

***Toona calcicola*, a new species and *Reinwardtiodendron humile*, a new record to Thailand**

SUKID RUEANGRUEA¹, SHUICHIRO TAGANE^{2,*}, SOMRAN SUDDEE¹, NAIYANA TETSANA¹,
MANOP POOPATH¹, HIDETOSHI NAGAMASU³ & AKIYO NAIKI⁴

ABSTRACT. Two species of Meliaceae, *Toona calcicola* and *Reinwardtiodendron humile* are newly added for flora of Thailand. *Toona calcicola*, a new species from Suan Hin Pha Ngam Forest Park, Loei Province, is described and illustrated. This species is endemic to ridge of limestone hill and characterized by *Cycas petraea* A.Lindstr. & K.D.Hill and *Dracaena cambodiana* Pierre ex Gagnep. Since this is the first account of the genus *Reinwardtiodendron* to the flora of Thailand, the key to the genera of Meliaceae (based on flowers) in Thailand is revised.

KEY WORDS: Meliaceae, *Reinwardtiodendron*, *Toona*, new species, new record, Flora of Thailand.

INTRODUCTION

Meliaceae is a large family containing 49–50 genera and ca 620 species and distributed in pan-tropical area expanding to temperate zone (Mabberley *et al.*, 2007). In Southeast Asia, species of Meliaceae are widely found from lowlands to higher elevation highlands, and are one of important components in tropical and subtropical evergreen forests. In Thailand, 18 genera, 84 species, 3 subspecies and 4 varieties were recognized (Wongprasert *et al.*, 2011; Pooma & Suddee, 2014).

During our botanical surveys in Kaeng Krachan National Park, Phetchaburi Province and Suan Hin Pha Ngam Forest Park, Loei Province, we found two species of Meliaceae which are undocumented in Thailand. To contribute to the Flora of Thailand, we here provide the new records of them based on our materials and herbarium specimens with their descriptions and photographs.

DESCRIPTION

Toona calcicola* Rueangr., Tagane & Suddee, *sp. nov.

Erect inflorescences and subsessile to short petiolules up to 2 mm long are characteristic of this species, differing from all the other species of *Toona*. Phenotypically similar to *Toona ciliata* M. Roem. but differs in having puberulent leaf blades on both surfaces, cordate leaf base (vs. rounded and mostly oblique), short petiolules (vs. 0.2–10(–14) mm long), calyx lobes valvate (vs. imbricate), glabrous disc and ovary (vs. puberulent) and 8–10 ovules (vs. 5–8 ovules). It is also similar to *T. sinensis* (A. Juss.) M. Roem., but differing in its ciliate margins of petals (vs. not ciliate), more ovules (vs. 6 ovules) and absence of staminodes (vs. always presence). Type. Thailand. Loei, Suan Hin Pha Ngam Park, Suan Sawan Nature Trail, limestone area, 17°03'31.50"N, 101°45'45.45"E, alt. 547 m, 8

¹ Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Chatuchak, Bangkok, 10900, Thailand.

² Center for Asian Conservation Ecology, Kyushu University, 744 Motooka, Fukuoka, 819-0395, Japan.

³ The Kyoto University Museum, Kyoto University, Yoshida Honmachi, Sakyo-ku, Kyoto, 606-8501, Japan.

⁴ Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus, 870 Uehara, Taketomi-cho, Yaeyama-gun, Okinawa, 907-1541, Japan.

*Corresponding author. Email: stagane29@gmail.com

Dec. 2014, *Tagane et al. T3673* (fl. & young fr.) (holotype **BKF!**; isotypes **FU!**, **K**, **KYO!**, **P**). Figs. 1 & 2.

