

**Ecology.** Mixed dipterocarp forest on yellow sandy and leached clay soils, and *kerangas* forest, to 450 m.

### 19. *Canarium pilosum* A.W. Benn.

(Latin, *pilosus* = having soft and distinct hairs; the twigs and leaves)

in Hooker *f. l.c.* 533; King *l.c.* 243; Ridley *l.c.* (1922) 372; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 472; Masamune *l.c.* 365; Leenhouts *l.c.* (1956) 281, *l.c.* (1959) 398; Burgess *l.c.* 61;



3 cm



margin; C, young  
leaf flower; G,  
16079.)



Kochummen *l.c.* (1972) 134; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 36. **Type:** *Maingay 3103*, Malacca (holotype K; isotype CAL).

Small to medium-sized tree to 27 m tall, 25 cm diameter. **Bark** pale brown, smooth; inner bark pink. **Sapwood** white. *Twigs densely woolly hairy. Stipules persistent, linear, inserted at the base of petiole or on the petiole, rarely absent. Leaves with 2–3 pairs of leaflets; rachis densely hairy, rarely glabrous; petiolules of lateral leaflets 2–3 mm long, densely hairy, rarely glabrous; blade densely hairy below, sparsely hairy above, rarely completely glabrous, elliptic, oblong or obovate, 7–19 x 3.5–9 cm; base cuneate or rounded, margin faintly to distinctly toothed, rarely entire, apex pointed, tip c. 1 cm long; midrib raised above; lateral veins 7–14 pairs, raised on both surfaces, curving and joining near margin; intercostal veins scalariform-reticulate, raised below, faint above. Flowers hairy, in axillary or terminal panicles. Fruits oblong, 2–3 x 1–1.5 cm.*

**Key to subspecies**

Stipules present. Leaflets hairy below, margin toothed.....

subsp. **pilosum**

Synonyms: *C. grandifolium* A.W. Benn. in Hooker *f. l.c.* 533; *C. hirtellum* A.W. Benn. in Hooker *f. l.c.* 533; *C. pilosum* var. *hirtellum* (A.W. Benn.) Ridl. *l.c.* (1922) 372; *C. motleyanum* Engl. in DC. *l.c.* 133.

Sumatra, Peninsular Malaysia and Borneo. In Sabah and Sarawak uncommon, recorded from Beaufort, Beluran, Papar, and Sandakan (Sabah), and from Kapit, Marudi, Miri (Sarawak). Also known in Kalimantan. Lowland forest.

Stipules absent. Leaflets glabrous below, margin entire.....

subsp. **borneensis** Leenh.

*l.c.* (1955) 193. **Type:** *Clemens 40163*, British North Borneo, Mt. Kinabalu (holotype L; isotypes A, BM, BO, G, NY). **Synonym:** *Dacryodes scandens* Husson, *Blumea* 7 (1952) 164.

Uncommon, known from Mt. Kinabalu, Lahad Datu and Sandakan in Sabah, and G. Lambir in Sarawak. Also found in Kalimantan.

**20. *Canarium pseudodecumanum* Hochr.**

(Latin, *pseudo* = false; resembling *C. decumanum*)

Pl. Bog. Exs. (1904) 61; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 438; Leenhouts *l.c.* (1956) 275, *l.c.* (1959) 388; Burgess *l.c.* 61; Kochummen *l.c.* (1972) 135; Whitmore, Tantra & Sutisna *l.c.* 36. **Type:** *Hort. Bot. Bog. VI E 6a*, Sumatra, Lampong (holotype L; isotypes B, BO, BRSL, G, K, L, WY, P). **Synonym:** *Canarium decumanum* (non Gaertn.) Engl. in Merrill *l.c.* (1929) 116.

Tree to 40 m tall and 120 cm diameter; buttresses to 6 m high. **Bark** grey-white, smooth to scaly; inner bark pale. **Sapwood** yellowish white. *Twigs stout, 1–1.5 cm thick, with large leaf-scars. Terminal bud 4–5 cm long, densely brown tomentose. Stipules absent. Leaves with 4–6 pairs of leaflets; petiole stout, light brown pubescent, swollen at base and flattened above; blade almost sessile, lanceolate or oblong, 17–23 x 7–11 cm, glabrous above except the midrib and lateral veins, densely minutely woolly tomentose below; base rounded or*

*subcordate, veins 17–20 prominent & above. Inflo 4–6 cm, den*

**Distributor**  
Sandakan an

**Ecology.** Lo

**Uses.** The r  
from the see

Closely relat  
and densely

**21. *Canarium***  
(resembling

Ann. Jard. Bc  
Leenhouts *l.c.*  
Sutisna *l.c.* 3  
(lectotype BO

Medium-size  
yellow-brow  
with many p  
*absent. Leav*  
2–7 cm; bas  
midrib flatte  
reticulate, p  
swollen at b  
sessile, dens  
ellipsoid, 5–

**Distribution**  
*S. 18215* fro

**Ecology.** Lo

**22. *Canarium***  
(resembling

*l.c.* (1994) 73.

Small tree to  
*absent. Leav*

Type: Maingay

smooth; inner  
near, inserted  
s of leaflets;  
long, densely  
by completely  
aded, margin  
midrib raised  
near margin;  
y, in axillary

*subcordate, margin minutely toothed*, apex pointed; midrib flattened to raised above; lateral veins 17–23 pairs, distinctly arching near margin, prominent below; *intercostal veins prominent giving pitted appearance to the lower surface*, veins and reticulations raised above. **Inflorescences** (male) axillary thyrses. **Flowers** pubescent. **Fruits** ellipsoid, 7–8 x 4–6 cm, densely tomentose when young.

**Distribution.** Sumatra, Peninsular Malaysia, and Borneo. In Sabah recorded from the Ranau, Sandakan and Tawau districts; not recorded from Sarawak. Also known in Kalimantan.

**Ecology.** Lowland forest to 280 m.

**Uses.** The resin is used for caulking boats. The fruit is edible. An edible oil is extracted from the seeds.

Closely related to *C. decumanum* but differing in the absence of stipules and by the toothed and densely woolly tomentose lower surface of the leaflets.

## 21. *Canarium pseudopatentinervium* H.J. Lam

(resembling *C. patentinervium*)

Ann. Jard. Bot. Btzig. 42 (1932) 214, Bull. Jard. Bot. Btzig. 3, 12 (1932) 490; Masamune *l.c.* 365; Leenhouts *l.c.* (1956) 274, *l.c.* (1959) 385; Burgess *l.c.* 61; Anderson *l.c.* 155; Whitmore, Tantra & Sutisna *l.c.* 36. **Type:** *bb.* 153, *T.* 3P. 336, Sumatra, Palembang, Lamatang Ilir near G. Megang (lectotype BO).

Medium-sized to large tree to 45 m tall, 100 cm diameter; buttresses to 5 m tall. **Bark** pale yellow-brown, irregularly scaly to dippled. Twigs whitish, with prominent leaf-scars, pith with many peripherally arranged vascular strands and often with a central cavity. *Stipules absent*. **Leaves** with 1–4 pairs of leaflets; *blade drying greenish*, ovate to elliptic, 5–12 x 2–7 cm; base asymmetric, rounded to broadly cuneate, *margin entire*, apex blunt to pointed; midrib flattened above; lateral veins 7–14 pairs, curving near margin; intercostal veins reticulate, prominent on both surfaces; petiolules of lateral leaflets 5–9 mm long, not swollen at both ends. **Inflorescences** (female) in terminal panicles. **Flowers** (female) subsessile, densely tomentose, *petals distinctly clawed*, apex inflexed, stamens free. **Fruits** ellipsoid, 5–7 x 2–3 cm; calyx triangular, hairy inside.

**Distribution.** Sumatra, Borneo. In Sarawak uncommon, known only by a single collection S. 18215 from Belaga; not yet found in Sabah. Also occurs in Kalimantan.

**Ecology.** Lowland forest at *c.* 100 m.

## 22. *Canarium pseudopimela* Kochummen

(resembling *C. pimela*)

*l.c.* (1994) 73. **Type:** *Ding Hou* 489, Sarawak, G. Raya (holotype SAR; isotype L).

Small tree to 12 m tall, 15 cm diameter. Twigs brown, *c.* 3 mm thick, rounded. *Stipules absent*. **Leaves** with 2–3 pairs of leaflets; blade thinly leathery, elliptic to narrowly obovate,

6–13 x 2.5–5 cm, slightly falcate; base cuneate, margin entire, apex cuspidate, tip 1.5–2 cm long; midrib raised above; lateral veins 5–7 pairs, arching and joining near margin, visible below, faint above; intercostal veins finely reticulate, distinctly visible below, faint above; petiolules of lateral leaflets 4–5 mm long, petiolules of terminal leaflet 2–3.5 cm long. **Inflorescences** (female) in racemes, *terminal*, glabrous, *c.* 23 cm long, with 13–14 cm long branches in few-flowered racemes, buds obovate. **Flowers** (female) *c.* 9 mm long, stalk *c.* 5 mm long; calyx funnel-shaped, with obtuse lobes, fleshy, with few irregular lines towards base; petals fleshy, irregularly wrinkled on drying; rudimentary stamens 6, connected into a cup-shaped staminal ring; disc undulate, *c.* 1 mm high; *ovary hairy*, faintly ridged, stigma capitate. **Infructescences** *c.* 13 cm long. **Fruits** ellipsoid, 3 x 1–1.5 cm, triangular, apex narrowed to sharp point; calyx almost flat; stalk *c.* 1.5 cm long.

**Distribution.** Endemic to Borneo. Uncommon, known by two collections only from G. Lambir (*S. 16613*) and G. Raya (*Ding Hou 489*) in Sarawak.

**Ecology.** Lowland forests.

Very close to *C. pimela* but differing in the terminal inflorescences, hairy ovary and in the long-pointed leaflets.

### 23. *Canarium sarawakanum* Kochummen

*l.c.* (1994) 75. **Type:** *Au S. 24802*, Sarawak, Kapit (holotype SAR; isotypes A, BO, K, KEP, L, SAN, SING).

Small tree to 8 m tall, 10 cm diameter. Twigs reddish brown hairy when young. *Stipules absent*. **Leaves** with 1–2 pairs of leaflets; rachis finely reddish brown hairy; blade thinly leathery, drying to reddish brown, glabrous above, sparsely reddish brown hairy below, elliptic to narrowly obovate, 8–20 x 3.5–8.5 cm; base cuneate, margin sub-entire to faintly toothed, apex acuminate, tip 1–2 cm long; midrib raised above; lateral veins 6–8 pairs, distinct below, faintly raised above, curving and joining near margin; intercostal veins reticulate, visible below, faint above; petiolules of lateral leaflets swollen near the apex, 1–1.5 cm long, that of terminal leaflet to 5 cm long. **Inflorescences** (female) axillary or terminal, thyrsoid, to 22 cm long, with few side branches; rachis brownish hairy. **Flowers** (male) with the calyx hairy outside, margins wavy to lobed; petals oblong, *c.* 4.5 mm long, hairy outside; *stamens* 3, joined at the base, filaments to 2.5 mm long; rudimentary ovary and style present. **Fruits** (immature) ellipsoid, 4.5–5.5 x 1.7–2 cm.

**Distribution.** Endemic to Borneo. Uncommon, known from a few collections from Kapit, Lubok Antu, G. Penrissen and Simanggang in Sarawak.

**Ecology.** Lowland to low submontane forests to 900 m.

Close to *C. latistipulatum* but that species has semi-persistent stipules.

ke  
Skrift. Dansl  
Kalkman, Bl  
& Bakhuizen  
42; Whitmor  
(1832) 89; C  
Soc. 82 (1920

Small to me  
**Bark** smoo  
rarely white  
and stipule-l  
*swollen at b*  
merous; sep  
filaments fr  
usually mo  
ellipsoid, 1-  
*when dry, g*  
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in *D. costat*

**Distribution**  
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**Ecology.** Lo

**Uses.** The ti  
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Rachis &
2. Rachis &  
Rachis &
3. Ultimato  
Ultimato

## 2. DACRYODES Vahl

(Greek, *dakruon* = a tear; the resin droplets on the bark surface)

*kedondong* (Sabah and Sarawak Malay), *kimayau* (Bidayuh in Sarawak)  
*kembayau* (Sabah Dusun), *seladah* (Sarawak Iban)

Skrift. Dansk. Nat. Hist. Selsk. 4 (1810) 116; H.J. Lam, Bull. Jard. Bot. Btztg. 3, 12 (1932) 334; Kalkman, Blumea 7 (1954) 500; Leenhouts *l.c.* (1956) 219, *l.c.* (1972) 917, *l.c.* (1976) 820; Backer & Bakhuizen *f. l.c.* 114; Kochummen *l.c.* (1972) 136; Cockburn *l.c.* 43; Anderson *l.c.* 156; Wong *l.c.* 42; Whitmore, Tantra & Sutisna *l.c.* 36; Ng *l.c.* 37. **Synonyms:** *Pachylobus* G. Don, Gen. Syst. 2 (1832) 89; *Canarium* section *Tenuipyrena* Engl. in DC. *l.c.* 104; *Curtisiana* Ridl., J. Str. Br. R. As. Soc. 82 (1920) 180; *Hemisantiria* H.J. Lam in Merrill *l.c.* (1929) 118.

Small to medium-sized, dioecious trees; buttresses small, short; sometimes with stilt-roots. **Bark** smooth to scaly; *inner bark orange, yellowish white or pink*, exudate often clear, rarely white. **Sapwood** pale. *Stipules absent* (in *D. laxa* the first pair of leaflets are smaller and stipule-like). **Leaflets entire**, the base often strongly unequal; *stalks (petiohules) strongly swollen at both ends*. **Inflorescence** an axillary or terminal panicle. **Flowers** unisexual, 3-merous; sepals free or united; *petals usually with thickened inflexed apex*; stamens 6, filaments free, bases united with the disc; disc intrastaminal, glabrous; ovary 3(-2)-celled, usually moderately reduced in male flowers; stigma sessile. **Fruit** a drupe, oblong or ellipsoid, 1-seeded; stigma usually apical; *pericarp fleshy and thick, coarsely wrinkled when dry*, glabrous; stone containing one fertile and two reduced cells; calyx persistent or caducous. **Seeds** round in cross-section; cotyledons 9-11-lobed in *D. rostrata*, and 5-lobed in *D. costata*, *D. laxa* and *D. rugosa*.

**Distribution.** About 40 species; tropical America, Africa and Asia. In Malesia mainly centred in Sumatra, Peninsular Malaysia and Borneo; 11 species in Sabah and Sarawak.

**Ecology.** Lowland (including swamp) to submontane forests to 1500 m.

**Uses.** The timbers of *Dacryodes* are essentially similar to that of *Canarium* in anatomical structure but they are on the whole heavier and the rays contain silica which makes them difficult to saw. Fruits of *Dacryodes rostrata* f. *cuspidata*, known in Sarawak as *keramoh* (Malay) and *kembayau* (Murut and Iban), are eaten.

### Key to *Dacryodes* species

1. Rachis and young twigs hairy.....2  
Rachis and young twigs glabrous.....7
2. Rachis and young twigs covered with long stiff hairs.....5. *D. laxa*  
Rachis and young twigs powdery hairy.....3
3. Ultimate leafy twigs c. 1 cm thick. Terminal bud c. 1.5 cm long:.....2. *D. elmeri*  
Ultimate leafy twigs to 0.5 cm thick. Terminal bud to 1 cm long.....4

- 4. Intercostal veins prominently raised below. Hairs not yellowish.....5  
Intercostal veins not raised, but visible below. Hairs yellowish.....10. **D. rubiginosa**
- 5. Intercostal veins scalariform. Leaflets densely hairy below.....8. **D. nervosa**  
Intercostal veins reticulate. Leaflets sparsely hairy below.....6
- 6. Petiolules strongly swollen at both ends; rachis glabrous.....11. **D. rugosa**  
Petiolules not strongly swollen at both ends; rachis hairy.....1. **D. costata**
- 7. Adaxial side of petiole flattened with sharp edges, petiolules of lateral leaflets 2.5–3.5  
cm long.....3. **D. expansa**  
Petiole and petiolules not so.....8
- 8. Midrib below sharply keeled; petiole strongly grooved or flattened above.....  
.....6. **D. longifolia**  
Midrib below not keeled; petiole rounded or flattened above.....9
- 9. Reticulations fine and more distinct on the upper than on the lower leaflet surface.  
Inner bark reddish; cut bark and twigs with white sap.....9. **D. rostrata**  
Reticulations more distinct on the lower surface. Inner bark yellowish; cut bark and  
twigs without white sap.....10
- 10. Leaflets usually of 2 pairs only. Trees with stilt-roots.....7. **D. macrocarpa**  
Leaflets more than 2 pairs. Trees without stilt-roots.....11
- 11. Lateral veins sunken above; intercostal veins raised below. Petiolule strongly swollen  
at both ends.....11. **D. rugosa**  
Lateral veins not sunken above; intercostal veins faintly visible below. Petiolule not  
prominently swollen.....4. **D. incurvata**

near marg:  
terminal or  
glabrous; st  
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**Ecology.** W  
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This specie:  
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*D. costata* t  
*D. rugosa* tl

**2. Dacryo**  
(A.D.E. El:  
Philippines)

Ann. Jard. I  
(1954) 521;  
*l.c.* (1929) 1  
BKH, BM).

