

FLAGELLARIACEAE

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Dumort., Anal. Fam. Pl. (1829) 59, 60, nom. cons.; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 129, p.p.; Ridley, Fl. Malay Penins. 4 (1924) 367, p.p.; Backer, Fl. Males., ser. 1, 4(3) (1951) 245, p.p.; Henderson, Malay. Wild Fls., Monocot. (1954) 206, p.p.; Backer & Bakhuizen van den Brink, Fl. Java (Spermatoph.) 3 (1968) 23; Smith, Fl. Vit. Nova 1 (1979) 283; Keng et al., Concise Fl. Singapore, vol. 2, Monocot. (1998) 25, p.p.; Appel & Bayer in Kubitzki (ed.), Fam. Gen. Vasc. Pl. 4 (1998) 208; Seberg in Heywood et al., Fl. Pl. Fam. World (2007) 368. **Type:** *Flagellaria* L.

Perennial lianas, reaching up to 50 m in length, arising from sympodial rhizome, occasionally branching. **Leaves** alternate, distichously arranged; leaf sheath mostly closed; petiole short, lamina simple, with midrib extending into a tendril. **Inflorescences** terminal, bearing many flowers, paniculate, clusters of flowers appearing at the end of second, third, fourth and fifth level branches. **Flowers** sessile or subsessile, trimerous (rarely dimerous), bisexual, subtended by small bracteoles. **Tepals** 6, in two whorls, subequal, free or fused at base. **Stamens** 6, arranged in two whorls, occasionally reduced to staminodia; filaments thin, short at first, elongating at anthesis; anthers linear, basifixed, tetrasporangiate, dehiscing by longitudinal slits. **Ovary** superior, syncarpous, 3-locular, placentation axile; ovules solitary, one per locule, pendulous, bitegmic, almost atropous, crassinucellate; style short, stigma with three spreading linear lobes. **Fruit** 1(–2)-seeded drupe with reduced testa. **Seeds** with abundant starchy endosperm, embryo minute, lenticular.

Distribution. Flagellariaceae is monogeneric, consisting of 5 species (Wepfer & Linder, Austral. Syst. Bot. 27 (2014) 159–179). It is confined to the paleotropics, where it is widespread throughout tropical Africa and Asia, extending to Australia and the Pacific. Based on current understanding and interpretation of species limits, the centre of diversity is in the Pacific islands with 3 of the 5 species occurring in Fiji. In Singapore 1 native species.

Ecology. Occurring in coastal areas and humid forests, forest margins and mangroves. Mainly at sea level and in lowlands, occasionally up to 1500 m.

Uses. Although inferior to rattan, the shoots are used in basketry and thatching. Occasional medicinal, cosmetic and veterinary uses have been recorded for *Flagellaria indica* L. in the region. Burkill (Dict. Econ. Prod. Malay Penins., ed. 2, 1 (1966) 1041–1042) reported that rhizomes, stems and flowers have diuretic properties, fruits are used for treatment of pox and young leaves can be used as hair wash. In Sumatra the plant is used to treat elephant ailments. A pharmacognostical and phytochemical overview of *Flagellaria indica* was provided by Mary et al. (J. Econ. Taxon. Bot. 6 (1985) 1–8).

Address: Singapore Botanic Gardens, National Parks Board, Singapore.

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Taxonomy. Historically the family was believed to include the genera *Hanguana* Blume and *Joinvillea* Gaudich. ex Brongn. & Gris, both of which are now placed in their own families.

FLAGELLARIA L.

(Greek, *flagellum* = tendril, whip; referring to leaf tip tendrils)

False rattan, whip vine, common flagellaria (English), *rotan dini, rotan tikus* (Malay)

Sp. Pl. 1 (1753) 333; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 130; Ridley, Fl. Malay Penins. 4 (1924) 367; Backer, Fl. Males., ser. 1, 4(3) (1951) 246; Backer & Bakhuizen van den Brink, Fl. Java (Spermatoph.) 3 (1968) 23; Appel & Bayer in Kubitzki (ed.), Fam. Gen. Vasc. Pl. 4 (1998) 208; Wepfer & Linder, Austral. Syst. Bot. 27 (2014) 171. **Type:** *Flagellaria indica* L.