Trees, 8 m tall; bark grayish white to brown, fissured and flaking; young twigs 1–1.3 cm in diam, puberulent, lenticellate. *Leaf scar* obcordate, 0.8–1.4 × 0.7–1.1 cm. *Leaves* spiral, paripinnate, occasionally abort one leaflet on top (looks imparipinnate), 32–55 cm long; petiole 6.5–13.5 cm long, puberulent, lenticellate, rachis puberulent, lenticellate; leaflets opposite, (6–)8–14 pairs; petiolules subsessile to 2 mm long, puberulent; leaflets blades ovate-lanceolate to oblong-lanceolate, 3–12 × 1.4–4.7 cm, apex acuminate, margin entire, revolute, base cordate, asymmetric, glabrous except minutely puberulent on veins on adaxial surface, densely puberulent and glaucous on abaxial surface, midrib densely hairy, sunken adaxially, prominent abaxially with small lenticels, lateral veins 20–28 pairs, looped to upper ones near margin, densely hairy, sunken adaxially, prominent abaxially, tertiary veins scalariform-reticulate, inconspicuous on upper surface, prominent on lower surface. *Inflorescences* terminal, erect, panicle, 59–79.5 cm long, rachis puberulent, reddish brown. *Flowers* ca 5 mm in diam. *Pedicle* 0.5–1.6 mm long, densely puberulent. *Calyx* 5(–6), ca 1.5 mm long, outside hairy, inside glabrous, 5-lobed, free; sepals broadly triangular, ca 1–1.2 × 1.3–1.6 mm, margins shortly ciliate. *Petals* 5(–6), cream in vivo, elliptic-oblong 5 × 2.5–3 mm, raised on the mid-part near base inside and inserted on the androgynophore (disk), apex acute to obtuse, both surfaces puberulent, denser near margin on the outside, margins ciliate, denser at the middle on the inside. *Male flowers*: anthers 5(–6), 1.2 × 0.6–0.8 mm, filaments ca 1.8 mm long, glabrous; disk 1.8–2 mm in diam., yellowish to reddish orange; ovary 5-locular, ca 2.5 × 2.0 mm, glabrous; style ca 2.5 mm long, glabrous, stigma capitate, ca 1 mm in diam. *Female flowers*: antherodes (non-functional anthers) 5(–6), ca 0.8 × 0.4 mm, filaments 1.1–1.3 mm long, glabrous; staminodes absent; disk 1.8–2 mm in diam., reddish orange, glabrous; ovary 5-locular, 3 × 2.3 mm, glabrous, lenticellate; ovules 8–10 per locule; style ca 1.1 mm long, glabrous, stigma capitate, ca 1.2 mm in diam. *Mature capsule*, ovoid, 2–2.5 × 2.5–3 cm,

with scattered lenticels, opening from apex with 5 valves; columella softly woody, 5-angled to shallowly 5-winged, extending to apex of capsule. *Seed*, winged at one end, flat, 1.2–2 × 0.4–0.8 cm, body 0.5–1 × 0.2–0.5 cm, brown when dry, attached by seed-end to proximal part of the columella.

Thailand.— NORTH-EASTERN: Loei [Suan Hin Pha Ngam Forest Park, Suan Sawan Nature Trail, limestone area, 17°03'31.50"N, 101°45'45.45"E, alt. 547 m, 8 Dec. 2014, *Tagane et al. T3673* (fl. & young fr.) (**BKF!**, **FU!**, **KYO!**); *ibid*, 19 Feb. 2015, *Tetsana et al. NT919* (fr.) (**BKF!**)].

Distribution.— Endemic (so far known only from the type locality).

Vernacular.— Yom hin pun (ยวมหินปูน).

Ecology.— In ridge of limestone hill; alt. ca 550 m.

Phenology.— Flowering: November–December. Fruiting: December–March.

Etymology.— The specific epithet refers to the limestone habitat.

Genbank accession No.— *Tagane et al. T3673*: LC052213 (*rbcl*), LC052214 (*matK*).

Note. — It is noteworthy that *Toona calcicola* has erect inflorescences (Fig. 1A, Fig. 2B & K), while all the previously known species of this genus, *T. calantas* Merr. & Rolfe, *T. ciliata* M. Roem, *T. fargesii* A. Chev., *T. sinensis* (A. Juss.) M. Roem. and *T. sureni* (Blume) Merr., show pendulous ones. The closely related genus *Cedrela*, distributed in tropical America and widely introduced to tropical regions including SE Asia for timber plantations, has erect inflorescence and species of the genus are seemingly similar, but differ in having larger petals, cylindric androgynophore (disk) and one-winged seeds attached to distal end of columella (Chung *et al.*, 1995; Mabberley 2011). The *matK* sequence of *T. calcicola* resulted in homology as high as 781/785 bp with the sequence of *T. ciliata* (Phu Kradueng, Thailand, *Tagane et al. T4759*, **FU**), *T. sinensis* (Genbank accession no. JN680341), *T. sureni* (Blume) Merr. (Mt. Bokor, Cambodia, *Tagane et al. 4299*, **FU**) and 764/772 bp with that of *C. odorata* (JQ588333) in the DNA database.