Tree, to 75  
pith with m:  
**Leaves** with  
glabrous; bl:  
rounded, ap  
flower unkn

**Distributor**  
and from Br

**Ecology.** Lo

**3. Dacryo**  
(Latin, *expa*

Ann. Jard. Bc  
Kalkman *l.c.*  
*Canarium exp*

**1. Dacryodes costata** (A.W. Benn.) H.J. Lam

(Latin, *costatus* = ribbed; probably the prominent veins on the lower leaflet surface)

Ann. Jard. Bot. Btztg. 42 (1932) 204, Bull. Jard. Bot. Btztg. 3, 12 (1932) 359; Masamune *l.c.* 366; Kalkman *l.c.* (1954) 508; Leenhouts *l.c.* (1956) 222; Burgess *l.c.* 61; Kochummen *l.c.* (1972) 140; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 36. **Basionym:** *Santiria costata* A.W. Benn. in Hooker *f. l.c.* 537. **Type:** *Maingay 313/3295*, Malacca (holotype K; isotype CAL). **Synonym:** *Canarium costatum* (A.W. Benn.) Ridl. *l.c.* (1930) 82.

Medium-sized to large tree to 45 m tall, 45 cm diameter; buttresses short. **Bark** grey-brown, smooth to flaky; inner bark yellow-brown, with droplets of white sap. **Sapwood** whitish. Ultimate leafy twigs to 0.5 cm thick, rusty-brown velvety hairy when young. **Leaves** with 1–3 pairs of leaflets; *rachis powdery rusty hairy; petiole hairy, flattened above; petiolules of lateral leaflets 5–15 mm long, powdery hairy to glabrous, slightly swollen at both ends; blade sparsely hairy on midrib and veins below, elliptic to oblong, 6–15 x 2.5–6 cm; base cuneate, often unequal, apex pointed, tip 1–2 cm long; midrib raised above; lateral veins 10–14 pairs, prominently raised below, faint above, looping and joining*

.....5  
**rubiginosa**

**D. nervosa**  
 .....6

**D. rugosa**  
**D. costata**

lets 2.5–3.5  
**D. expansa**  
 .....8

.....  
**D. longifolia**  
 .....9

flat surface.  
**D. rostrata**  
 at bark and  
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**macrocarpa**  
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gly swollen  
**D. rugosa**  
 etiolule not  
**D. incurvata**

ice)

une *l.c.* 366;  
 (1972) 140;  
 W. Benn. in  
 1. **Synonym:**

**Bark grey-**  
**Sapwood**  
 hen young.  
 y, flattened  
 us, slightly  
 oblong, 6–  
 idrib raised  
 and joining

near margin; intercostal veins reticulate, distinct below, faint above. **Inflorescences** terminal or from upper leaf axils, axes densely hairy. **Flowers** pubescent; petals whitish, glabrous; *stamen filaments free from the disc; disc annular to 6-lobed*. **Fruits** ellipsoid or ovoid, 1.7–2.2 x 1–1.2 cm; stalk *c.* 1 cm long.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sabah reported from Ranau, Sandakan and Tawau; in Sarawak, known only from the Lambir National Park and Semengoh FR. Also known in Kalimantan.

**Ecology.** Widely distributed from lowland to hill forests to 540 m, mainly on ridges and hillsides. Flowering in May and September, and fruiting in July, October and November.

This species is very similar to *D. rugosa* from which it can be distinguished by the hairy petioles, and the less swollen leaflet stalks. The flowers of both species are quite distinct, in *D. costata* the disc is annular to 6-lobed and the stamen filaments free from disc, while in *D. rugosa* the disc is cup-shaped and stamen filaments adnate to disc.

## 2. *Dacryodes elmeri* H.J. Lam

(A.D.E. Elmer, 1870–1942; plant collector with the Bureau of Science, Manila, the Philippines)

Ann. Jard. Bot. Btzig. 42 (1932) 203, Bull. Jard. Bot. Btzig. 3, 12 (1932) 344; Kalkman *l.c.* (1954) 521; Leenhouts *l.c.* (1956) 225. **Synonym:** *Hemisantria ?n. sp.* H.J. Lam in Merrill *l.c.* (1929) 199. **Type:** *Elmer 21573*, British North Borneo, Tawau (holotype L; isotypes A, BKH, BM).

Tree, to 75 cm in diameter. *Ultimate leafy twigs c. 1 cm thick*, densely minutely villous; pith with many scattered vascular strands. Terminal bud *c.* 1.5 cm long, densely pubescent. **Leaves** with 3–4 pairs of leaflets; rachis strongly flattened at base, hairy at first becoming glabrous; blade oblong, 12–22 x 5–8.5 cm, chartaceous; base oblique-cuneate, on one half rounded, apex pointed; lateral veins 13–18 pairs, prominent beneath. Inflorescence and flower unknown. **Fruits** ovoid, 4–4.7 x 2.25 cm, with rounded apex and base.

**Distribution.** Endemic to Borneo. Very uncommon, known from the type collection (Sabah) and from Brunei.

**Ecology.** Lowland forest.

## 3. *Dacryodes expansa* (Ridl.) H.J. Lam

(Latin, *expansus* = spread out, diffuse; the thin, spread out petals)

Ann. Jard. Bot. Btzig. 42 (1932) 204, Bull. Jard. Bot. Btzig. 3, 12 (1932) 366; Masamune *l.c.* 366; Kalkman *l.c.* (1954) 510; Leenhouts *l.c.* (1956) 228, *l.c.* (1972) 919, *l.c.* (1976) 821. **Basionym:** *Canarium expansum* Ridl. *l.c.* (1930) 83. **Type:** *Haviland 2271*, Sarawak, Kuching (K).

Small tree. Buds reddish brown, hairy. **Leaves** with 4 pairs of leaflets; adaxial side of petiole flattened with sharp edges; petiolules of lateral leaflets 2.5–3.5 cm long, strongly swollen at both ends; blade oblong to oblong-lanceolate, 17–23 x 6–7.5 cm, brownish when dried; base cuneate, apex pointed; midrib raised above; lateral veins 10–12 pairs, prominent below; intercostal veins faint. **Inflorescences** (male) probably lateral on axillary shoots, to 24 cm long, glabrous; *pedicels* 3–7 mm long, *articulated*. **Flowers** (male) glabrous; calyx-lobes deltoid; *petals* very thin, *spreading*; stamens free from disc; disc annular, thick; ovary in male flowers reduced. Infructescence and fruit unknown.

**Distribution.** Endemic to Borneo. Uncommon, known from the type collection only and from Brunei.

**Ecology.** Lowland forest.

#### 4. *Dacryodes incurvata* (Engl.) H.J. Lam

(Latin, *incurvatus* = bending inward; the leaflet margin)

Ann. Jard. Bot. Btzg. 42 (1932) 204, Bull. Jard. Bot. Btzg. 3, 12 (1932) 362; Kalkman *l.c.* (1954) 506; Leenhouts *l.c.* (1956) 224; Burgess *l.c.* 61; Kochummen *l.c.* (1972) 140; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 36. **Basionym:** *Canarium incurvatum* Engl. in DC. *l.c.* 138. **Type:** *Beccari PB 2937*, Sarawak (holotype P; isotype FI). **Synonyms:** *Santiria nitida* Merr., Publ. Govt. Lab. Philip. 35 (1906) 29; *Canarium nitens* Merr., Philip. J. Sc. 10 (1915) Bot. 24; *Hemisantiria nitida* H.J. Lam in Merrill *l.c.* (1929) 118; *Canarium angulatum* Ridl., Kew Bull. (1931) 493; *Dacryodes angulata* (Ridl.) H.J. Lam, Ann. Jard. Bot. Btzg. 42 (1932) 204.

Medium-sized to large tree to 35 m tall, 30 cm diameter; buttresses steep to 2 m high. **Bark** grey-brown, smooth, with horizontal rings; inner bark pink with droplets of white sap. **Sapwood** pale white. Twigs dark brown. **Leaves** with 1–4 pairs of leaflets; petiole strongly flattened at base; petiolules of lateral leaflets 1–2 cm long, swollen at both ends; blade thinly to thickly leathery, shiny above, elliptic, oblong or lanceolate, 6–16 x 2–9 cm; base rounded, subcordate or cuneate, apex pointed; midrib raised or flattened above; lateral veins 10–16 pairs, raised on both surfaces; intercostal veins reticulate, faintly visible on both surfaces. **Flowers** hairy, usually in terminal panicles. **Fruits** ovoid or ellipsoid, 2.5–3 x 1.7–2 cm, ripening to yellow and then purplish.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo, and the Philippines. Common in Sabah, recorded from Beaufort, Sipitang and Tawau. In Sarawak recorded from Bintulu, Lambir National Park, Serian and Kuching. Also found in Brunei and Kalimantan.

**Ecology.** Mixed dipterocarp forests to 860 m; uncommon in mixed peat swamp forest. Flowering in April, June and September, and fruiting in March and June–November.

#### 5. *Dacryodes laxa* (A.W. Benn.) H.J. Lam

(Latin, *laxus* = loose or distant; the inflorescence)

Ann. Jard. Bot. Btzg. 42 (1932) 204, Bull. Jard. Bot. Btzg. 3, 12 (1932) 355; Kalkman *l.c.* (1954) 503; Leenhouts *l.c.* (1956) 224; Kochummen *l.c.* (1972) 141; Cockburn *l.c.* 45; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 37. **Basionym:** *Canarium laxum* A.W. Benn. in Hooker *f. l.c.* 535.

**Type:** *Maing*  
DC. *l.c.* 138; 1

Small to me  
bark pale ye  
with up to 5  
long, hairy; l  
base cuneate  
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80 cm) *term*.  
2.5–4.5 x 1–

**Distribution**  
Sarawak rep  
known in Br

**Ecology.** Co  
Flowering fr

#### 6. *Dacryoc* (Latin, *longu*

Ann. Jard. Bot  
509; Leenhout  
*longifolia* Kin  
*Curtisiana per*  
Lam, Ann. Jar

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faintly visible  
2.5–3.5 x 1.5

**Distribution.**  
widely distrib

**Ecology.** Lov

#### 7. *Dacryod* (Greek, *makr*

Ann. Jard. Bot  
Kalkman *l.c.* (

**Type:** *Maingay 366*, Malacca (holotype K; isotypes CAL, L). **Synonyms:** *Canarium fragile* Engl. in DC. *l.c.* 138; *Santiria laxa* (A.W. Benn.) King, *l.c.* 254.

Small to medium-sized tree to 30 m tall, 30 cm diameter. **Bark** grey, smooth to scaly; inner bark pale yellow. **Sapwood** pale white. *Twigs with long rough hairs when young.* **Leaves** with up to 5 pairs of leaflets; *rachis rough-hairy*; petiolules of lateral leaflets 3–10 mm long, hairy; blade drying greenish, oblong, lanceolate or oblanceolate, 8.5–34 x 4.5–9 cm; base cuneate, apex pointed, tip to 1.5 cm long; midrib raised above; lateral veins 9–30 pairs, raised on both surfaces, curving and joining near margin; *intercostal veins* reticulate, raised below, *sunken above*; petiole strongly swollen at base. **Flowers** in branched, long (c. 80 cm) *terminal panicles*; petals glabrous. **Fruits** pink ripening to blue, oblong or ovoid, 2.5–4.5 x 1–2 cm, apex pointed; stalk 2–2.5 cm long, slender.

**Distribution.** Sumatra, Peninsular Malaysia, and Borneo. Widely distributed in Sabah. In Sarawak reported only from Bako National Park, Semengoh Arboretum and Lundu. Also known in Brunei.

**Ecology.** Common in mixed dipterocarp forests on yellow sandy clay soils, to 700 m. Flowering from April to June, and fruiting from June to November.

## 6. *Dacryodes longifolia* (King) H.J. Lam

(Latin, *longus* = long, *folium* = leaf)

Ann. Jard. Bot. Btzig. 42 (1932) 202, Bull. Jard. Bot. Btzig. 3, 12 (1932) 340; Kalkman *l.c.* (1954) 509; Leenhouts *l.c.* (1956) 228, *l.c.* (1972) 919; Kochummen *l.c.* (1972) 141. **Basionym:** *Santiria longifolia* King *l.c.* 258. **Type:** *King's collectors 6838*, Perak (holotype K; isotype L). **Synonyms:** *Curtisiana penangensis* Ridl. *l.c.* (1920) 180; *Dacryodes longifolia* var. *penangensis* (Ridl.) H.J. Lam, Ann. Jard. Bot. Btzig. 42 (1932) 202.

Medium-sized to large tree to 40 m tall. **Bark** dark grey, smooth; inner bark orange-yellow. Twigs brown, with scattered white lenticels. **Leaves** with 2–6 pairs of leaflets; *petiole strongly grooved or flattened above*; petiolules of lateral leaflets 1–2 cm long, strongly swollen at both ends; blade oblong to lanceolate, 6.5–18 x 2.5–4.5 cm; base usually unequal, broadly cuneate to rounded, apex pointed; *midrib* raised above, *sharply keeled below*; lateral veins 7–12 pairs, distinct below, faint above; *intercostal veins* reticulate, faintly visible on both surfaces. **Flowers** (male) in axillary panicles, glabrous. **Fruits** ellipsoid, 2.5–3.5 x 1.5–2.5 cm, much wrinkled on drying; stalk c. 7 mm long.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo and the Philippines. Common and widely distributed in Sabah; less common in Sarawak.

**Ecology.** Lowland to submontane forests to 1500 m.

## 7. *Dacryodes macrocarpa* (King) H.J. Lam

(Greek, *makros* = large, *karpos* = fruit)

Ann. Jard. Bot. Btzig. 42 (1932) 203, Bull. Jard. Bot. Btzig. 3, 12 (1932) 342; Masamune *l.c.* 366; Kalkman *l.c.* (1954) 514; Leenhouts *l.c.* (1956) 228, *l.c.* (1972) 919, *l.c.* (1976) 820; Burgess *l.c.* 61;



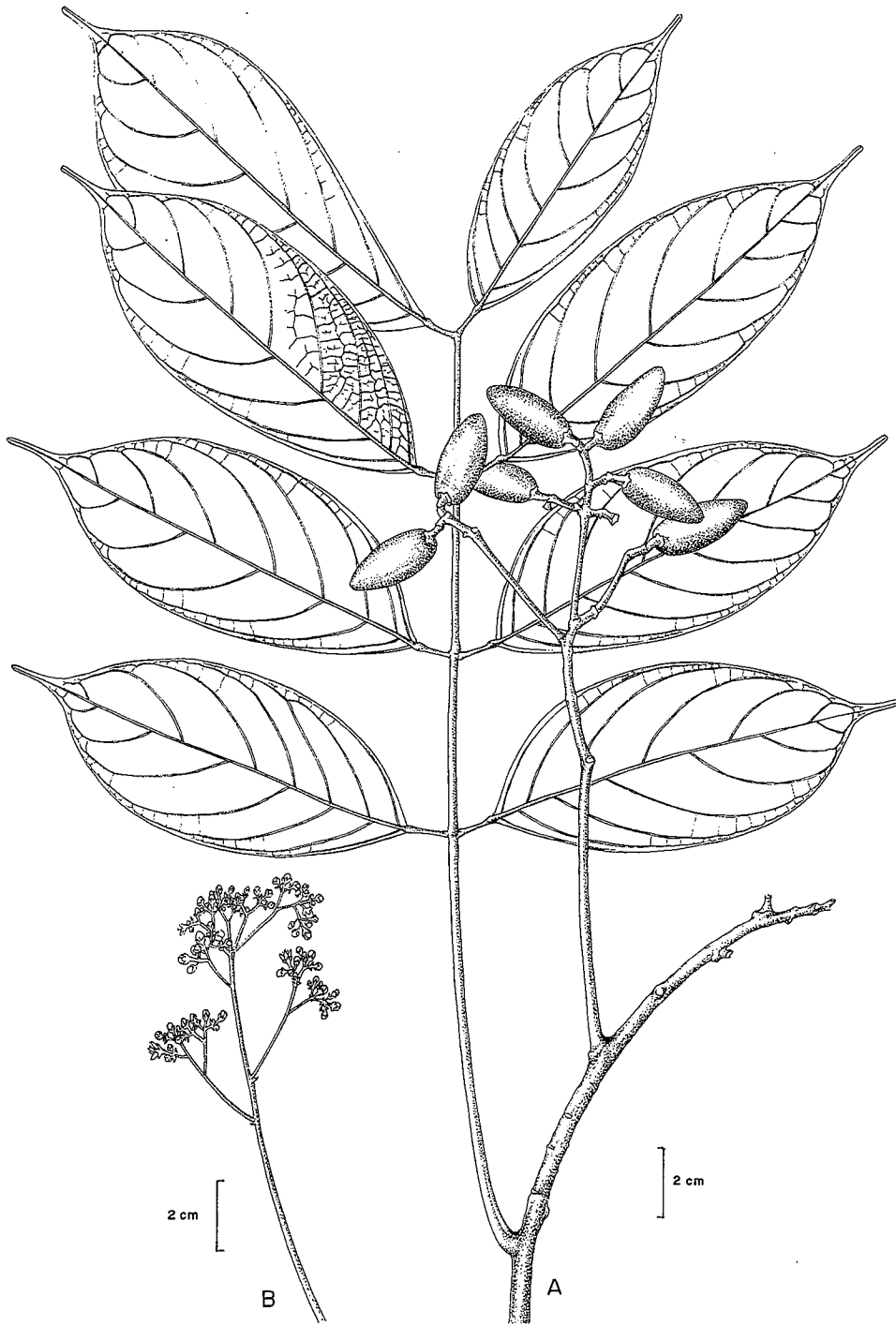


Fig. 2. *Dacryodes rostrata*. A, fruiting leafy twig; B, part of inflorescence. (A from SAN 39742, B from SAN 30412.)