Perennial lianas; reaching up to 50 m in length, aerial shoots solid, round (rarely lenticular) in cross section, glabrous, arising from sympodial rhizome, occasionally branching. **Leaves** alternate, distichously arranged, glabrous; leaf sheath mostly closed, dorsally obtuse, obcordate, crenate or split, upper margin closely appressed to culm or producing a revolute collar; petiole short, lamina simple, narrowly ovate to narrowly elliptic, nerves longitudinal with faint, short, oblique cross-nerves, base attenuate, round or auriculate, apex attenuate with midrib extending into a tendril, tendril simple, sensitive adaxially, involutely coiled. **Inflorescences** terminal, bearing many flowers, paniculate, clusters of flowers appearing at the end of second, third, fourth and fifth level branches. **Flowers** sessile or subsessile, trimerous (rarely dimerous), bisexual, subtended by small bracteoles. **Tepals** 6, in two whorls, subequal, somewhat saccate, sometimes with basal thickening, membranous distally, free or fused at base, whitish. **Stamens** six, arranged in two whorls, occasionally reduced to staminodia; filaments thin, short at first, elongating at anthesis; anthers linear, basifixed, tetrasporangiate, dehiscent by longitudinal slits. **Ovary** superior, syncarpous, 3-locular, placentation axile; ovules solitary, one per locule, pendulous, bitegmic, almost atropous, crassinucellate; style short, stigma with three spreading linear lobes with papillose upper surface. **Fruit** 1(–2)-seeded drupe with reduced testa, ripening white, pink, orange, red or black. **Seeds** with abundant starchy endosperm, embryo minute, lenticular.

Distribution. Same as for the family. In Singapore 1 native species.

Ecology. Same as for the family.

Taxonomy. The genus was previously considered to consist of about 4 species. The revision by Wepfer & Linder (Wepfer & Linder, Austral. Syst. Bot. 27 (2014) 159–179) included a fifth species (*Flagellaria collaris* Wepfer & H.P.Linder) and highlighted the existence of another unusual and yet formally unrecognised morphotype (*F. 'lenticularis'*) both from Fiji. Their taxonomic treatment is, however, largely based on morphology and is not supported by their own molecular phylogenetic work. Further detailed studies with far more extensive sampling and better gene coverage is needed to better understand species delimitation in this genus.

Flagellaria indica L.

(of India)

Sp. Pl. 1 (1753) 333; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 170; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 130; Ridley, Fl. Malay Penins. 4 (1924) 368; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1024; Burkill, Dict. Econ. Prod. Malay Penins., ed. 2, 1 (1966) 1041; Backer, Fl. Males., ser. 1, 4(3) (1951) 246; Henderson, Malay. Wild Fls., Monocot. (1954) 206; Backer & Bakhuizen van den Brink, Fl. Java (Spermatoph.) 3 (1968) 23; Mary et al., J. Econ. Taxon. Bot. 6 (1985) 1; Keng, Gard. Bull. Singapore 40 (1987) 125; Turner Gard. Bull. Singapore 45 (1993) 91; Chew et al., Gard. Bull. Singapore 49(2) (1999 [‘1997’]) 186; Keng et al., Concise Fl. Singapore, vol. 2, Monocot. (1998) 25; Chong et al., Checkl. Vasc. Pl. Fl. Singapore (2009) 43, 137, 228; Wong et al., Checkl. Pl. Sp. Nee Soon Swamp For. Singapore (2013) 121. **Type:** *Collector unknown s.n.* (lectotype LINN [Herb. Linn. no. 463.1], designated by Napper in Milne-Redhead & Polhil, Fl. Trop. E. Africa, Flagellariaceae (1971) 3).

Fig. 1, 2.

Flagellaria angustifolia Wall., Numer. List no. 5199 (1831), nom. nud.

Flagellaria minor Blume ex Schultes & Schultes, Syst. Veg., ed. 15 bis 7(2) (1830) 1493. **Synonym:** *Flagellaria indica* L. var. *minor* (Blume ex Schultes & Schultes) Hook.f., Fl. Brit. India 6, fasc. 18 (1892) 391; Ridley, J. Straits Branch Roy. Asiat. Soc. 33 (1900) 170; Ridley, Mat. Fl. Malay. Penins. 2 (1907) 130; Ridley, Fl. Malay Penins. 4 (1924) 368. **Type:** *Blume s.n.*, Indonesia, Java, Kuripan, (lectotype L [L0041789; plant mounted on the right], first step designated by Wepfer & Linder, Austral. Syst. Bot. 27 (2014) 174, second step designated here).