Figure 1. *Toona calcicola* Rueangr., Tagane & Suddee, A. leaves and inflorescences; B. female flower with sepals and petals removed; C. longitudinal section of male flower; D. young fruit, whole and cross-section showing ovules; E. capsules; F. seeds. A–D from Tagane *et al.* T3673 (BKF); E–F from Tetsana *et al.* NT919 (BKF). All drawn by O. Kerdkaew.

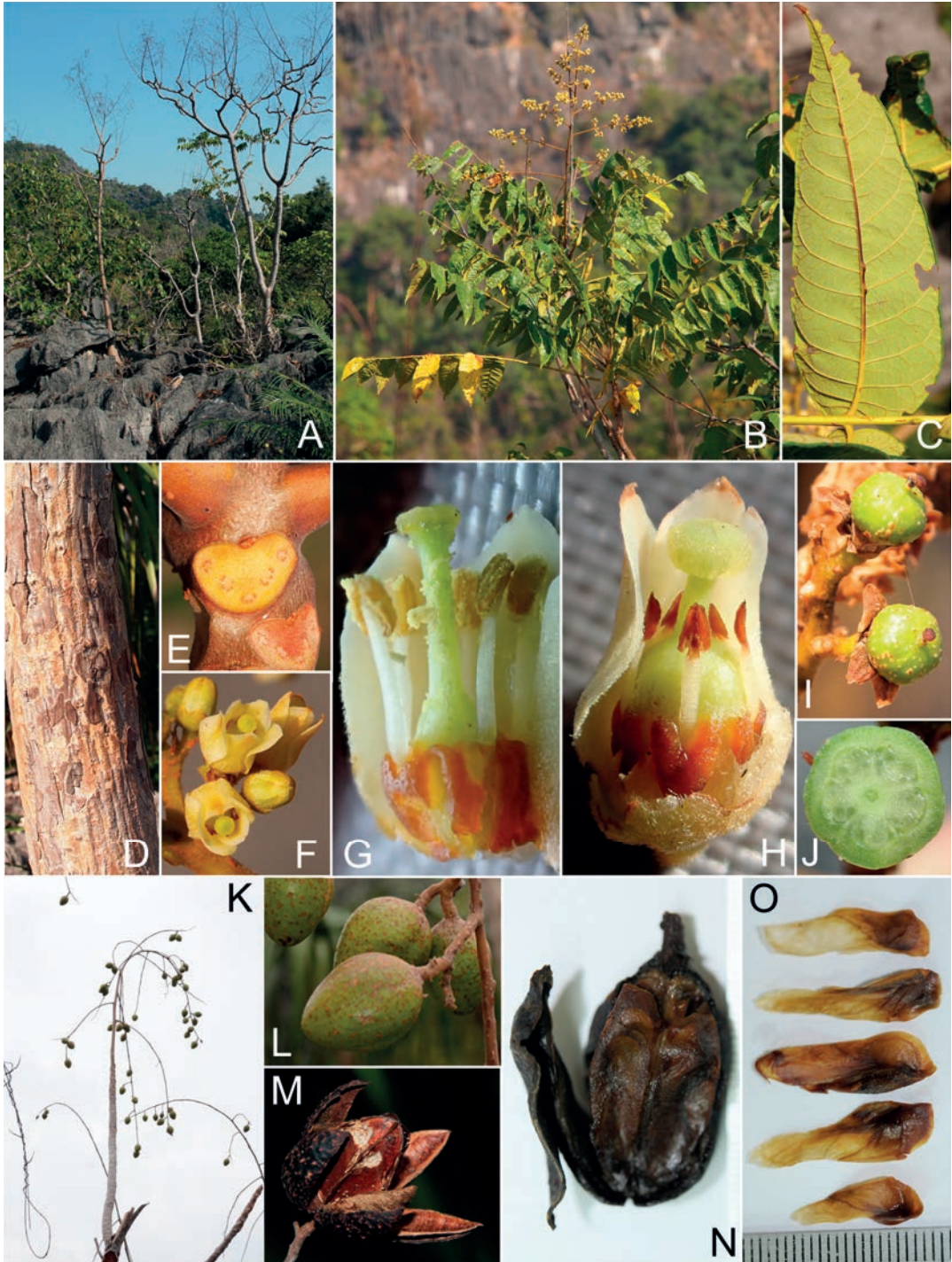


Figure 2. *Toona calcicola* Rueangr., Tagane & Suddee, A. habitat; B. flowering branch; C. abaxial surface of leaflet; D. bark; E. leaf scar; F. flowers; G. male flower with some petals removed; H. female flower with some petals removed; I. young fruits; J. cross section of young fruit; K. infructescence; L–M. capsules; N. capsules and seeds showing seeds attached by seed-end to proximal part of the columella; O. seeds. Photos: A & M. by Sukid Rueangruea; B–J. by Shuichiro Tagane; K & L. by Naiyana Tetsana. N & O. from Tetsana et al. NT919 (BKF).

Conservation status.— DD (Data Deficient). A few similar trees have been observed on limestone areas in Loei Province but flowers and fruits have not been seen. More exploration in nearby limestone areas is needed in order to gain more information for a robust conservation assessment.

Reinwardtiodendron humile (Hassk.) Mabb., Malaysian Forester 45(3): 452. 1982; Mabberley & Pannell, Tr. Fl. Malaya 4: 249, fig. 7. 1989; Mabberley *et al.*, Fl. Males., Ser. 1, Spermat. 12(1): 326, fig. 48. 1995; Mabberley *et al.*, Tr. Fl. Sabah & Sarawak 6: 187, fig. 27. 2007; H. Peng & Mabberley in Z.Y. Wu, P.H. Raven & D.Y. Hong (eds), Fl. China 11: 125. 2008; Mabberley *et al.*, Fl. Penins. Malaysia 4: 240. 2013. Lectotype: Hort Bogor. III-B-47 ('417'), Java, Bogor, cultivated [ex Sumatra] (K) (Mabberley, 1982).— *Lansium humile* Hassk., Hort. Bog. Desc. i: 121. 1858.

Lansium dubium Merr., Publ. Bur. Sci. Gov. Lab. 17: 23. 1904.