Kochummen /  
*Santiria macr*  
SING).

Medium-size  
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pointed; mid  
veins scalarit  
panicles. Fru

**Key to varie**

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Leaflets  
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**Ecology.** Co:  
March–April

Kochummen *l.c.* (1972) 142; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 37. **Basionym:** *Santiria macrocarpa* King *l.c.* 256. **Type:** *King's collectors 7298*, Perak (holotype K; isotypes CAL, SING).

Medium-sized to tall tree; stilt-roots and buttresses present. **Bark** reddish brown, cracking. Twigs dark brown to blackish when dry. **Leaves** with 1–2 pairs of leaflets; petiolules of lateral leaflets 0.7–2 cm long, swollen at both ends; blade elliptic, obovate or ovate, 6–12 x 3–6 cm; base often unequal, rounded to broadly cuneate, apex blunt, rounded or shortly pointed; midrib flattened above; lateral veins 6–9 pairs, visible on both surfaces; intercostal veins scalariform-reticulate, faintly visible on both surfaces. **Flowers** glabrous, in axillary panicles. **Fruits** ovoid or ellipsoid, 2.5–4 x 2.5 cm.

#### Key to varieties

1. Leaflets widest around the middle, equal-sided at base; lateral veins at right angle to midrib.....
  - var. **patentinervia** Leenh.  
*l.c.* (1976) 821. Type: *Sinclair & Kadim 10492*, Brunei, Bt. Labi FR (holotype L; isotypes K, SAR, SING).  
Endemic to Borneo. In Sabah uncommon, known only from Bt. Hampuan, Ranau district (*SAN 25331*). In Sarawak scattered through 3rd, 4th and 5th Div. in the lowland to submontane forest to 1500m. Also in Brunei. Vernacular names: Sarawak—*seladah* (Iban). Brunei—*sabal* (Iban), *sibut* (Tutong, Dusun).
- Leaflets widest in the lower half, oblique at base; lateral veins at acute angle with midrib.....2
2. Twigs blackish when dry. Midrib and veins not prominent beneath.....
  - var. **macrocarpa**  
Synonym: *D. macrocarpa* var. *genuina* H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 343. Sumatra, Peninsular Malaysia, and Borneo. Uncommon in Sabah, more common in Sarawak. Also in Brunei and Kalimantan. Vernacular names: Sabah—*asam-asam* (Dusun). Sarawak—*icerawas burung*, *keruas* (Malay). Brunei—*kedondong*, *pasoh-pasoh* (Malay).

Twigs and rachis scaly to powdery hairy and brown when dry. Midrib and veins prominent below.....

#### var. **kostermansii** (Kalkman) Kalkman

in Leenhouts *l.c.* (1956) 228. Synonym: *D. kostermansii* Kalkman *l.c.* (1954) 515. Type: *Kostermans 6725*, SE Borneo, Loa Djanan, W Samarinda (holotype L; isotypes BO). Endemic to Borneo. In Sabah known by a single collection (*SAN 25572*) from the Silam FR, Lahad Datu district; not recorded in Sarawak. Also found in Kalimantan.

**Ecology.** Coastal and mixed swamp forests. Flowering in September and fruiting in March–April and November.

**8. *Dacryodes nervosa* (H.J. Lam) Leenh.**  
(Latin, *nervosus* = prominently nerved; the leaves)

Blumea 12 (1964) 19, *l.c.* (1972) 919. **Basionym:** *Santiria nervosa* H.J. Lam, Ann Jard. Bot. Btztg. 42 (1932) 206, Bull. Jard. Bot. Btztg. 12, 3 (1932) 387. **Type:** *Grashoff 960*, Sumatra (L).

Medium-sized tree to 30 m tall, 35 cm diameter; buttresses to 1.5 m tall. **Bark** smooth to scaly, dark brown. Ultimate leafy twigs to 0.5 cm thick. Terminal bud 0.5–1 cm long. **Leaves** with 1–4 pairs of leaflets; blade oblong to ovate, 5.5–17 x 3–7.5 cm, upper surface greenish when dried, lower surface pubescent to glabrous; base broadly cuneate, asymmetric, apex pointed; midrib raised above; lateral veins 10–15 pairs, prominent below; intercostal veins scalariform, raised below; petiolule 8–11 mm long, hairy. **Inflorescences** axillary. **Flowers** sessile or shortly stalked. **Fruits** pink when fresh, ellipsoid, 1.6–1.7 x 1.1 cm.

**Distribution.** Sumatra, Peninsular Malaysia, and Borneo. Uncommon, in Sarawak so far recorded only from Bako National Park, Bintulu and Sadong (*S. 13389*, *S. 16228*, *S. 18192*, *S. 37488*); not yet found in Sabah. Also occurs in Kalimantan.

**Ecology.** Lowland forest to 350 m.

**9. *Dacryodes rostrata* (Blume) H.J. Lam**  
(Latin, *rostratus* = with a beak or narrowed tip; the leaves)

Fig. 2.

Ann. Jard. Bot. Btztg. 42 (1932) 203, Bull. Jard. Bot. Btztg. 3, 12 (1932) 349; Masamune *l.c.* 366; Kalkman *l.c.* (1954) 519; Leenhouts *l.c.* (1956) 225; Burgess *l.c.* 161; Kochummen *l.c.* (1972) 143; Cockburn *l.c.* 45; Anderson *l.c.* 156; Whitmore, Tantra & Sutisna *l.c.* 37. **Basionym:** *Santiria rostrata* Blume *l.c.* (1850) 213. **Type:** *Korthals, s.n.* (= *Leiden no. 898.321–228*), Borneo (L). **Synonym:** *Hemisantiria rostrata* (Blume) H.J. Lam in Merrill *l.c.* (1929) 119.

Small to very large tree to 45 m tall, 200 cm diameter. **Bark** dark grey, smooth to scaly or dippled; inner bark reddish or pinkish with droplets of white sap. **Sapwood** whitish. Twigs thin to very thick (0.4–2.5 cm), dark brown, lenticellate. **Leaves** with 2–8 pairs of leaflets; petiolules of lateral leaflets 1–2 cm long, swollen at both ends; blade thinly to thickly leathery, glabrous or (sometimes) with tiny inconspicuous hairs below, ovate to oblong, 8–30 x 3.5–11 cm; base strongly unequal, apex pointed, tip *c.* 2 cm long; midrib raised above; lateral veins 5–15 pairs, raised on both surfaces; intercostal veins reticulate, faint to distinct on both surfaces or sometimes more distinct above than below; petioles strongly flattened at base in those with thick twigs. **Flowers** densely hairy, in axillary panicles 5–35 cm long. **Fruits** ovoid to oblong, 2–3.5 x 1–2 cm, often strongly wrinkled on drying, ripening to blue, with white sap.

**Key to forms**

Ultimate leafy twigs 1.5–2.5 cm thick. Leaflets at least 10 cm long, drying greenish grey; reticulations more distinct on the upper than on lower surface.....

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Bull. Jar  
(1850). 1  
*minahass*  
(1915) 27  
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*16612*),  
Rawan (C  
3rd Div.  
Forest (C  
Sabah—

Ultimate leaf  
not so.....  
forma ro  
Synonyms:  
*montana*  
*kedondon*  
Sumatra,  
and Sara

**Ecology.** Ve:  
September, a:

**10. *Dacryo***  
(Latin, *rubigi*

Ann. Jard. Bot  
Kalkman *l.c.* (C  
& Sutisna *l.c.*  
*rubiginosum* M  
(holotype K; is

Medium-size  
*yellowish br*  
appressed hai  
*sparsely hair*  
apex pointed,  
raised below,  
**Flowers** (mal  
**Fruits** ellipso

**Distribution.**  
known only fr  
and Ulu Sg. S

**Ecology.** Low

**forma cuspidata** (Blume) H.J. Lam

Bull. Jard. Bot. Btzig. 3, 12 (1932) 351. Basionym: *Dracontomelon cuspidatum* Blume *l.c.* (1850). Type: *Korthals, s.n.* (= *Leiden no. 897. 363-270*), Borneo (L). Synonym: *Canarium minahassae* Koord. *l.c.* 96; *Santria samarensis* Merr. *l.c.* (1915) 315; *C. crassifolium* Merr. *l.c.* (1915) 274; *C. cuspidatum* (Blume) Merr. *l.c.* (1921) 316; *C. reticulatum* Ridl. *l.c.* (1930) 83.

Indo-China, Sumatra, Borneo, Philippines, and N Celebes. In Sabah, known from a few collections from Labuan FR (*FDBNB 44236*), Bt. Batangan, Sipitang district (*SAN 16612*), and Nabutan, Ranau district (*SAN 100230*). In Sarawak recorded from Bt. Rawan (*S. 45575*) and Semengoh Arboretum (*S. 32406*) in 1st Div., Ulu Balleh, Kapit, 3rd Div. (*S. 29100*); and Ulu Dapoi, Marudi (*S. 23056 & S. 23474*), Kebulu Protected Forest (*S. 49126*), and Dulit Range (*S. 46672*) in the 4th Div. Vernacular names: Sabah—*kedondong, salong banggi* (Malay). Sarawak—*seladah* (Iban).

Ultimate leafy twigs to 0.5 cm thick. Leaflets smaller, drying reddish brown; reticulations not so.....

**forma rostrata**

Synonyms: *D. rostrata f. genuina* H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 351; *Santiria montana* Blume *l.c.* (1850) 212; *C. montanum* (Blume) Korth. *ex* Miq. *l.c.* (1859) 649; *C. kedondong* A.W. Benn. in Hooker *f. l.c.* 535.

Sumatra, Peninsular Malaysia, and Borneo. Common and widely distributed in Sabah and Sarawak. Vernacular names: Sabah—*kedondong, kambayau* (Dusun).

**Ecology.** Very common in mixed dipterocarp forest to 800 m. Flowering in February–September, and fruiting in April and June–December.

**10. Dacryodes rubiginosa** (A.W. Benn.) H.J. Lam

(Latin, *rubiginosus* = of rusty colour; the tomentum)

Ann. Jard. Bot. Btzig. 42 (1932) 204, Bull. Jard. Bot. Btzig. 3, 12 (1932) 361; Masamune *l.c.* 367; Kalkman *l.c.* (1954) 521; Leenhouts *l.c.* (1956) 225; Kochummen *l.c.* (1972) 143; Whitmore, Tantra & Sutisna *l.c.* 37. **Basionym:** *Canarium rubiginosum* A.W. Benn. in Hooker *f. l.c.* 535, non *C. rubiginosum* Miq. *l.c.* (1859) 651 (= *Santiria rubiginosa* Blume). **Type:** *Maingay 309*, Malacca (holotype K; isotypes CAL, L):

Medium-sized tree to 20 m tall, 20 cm diameter. *Ultimate leafy twigs to 0.5 cm thick, yellowish brown velvety hairy* when young. **Leaves** with 2–3 pairs of leaflets; rachis appressed hairy; petiolules of lateral leaflets 0.5–1 cm long, swollen at both ends; *blade sparsely hairy below*, elliptic or oblong, 9.5–19.5 x 2.5–6.5 cm; base cuneate, unequal, apex pointed, tip *c.* 1.5 cm long; midrib raised above; lateral veins 8–12 pairs, prominently raised below, faintly raised above; intercostal veins scalariform-reticulate, visible below. **Flowers** (male) tomentose, in terminal inflorescences, *axes densely yellowish brown hairy*. **Fruits** ellipsoid, 2–2.5 x 1 cm.

**Distribution.** Peninsular Malaysia and Borneo. In Sabah scattered. In Sarawak uncommon, known only from two collections (*S. 43194* and *S. 43377*) from Samunsam Wildlife Sanctuary and Ulu Sg. Semawat respectively. Also found in Kalimantan.

**Ecology.** Lowland forest to 200 m.

11. **Dacryodes rugosa** (Blume) H.J. Lam

(Latin, *rugosus* = wrinkled; the bullate leaflets)

Ann. Jard. Bot. Btzig. 42 (1932) 203, Bull. Jard. Bot. Btzig. 3, 12 (1932) 345; Masamune *l.c.* 367; Kalkman *l.c.* (1954) 505; Leenhouts *l.c.* (1956) 221; Backer & Bakhuizen *f. l.c.* (1972) 114; Burgess *l.c.* 62; Kochummen *l.c.* 144; Cockburn *l.c.* 47; Anderson *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 37. **Basionym:** *Santiria rugosa* Blume *l.c.* 212. **Type:** *Korthals, s.n.* (= *Leiden no. 898.321-232*), Java (L). **Synonyms:** *Canarium rugosum* (Blume) Miq. *l.c.* (1859) 649 (including var. *sumatranum*); *Hemisantiria rugosa* (Blume) H.J. Lam in Merrill *l.c.* (1929) 119.

Small to medium-sized tree, rarely to 30 m tall and 40 cm diameter. **Bark** grey-white, smooth to scaly; inner bark yellowish. **Sapwood** pale. Ultimate leafy twigs 0.3-0.5 cm thick. **Leaves** with 1-4 pairs of leaflets; rachis flattened above; *petiole glabrous; petiolules of leaflets strongly swollen at both ends*; blade glabrous or appressed pubescent below or with erect hairs on midrib and veins below (var. *virgata*), elliptic, ovate to oblong-lanceolate, 6-22 x 2.5-11 cm, sometimes bullate; base cuneate, apex pointed with long tip; midrib raised above; lateral veins 7-12 pairs, raised below, flattened above (sunken in var. *rugosa*), often curving and joining near margin; intercostal veins reticulate, raised below, faint or sunken above. **Flowers** in axillary panicles, glabrous (var. *virgata*) or hairy; *stamen filaments adnate to the disc; disc cup-shaped*. **Fruits** ovoid, slightly oblique, 1.5-2.5 x 1-1.5 cm.

**Key to varieties**

Lateral veins sunken on upper leaflet surface. Leaflets glabrous or appressed-hairy on lower surface. Flowers densely hairy.....

var. **rugosa**

Synonyms: *Dacryodes rugosa* var. *genuina* H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 347; *Santiria fasciculata* A.W. Benn. in Hooker *f. l.c.* 539.

Sumatra, Peninsular Malaysia, Java, and Borneo. Widespread in Sabah and Sarawak in mixed dipterocarp forest on yellow sandy clay soils. Also in Kalimantan.

Lateral veins not sunken on upper leaflet surface. Leaflets with scattered erect hairs on midrib and veins on lower side. Flowers glabrous.....

var. **virgata** (Blume) H.J. Lam

Bull. Jard. Bot. Btzig. 3, 12 (1932) 348. **Basionym:** *Santiria virgata* Blume *l.c.* (1850) 213.

**Synonym:** *Canarium virgatum* (Blume) Miq. *l.c.* (1959) 650. **Type:** *Korthals, s.n.*, W Borneo, G. Pamaton (holotype L; isotype BO).

Widely distributed in Sabah and Sarawak; also in Kalimantan.

**Ecology.** Lowland to hill mixed dipterocarp forests to 900 m. Flowering in April-November, and fruiting in March-December.

3. **GARUGA** Roxb.

(an Indo-Malayan plant name, origin uncertain)

Pl. Corom. 3 (1811) 5; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 325; Kalkman *l.c.* (1954) 459; Leenhouts *l.c.* (1956) 215; Kochummen *l.c.* (1972) 144; Whitmore, Tantra & Sutisna *l.c.* 37.

Deciduous to stipules, stipule leaflets tooth concave, glot with 10 lobe pyrenes 1-5,

**Distribution.** Melanesia, N

**Ecology.** Low

**Garuga fl** (Latin, *florib*

Nouv. Ann. M Kalkman *l.c.* ( & Sutisna *l.c.* *abito* Blanco, 1 73; *Garuga li*

Small to me covered with petioles, cad subsessile, el rounded, ma distinct on bc cup-shaped r mm.

**Distribution.** Moluccas, Ne some islands

**Ecology.** Coz

A second var Hainan.

Ann. Jard. Bot Husson & H.J. Whitmore, Tar

Deciduous trees. *Pith of branches and petioles without vascular strands. Leaves with stipules, stipellae* (stipule-like outgrowths at the base of leaflets) *often present; margin of leaflets toothed. Inflorescence* an axillary panicle. **Flowers** *bisexual, 5-merous; receptacle concave, globose or cup-like; sepals free; stamens 10; disc adnate to the receptacle, glabrous with 10 lobes between the stamens; ovary 5-celled. Fruit* drupaceous; pericarp fleshy; pyrenes 1–5, furrowed, bony. Cotyledons twisted and folded.

**Distribution.** 4 species; continental SE Asia, with a variety of one species in Malesia, Melanesia, N Australia, and the Solomon Islands.

**Ecology.** Lowland forest to 200 m.

#### **Garuga floribunda** Decne. var. **floribunda**

Fig. 3.

(Latin, *floribundus* = with abundant flowers)

Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 477; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 326; Kalkman *l.c.* (1954) 463; Leenhouts *l.c.* (1956) 215; Kochummen *l.c.* (1972) 144, Whitmore, Tantra & Sutisna *l.c.* 37. **Type:** *sine coll., s.n.*, Timor (holotype G; isotype NY). **Synonyms:** *Guaiacum abilo* Blanco, Fl. Filip. (1837) 364; *Garuga abilo* (Blanco) Merr., Publ. Govt. Lab. Philip. 35 (1905) 73; *Garuga littoralis* Merr. *l.c.* (1915) 27; *Garuga clarkei* Merr. *l.c.* (1915) 29.