Flagellaria indica L. var. *bifurcata* Wepfer & H.P.Linder, Austral. Syst. Bot. 27 (2014) 173. **Type:** *Kessler 14336*, Australia, Queensland, Daintree National Park, trail to Mount Sorrow, S16.08° E145.5°, 10 August 2011 (holotype Z; isotype BRI).

Liana, reaching up to 20 m in length; aerial shoots solid, glabrous, up to 1.3 cm in diam., arising from sympodial rhizome. **Leaves** alternate, distichously arranged; leaf sheath closed, terminating with two blunt lobes distally, c. 1–1.5 mm long, positioned opposite to lamina; lamina narrowly ovate to narrowly elliptic with a short basal claw (pseudopetiole); basal claw yellow to ochraceous, 2–4 mm long, 3–5 mm wide, lamina (5–)8–25(–36) × 0.7–2.6(–3) cm, base round, apex narrowly attenuate, ending in a tendril (tendril is absent on young plantlets or freshly rooted off-shoots). **Inflorescences** terminal, paniculate, composed of 5–12 branches, each branch supported by a minute rudimentary white bract (less than 1 mm long, turning brown with age), rachis c. 6–9 cm long, light green at base but mostly cream white, glabrous. **Flowers** mildly pleasantly scented, sessile, trimerous, bisexual, each supported by a minute rudimentary semilunar white bracteole (less than 1 mm long, turning brown with age). **Tepals** in two whorls, subequal, ovate with bulbous base, fused in basal 1/2, outer tepals c. 2 mm long, inner tepals 2.5 mm, whitish with greenish margins soon turning dark brown. **Stamens** 6, arranged in two whorls; filaments c. 4.5–5 mm long, flattened, white; anthers 2–2.5 mm, pale yellow. **Ovary** ovate, 2 × 1 mm, greenish, glabrous; style short, almost absent, stigma 3-lobed, each lobe 1.2–1.5 mm long, densely finely papillose, pure white. **Fruit** a 1-seeded drupe, globose, c. 6 mm in diam., green (unripe), ripening pink to orange-red. **Seeds** 4–5 mm in diam., quite hard, dark brown, almost black, round, internally with white abundant starchy endosperm.