Reinwardtiodendron dubium (Merr.) X.M. Chen, J. Wuhan Bot. Res. 4(2): 183. 1986.

Tree, 27 m tall. Twigs greyish brown, lenticellate, subglabrous except densely pubescent apices. Leaves odd-pinnate, 12–25 cm long; petiole 2.5–4.1 cm long, petiole and rachis flat above, rounded below; leaflets 3 or 5, subopposite to opposite; petiolules 2–4 mm long, blades elliptic to oblanceolate, 4.7–19 × 2.2–6 cm, base cuneate, channelled, margin entire, apex acuminate, acumen to 1.8 cm long, subcoriaceous, glossy on both surfaces, glabrous except with very sparse hairs on abaxial surface of midrib; midrib sunken above, prominent below, secondary veins 13–19 pairs, at an angle of ca 60° from midrib, connected to the above ones near margin, prominent on both surfaces, tertiary veins finely reticulated, prominent on both surfaces. Inflorescence spike or panicles, 2–7.2 cm long, peduncles and rachis very sparsely hairy, lenticellate; bract ovate, ca 1.8 mm long, sparsely pubescent.

Flower buds globose, ca 2 mm in diam., sessile. Calyx lobes 5, orbicular, ca 1.5 mm in diam., imbricate, glabrescent, margin ciliate; petals 5, obovate, 3.5–4.5 × ca 2 mm, yellow, very sparsely pubescent outside, glabrous inside; staminal tube subglobose, ca 3.2 mm in diam., glabrous outside, pubescent inside, anthers 10, 2 whorls of 5, ca 1 mm long. Ovary 5-locular, one ovule per locule, style ca 0.5 mm long, Fruits not seen.

Thailand.— SOUTH-WESTERN: Phetchaburi [Kaeng Krachan National Park, 12°48'11.4"N, 99°26'31.6"E, alt. 400–410 m, 6 Oct. 2012, Tagane *et al.* T565 (BKF!, FU!); 12°48'25.6"N, 99°24'24.0"E, alt. 680 m, 25 Oct. 2013, Tagane *et al.* T2249 (BKF!, FU!) & 27 Oct. 2013, T2305 (fl.) (BKF!, FU!, K, KYO!)]]; PENINSULAR: Phangnga [Ton Pariwat Wildlife Sanctuary, 8°36'N, 98°33'E, alt. 650 m, 18 Nov. 2005, Gardner & Khumchompoo ST1920 (K!); Songkhla [Ton Nga Chang Wildlife Sanctuary, 6°56'N, 100°14'E, alt. 140 m, 1 Feb. 2006, Gardner ST2284 (K!)]]. Fig. 3.