Small to medium-sized tree to 12 m tall, 10 cm diameter. **Bark** grey, smooth. Twigs covered with many leaf-scars, minutely tomentose at tips. Stipules inserted at base of petioles, caducous. **Leaves** crowded at ends of twigs, leaflets 4–10(–15) pairs; blade subsessile, elliptic to oblong or lanceolate, 5–19 x 2–5.5 cm; base oblique, cordate or rounded, *margin toothed*, apex pointed; midrib raised above; lateral veins 10–20 pairs, distinct on both surfaces; intercostal veins reticulate, visible on both surfaces. **Flowers** with cup-shaped receptacle; petals tomentose inside. **Fruits** obliquely pear-shaped, 5–9 x 5–12 mm.

**Distribution.** Peninsular Malaysia, Java, Borneo, Philippines, Celebes, Lesser Sunda Islands, Moluccas, New Guinea, Melanesia, and W Australia. In Borneo uncommon, known only from some islands (Gaya and Sipadan) in Sabah.

**Ecology.** Coastal forests at low altitude.

A second variety, var. *gamblei*, is known from E India, Sikhim, Bangladesh, W China and Hainan.

#### 4. **HAPLOLOBUS** H.J. Lam

(Greek, *haplos* = single, *lobus* = lobe; the single-lobed seed)

Ann. Jard. Bot. Btzg. 42 (1932) 25, Bull. Jard. Bot. Btzg. 3, 12 (1932) 404, Blumea 9 (1958) 237; Husson & H.J. Lam, Blumea 7 (1953) 413; Leenhouts *l.c.* (1956) 239, Blumea 20 (1972) 283 & 311; Whitmore, Tantra & Sutisna *l.c.* 37; Kochummen, Sandakania 5 (1994) 75.

Small to medium-sized, dioecious trees. **Bark** greyish, scaly. *Pith of branches and petioles mostly without vascular strands.* **Leaves** without stipules, imparipinnate; leaflets entire. **Inflorescences** paniculate, axillary or borne on leafless twigs or stems, sometimes with vegetative terminal bud. **Flowers** 3-merous, functionally unisexual, organs of the other sex always present and sometimes only little reduced in size; sepals united; petals free with inflexed tip; stamens 6 (occasionally only 3), inserted outside the annular disc or filaments slightly connate to it at base; ovary 3-celled, each cell with 2 collateral, pendulous, axile ovules; stigma 3-lobed to subglobular. **Fruits** ovoid to subglobular, calyx persistent, spreading, stigma terminal; pericarp dry, thin, smooth. **Seed** mostly 1 in each pyrene; cotyledons plano-convex, thick, entire; germination hypogeal.

**Distribution.** 19 species; from Borneo and Celebes through the Moluccas and New Guinea to Western Polynesia. 6 species in Sabah and Sarawak.

**Ecology.** From sea-level to 1800 m.

**Taxonomy.** Species of this genus are difficult to distinguish from some *Santiria* and *Dacryodes* species in the sterile state or even with flowers. Generally in *Haplolobus* the twigs are lenticellate, occasionally some species have galls or their holes on the leaf-blade, and often the inflorescences are short and usually terminate in a vegetative bud.

### Key to *Haplolobus* species

1. Leaflets hairy below.....2  
    Leaflets glabrous below.....3
2. Leaflets densely hairy below; lateral veins 25–30 pairs; petiole thin, lower part distinctly grooved.....1. **H. beccarii**  
    Leaflets sparsely hairy below; lateral veins 7–9 pairs; petiole thicker, not grooved.....  
    .....2. **H. bintuluensis**
3. Petiole channelled above, with incurved edges, petiolules with horizontal cracks, swollen at both ends.....5. **H. leenhoutsii**  
    Not this combination of characters.....4
4. Leaflets drying greenish brown above, reddish brown below. Young twigs strongly angled.....4. **H. kapitensis**  
    Leaflets drying the same colour on both surfaces. Young twigs not angled.....5
5. Leaflets drying dark brown, strongly asymmetric; midrib not in the centre, sharply keeled below.....3. **H. inaequifolius**  
    Leaflets drying yellowish; midrib not so.....6. **H. sarawakanus**

#### 1. *Haplolobus beccarii* Husson

(Odoardo Beccari, Italian explorer and botanist, 1843–1920)

in Husson & H.J. Lam *l.c.* 431; Leenhouts *l.c.* (1956) 243, *l.c.* (1972) 292; H.J. Lam *l.c.* (1958) 248; Whitmore, Tantra Sutisna *l.c.* 37. **Type:** Beccari PB 1803, Sarawak (FI).

Fig. 3. *Garuga* flower. (A & B)



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 or filaments  
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 ach pyrene;

New Guinea

*Santiria* and  
*plolobus* the  
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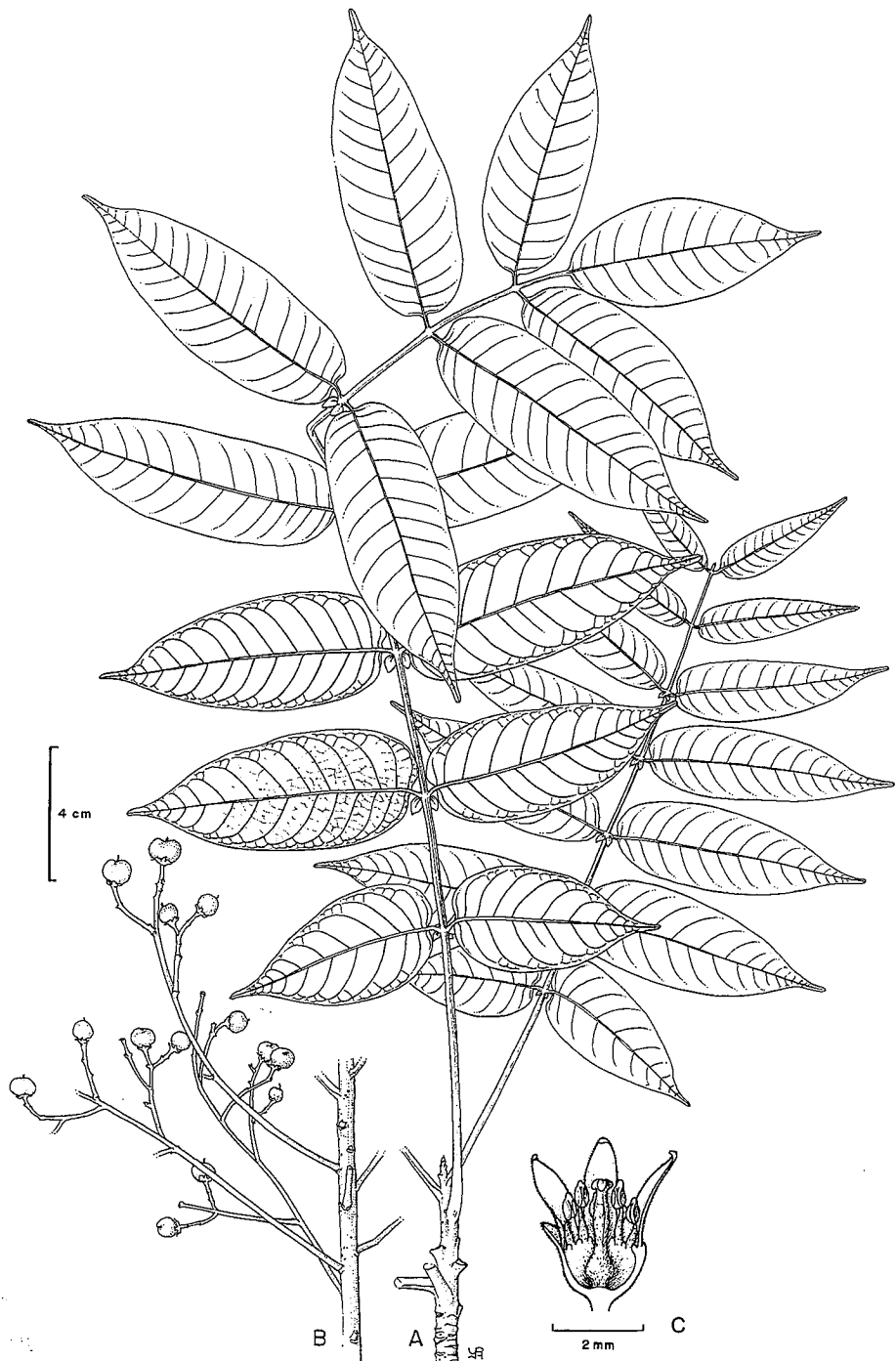
.....2  
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lower part  
**H. beccarii**  
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**bintuluensis**

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**leenhoutsii**  
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igs strongly  
**kapitensis**  
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ntre, sharply  
**naequifolius**  
**arawakanus**



**Fig. 3.** *Garuga floribunda* var. *floribunda*. A, leafy twig; B, infructescence; C, longitudinal section of flower. (A & B from SAN 93006, C after FM 1, 5 (1956) 217, fig. 6.)

2. (1958) 248;



Tree. Twigs s  
petioles with  
x 7.5–10 cm,  
25–30 pairs, a  
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twigs or stems

**Distribution.**  
Mt. Matang.

**Ecology.** Low

**2. Haplolob**  
(of Bintulu in

*l.c.* (1994) 75.

Treelet to 3 m  
Terminal bud  
swollen at base  
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1 cm long; *bl*  
*midrib and ve*  
1–2 cm long;  
curving and  
Inflorescences  
when fresh, y

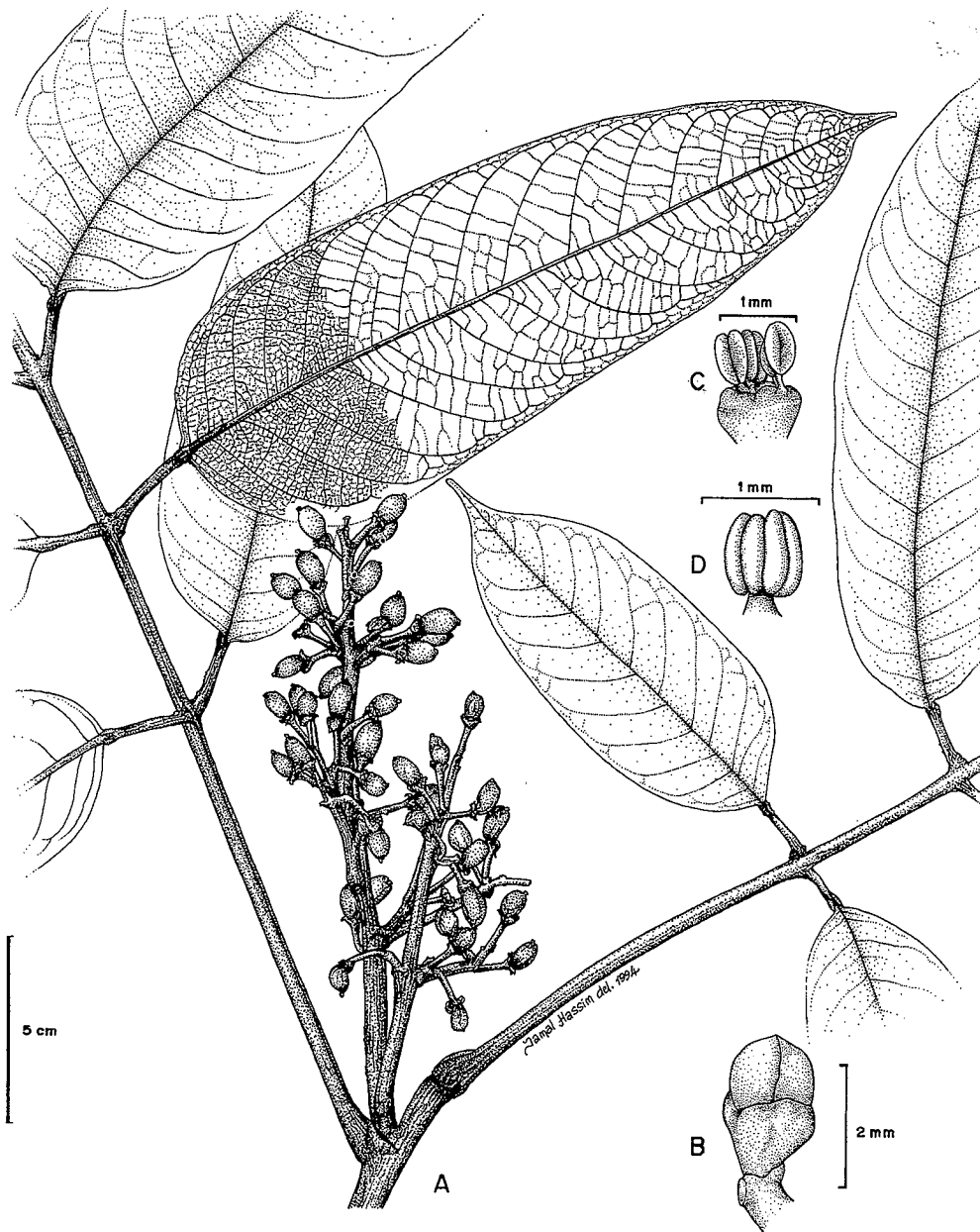
**Distribution.**  
the Nyabau C

**Ecology.** Mix

**3. Haplolob**  
(Latin, *inaequ*

*l.c.* (1994) 78.

Small tree to 1  
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leaflet c. 4.5 c  
with 1-mm-wi  
*asymmetric*; l  
*below*; latera  
visible on bc



**Fig. 4.** *Haplolobus leenhoutsii* (A) and *H. kapitensis* (B–D). A, fruiting leafy twig; B, flower bud; C, male flower with sepals and petals removed; D, stamen. (A from S. 41304, B–D from S. 23966.)

Tree. Twigs stout to 2.5 cm diameter, lenticellate. **Leaves** with 6 pairs of leaflets; pith of petioles with 15–20 vascular strands; *rachis* to 23 cm long; *blade* lanceolate-oblong, 21–36 x 7.5–10 cm, densely hairy on the under surface; base cuneate, apex pointed; lateral veins 25–30 pairs, arching near margin; *petiole* flattened on the upper side, and distinctly striate on the lower side. Inflorescences and flowers unknown. **Infructescences** borne on leafless twigs or stems. **Fruits** oblong, with pointed tip, 13–15 x 12 mm.

**Distribution.** Endemic to Sarawak. Uncommon, known only from the type specimen from Mt. Matang.

**Ecology.** Lowland forest.

## 2. *Haplobus bintuluensis* Kochummen (of Bintulu in Sarawak)

*l.c.* (1994) 75. **Type:** *Sibat S. 24562*, Sarawak (holotype SAR; isotypes A, K, L, SAN, SING).

Treelet to 3 m tall, 5 cm diameter. Twigs *c.* 7 mm thick, greyish, with white lenticels. Terminal bud oblong, *c.* 10 x 3 mm, rusty hairy. **Leaves:** *rachis* *c.* 23 cm long, slightly swollen at base, dark brown-hairy with 2–3 pairs of leaflets; *petiolules* of lateral leaflets 8–15 mm long, dark brown hairy, swollen at both ends, *petiolules* of terminal leaflets 3.5–4.5 cm long; *blade* thinly leathery, glabrous above except midrib, dark brown hairy on the midrib and veins below, 10.5–17 x 5.5–7 cm; base cuneate, apex long-pointed, tip narrow, 1–2 cm long; midrib flattened above; lateral veins 7–9 pairs, distinct below, faint above, curving and joining near margin; intercostal veins reticulate, faintly visible below. Inflorescences and flowers unknown. **Infructescence** *c.* 2 cm long. **Fruits** oblong, reddish when fresh, yellowish brown on drying, 16–20 x 11–12 mm, with pointed tip.

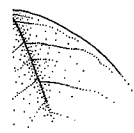
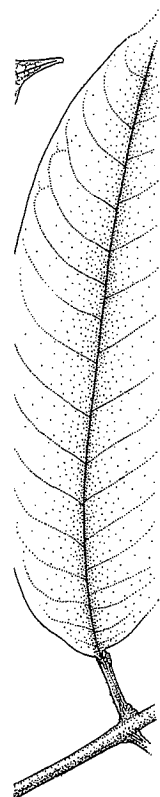
**Distribution.** Endemic to Sarawak. Uncommon, known from the type collection only, from the Nyabau Catchment area, Bintulu.

**Ecology.** Mixed dipterocarp forest on yellow-red sandy humult ultisol, at about 100 m.

## 3. *Haplobus inaequifolius* Kochummen (Latin, *inaequalis* = unequal, *folium* = leaf, the asymmetric leaflets)

*l.c.* (1994) 78. **Type:** *Yii S. 40756*, Sarawak (holotype KEP; isotypes K, L, MO, SAN, SAR).

Small tree to 15 m tall, 10 cm diameter. Twigs brownish, *c.* 5 mm thick with whitish lenticels. Terminal bud oblong, *c.* 12 mm long, rusty hairy. **Leaves** glabrous, with 2 pairs of leaflets; *rachis* grey, not swollen at base; *petiolules* of lateral leaflets 8–15 mm long, of terminal leaflet *c.* 4.5 cm long, the ends black on drying; *blade* greenish brown on drying, leathery, with 1-mm-wide circular galls, elliptic to ovate or oblong, 7.5–15.5 x 2.5–6 cm, strongly asymmetric; base broadly cuneate, apex pointed; *midrib* flattened above, sharply keeled below; lateral veins 10 pairs, faint on both surfaces; intercostal veins finely reticulate, visible on both surfaces. **Inflorescence** (male) glabrous, axillary, 4–8 cm long, often



2 mm

flower bud; C,  
' 23966.)

terminating in a vegetative shoot. **Flowers** (male): calyx-lobes triangular with pointed tip; petals oblong; stamens 6 with short stout filaments; disc with wavy margin; rudimentary ovary with 3 distinct stigma. Fruits unknown.