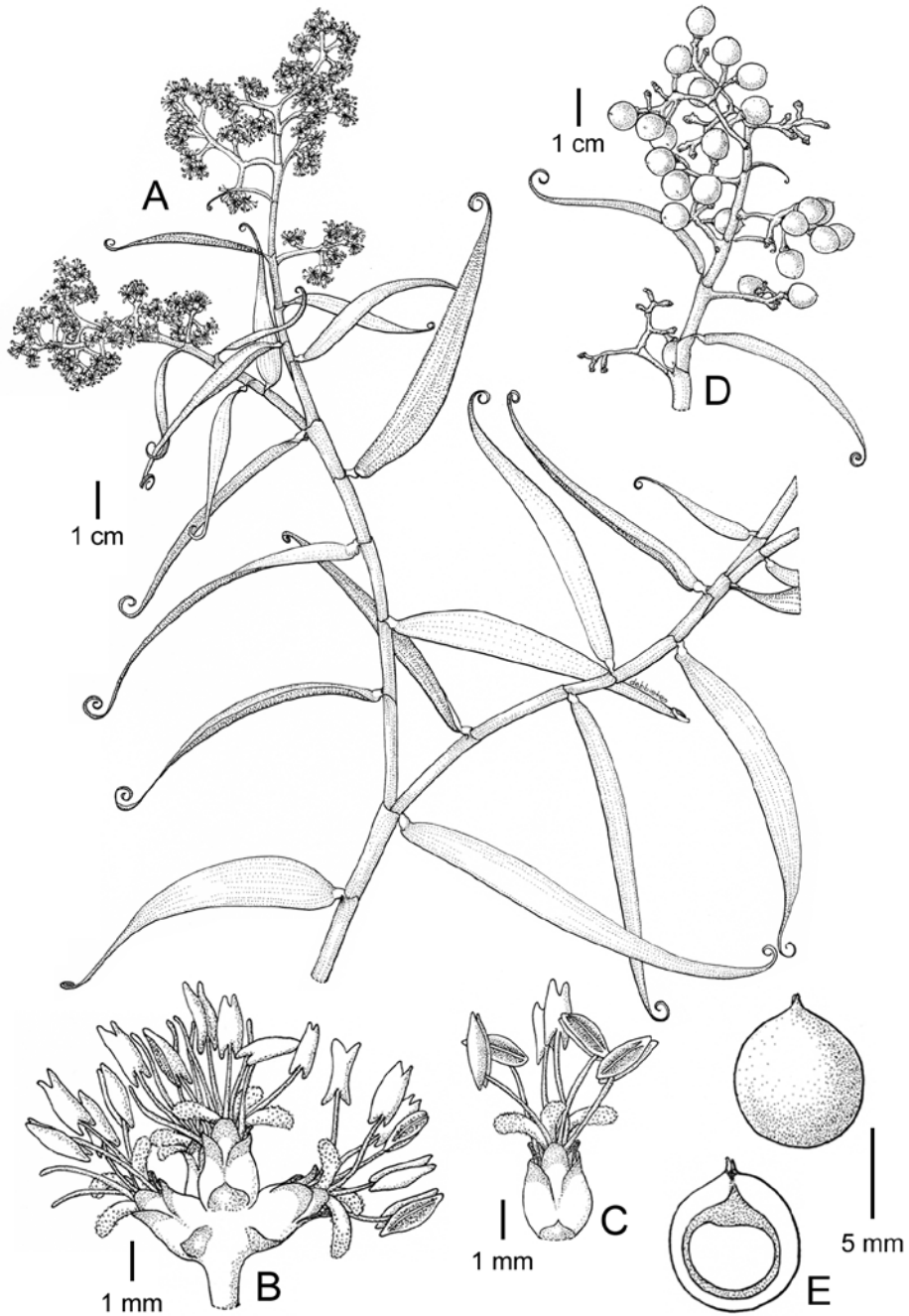


Figure 1. *Flagellaria indica* L. **A.** Habit. **B.** Cluster of flowers. **C.** Single flower. **D.** Infructescence. **E.** Fruit externally and in longitudinal dissection. (From Singapore, Nee Soon, *Lim & Ng FLA-6*. Drawn by D. Teo).