Distribution.— China (Hainan), Laos, Cambodia, Vietnam, Peninsular Malaysia, Sumatra, Borneo (Kalimantan, Sabah, Sarawak), Java, Philippines, Sulawesi.

Vernacular.— Mang kha (มังคะ)(Phangnga).

Ecology.— In lowland evergreen forest, semi-disturbed evergreen forest; alt. 140–680 m. In Kaeng Krachan National Park, *R. humile* is growing with *Goniothalamus undulates* Ridl., *Bouea oppositifolia* (Roxb.) Meisn., *Hunteria ceylanica* (Retz.) Gardner ex Thwaites, *Aglaia cf. edulis* (Roxb.) Wall., *Alchornea rugosa* (Lour.) Müll. Arg., *Streblus taxoides* (Heynes) Kurz, *Knema cf. lenta* Warb., *Diplospora* sp., *Croton persimilis* Müll. Arg., *Xerospermum noronhianum* Blume, *Chrysophyllum roxburghiana* G. Don, *Payena acuminata* (Blume) Pierre, *Aphananthe cuspidata* (Blume) Planch., *Cryptocarya cf. ferrea* Blume.

Phenology.— Flowering: October, November, February.

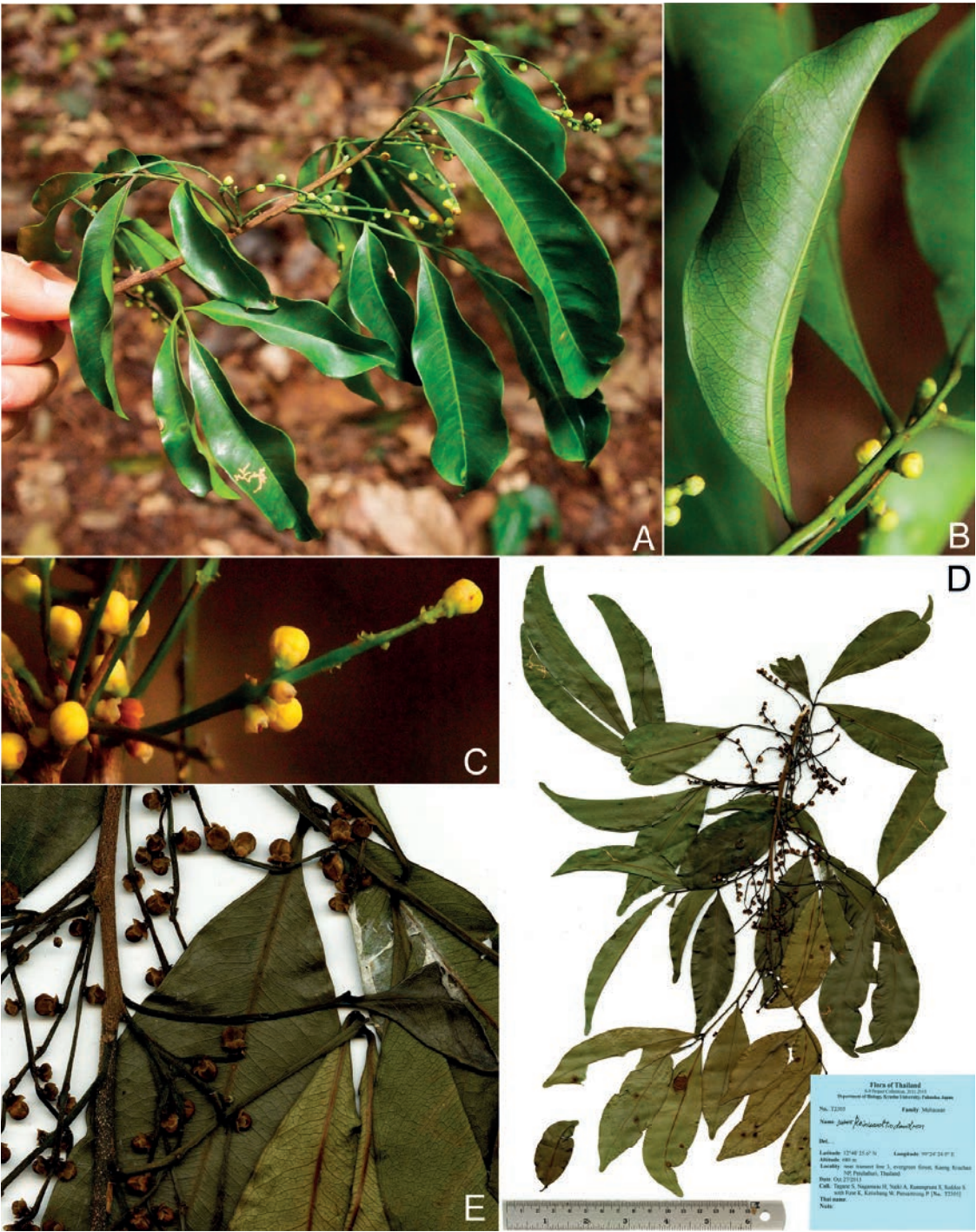


Figure 3. Photographs of *Reinwardtiodendron humile* (Hassk.) Mabb. A. branchlet with flower buds; B. abaxial surface of leaflet; C. inflorescence; D. voucher specimen: Tagane et al. T2305 (FU). E. close up specimen image showing prominent reticulated venation on both upper and lower surfaces. Photographs: A–C. 27 Oct. 2013, Kaeng Krachan National Park.

KEY TO THE GENERA OF MELIACEAE IN THAILAND

(based on flowering specimens, modified from Wongprasert *et al.* (2011) in order to add *Cedrela* and *Reinwardtiodendron*).

1. Flower buds ovoid, obovoid or obconical; petals not exceeding 5 mm long
 2. Leaves paripinnate
 3. Staminal tube absent; anthers 5(–6); androgynophore (disk) prominent **15. Toona**
 3. Staminal tube present; anthers 8–10
 4. Calyx 5, corolla 5. Bud scales present **14. Swietenia**
 4. Calyx 4, corolla 4. Bud scales absent **18. Xylocarpus**
 2. Leaves imparipinnate (leaves simple in *Aglaia simplicifolia*)
 5. Disc distinct
 6. Disc disciform, ovary obovoid **6. Cipadessa**