**Distribution.** Endemic to Borneo. Uncommon, known only by the type specimen from the Sabal Forest Reserve in Sarawak.

**Ecology.** Hill forest at about 360 m.

4. **Haplolobus kapitensis** Kochummen  
(of Kapit, Sarawak)

Fig. 4B–D.

*l.c.* (1994) 78. **Type:** *Wright S. 23966*, Sarawak, Kapit (holotype KEP; isotypes A, BO, K, L, SAN, SAR, SING).

Emergent tree to 40 m tall, 80 cm diameter. *Twigs* greyish white or grey-brown, *c.* 1 cm thick, lenticellate, *youngest strongly angled*. **Leaves** glabrous, with 2–3 pairs of leaflets; *rachis c.* 26 cm long, *channelled above near base*; petiolules of lateral leaflets 1.5–2 cm long, of terminal leaflets *c.* 4.5 cm long, strongly swollen at both ends; *blade* thickly leathery, *drying to reddish brown below and greenish brown above*, oblong to lanceolate, 11.5–20 x 4.5–9 cm; *base asymmetric*, almost rounded to broadly cuneate, apex pointed; midrib raised above; lateral veins 9–12 pairs, distinctly looping near margin, distinct on both surfaces; intercostal veins reticulate, more distinct above than below. **Inflorescence** (male) axillary, to 21 cm long, on leafless vegetative shoot. **Flowers** (male): calyx cup-shaped with truncate apex; petals yellow, oblong; stamens 3 or 6, with short filaments; disc cup-shaped with wavy margin; pistil rudimentary. Fruits unknown.

**Distribution.** Endemic to Borneo. Uncommon, known by four collections, *S. 23966* and *S. 29162* from Kapit, Sarawak, and *SAN 22391* and *SAN 62657* from Ranau in Sabah.

**Ecology.** Lowland and hill forests to 600 m.

5. **Haplolobus leenhoutsii** Kochummen  
(P.W. Leenhouts, botanist at Rijksherbarium, Leiden, the Netherlands)

Fig. 4A.

*l.c.* (1994) 81. **Type:** *Othman et al. S. 41304*, Sarawak, Kapit (holotype SAR; isotypes K, KEP, L, MO, SAN).

Small tree to 20 m tall, 20 cm diameter. **Bark** brownish green, scaly. *Twigs* brown, *c.* 1 cm thick. **Leaves** with 3 pairs of leaflets; *rachis c.* 23 cm long; *petioles channelled with incurled edges above, with many shallow grooves on the remaining part*; petiolules of lateral and terminal leaflets *c.* 2 cm long, strongly swollen at both ends and with horizontal cracks; *blade* drying to greenish brown, glabrous, leathery, lanceolate to elliptic, 14–23 x 4.5–7.5 cm, *with many circular (3-mm-diameter) domatia holes*; base rounded or broadly cuneate, apex pointed; midrib raised above, channelled below; lateral veins 14–17 pairs, distinct below, faint above; intercostal veins reticulate, visible on both surfaces. Inflorescences and

flowers unk  
(immature)  
stigma, surf

**Distribution**  
Ulu Balleh,

**Ecology.** M

6. **Haplolobus**  
(of Sarawak)

*l.c.* (1994) 81  
MO).

Small tree to  
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slightly asy  
below, faint  
on both su  
**Fruits** (imm

**Distribution**  
Kapit, Sara  
better mater

**Ecology.** M

Fl. Ind. (176;  
(1956) 213; I

Trees or shr  
stipules, tips  
rarely pseud  
sepals unite  
*petals*, free;  
stigma subs  
reflexed lob

flowers unknown. **Infructescences** axillary, *c.* 15.5 cm long, with many branches. **Fruits** (immature) red when fresh, black on drying, oblong, *c.* 1 cm long, with prominent apical stigma, surface slightly rugose, with remains of floral parts at base, stalk *c.* 1 cm long.

**Distribution.** Endemic to Borneo. Uncommon, known only from the type specimen from Ulu Balleh, Kapit, Sarawak.

**Ecology.** Mixed dipterocarp forest at about 500 m, on ridge.

### 6. *Haplolobus sarawakanus* Kochummen (of Sarawak)

*l.c.* (1994) 81. **Type:** *Othman et al. S. 41339*, Sarawak (holotype SAR; isotypes K, KEP, L, SAN, MO).

Small tree to 11 m tall, 15 cm diameter. **Bark** greyish brown, scaly. Twigs *c.* 5 mm thick, pale brown, shallowly grooved, with pale lenticels. **Leaves** glabrous, with 3–4 pairs of leaflets; rachis *c.* 25 cm long, slightly swollen at base; petiolules of lateral leaflets *c.* 1 cm long, of terminal leaflet *c.* 3 cm long, the ends swollen and whitish or blackish; blade thinly leathery, drying to yellowish brown, elliptic or oblong, 12–15 x 3.5–5 cm; base cuneate, slightly asymmetric, apex pointed; midrib flattened above; lateral veins 8–9 pairs, distinct below, faint above, curving and joining near margin; intercostal veins reticulate, very faint on both surfaces. Inflorescences and flowers unknown. **Infructescences** *c.* 4 cm long. **Fruits** (immature) *c.* 8 x 5 mm, calyx funnel-shaped.

**Distribution.** Endemic to Borneo. Uncommon, known only by the type from Ulu Balleh, Kapit, Sarawak. A collection from Sabah, *SAN 97191*, probably belongs to this species but better material is needed to confirm this.

**Ecology.** Mixed dipterocarp forest at about 500 m, on ridge.

### 5. *PROTIUM* Burm. *f.*, *nom. cons.*

(Greek, *proteion* = first-class; probably referring to the hardness and strength of the wood)

Fl. Ind. (1768) 88; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 318; Leenhouts *l.c.* (1952) 154, *l.c.* (1956) 213; Backer & Bakhuizen *f. l.c.* 113.

Trees or shrubs. *Pith of branchlets and petioles withouts vascular strands.* **Leaves** without stipules, *tips of the leaflets usually distinctly mucronulate.* **Inflorescences** paniculate, axillary, rarely pseudo-terminal. **Flowers** 4–5-merous, structurally not always completely unisexual; sepals united; petals valvate with inflexed margins, glabrous; *stamens double the number of petals*, free; disc intrastaminal, annular, truncate to undulate, glabrous; ovary 3–5-celled, stigma sessile. **Fruits** drupaceous, pericarp fleshy, calyx persistent, not enlarged, with reflexed lobes. Cotyledons plicate, lobed to palmatifid.

**Distribution.**  
India and Ma

**Ecology.** Lov

**Protium co**  
(with the leaf

*l.c.* (1915) 30  
(1956) 215. **E**  
*Merrill* 787, P  
7 (1915) 2571

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looping, visil  
surfaces. **Inf**  
**Flowers** tom  
pyrenes.

**Distribution**  
collection *S*  
species is rat

**Ecology.** Lov

*l.c.* (1850) 20  
*l.c.* (1954) 52  
Cockburn *l.c.*  
**Synonyms:** *T.*  
*R. As. Soc.* 75

Medium-size  
or flaky, wit  
yellowish w  
colourless e  
*strands*. **Le:**  
swollen at b  
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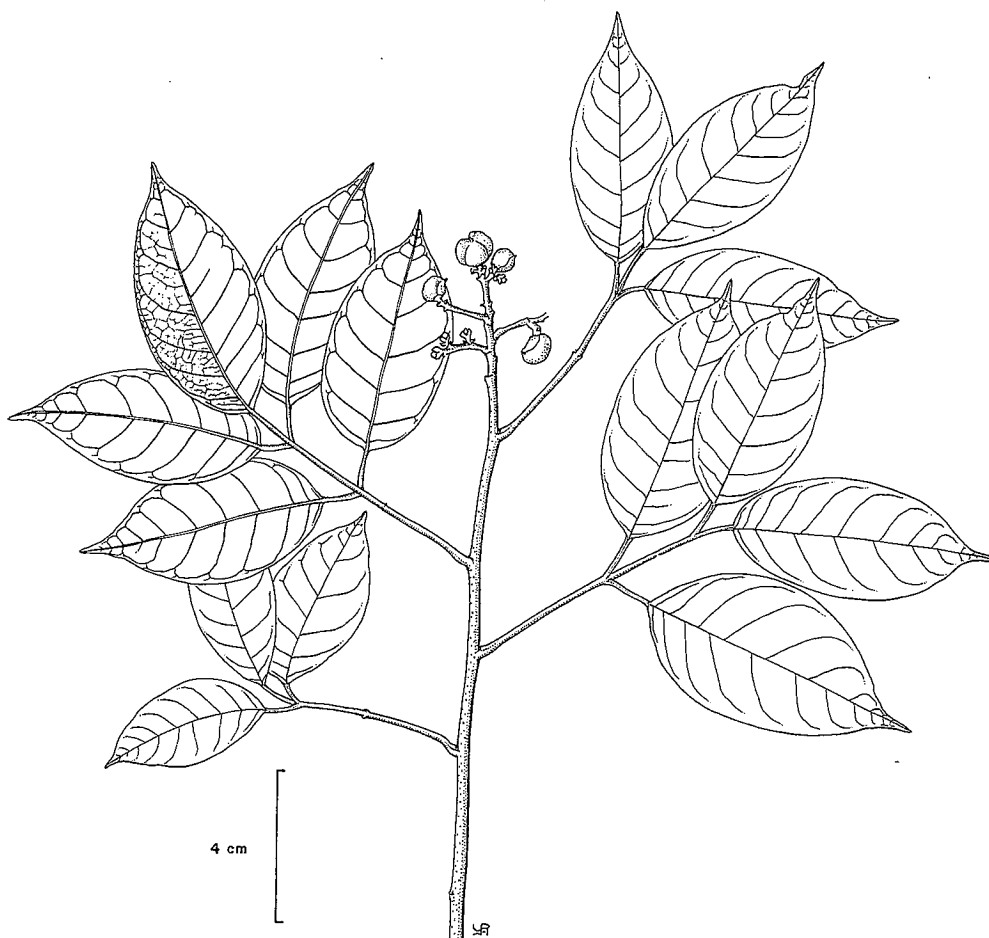


Fig. 5. *Protium connarifolium*. Fruiting leafy twig. (From *SAN* 89964.)

**Distribution.** About 85 species; mainly in the American tropics, Madagascar, Mascarenes, India and Malasia. Only one species has been recorded in Sabah; not yet found in Sarawak.

**Ecology.** Lowland forests.

**Protium connarifolium** (Perkins) Merr.  
(with the leaflets resembling those of *Connarus*)

Fig. 5.

*l.c.* (1915) 30; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 320; Leenhouts *l.c.* (1952) 155, *l.c.* (1956) 215. **Basionym:** *Canarium connarifolium* Perkins, Fragm. Fl. Philip. 2 (1904) 92. **Type:** Merrill 787, Philippines, Palawan (GH, K, L). **Synonym:** *P. philippinensis* Elmer, Leafl. Philip. Bot. 7 (1915) 2571.

Small tree. **Leaves** with up to 3 pairs of leaflets; petiolules of lateral leaflets to 2 cm long, swollen at both ends; blade ovate to elliptic, 3–11 x 2–5 cm; base cuneate, margin entire, apex pointed with mucronate tip; midrib slightly sunken above; lateral veins 5–7 pairs, looping, visible below, faint above; intercostal veins reticulate, very faintly visible on both surfaces. **Inflorescences** axillary, or female inflorescences sometimes pseudo-terminal. **Flowers** tomentose. **Fruits** 7–8 x 5–13 mm, sparsely pubescent to glabrous, with 1–4 pyrenes.

**Distribution.** Borneo, Philippines (Palawan). Very uncommon, known by a single collection SAN 89964 from Semporna in Sabah. According to Leenhouts *l.c.* (1956), this species is rather isolated taxonomically from the rest.

**Ecology.** Lowland forests.

## 6. SANTIRIA Blume

(Santir, Blume's native guide to G. Salak, Java)

*kerantai* (Sabah), *seladah* (Sarawak)

*l.c.* (1850) 209; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 367; Ridley *l.c.* (1922) 376; Kalkman *l.c.* (1954) 522; Leenhouts *l.c.* (1956) 229; Kochummen *l.c.* (1972) 145, Sandakania 5 (1994) 83; Cockburn *l.c.* 47; Anderson *l.c.* 157; Wong *l.c.* 212; Whitmore, Tantra & Sutisna *l.c.* 38; Ng *l.c.* 38. **Synonyms:** *Trigonochlamys* Hook. f., Trans. Linn. Soc. 23, 1 (1860) 170; *Icicaster* Ridl., J. Str. Br. R. As. Soc. 75 (1917) 15.

Medium-sized to large dioecious trees. **Bark** brown, fawn or grey, smooth to fissured, scaly or flaky, with many small or large lenticels; inner bark either pink, soft, and laminated or yellowish white, hard mottled and granular (*S. griffithii*, *S. rubiginosa*), with white to colourless exudate darkening on drying. **Pith of twigs and petioles with or without vascular strands.** **Leaves** without stipules, imparipinnate; leaflets entire, petiolules only slightly swollen at both ends; petiole usually flat or channelled on the upper surface. **Inflorescences** usually axillary, rarely terminal panicles. **Flowers** unisexual, 3-merous; sepals free or united; petals usually with thickened inflexed apex; stamens 6 or 3, anthers basifixed or

dorsifixed; disc intrastaminal, glabrous; ovary 3-celled, glabrous, in male flowers reduced; stigma (sub)-sessile. **Fruits** brightly coloured drupes, irregularly globose or ellipsoid, *more or less oblique*, in big bunches, usually seated on persistent calyx; *stigma off-centre, sometimes nearly basal*; rind thin and firm, *almost smooth when dry*; stone thinly woody containing one fertile and two sterile cells. **Seeds** almost round, not angled; germination in *S. laevigata* and *S. oblongifolia* epigeal, cotyledons 5-lobed, fleshy, first two leaves opposite, subsequent leaves alternate, leaves in young seedling simple; in *S. griffithii* and *S. rubiginosa* germination hypogeal, first two leaves opposite, subsequent leaves alternate and then spiral, leaves in young seedlings pinnate.

**Distribution.** About 22 species, with 6 species restricted to W Africa and the rest in Malesia (mainly Sumatra, Peninsular Malaysia, Borneo). 15 species in Sabah and Sarawak.

**Ecology.** Lowland forest, including swamp forest, to submontane forest to 1650 m.

**Uses.** The timber is commonly grouped together with other members of the family and sold as *kedondong*. The wood is light hardwood. It is essentially similar in anatomical structure to the timber of *Canarium* and *Dacryodes* but is more variable in colour, weight and hardness. Silica is present in all species. *S. laevigata* and *S. tomentosa* are important sources of *kedondong* timber in Peninsular Malaysia. The buttresses of *S. tomentosa* are interlocked and frequently used for *parang* sheaths.

**Taxonomy.** The genus is sub-divided into two sections: section *Santiria* and section *Icicopsis*. Apart from the differences in floral characters by which these sections were established, evidence from wood anatomy and germination supports the distinction of these sections. In Sabah and Sarawak, section *Icicopsis* is represented by *S. griffithii* and *S. rubiginosa*.

### Key to *Santiria* species

1. Leaflets hairy on the lower side, at least on the midrib.....2  
    Leaflets glabrous.....6
2. Leaflets densely velvety or woolly hairy on the lower side.....3  
    Leaflets sparsely hairy on the lower side.....5
3. Intercostal veins scalariform.....15. *S. tomentosa*  
    Intercostal veins reticulate.....4
4. Leaflets concave, hairs dark brown; petiolule not swollen at ends. Twigs covered with lenticels. Stigma on fruit more than 90° excentric.....10. *S. mollis*  
    Leaflets not concave, hairs yellowish brown; petiolule swollen at ends. Twigs not so. Stigma prominently excentric, near pedicel.....1. *S. apiculata*
5. Twigs stout, c. 1.5 cm thick. Terminal bud c. 2 cm long. Petiole strongly channelled above with deep groove.....4. *S. grandiflora*  
    Twigs slender, c. 6 mm thick. Terminal bud up to 0.5 cm long. Petiole not channelled or grooved .....14. *S. sarawakana*

6. Lateral v  
Lateral v
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  8. Terminal  
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(Latin, *apicu*  
in Hooker f. l  
Masamune l.