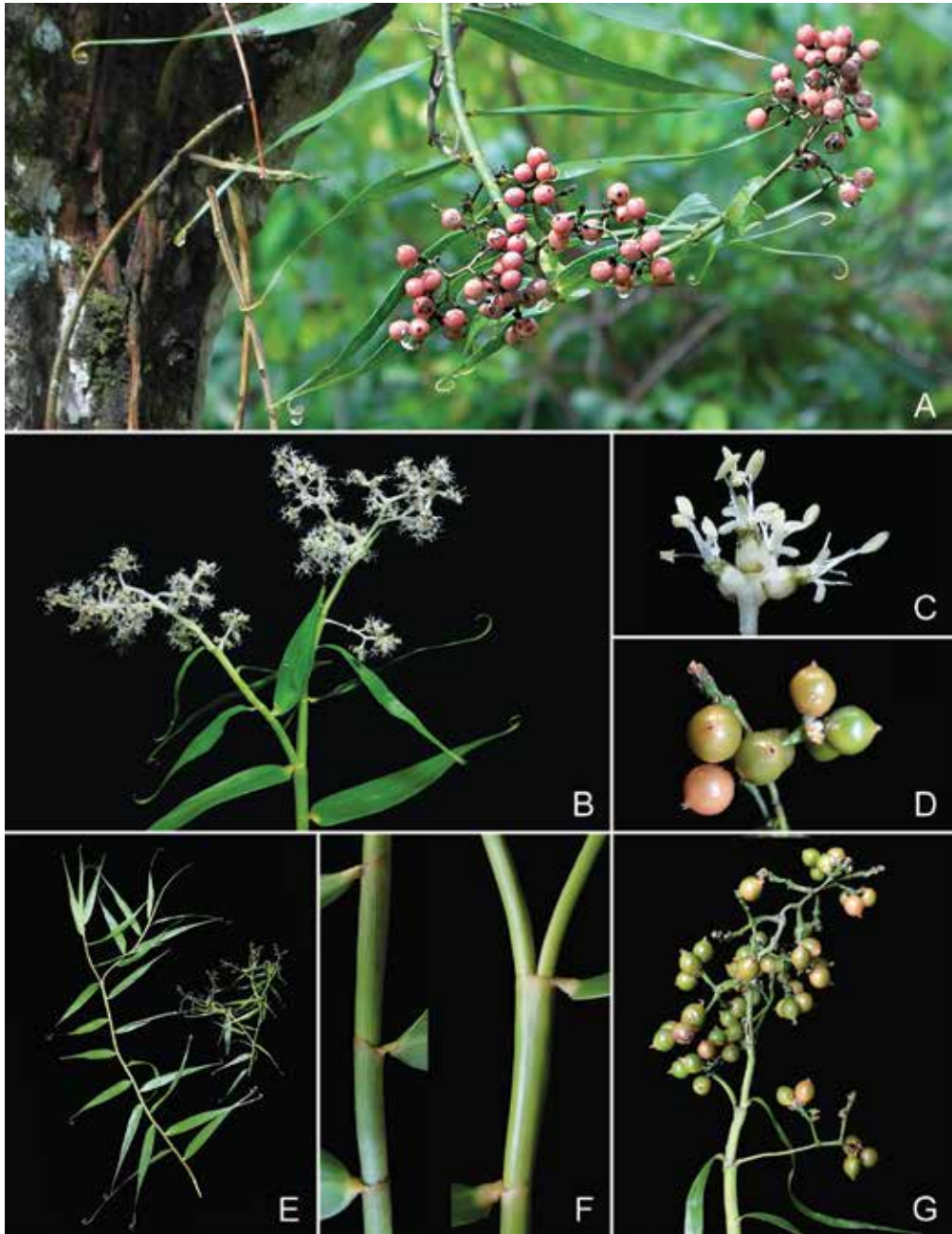


Figure 2. *Flagellaria indica* L. **A.** Infructescence. **B.** Inflorescence. **C.** Cluster of flowers. **D.** Cluster of fruits. **E.** Branches from different parts of a single shoot showing remarkable leaf size difference. **F.** Stems showing leaf sheaths with blunt lobes and bifurcate branching. **G.** Infructescence. (From Singapore, A from Springleaf Nature Park; B, C from Nee Soon, *Leong-Škorničková & Niissalo FLA-2*; D–G from Pulau Ubin, *Lai et al. FLA-3*. Photos: A, R. Lim; B–G, J. Leong-Škorničková).

Distribution. Asia, Indo-Pacific and Madagascar. In Singapore known from many historical and recent collections from the mainland and some offshore islands: for example Upper Peirce (*Niissalo et al. SING2018-046*, Jan 2018, SING [SING0263967]), Seletar (*Ridley s.n.*, 1894, SING [SING0017565]), Changi (*Goodenough s.n.*, 1890, SING [SING0255831]), Pulau Tekong (*Koh SING2012-054*, 2 Mar 2012, SING [SING0171442]) and Pulau Ubin (*Gwee et al. GAT 365*, 1 Oct 2003, SING [SING0047787]).

Ecology. In Singapore it occurs in swamp forest and mangroves and at the margins of lowland forest in primary, secondary and disturbed habitats.

Provisional conservation assessment. Globally Least Concern (LC). This species is widespread in the region and locally common, therefore also Least Concern (LC) in Singapore.

Vernacular names. *False rattan*, *whip vine* (English), *rotan dini*, *rotan tikus* (Malay).

Taxonomy. Wepfer & Linder (*Austral. Syst. Bot.* 27 (2014) 159–179) have suggested that *Flagellaria indica* should be divided into six varieties. According to them, the material in Singapore belongs to two varieties, namely *Flagellaria indica* var. *bifurcata* Wepfer & H.P.Linder and var. *minor* (Blume ex Schultes & Schultes) Hook.f. Both of these varieties have a bifurcate branching pattern of aerial shoots and the difference between them is merely in the size of the leaves. Studies based on field surveys, herbarium material and preliminary molecular studies (Niissalo et al., unpublished) suggest that only a single taxon is present in Singapore. As observed in the field, the leaf size and shape varies tremendously depending on the stage of development and the position of the leaves along the liana, which can extend up to 20 m in length with multiple levels of branching. As the treatment of varieties in *Flagellaria indica* by Wepfer & Linder (*Austral. Syst. Bot.* 27 (2014) 159–179) has very weak morphological support and no molecular support, varieties are not recognised here for the Singapore material until a better understanding of variation in the species is achieved. The species description is based solely on Singaporean material.