 6. Disc annular, ovary ovoid or depressed
 7. Rachis of leaf not swollen; leaves membranous **8. Heynea**
 7. Rachis of leaf swollen; leaves cretaceous to thinly leathery **17. Walsura**
 5. Disc indistinct or absent
 8. Inflorescences spikes, spikelets or catkins
 9. Leaves less than 25 cm long **19. Reinwardtiodendron**
 9. Leaves more than 30 cm long
 10. Inflorescences long spikes or with spikelets, axillary to supra-axillary **2. Aphanamixis**
 10. Inflorescences catkins on old branches or on stems **9. Lansium**
 8. Inflorescences compound thyrses
 11. Leaves and young parts with stellate and scaly indumentum **1. Aglaia** (leaves simple in *Aglaia simplicifolia*)
 11. Leaves and young parts puberulous, with indumentum of simple hairs, then glabrous **12. Pseudoclausena**
 1. Flower buds, short cylindric, tubular-cylindric; petals not less than 5 mm long
 12. Leaves paripinnate or simply imparipinnate
 13. Leaves all paripinnate in adult (leaves of young trees mostly bipinnate with incised or lobed leaflet), usually with juvenile leaflet hairy **5. Chukrasia**
 13. Leaves imparipinnate (or rarely paripinnate in *Azadirachta*).
 14. Pistil glabrous. Leaves imparipinnate, rarely paripinnate
 15. Stamens connate, staminal tube cylindric **3. Azadirachta**
 15. Stamens free, distinct **20. Cedrela** (*C. odorata*)
 14. Pistil hairy
 16. Leaf indeterminate, with bud of undeveloped leaflets **4. Chisocheton**
 16. Apical leaflets expand later than the proximal, but the leaf is not indeterminate **7. Dysoxylum**
 12. Leaves trifoliolate, 2–(3)-imparipinnate or simple
 17. Shrub or undershrub
 18. Leaf margin entire. Petals free **16. Turraea**
 18. Leaf margin serrate or undulate. Petals united into a long tube **11. Munronia**
 17. Tree
 19. Leaves 2–(3)-imparipinnate; leaflet margin serrate **10. Melia**
 19. Leaves trifoliolate; leaflet margin entire **13. Sandoricum**

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