6. Lateral veins sunken above..... **6. S. impressinervis**  
Lateral veins not sunken above..... 7
7. Twigs stout, 1.5–3 cm thick..... 8  
Twigs slender, to 1 cm thick..... 9
8. Terminal bud *c.* 6 cm long with curved tip. Leaflets 7–9 cm wide; petiolules of lateral leaflets to 2.5 cm long. Stigma of fruit more than 90° excentric..... **7. S. kalkmaniana**  
Terminal bud *c.* 1.5 cm long, tip not curved. Leaflets 13–22 cm wide; petiolules of lateral leaflets 4–5 cm long. Stigma of fruit near pedicel..... **9. S. megaphylla**
9. Stigma of fruit more than 90° excentric, near pedicel..... 10  
Stigma of fruit less than 90° excentric..... 12
10. Terminal bud *c.* 2 cm long. Petiole strongly channelled at base with sharp edges. Midrib raised above..... **2. S. conferta**  
Terminal bud up to 1 cm long. Petiole not so. Midrib flattened to slightly sunken above..... 11
11. Midrib below channelled. Leaflet margin not curled inwards; intercostal veins distinct below..... **1. S. apiculata**  
Midrib below not channelled. Leaflet margin curled inwards; intercostal veins invisible below..... **3. S. dacrydifolia**
12. Terminal bud 0.5–2.5 cm long, often resin-coated. Leaflets drying reddish brown or dark brown..... **8. S. laevigata**  
Not this combination of characters..... 13
13. Rachis blackish, oily, shiny. Lateral veins of leaflets very faint. Stigma on fruit only slightly excentric..... **11. S. nigricans**  
Rachis not so. Lateral veins of leaflets distinct. Stigma in fruit 90° excentric..... 14
14. Lateral veins distinctly looping near margin; intercostal veins parallel to lateral veins. Fruits to 1.3 cm long..... 15  
Lateral veins faintly looping near margin; intercostal veins not parallel to lateral veins. Fruit to 3 cm long..... **12. S. oblongifolia**
15. Leaflets not asymmetric at base, petiolules of lateral leaflets to 5 mm long, not swollen at ends..... **5. S. griffithii**  
Leaflets asymmetric at base, petiolules of lateral leaflets to 2 cm long, swollen at both ends..... **13. S. rubiginosa**

**1. Santiria apiculata** A.W. Benn.

(Latin, *apiculatus* = furnished with a little point; the pointed leaflets)

in Hooker *f. l.c.* 537; Ridley *l.c.* (1922) 378; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 375; Masamune *l.c.* 367; Kalkman *l.c.* (1954) 538; Leenhouts *l.c.* (1956) 234; Burgess *l.c.* 62;



Kochummen *l.c.* (1972) 146; Cockburn *l.c.* 48; Anderson *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 38. **Type:** *Maingay 303*, Malacca (holotype K; isotype L).

Small to medium-sized tree rarely more than 30 m tall. **Bark** grey or brown, smooth to scaly; inner bark pinkish with droplets of white sap and with strong resinous smell. **Sapwood** pale yellow. Twigs pale or whitish, glabrous or densely brownish hairy (var. *pilosa*). **Leaves** trifoliate or with 2–5 pairs of leaflets; blade glabrous, drying greenish or hairy below and drying brownish (var. *pilosa*), elliptic or lanceolate, 3.5–16 x 1.5–7 cm; base broadly cuneate, apex pointed with long tip; *midrib* flattened to slightly sunken above, *distinctly grooved below*; *lateral veins* 5–14 pairs, distinct below, faint above, *curving and joining a few millimeters away from margin*; intercostal veins reticulate, faintly visible below, faint to invisible above; with a strong resinous smell when freshly crushed; petiolules usually whitish, glabrous or hairy, 0.5–3 cm long. **Flowers** yellow or reddish, usually in short axillary inflorescences, glabrous or hairy (var. *pilosa*). **Fruits** globose or ellipsoid, 1–2 x 1 cm, *stigma usually more than 90° excentric, sometimes near the pedicel*.

**Key to varieties**

Twigs, leaflets and flowers densely hairy.....  
 var. ***pilosa*** (Engl.) Kalkman  
 in Leenhouts *l.c.* (1956) 236. Basionym: *Santiria pilosa* Engl. in DC. *l.c.* 159.  
 Endemic to Borneo. In Sabah and Sarawak widely distributed from lowland to submontane forest but less common compared to var. *apiculata*.

Twigs, leaflets and flowers glabrous.....  
 var. ***apiculata***  
 Synonyms: *S. beccarii* Engl. in DC. *l.c.* 159; *S. glabra* Merr. *l.c.* (1915) 30; *S. minutiflora* Ridl. *l.c.* (1922) 377; *S. brachystachys* Ridl. *l.c.* (1925) 79; *Canarium pauciflorum* Ridl. *l.c.* (1930) 80; *Haplolobus borneensis* H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 418.  
 Sumatra, Peninsular Malaysia, Borneo, Philippines, Celebes, Moluccas. Common and widely distributed throughout Sabah and Sarawak. Mixed dipterocarp to submontane forests to 1300 m.

**2. Santiria conferta** A.W. Benn.  
 (Latin, *confertus* = crowded; the flowers)

in Hooker *f. l.c.* 537; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 381; Kalkman *l.c.* (1954) 528; Leenhouts *l.c.* (1956) 233; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 146; Whitmore, Tantra & Sutisna *l.c.* 38. **Type:** *Griffith 1150*, Malacca (holotype K; isotype P). **Synonyms:** *S. wrayi* King *l.c.* (1893) 259; *S. conferta* var. *wrayi* (King) H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 381.

Small to medium-sized tree to 30 m tall, 50 cm diameter. **Bark** grey-brown; inner bark yellow. Terminal bud *c.* 2 cm long. Twigs greyish yellow, *c.* 1 cm thick. **Leaves:** petiole strongly channelled with sharp edges; leaflets thickly leathery, oblong, ovate or elliptic, sometimes glaucous below, 11–17 x 5.5–8.5 cm; base rounded to broadly cuneate, apex

pointed; midrib surfaces; inflorescence excentric, near

**Distribution.** few collection

**Ecology.** Sub

**3. Santiria**  
 (with leaves 1

*l.c.* (1994) 83. SING).

Small tree to brownish, firm rounded, not rhomboid, 8. *midrib sunken* veins reticulate of terminal leaf unknown. In red when fresh rugose, *stigma*

**Distribution** Maria, Lawa

**Ecology.** Ric

Appears close margins and

**4. Santiria**  
 (Latin, *gracile*

*l.c.* (1954) 52 **Type:** *Richardson*

Medium-sized white sap. Small hairy towards

Sutisna *l.c.*

smooth to  
ous smell.  
hairy (var.  
greenish or  
1.5–7 cm;  
ken above,  
urving and  
rtly visible  
y crushed;  
or reddish,  
globose or  
ie pedicel.

pointed; midrib raised above; lateral veins 11–14 pairs, arching near margin, raised on both surfaces; intercostal veins reticulate, faintly visible on both surfaces. **Flowers** in axillary inflorescences. **Fruits** reddish when fresh, subglobose, 1.5–2 x 1.2–1.5 cm, stigma strongly excentric, near pedicel; surface warty.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Borneo uncommon, known from a few collections from Sabah and Sarawak.

**Ecology.** Submontane forest at 1200–1650 m. Fruiting in November and December.

### 3. *Santiria dacryodifolia* Kochummen

(with leaves resembling those of *Dacryodes*)

*l.c.* (1994) 83. **Type:** *Tong & Jugah S. 32944*, Sarawak (holotype KEP; isotypes K, L, SAN, SAR, SING).

Small tree to 12 m tall, 25 cm diameter; bole fluted. **Bark** light brown, flaky. Twigs brownish, finely lenticellate, *c.* 7 mm thick. **Leaves** with 2 pairs of leaflets; rachis pustular, rounded, not swollen at base; blade coriaceous, glabrous, drying to brownish, elliptic to rhomboid, 8.5–10.5 x 3.5–5.5 cm; base cuneate, *margin curled inwards, apex pointed; midrib sunken above*; lateral veins 5–7 pairs, faintly visible on both surfaces; intercostal veins reticulate, visible above, invisible below; *petiolules* of lateral leaflets 1–1.5 cm long, of terminal leaflet *c.* 4.5 cm long, *strongly swollen at both ends*. Inflorescences and flowers unknown. **Infructescence** axillary and terminal, *c.* 14 cm long. **Fruits** yellowish to deep red when fresh, drying to dark brown, obliquely oblong, 7–8 x 5–6 mm, surface slightly rugose, *stigma more than 90° excentric, near the pedicel*.

**Distribution.** Endemic to Sarawak. Uncommon, known from the type only from Ulu Sg. Maria, Lawas.

**Ecology.** Ridge tops at about 1400 m.

Appears close to *S. apiculata* differing in the stout twigs, thick leaflets with recurved margins and in the petiolules with strongly swollen ends.

### 4. *Santiria grandiflora* Kalkman

(Latin, *grandis* = large, *florus* = flower)

*l.c.* (1954) 525; Leenhouts *l.c.* (1956) 232; Anderson *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 38. **Type:** *Richards 1278*, Sarawak (holotype K; isotype SING).

Medium-sized tree to 30 m tall. **Bark** grey-brown, scaly; inner bark pink, with droplets of white sap. **Sapwood** pale. Twig stout, *c.* 1.5 cm thick, lenticellate, dark brown powdery hairy towards the tip. **Terminal bud** *c.* 2 cm long. **Leaves** with 4–6 pairs of leaflets;

petiolules of lateral leaflets 1–2 cm long, powdery hairy; *blade glabrous above except the midrib, powdery hairy below*, oblong-elliptic, 16–29 x 5–9 cm; base rounded or broadly cuneate, apex pointed; midrib raised below, flat and faint above; lateral veins 15–24 pairs; intercostal veins scalariform-reticulate, distinct below, faint above; *petiole strongly channelled above with deep groove*, powdery brown-hairy. **Flowers** (male) in axillary inflorescences. **Infructescences** 9–18 cm long. **Fruits** obliquely ellipsoid, yellowish green, ripening pink, with white waxy bloom on drying, 1.5–1.9 x 1.1–1.3 cm, with faintly wrinkled surface; stigma slightly excentric; persistent calyx reflexed.

**Distribution.** Endemic to Borneo. Uncommon, recorded from Mt. Dulit, Mulu National Park, and Lambir Hills in Sarawak. Also known from Brunei.

**Ecology.** Mixed dipterocarp forest to 300 m, on ridges or yellow sandy clay soils. Fruiting in March and April.

This species is somewhat similar to *S. tomentosa* but the strongly channelled petiole will distinguish it.

**5. Santiria griffithii** (Hook. f.) Engl.  
(W. Griffith, 1810–45, surgeon at Malacca)

Bot. Jahrb. 1 (1881) 43; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 394; Masamune *l.c.* 368; Kalkman *l.c.* (1954) 545; Leenhouts *l.c.* (1956) 236; Kochummen *l.c.* (1972) 147; Burgess *l.c.* 62; Anderson *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 38. **Basionym:** *Trigonochlamys griffithii* Hook. f. *l.c.* (1860) 170. **Type:** Griffith 1148, Malacca (holotype K; isotype L). **Synonym:** *Santiria borneensis* Engl. *l.c.* 43.

Medium-sized tree to 30 m tall, 55 cm diameter; buttresses to 2 m tall. **Bark** grey-brown, smooth to scaly; inner bark brownish. **Sapwood** pale. Twigs reddish brown-hairy when young. **Leaves** with 5–11 pairs of opposite or subopposite leaflets; rachis minutely hairy; petiolules of leaflets *c.* 5 mm long, hairy, not swollen; blade glabrous or sparsely hairy below, lanceolate or elliptic, 5–10.5 x 1.5–3 cm; base broadly cuneate to rounded, slightly unequal, apex pointed with long tip; midrib flattened above; *lateral veins* 15–18 pairs, faintly visible below, faint to inconspicuous above, *distinctly curving and joining near margin*; intercostal veins reticulate, visible below, faint above. **Inflorescences** axillary, pubescent. **Flowers** tomentose; calyx deeply divided; petals pubescent; stamens 6, filaments adnate to disc, pistil in male flowers reduced. **Fruits** obliquely globose, 8–13 x 8–16 mm; stigma almost 90° excentric.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sabah uncommon, recorded from Keningau and Tawau only. In Sarawak more common and widely distributed. Also occurs in Brunei and Kalimantan.

**Ecology.** Mixed dipterocarp forest on yellow sandy soils to 300 m. Flowering in March–November and fruiting in September–October.

**6. Santiria**  
(Latin, *impre*  
surface)

*l.c.* (1994) 83.

Small tree to brownish, wi flattened abo terminal leaf drying to yell asymmetric, : 9 pairs, *sun*. Inflorescence glaucous gre prominently c

**Distribution.**  
Pamerario riv

**Ecology.** Old

Appears clos intercostal ve

**7. Santiria**  
(C. Kalkman

*l.c.* (1994) 86.

Medium-size smooth, lent: cm thick, gre *curved tip*. channelled a petiolules of 18–35 x 7–9 above; latera distinct on tl long, axes s scarlet, oblo **Infructescer** black, subglc 90° excentric

**6. Santiria impressinervis** Kochummen

(Latin, *impressus* = pressed in, *nervus* = nerve; the sunken veins on the upper leaflet surface)

*l.c.* (1994) 83. **Type:** *Nooteboom & Chai 2113*, Sarawak (holotype KEP; isotype SAR).

Small tree to 15 m tall, 15 cm diameter. **Bark** yellowish, smooth. Twigs *c.* 4 mm thick, brownish, with small lenticels. **Leaves** with 2–3 pairs of leaflets; rachis slender, slightly flattened above towards the base; *petiolules* of lateral leaflets 0.8–1.5 cm long, that of terminal leaflet *c.* 2 cm long, *strongly swollen at both ends*; blade glabrous, coriaceous, drying to yellowish brown, ovate to lanceolate, 6–9 x 2–4 cm; base broadly cuneate, slightly asymmetric, apex pointed, tip 5–10 mm long; midrib faintly sunken above; *lateral veins* 7–9 pairs, *sunken above*, curving and joining near margin; *intercostal veins invisible*. Inflorescences and flowers unknown. **Infructescences** axillary, to 11 cm long. **Fruits** glaucous green when fresh, drying to brownish, smooth, ovoid, *c.* 10 x 7 mm, *stigma prominently off-centre, near pedicel*.

**Distribution.** Endemic to Sarawak. Uncommon, known only from the type from the Pamerario river at Bario in the Kelabit Highlands.

**Ecology.** Old secondary forest at 1000 m.

Appears close to *S. apiculata* but differing in the thickly coriaceous leaflets with invisible intercostal veins and in the sunken lateral veins.

**7. Santiria kalkmaniana** Kochummen

(C. Kalkman, former director of the Rijksherbarium, Leiden, Netherlands)

Fig. 6.

*l.c.* (1994) 86. **Type:** *Saikeh-SAN 72293*, Sabah (holotype SAN; isotypes A, K, SAR, SING).

Medium-sized tree to 30 m tall, 45 cm diameter; buttresses to 3 m tall. **Bark** greyish, smooth, lenticellate; inner bark yellowish. **Sapwood** pale yellow. Twigs very stout, 1.5–2 cm thick, grey-brown, lenticellate. *Terminal bud lanceolate, rusty brown, c. 6 cm long with curved tip*. **Leaves** with 5 pairs of leaflets, glabrous; rachis *c.* 54 cm long, petiole channelled above; *petiolules* of lateral leaflets 2–2.5 cm long, slightly swollen at both ends, *petiolules* of terminal leaflets 5–8.5 cm long; blade thinly leathery, oblong to lanceolate, 18–35 x 7–9 cm; base rounded or broadly cuneate, asymmetric, apex pointed; midrib raised above; *lateral veins* 16–19 pairs, raised below, faint above; *intercostal veins reticulate*, more distinct on the upper surfaces. **Inflorescences** (male) axillary, glabrous, panicles to 27 cm long, axes sharply angled. **Flowers** (male) glabrous; calyx red, cup-shaped; petals deep scarlet, oblong; stamens 6, inserted on rim of disc; disc annular; ovary rudimentary. **Infructescences** *c.* 6 cm long, with short branches. **Fruits** light yellow when fresh drying black, subglobose or hemispherical, 1.7–2 x 1.0–1.8 cm, flattened above; stigma more than 90° excentric.

**Distribution.** Endemic to Borneo. Uncommon, known from few collections from Sabah (SAN 72293, Sipitang; SAN 49754, Ranau), and Sarawak (S. 14727, Kapit; S. 39782, G. Mulu, and S. 4030 from Baram).

**Ecology.** Lowland and hill forests to 450 m.

This species appears close to *S. laevigata* but differs in the long rusty brown curved terminal bud and in the fruit stigmas that are more than 90° off-centre.

### 8. *Santiria laevigata* Blume

(Latin, *laevigatus* = smooth and polished; the leaflets)

*l.c.* (1850) 211; King *l.c.* 257; Ridley *l.c.* (1922) 378; H.J. Lam, Bull. Jard. Bot. Btztg. 3, 12 (1932) 382; Masamune *l.c.* 368; Kalkman *l.c.* (1954) 535; Leenhouts *l.c.* (1956) 232; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 147; Cockburn *l.c.* 48; Anderson *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 38. **Type:** *Korthals, s.n.* (= *Leiden no. 898.321-201*), Sumatra (L). **Synonym:** *Canarium laevigatum* (Blume) Miq. *l.c.* (1859) 648.

Medium-sized tree to 30 m tall, 80 cm diameter; buttresses to 4 m tall. **Bark** grey-brown, fissured and scaly, lenticellate; inner bark pinkish, laminated, with droplets of white sap. **Sapwood** pale white. **Terminal bud** 0.5–2.5 cm long, often resin-coated. **Twigs** c. 1 cm thick, lenticellate, dark brown. **Leaves** with 1–4 pairs of leaflets; petiole flattened above with sharp edges (forma *laevigata*) or not flattened (forma *glabrifolia*); petiolules of lateral leaflets 1–1.5 cm long, slightly swollen at both ends, sometimes the swollen parts drying black; *blade drying reddish or dark brown*, elliptic, ovate or oblong, 7–12 x 2.5–6.5 cm; base rounded to broadly cuneate, sometimes unequal, apex pointed; midrib raised above; lateral veins 7–15 pairs, fairly raised on both surfaces, curving and joining near margin; intercostal veins reticulate, very faintly visible on both surfaces. **Flowers** glabrous, in axillary inflorescences. **Fruits** rounded to oblong, 1–2 cm across; stigma less than 90° excentric.

#### Key to forms

Petiole flattened above, at base with sharp edges.....

##### forma *laevigata*

Synonyms: *Santiria laevigata* forma *typica* H.J. Lam, Bull. Jard. Bot. Btztg. 3, 12 (1932) 384; *S. violacea* H.J. Lam, Ann. Jard. Bot. Btztg. 42 (1932) 205.

Sumatra, Peninsular Malaysia, Borneo, and Celebes. In Sarawak uncommon, known from two collections (S. 32817 and S. 41457). Not yet recorded from Sabah.

Petiole rounded at base, without sharp edges.....

##### forma *glabrifolia* (Engl.) H.J. Lam

Ann. Jard. Bot. Btztg. 42 (1932) 205. Basionym: *Santiria glabrifolia* Engl. in DC. *l.c.* 164. Type: *Beccari PB 3756*, Sarawak (FI).

Sumatra, Peninsular Malaysia, and Borneo. Common and widely distributed in Sabah and Sarawak.

**Ecology.** Mixed dipterocarp, mixed peat swamp and *kerangas* forests on low-nutrient soils to submontane forests to 1200 m.



Fig. 6. *Sar.*  
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C & D for

from Sabah  
 : 39782, G.

own curved

3, 12 (1932)  
 gress l.c. 62,  
 & Sutsina l.c.  
*m laevigatum*

grey-brown,  
 of white sap.  
 igs c. 1 cm  
 ttened above  
 les of lateral  
 parts drying  
 2.5–6.5 cm;  
 aised above;  
 ear margin;  
 glabrous, in  
 ss than 90°

(1932) 384; S.

mon, known  
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l.c. 164. Type:

ted in Sabah

nutrient soils



Fig. 6. *Santiria kalkmaniana*. A, Leafy shoot with infructescences; B, inflorescence with flower buds; C, flower bud; D, flower bud with sepals and petals removed. (A from SAN 72293, B from S. 39782, C & D from S. 4030.)

**9. Santiria megaphylla** Kalkman

(Greek, *mega* = large, *phyllon* = leaf)

*I.c.* (1954) 533; Leenhouts *I.c.* (1956) 236; Burgess *I.c.* 62; Anderson *I.c.* 157; Whitmore, Tantra & Sutisna *I.c.* 38. **Type:** *Beccari PB 3059*, Sarawak (FI).

Medium-sized tree to 25 m tall. *Twigs very stout, c. 3 cm thick, grey with circular lenticels and with stipule-like undeveloped leaves.* Terminal bud *c. 1.5 cm long.* **Leaves** with 3–5 pairs of leaflets; *petiole stout, strongly channelled at base;* petiolules of lateral leaflets 4–5 cm long, petiolules of terminal leaflets *c. 11 cm long, strongly swollen at both ends;* *blade thickly leathery, very large, oblong, 25–61 x 13–22 cm;* base broadly cuneate, apex pointed; midrib raised above; lateral veins 8–14 pairs, raised on both surfaces, curving and joining near margin; intercostal veins reticulate, faintly visible on both surfaces. **Flowers** in axillary inflorescences. **Fruits** pink when fresh, asymmetric, ellipsoid, 1.5–1.7 x 1–1.25 cm; *stigma excentric, near pedicel.*

**Distribution.** Endemic to Borneo. Uncommon, known from few collections from Sabah (*SAN A 1746*, Beaufort; *SAN 15152*, Sipitang) and Sarawak (*S. 38747* and *S. 43958* from Semengoh Arboretum and Mt. Dulit), and ecological plots at Bako and Lambir NP, and Segam FR. Also known from Brunei.

**Ecology.** Mixed dipterocarp forests on deep sandy humult ultisols.

The stout twigs and very large leaflets are good diagnostic features for the species.

**10. Santiria mollis** Engl.

(Latin, *mollis* = soft-hairy; the indumentum of young twigs, leaves and flowers)

in DC. *I.c.* 156; H.J. Lam, *Bull. Jard. Bot. Btzg.* 3, 12 (1932) 388; Masamune *I.c.* 368; Kalkman *I.c.* (1954) 530; Leenhouts *I.c.* (1956) 231; Burgess *I.c.* 62; Anderson *I.c.* 157; Whitmore, Tantra & Sutisna *I.c.* 38. **Type:** *Beccari PB 3497*, Sarawak (FI). **Synonym:** *Canarium hirtipetalum* Ridl. *I.c.* (1930) 84.

Medium-sized tree to 24 m tall, 70 cm diameter; buttresses to 3 m high. **Bark** brown, smooth; inner bark reddish brown, with white latex. **Sapwood** pale yellow. Twigs densely reddish brown-hairy with abundant small lenticels when young. Terminal bud stout, *c. 1 x 0.5 cm, hairy as the twig.* **Leaves** with 2–4 pairs of leaflets; rachis densely reddish brown-hairy; *petiolules of lateral leaflets to 1 cm long, not swollen at both ends, hairy;* *blade densely velvety hairy below and on midrib above, obovate, oblong or elliptic, often concave, 7.5–15.5 x 3–7 cm;* base cuneate or rounded, often unequal, *margin curled inwards,* apex pointed with long tip; midrib raised above; lateral veins 10–13 pairs, raised below, faint to sunken above; intercostal veins reticulate, raised below, faint to invisible above. **Flowers** (male) in hairy axillary inflorescences; sepals almost free, sparsely hairy outside; petals densely hairy on both sides. **Fruits** subglobose, 1.5–1.8 cm across; stigma more than 90° excentric.

**Distribution.** Endemic to Borneo. Uncommon, in Sabah recorded from Beaufort and Tawau. In Sarawak collected from Semengoh Arboretum and Lambir National Park. Also known from Brunei and Kalimantan.

**Ecology.** Mi  
November an

Very atypica

**11. Santiria**  
(Latin, *nigri*

*I.c.* (1994) 89

Large tree to  
**Sapwood** wl  
of leaflets, g  
base; petiole  
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**Distribution**  
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24939) and S

**Ecology.** Mi

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**12. Santiria**  
(Latin, *oblo*

*I.c.* (1850) 21  
Ridley *I.c.* (1  
Kochummen  
*Praetorius, s.*  
166; *S. latifol*

Medium-siz  
high. **Bark** g  
**Sapwood** pe  
cm long, sw  
x 3–7.5 cm;  
pairs, visible

**Ecology.** Mixed dipterocarp forest to 200 m, often by streams. Flowering in March and November and fruiting in February and March.

Very atypical of *Santiria* in vegetative features.

### 11. *Santiria nigricans* Kochummen

(Latin, *nigricans* = becoming black; the leaf rachis)

*l.c.* (1994) 89. **Type:** *Ilias & Yeo S. 38319*, Sarawak (holotype KEP; isotypes K, L, MO, SAN, SAR).

Large tree to 30 m tall, 100 cm diameter. **Bark** brownish, scaly; inner bark reddish brown. **Sapwood** whitish. Twigs brown or greyish brown, 3–4 mm thick. **Leaves** with up to 3 pairs of leaflets, glabrous; *rachis* slender, dark brown, *surface oily*, slightly swollen at the very base; petiolules of lateral leaflets slender, 1–1.5 cm long, of the terminal leaflets to 4 cm long, slightly swollen at both ends, drying to dark brown; blade thinly leathery, drying to grey-brown, elliptic to lanceolate, 6.5–11.5 x 2.8–4.7 cm; *base* cuneate, *strongly asymmetric*, apex pointed; midrib raised above; lateral veins 7–11 pairs, very faint on both surfaces; intercostal veins reticulate, faintly visible on both surfaces. **Inflorescences** (male) axillary and terminal, glabrous. **Flowers** (male) with green calyx and white petals. **Fruits** green, ripening deep purple to blackish, drying to pale brownish, subglobose, 11–14 mm across, surface with shallow reticulate veins; stigma only slightly off-centre.

**Distribution.** Endemic to Sarawak; of scattered distribution in Lambir National Park (*S. 38319* and *S. 46599*), Mulu National Park (*S. 42406*), Balingian (*S. 23687*), Selampit (*S. 24939*) and Sg. Jelalong (*S. 48804*).

**Ecology.** Mixed dipterocarp forest from lowlands to 1600 m.

Somewhat close to *S. oblongifolia* but the dark brown rachis, very faint lateral veins and the subglobose fruits distinguish this species.

### 12. *Santiria oblongifolia* Blume

(Latin, *oblongus* = rather long, *folium* = leaf; the leaflet shape)

*l.c.* (1850) 211; H.J. Lam, *Bull. Jard. Bot. Btzig.* 3, 12 (1932) 372; Masamune *l.c.* 369; King *l.c.* 257; Ridley *l.c.* (1922) 379; Kalkman, *l.c.* (1954) 537; Leenhouts *l.c.* (1956) 233; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 150; Anderson *l.c.* 157; Whitmore, Tantra & Sutisna *l.c.* 39. **Type:** *Praetorius, s.n.* (= *Leiden no. 898.321–221*), Sumatra (L). **Synonyms:** *S. caesia* Engl. in DC. *l.c.* 166; *S. latifolia* Stapf. *ex* Ridl. *l.c.* (1930) 86.

Medium-sized tree 30 m tall, very rarely to 50 m tall, 80 cm diameter; buttresses to 1.5 m high. **Bark** grey-brown, smooth, lenticellate, rarely scaly or flaky; inner bark pink, laminated. **Sapwood** pale white. **Leaves** with 2–4 pairs of leaflets; petiolules of lateral leaflets 1–3.5 cm long, swollen at both ends; blade thinly to thickly leathery, oblong to lanceolate, 8–21.5 x 3–7.5 cm; *base* broadly cuneate, apex pointed; midrib raised above; lateral veins 8–10 pairs, visible on both surfaces. *curving and joining near margin*; intercostal veins reticulate,



faint on both surfaces. **Flowers** in axillary or terminal inflorescences, glabrous or sparsely hairy. **Fruits** oblong-ellipsoid, 1.2–3 x 1.1–2.2 cm; stigma slightly excentric.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Widely distributed in Sabah. In Sarawak collected mainly from the Bako National Park and Semengoh Forest Reserve area. Also found in Kalimantan.

**Ecology.** Mixed dipterocarp forest on yellow sandy and clay soils, heath forest and submontane forest to 1000 m. Flowering in March, May and September and fruiting in January, March–May and September.

### 13. *Santiria rubiginosa* Blume

(Latin, *rubiginosus* = rusty coloured; the indumentum)

*l.c.* (1850) 213; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 399; Masamune *l.c.* 369; Kalkman *l.c.* (1954) 542; Leenhouts *l.c.* (1956) 237; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 151; Anderson *l.c.* 158; Whitmore, Tantra & Sutisna *l.c.* 39. **Type:** *Praetorius*, *s.n.* (=Leiden no. 898.321–229), Sumatra (L). **Synonym:** *Canarium rubiginosum* (Blume) Miq. *l.c.* (1859) 651.

Medium-sized tree to 28 m tall, 40 cm diameter; buttresses to 1.5 m high. **Bark** grey, smooth, lenticellate. Twigs brownish, glabrous, except the tip. **Leaves** with 1–4 pairs of leaflets, sometimes mixed with simple leaves; petiolules of lateral leaflets 0.5–2 cm long, either rounded or strongly flattened, swollen at both ends; blade glabrous or very sparsely powdery hairy below, elliptic to lanceolate, 4.5–13.5 x 1.5–6 cm; base cuneate, often unequal, apex pointed with long tip; midrib raised above; lateral veins 9–13 pairs, visible below, faint above, arching and joining near margin; intercostal veins reticulate, faintly visible on both surfaces. **Flowers** in axillary inflorescences, glabrous; sepals almost free; stamens 3. **Fruits** globular or ellipsoid, 10–14 x 8–10 mm; stigma less than 90° excentric.

*S. rubiginosa* is very similar to *S. griffithii* in vegetative characters but the asymmetric leaflets of *S. rubiginosa* are distinctive.

#### Key to varieties

1. Pedicels 1–3 mm long, shorter or as long as the flowers.....2  
 Pedicel 2–8 mm long, longer than the flowers.....  
     var. **pedicellata** (Ridl.) Kalkman  
     *l.c.* (1954) 544. Basionym: *Santiria pedicellata* Ridl. *l.c.* (1930) 86. Synonym: *S. minimiflora* Ridl. *l.c.* (1930) 87. Type: *Haviland 1866*, Sarawak, Sibuan, Rejang (SING).  
     Endemic to Borneo. Common in Sarawak but not yet reported from Sabah. Fresh-water, heath and peat swamp forest.
2. Leaflet apex caudate-acuminate, more than 1 cm long; petiolule flattened, the ends blacken on drying.....  
     var. **latipetiolata** Kochummen  
     *l.c.* (1994) 89. Type: *George S. 40254*, Sarawak (holotype KEP; isotypes E, K, L, MO, SAN, SAR).

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### 14. *Santiria* (of Sarawak)

*l.c.* (1994) 91

Medium-sized tree to 28 m tall, 40 cm diameter; buttresses to 1.5 m high. **Bark** grey, smooth, lenticellate. Twigs brownish, glabrous, except the tip. **Leaves** with 1–4 pairs of leaflets, sometimes mixed with simple leaves; petiolules of lateral leaflets 0.5–2 cm long, either rounded or strongly flattened, swollen at both ends; blade glabrous or very sparsely powdery hairy below, elliptic to lanceolate, 4.5–13.5 x 1.5–6 cm; base cuneate, often unequal, apex pointed with long tip; midrib raised above; lateral veins 9–13 pairs, visible below, faint above, arching and joining near margin; intercostal veins reticulate, faintly visible on both surfaces. **Flowers** in axillary inflorescences, glabrous; sepals almost free; stamens 3. **Fruits** globular or ellipsoid, 10–14 x 8–10 mm; stigma less than 90° excentric.

**Distribution.** Forest Reserve

**Ecology.** L

Close to *S. rubiginosa* but distinct.

### 15. *Santiria* (Latin, *ton* buds and l

*l.c.* (1850):  
(1954) 529  
49; Anders

or sparsely

Endemic to Sarawak, known from two collections from the Lambir National Park (S. 40254 and S. 47190). Mixed dipterocarp forest on ridges at 250 m.

Sabah. In  
reserve area.

Leaf apex not so, petiole not flattened.....

var. **rubiginosa**

Synonyms: *Santiria planchonii* A.W. Benn. in Hooker f. *l.c.* 536; *C. planchonii* (A.W. Benn.) King *l.c.* 240; *Icicaster planchonii* (A.W. Benn.) Ridl. *l.c.* (1917) 15; *S. havilandii* Ridl. *l.c.* (1930) 85.

forest and  
fruiting in

Sumatra, Peninsular Malaysia, Borneo, and New Guinea. Common and widely distributed in Sarawak in mixed dipterocarp forest but uncommon in Sabah and known only by a single collection, SAN 16678, from Sipitang at 750 m.

14. **Santiria sarawakana** Kochummen

(of Sarawak)

Kalkman *l.c.*  
Anderson *l.c.*  
8.321–229),

*l.c.* (1994) 91. Type: Tong *et al.*, S. 34287, Sarawak (holotype SAR; isotypes K, KEP, L, MO, SAN).

Bark grey,  
–4 pairs of  
2 cm long,  
sparser  
often  
visible  
faintly  
almost free;  
excentric.

Medium-sized tree to 26 m tall, 30 cm diameter. **Bark** dark brown, flaky. *Twigs whitish*, powdery brown-hairy. Terminal bud ovate, *c.* 5 x 3 mm. **Leaves** with 3 pairs of leaflets; rachis hairy as the twig, rounded; petiolules of lateral leaflets 7–15 mm long, of terminal leaflets 1.5–3 cm long, hairy and swollen at both ends; *blade leathery*, glabrous above except the midrib, *densely hairy on midrib and lateral veins below*, ovate to oblong or elliptic, 6–14 x 3–5 cm; base broadly cuneate, asymmetric, *margin curled inwards*, apex pointed; midrib raised above; lateral veins 9–12 pairs, curving and joining near margin, raised below, visible above; intercostal veins scalariform-reticulate, visible on both surfaces. Inflorescences and flowers unknown. **Infructescences** axillary, to 11.5 m long, axes hairy. **Fruits** glaucous black when fresh, black on drying, oblong, 11–13 x 7–10 mm; stigma less than 90° excentric.

asymmetric

**Distribution.** Endemic to Sarawak. Uncommon, known only from Miri and the Sabal Forest Reserve (S. 24119 and S. 34287).

**Ecology.** Lowland forest to 120 m.

Close to *Santiria tomentosa* but the sparsely hairy leaflets and short terminal buds are quite distinct.

Synonym: *S.*  
(SING).  
Sabah. Fresh-

15. **Santiria tomentosa** Blume

(Latin, *tomentosus* = densely pubescent with matted, woolly or short hairs; the young twigs, buds and leaflets)

l, the ends

*l.c.* (1850) 211; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 391; Masamune *l.c.* 369; Kalkman *l.c.* (1954) 529; Leenhouts *l.c.* (1956) 231; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 151; Cockburn *l.c.* 49; Anderson *l.c.* 158; Whitmore, Tantra & Sutisna *l.c.* 39. Type: *Korthals, s.n.* (= *Leiden no.*

K, L, MO,

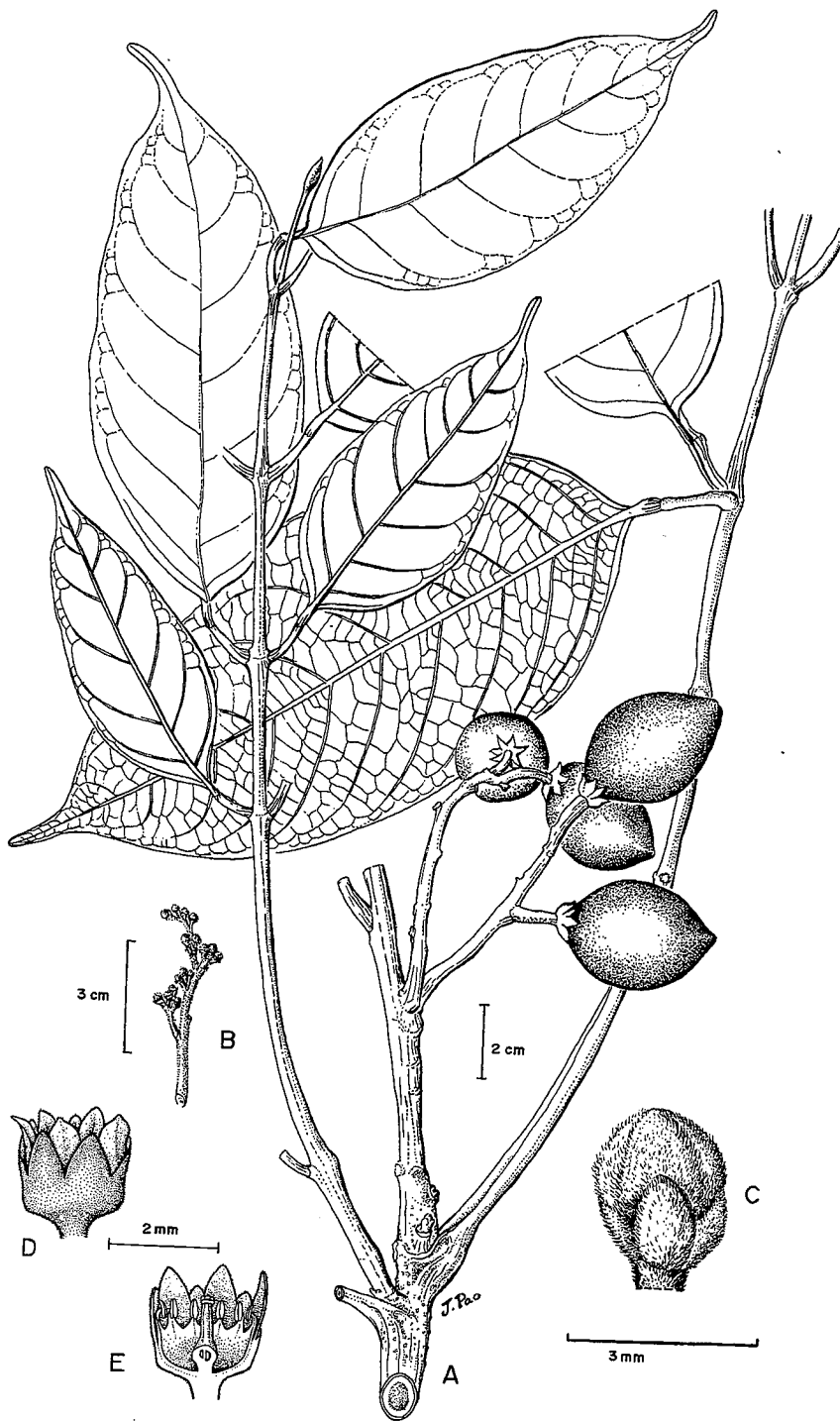


Fig. 7. *Scutinanthe brunnea*. A, fruiting leafy twig; B, inflorescence; C, flower bud; D, open flower; E, longitudinal section of flower. (A from S. 43904, B & C from S. 21666, D & E after FM 1, 5 (1956) 247, fig. 18.)

898.321-24:  
*multiflora* A  
*mollissima* F

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10-20 pair  
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Fruits glob

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Sabah and

**Ecology.** M  
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in Hooker f.  
Leenhouts l.  
215; Ng l.c.

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raspberry-  
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axillary, p  
petals free  
longer, in  
receptacle;  
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reduced; p  
cotyledons

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Sabah and

**Ecology.** I

**Uses.** The  
family and

898.321–245), Sumatra (L). **Synonyms:** *Canarium korthalsii* Miq. *l.c.* (1859) 645; *Santiria multiflora* A.W. Benn. in Hooker *f. l.c.* (1875) 538; *C. micrantherum* Stapf *ex Ridl. l.c.* (1930) 82; *S. mollissima* Ridl. *l.c.* (1930) 85.

Medium-sized tree to 30 m tall, 50 cm diameter; buttresses to 2 m high. **Bark** grey-brown, scaly; inner bark pinkish with droplets of white sap. **Sapwood** pale yellow. Twigs 5–15 mm thick, slightly angled, woolly hairy. Terminal bud to 2 cm long, hairy. **Leaves** with 1–4 pairs of leaflets; *rachis woolly hairy*; petiolules of lateral leaflets 0.5–2 cm long, hairy; *blade woolly hairy below and on midrib above*, ovate to oblong, 11–27 x 4–12 cm; base rounded or cuneate, sometimes unequal, apex pointed; midrib raised above; lateral veins 10–20 pairs, raised on both surfaces, curving and joining near margin; intercostal veins scalariform-reticulate, distinct below, faint above. **Flowers** hairy, in axillary inflorescences. **Fruits** globose or oblong, 2–2.7 x 1.5–2 cm; stigma less than 90° excentric.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Common and widely distributed in Sabah and Sarawak. Also in Brunei and Kalimantan.

**Ecology.** Mixed dipterocarp forests, rarely in swamps, to 300 m. Flowering in May–October and fruiting in March, April, June, October and November.

There is great variation in the size of leaflets and in the degree of pubescence.

## 7. SCUTINANTHE Thwaites

(Latin, *scutum* = shield, *anthus* = flower; the shape of the flower)

in Hooker *f.*, J. Bot. Kew Misc. 8 (1856) 266; H.J. Lam, Bull. Jard. Bot. Btze. 3, 12 (1932) 420; Leenhouts *l.c.* (1952) 160, *l.c.* (1956) 246; Kochummen *l.c.* (1972) 152; Anderson *l.c.* 158; Wong *l.c.* 215; Ng *l.c.* 38; Whitmore, Tantra & Sutisna *l.c.* 39.

Dioecious trees; *bole smooth with horizontal ring or occasionally scaly; inner bark raspberry-red with large beads of creamy to colourless exudate. Pith of branchlets and petioles without vascular strands. Leaves without stipules; leaflets entire. Inflorescences axillary, paniculate. Flowers unisexual, 5-merous, receptacle cup-shaped; sepals free; petals free with slightly thickened apex; stamens 10, confluent at base, episealous ones longer, in female flowers slightly reduced in size, sterile; disc intrastaminal, adnate to receptacle; ovary hairy, 3-celled, only slightly reduced in male flowers. Fruits drupaceous, stigmatic scar nearly apical, pericarp fleshy; pyrene hard and bony, usually 2 cells strongly reduced; persistent calyx not enlarged. Seeds one; germination in *S. brunnea* epigeal; cotyledons leafy, entire; leaves of young seedling simple, alternate to spiral.*

**Distribution.** Two species in Sri Lanka, S Burma, W Malesia and Celebes. One species in Sabah and Sarawak.

**Ecology.** Lowland forests to 100 m.

**Uses.** The light hardwood timber is commonly grouped together with other members of the family and sold as *kedondong*.

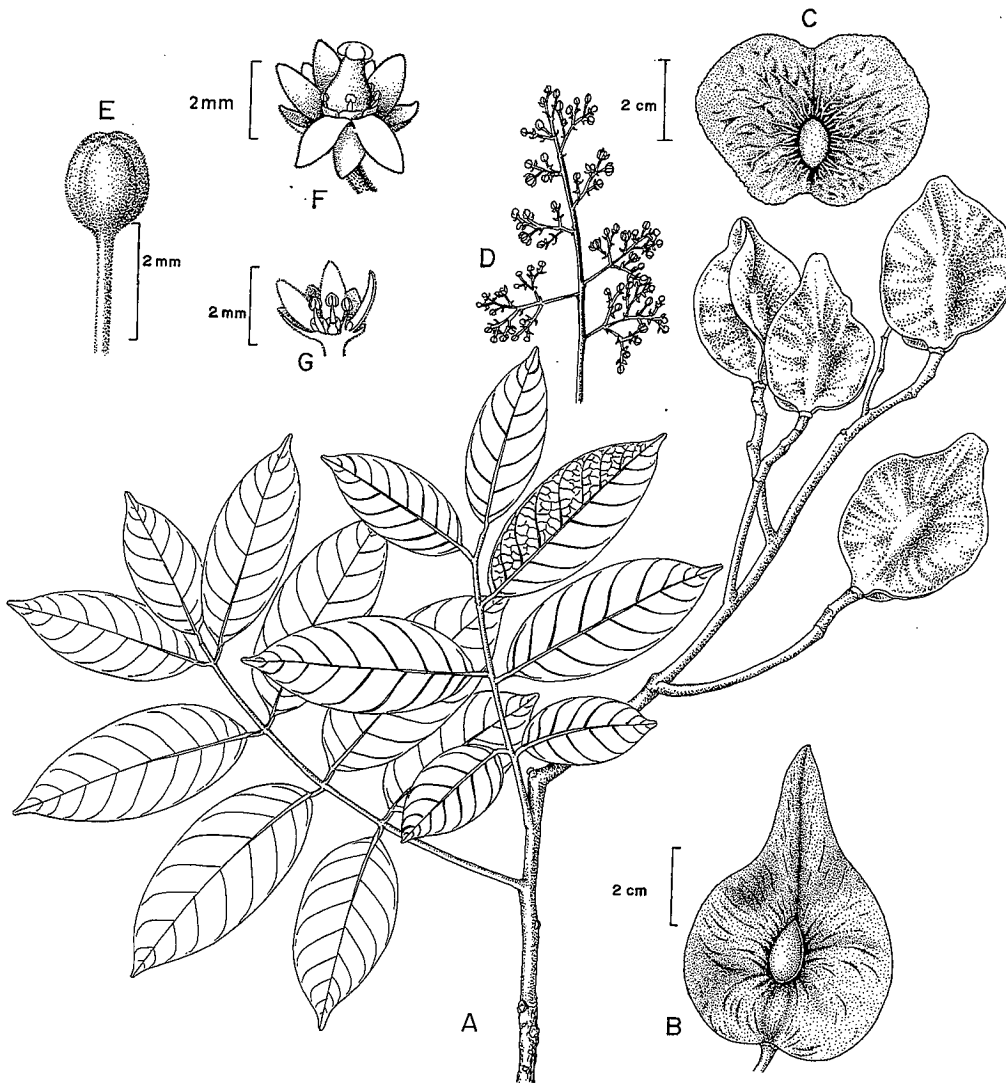


Fig. 8. *Triomma malaccensis*. A, fruiting leafy twig; B, dehiscent fruit; C, seed; D, part of inflorescence; E, flower bud; F, female flower; G, section through male flower. (A from SAN 37050, B-C from FRI 21209, D-E from SAN 40617, F-G after FM 1, 5 (1956) 219, fig. 8.)

**Scutinan**  
(Latin, *bru*)

in Hooker *f.*  
162, *l.c.* (15  
Tantra & Su  
Marchand, *A*  
*t.* 127.

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surfaces. I  
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**Scutinanthe brunnea** Thwaites

Fig. 7.

(Latin, *brunneus* = brown; the indumentum on the inflorescence)

in Hooker *f. l.c.* (1856) 267; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 420; Leenhouts *l.c.* (1952) 162, *l.c.* (1956) 247; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 152; Anderson *l.c.* 158; Whitmore, Tantra & Sutisna *l.c.* 39. **Type:** *Thwaites 1149*, Ceylon (K). **Synonyms:** *Garuga brunnea* (Thwaites) Marchand, Adansonia 8 (1867) 34, 66; *Canarium brunneum* (Thwaites) Beddome, Fl. Sylv. 1 (1868) t. 127.

Medium-sized tree to 30 m tall, 30 cm diameter. **Sapwood** pale. Twigs brownish, lenticellate. **Leaves** with 3–6 pairs of leaflets; petiolules of lateral leaflets 1–2.5 cm long, swollen at both ends; blade elliptic to obovate, 8–21 x 4–8 cm; base broadly cuncate, unequal, apex pointed; *midrib sunken above*; lateral veins 8–10 pairs, raised below, faint above, curving and joining near margin; intercostal veins reticulate, visible on both surfaces. **Inflorescences** *rusty red-pubescent*. **Flowers** densely pubescent with greenish white inner face. **Fruits** ellipsoid, 4–6.5 x 2–3 cm, green, ripening yellow, with persistent calyx.

**Distribution.** Sri Lanka, Sumatra, Peninsular Malaysia, and Borneo. In Sabah and Sarawak uncommon, known only by a few collections. Also in Brunei and Kalimantan.

**Ecology.** Lowland forests to 100 m.

8. **TRIOMMA** Hook. *f.*

(Greek, *tri* = 3, *omma* = eyes or openings;  
the triangular seed showing 3 openings in cross-section)

Trans. Linn. Soc. 23 (1860) 171; Ridley *l.c.* (1922) 369; H.J. Lam, Bull. Jard. Bot. Btzg. 3, 12 (1932) 331; Kalkman *l.c.* (1954) 499; Leenhouts *l.c.* (1956) 218; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 154; Cockburn *l.c.* 49; Anderson *l.c.* 158; Wong *l.c.* 248; Ng *l.c.* 38; Whitmore, Tantra & Sutisna *l.c.* 39.

Dioecious trees. *Pith of branchlets without vascular strands. Stipules absent. Leaflets* with entire margin, *strongly asymmetrical at base; stalk not swollen. Inflorescences* axillary panicles. **Flowers** unisexual, 5-merous; sepals and petals free; stamens 5, episepalous, base of filaments adnate to disc; *disc extrastaminal*, 5-lobed, lobes emarginate; ovary triangular, 3-celled, in male flowers entirely reduced. **Fruits** 3-winged, dry, woody capsule, splitting into 3 valves. **Seeds** 3, broadly winged; germination epigeal; cotyledons shallowly 5-lobed, leafy; leaves of young seedling alternate to spiral, simple for the first few nodes, later with 3 and 5 leaflets, margin initially toothed becoming entire later.

**Distribution.** One species confined to W Malesia.

**Ecology.** Lowland forests.

**Uses.** The timber is commonly grouped with other members of the family and sold as *kedondong*. The wood is light hardwood, and used for indoor construction. The resin is sometimes used for torches.

**Triomma malaccensis** Hook. f.  
(of Malacca)

Fig. 8.

*l.c.* (1860) 171; King *l.c.* 236; Ridley *l.c.* (1922) 369; Merrill *l.c.* (1929) 119; H.J. Lam, Bull. Jard. Bot. Btzig. 3, 12 (1932) 332; Kalkman *l.c.* (1954) 499; Leenhouts *l.c.* (1956) 218; Burgess *l.c.* 62; Kochummen *l.c.* (1972) 154; Cockburn *l.c.* 49; Anderson *l.c.* 158; Whitmore, Tantra & Sutisna *l.c.* 39. **Type:** *Maingay 299*, Malacca (holotype K; isotype L).

Tree to 60 m tall, 100 cm diameter; buttresses to 5 m high, spreading. **Bark** smooth to scaly, grey-brown; inner bark pink or reddish brown, with a strong mango smell. **Sapwood** pale yellow. Twigs dark brown. **Leaves** with 2–5 pairs of leaflets; *petiolules of leaflets not swollen; blade withering yellow with pink midrib and veins*, oblong or ovate, 4–12 x 2–8 cm; *base strongly unequal with one half rounded*, apex pointed; midrib raised above; lateral veins 6–11 pairs, raised on both surfaces; intercostal veins reticulate, distinct on both surfaces. **Inflorescences** many-branched, hairy. **Flowers:** sepals and petals densely tomentose. **Fruits** 5–7 x 2–2.5 cm. **Seeds** 3 with broad membranous wing. Saplings with densely hairy rachis and leaflets.

**Vernacular name.** Sabah—*kedondong asam* (Malay).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sabah a common emergent tree of the lowland forests, especially by streams. Widespread but not common in Sarawak, known from only two collections from Lambir National Park (*S. 46465*) and Limbang district (*S. 42833*). Also occurs in Kalimantan.

**Ecology.** Mixed dipterocarp forest on yellow sandy clay soils. Flowering in April–September and fruiting in May–December.

Merrill, EB (822; Whitmore Corner, WST

Trees, shrubs 5–7-lobed, **Inflorescences** axillary or **Flowers** biserial until anthesis whorls of 2, asymmetric conical; *stamens* of the ovary 1–6-loculed small, simple (*Stixis*), mono-

**Distribution.** In Sabah and Sarawak, genera are rare

**Ecology.** Most of the Cappadocian riverine trees suggesting flowering. However, has

**Uses.** The timber is used in the region. Several collections (68–70). Sometimes planted for

**Taxonomy.** The species has been recognized